the whitewater project

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THE WHITEWATER PROJECT

A Report on the Results of a Project Undertaken by the Second Year Planning Class of the Wildland Recreation Technology Program. The Participants in this Study were:

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ACKNOWLEDGEMENTS

This report could not have been completed without the very generous input of many individuals and agencies. Much technical direction was provided by the Recreation Design Department of Underwood, McLellan and Associates, Calgary. Additional technical help, as well as report reproduction support was contributed by Mr. Al Raine, Coordinator of Ski Area Development, Minstry of the Environment, Lands Branch.

A very special vote of thanks is extended to Mr. Dave Birch, Cartographer with the Regional District of Kootenay Boundary. Dave's patience seemed endless as he guided us through the process of lithographic map reproduction.

Thanks is also due Mr. Dennis Holden who contributed much to the biophysical analysis contained herein. Dr. Bruce Fraser helped to keep the various resource issues in perspective. Appreciation is also due the administrators of Selkirk College who expressed confidence in the project through unfailing financial support.

We would be remiss if we did not also thank the women who bravely ploughed through the handwritten stacks of final draft text. Thankyou Bea Dahl and Kathy Markin.

A limited number of copies of this Report have been published. Persons or agencies interested in acquiring copies should direct their inquiries to:

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SUMMARY OF RECOMMENDATIONS

Throughout this analysis, quite a number of ideas and proposals concerning the planning and developing of the Whitewater Area, have been suggested. A summary of these recommendations is listed in brief, point form below:

A. In General:

i) For proper ski area planning, an inventory of all physical site factors should be made. These include:
   a) Slope
   b) Fall-line
   c) Avalanche Hazard
   d) Biophysical Data

ii) Recommend use of Criteria for Slope Capacity.

B. Actual Skiing Area:

i) Avalanche hazard - recommend use of Avalaunchers as an addition of the avalanche control program.

ii) Existing ski runs - redesign existing runs by:
   a) Widening steep areas.
   b) Removing skier obstacles (trees, rocks).
   c) Cut new sections of runs and glade some areas.
   d) Additional grooming.
   e) Install snow creep deflectors on the summit chair towers.
   f) Decrease slope of road cutbanks which intersect runs.
   g) Reclassify runs to their skier-skill levels, and these runs, in turn, be re-named and re-signed.

Summer field checks should be made prior to any actual modifications.

iii) Development Options for Potential Runs

a) A new novice run (almost parallel to the Hummingbird chairlift) which would be serviced by a T-Bar.

b) A new chairlift (across the valley) to service low intermediate to advanced terrain.
   - this would mean cutting new runs and using some of the existing cut areas as runs also.
   - feathering of run edges.
   - developing a traverse route to some of these runs.
   - filling in skid road cuts.

c) Removal of present Hummingbird chairlift if the proposed chairlift is actually constructed.

C. Physical Concerns:

i) Biophysical recommendations:

a) Additional roads and removal of vegetation within Apex creek not recommended on the proposed novice run.

b) Caution exercised when removing trees in fragile areas.

c) Impose set standards for water quality.

d) Site-specific studies further recommended.

ii) Erosional Problems:

a) Existing Runs
   - put water back into natural course by use of French drains, culverts and water bars.
   - back-hoe sidecast material back onto skid roads.
   - all areas should be seeded.

b) For cutting new runs or removing trees
   - trees should be bucked up, limbed and laid perpendicular to fall line.

- trees felled could also be used for building material of water bars.

D. Facilities and Access:

i) Improve Access:

a) Resurfacing road and improving drainage.
b) Provide a shuttle bus service.

ii) Increase Parking Capabilities:

a) Employment of a parking lot attendant.
b) Provide a shuttle bus system.
c) Encourage car pools as an incentive to fill vehicles to their capacity.
d) If a new parking lot is to be considered
   - the area above the existing lot (on the west side of the valley) should be further investigated for its possible potential.

E. Cross Country Skiing:

A number of possible trail routes in the Whitewater Area have been suggested, but it is felt that a decision should first be reached as to whether or not Whitewater, indeed, wants to offer cross country skiing to the public.

F. In Conclusion:

i) If any of these recommendations are to be actually followed through by Whitewater, it is hoped that the Wildland Recreation students involved in this analysis would be contacted prior to any actual work being accomplished. In this way, the planning process would be followed to its fullest extent and, that any questions, ideas or problems regarding the previously mentioned recommendations could be further discussed.

ii) It is recommended that an analysis concerning skiing potential of adjacent basins surrounding Whitewater be undertaken.

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INTRODUCTION

The Whitewater Ski Area Planning Project was undertaken by the Second Year Planning Class as a part of the Wildland Recreation Technology Program at Selkirk College, Castlegar, B.C., between January and March, 1977.

STUDY GOALS

The Goals of the Project were:

1. To produce, in a limited time, a high quality data base from which a range of planning-related decisions could be made. These decisions in turn would enable certain judgements to be made in regard to the possibilities and implications of future development of the Whitewater Ski Area.

2. These judgements would be put forth for public scrutiny through both a presentation of the results at a Public Meeting and through Publication.

STUDY OBJECTIVE

The objective of this study was to challenge the students, as a Class, to think through a relatively complex planning problem, to identify its dimensions and to set a systematic course for the attainment of the prescribed goals. An important component of this challenge was for the students to gain some real experience in the presentation of their results for criticism at a public meeting.

FRAMEWORK WITHIN WHICH THIS WORK WAS DONE

While reading this Report the reader is advised to keep several factors in mind. This project was produced by a group of fifteen students, none of whom had any previous experience in ski area planning. As such, substantial research and thought was required to gain an understanding of the true dimensions of the problem. Every effort has been made in the writing of this Report, to remain cognizant of the limits to our expertise. Hence, the reader searching for detailed information, for example, on the precise location of proposed lift towers, along with engineering detail, will be disappointed. Matters such as these have been left largely to the professionals.

The major single limitation on this Study is surely that of time. Although much energy and enthusiasm has been focused on this Project, one must remember that these same students had many other courses demanding their attention throughout the ten weeks during which this Project was completed. Doubtless an even better job could have been done had time permitted.

- Rod Loftus
  Planning Instructor
  Project Co-ordinator

THE BASE DATA FOR SKI AREA PLANNING

REGIONAL SKI MARKET

a.) The Kootenays

As of 1975, the skier population of B.C. was estimated to be about 106,000 skiers, which represents 4.4% of the Province's total population. The Kootenay region contains 6% of the provincial population or 140,000 persons. It is significant that, in the Kootenays, a disproportionately large percentage of the population skis.[1]

The Kootenays have been estimated to contain 13% of British Columbia's ski area capacity. When this is related to the Kootenays' population of 6% of the provincial total, it appears that the region contains a ski area capacity well in excess of local resident demands. The number of skier days actually occurring in the Kootenays by skiers from outside the region is very small in relation to local and regional resident demand.

b.) Whitewater

The Whitewater Ski Area is located 12 miles from Nelson on Highway 6. (Map #1) During its early days it was thought that

[1] Pearse Bowden Economic Consultants Ltd., The British Columbia Industry and Its Economic Effects; prepared for the Department of Travel Industry, Victoria, British Columbia.

MAP 1

Travel Times to Whitewater Ski Area

FROM:	Road Travel Time
Nelson	30 min.
Castlegar	1.5 hr.
Spokane	4 hr.
Calgary	8 hr.

the Whitewater ski market would extend beyond the immediate Nelson-Salmo-Trail-Castlegar area and into Alberta and the Northwestern United States. While there is no doubt that a portion of the skier population of Whitewater does come from Washington, Idaho and Alberta, the majority of the Whitewater ski market is still made up of residents from the local area. Skier visits from Washington, Idaho and Alberta would probably increase substantially if it were not for the presence of so many intervening opportunities.

The prospective Whitewater patron must bypass three major ski areas and several smaller ones to get to Whitewater. This includes such areas as Mt. Spokane, 49^{o} North, Red Mountain, and Salmo. For a Spokane-based individual to bypass all of these to drive to Whitewater takes much incentive.

Similarly, for a Calgary resident to come to Whitewater by road, that individual must bypass such ski areas as Lake Louise, Banff, Mt. Norquay, Radium, Mt. McKenzie and Kimberley. Again, Whitewater must prove to be a worthwhile product in the mind of the skier.

Nelson as an Accommodative Centre

If substantial numbers of skiers from out of the region choose to frequent Whitewater, they will demand such supportive facilities as motel/hotel accommodation, restaurants, entertainment, and shopping opportunities. Nelson presently offers approximately 315 accommodation units, in the form of hotels and motels, close to the city centre. A few motel units are also available out of town. Restaurants are few in number and in variety, and the night entertainment available is limited.

It would seem, in summary, that few skiers whose homes are in either Calgary or Spokane or other out-of-region population centres, will be regular Whitewater patrons. The supportive facilities simply do not encourage their long-term visits at the present time.

One must conclude, therefore, that the local skier will be by far the dominant factor in the Whitewater market.

SLOPE ANALYSIS

In order to provide optimum skiing for all skier ability levels, the planner must obtain a knowledge of an area's slope gradients. One of the best tools for ski area planning and development is the Slope Analysis Map. Such a map, along with additional base data, serves to identify slope percentages, slope continuity, aspect, possible avalanche hazards and hence helps to designate developable areas. The planner can then use this information to base his decisions on. These decisions include run capacities as defined by skier ability criterion, the potential for base facility development and avalanche control programming. Since the Slope Analysis Map is so vital as a base to Ski Area Planning, one was developed for the purposes of this Project. (Appendix Map A)

METHODOLOGY

The Slope Analysis Map was constructed using a 1"= 500' contour map with twenty foot contour intervals. Slope classifications were delineated by establishing the distance between contours, following the fall line. A graduated template was constructed to identify the various slope classifications. The graduations on the template were determined by use of the formula:

$$\text{Slope Percentage} = \frac{\text{Vertical Height}}{\text{Horizontal Distance}} \times 100$$

Once the slope percentages were defined, the map was color coded according to the slope calssifications. The slope classifications used were:

Percent Slope	Map Color
10% - 25%	(Yellow)
25% - 35%	(Orange)
35% - 45%	(Green)
45% - 60%	(Blue)
60% - 100%	(Red)
100% +	(Red Crosshatch)

These slope classifications were chosen as each corresponds with a skier ability level.

One of the primary uses of the Slope Analysis Map is determining areas of different skier ability levels. Standards must be accepted as to what slope percentages best accommodate each individual skier ability level. Several standards have been used in the past by agencies and consultants involved in ski area planning. One set of standards investigated was utilized by the B.C. Parks Branch in a slope analysis project compiled for Red Mountain Ski Area (1975). Their slope percentage/skier ability classifications were:

Hill Gradient	Skier Skill Level
10% - 25%	Novice - Beginner
25% - 35%	Low Intermediate
35% - 45%	Intermediate - High Intermediate
45% +	Advanced - Expert

The second set of standards considered was utilized by Underwood, McLellan and Associates Ltd. (The U.M.A. Group)

Their classifications were:

Hill Gradient	Skier Skill Level
10% - 15%	Beginner
15% - 25%	Novice
25% - 35%	Low Intermediate
30% - 40%	Intermediate
35% 45%	Advanced Intermediate
45% - 60%	Advanced
60% - 200%	Expert

After reviewing both of these standards we established a standard which in our judgement best suited the Whitewater Ski Area. The standards we decided upon were:

Hill Gradient	Skier Skill Level
10% - 25%	Novice
25% - 35%	Low Intermediate
35% - 45%	High Intermediate
45% - 60%	Advanced
60% - 100% +	Expert

(See Figure #1)

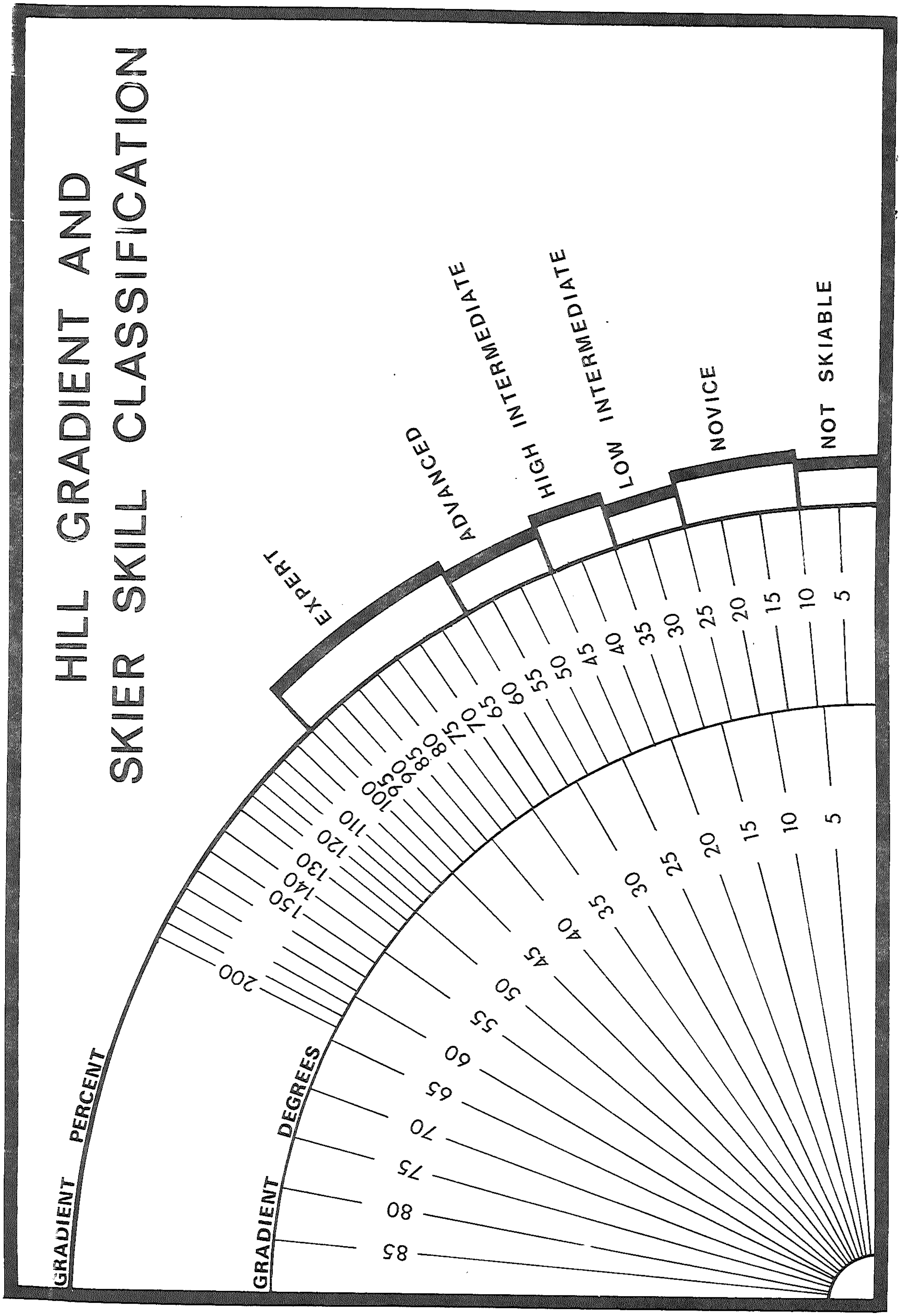
Slopes of less than 10% were considered to be unskiable but suited to base facility development, so long as biophysical analysis was favorable.

The purpose of establishing Slope Percentages and Skier Ability Standards is to assure that a market-proportional range of slopes is attained. The literature defines an optimum market representation of ski runs as 20% Advanced-Expert[2]. This ratio represents an optimum that ski area planners should strive to attain. However, optimum representation may not be possible due to limited suitable terrain, and indeed that target market ratio may not even be desirable due to the makeup of a particular ski area's market.

After reviewing the Slope Analysis Map of the Whitewater Ski Area, it has been concluded that it would be difficult to reach the optimal market proportion within the Apex drainage basin. The steep nature of the slopes within the basin provides little variation in

[2]Brandenberger, Bob. 'Estimating the Capacity of Ski Areas,' pp. 54-73 of Proceedings of the 1974 Ski Area Planning Symposium, USDA Forest Service, P.N.W. Region.

FIGURE 1


HILL GRADIENT AND
SKIER SKILL CLASSIFICATION
EXPERT
ADVANCED
HIGH INTERMEDIATE
LOW INTERMEDIATE
NOVICE
NOT SKIABLE
GRADIENT PERCENT
GRADIENT DEGREES

ADDENDUM (follows page 9)

skiable terrain. There are very few slopes of continuous grade and base facility development is limited to an extremely small area. In the future consideration of expansion outside of the Apex Drainage may prove necessary. While an analysis of slope parameters is essential to ski area planning, one also needs to be concerned with other resource uses and considerations, as well as the sensitivity of the natural environment.

THE BIOPHYSICAL APPROACH TO PLANNING IN THE WHITEWATER SKI AREA

The biophysical approach was undertaken to assess the environmental factors affecting Whitewater Ski Area development. The purpose of the biophysical information is to provide a base for ecologically sound developmental planning.

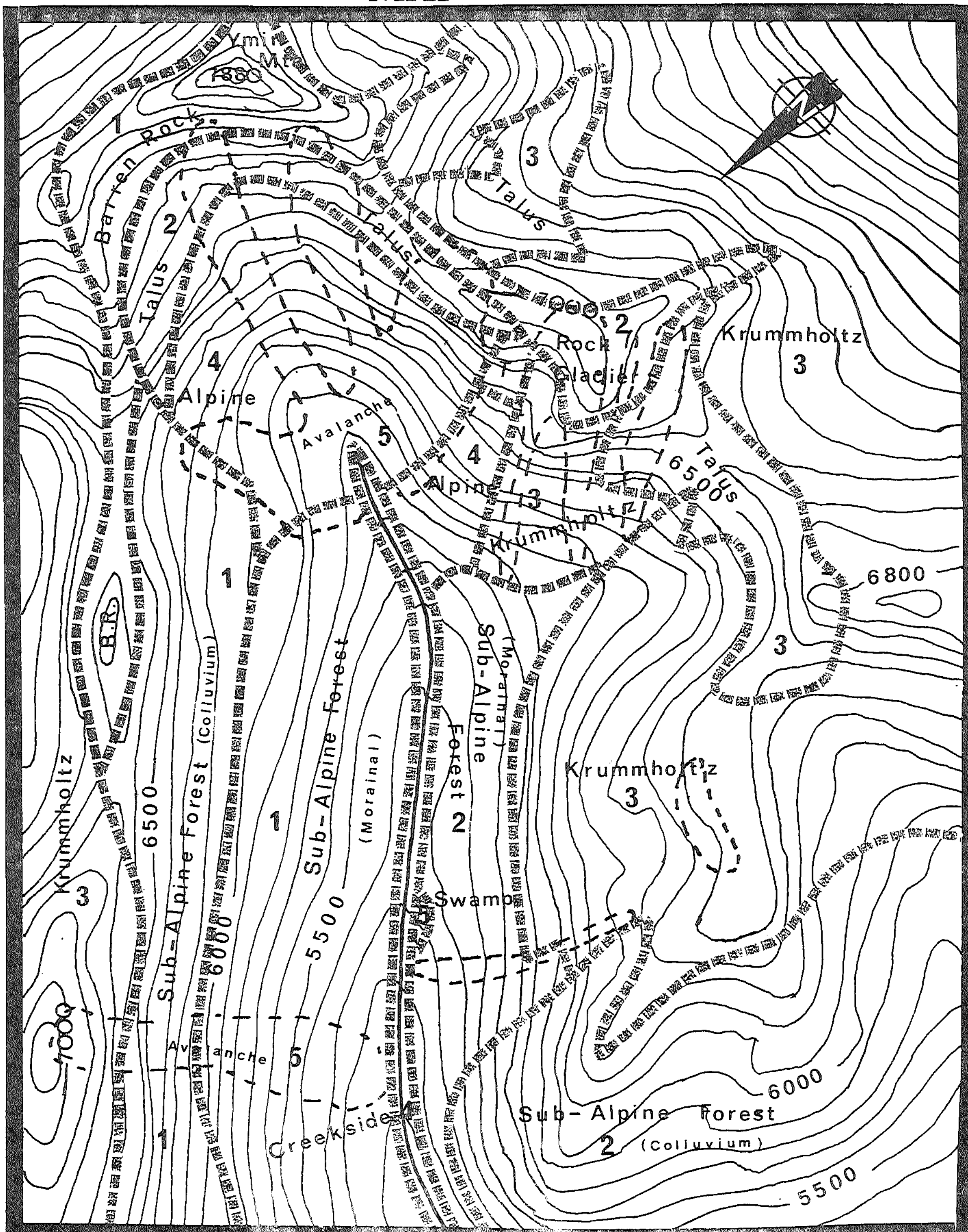
The biophysical study was prepared by the interpretation of aerial photographs, B. C. Forest Cover Map and B. C. Land Inventory Soils Map (82FW½) and Nelson Geological Survey Map (1090A) Memoir #308. Field trips were made by the research team in January, February and March of 1977 to examine the area.

This study was limited by the season of the year. Due to the snow-pack only limited field analysis could be carried out. No soil samples were taken and only vegetation above the snow-pack could be observed. There will be innaccuracies in the map-unit boundaries. The biophysical unit boundaries are subject to change upon further field study.

In short, the biophysical map attempts to classify and divide the land base into ecologically similiar units. Each mapped unit is uniform in terms of landform, soil and vegetation. (Map #2). An interpretation can then be made on the anticipated reaction of that particular unit to various development activities. Environmental capability and sensitivity ratings are produced to illustrate each unit's potential and limitations for development (see Environmental Component Chart).

The project area comprises approximately 1000 acres. It encompasses the headwaters of Apex Creek and between the heights

MAP 2



BIOPHYSICAL UNITS - Apex Creek

Boundary of Units	Fragility Ranking	
Avalanche Area - - - -	Most Fragile - 5 Most Stable - 1	SCALE 1:20,000

CHART 1

ENVIRONMENTAL COMPONENT CHART

BIOPHYSICAL UNIT	LANDFORM Mat'l. Erosion / Slope Aspect	SOIL TYPE	VEGETATION	Fragility Rating	TIMBER HARVESTING CONSIDERATIONS / EROSION POTENTIAL INDEX		Natural Stab'ty Index for Erosion		ENGINEERING CONSIDERATIONS	Building	Road Rating	SEDIMENT YIELD SILTATION INDEX		SEWAGE AND SEPTIC TANK LIMITATIONS		COMMENTS SPECIAL FEATURE
EXPOSED ROCK	Rs - M / H	$Ymir_4$ No soil	Lichens, dryas Very few scrubby trees	1		N/A	Stable	2	Mass movement potential when disturbed. Steep fractured rock inherently unstable. Level & gently sloping. Good for construction.	2	2	Low - Moderate	1	Not suitable	N/A	Physically very rugged. Danger for rock fall. Extremely exposed to temp. & wind. Distinctive visual landform.
TALUS SLOPES	Cb - M / F - G - W	No soil, or if any regisols $Ymir_4$ or $Beatrice_4$.	Lichens. Few mosses and dryas.	1	No harvesting considered on scree. SEVERE	N/A	Mod. Unstable		Colluvial action. Adverse topography. Mass movement potential when disturbed.	5	4	Low - Moderate	1	Not suitable	N/A	Rock glacier. No development - moving. May ski over to. Rapid drainage of H_2O. Constant downward movement of material.
ALPINE	Cv - M / G - E	Alpine Regisols Sombric Humo-ferric Podzol-Lithic (Alpine)	Alpine heather. Assorted herbaceous plants. Occasional small stunted tree.	5	No harvesting considerable regeneration difficult and slow slide hazard. SEVERE	5	Severe	4	Adverse topography. Shallow to bedrock soils. Proximity to avalanche zone. Seepage problems.	2	5	Moderate	3	SEVERE Shallow to bedrock. Adverse topography	4	Visibly a focal point from lodge. Attractive skiing area (powder); drainage poor in spots. Varying slopes.
KRUMMHOLTZ NORTHERN ASPECT	Cb - I / L - F - E	Orthic Regosols Ortho Ferro-Humic Podzols Rossland	Ecotone-Transition between Alpine & Sub-alpine forest clumps of stunted Alpine Fir, Larch, White-bark Pine, Grasses, Mosses, Lichens, Sedges, Heather plants	3	Low capability forest site Moderate windthrow hazard. Regeneration poor. Site damage can occur with harvesting. SEVERE Loss of soil potential high when skidding and yarding.	3	Mod. Stable	3	Drainage variable. May have some seepage but generally well drained. Low bearing capacity. Mod. steep topography. Construction can lead to creep and slump.	4	4	Low sediment yield	2	SEVERE Adverse topography.	4	Visually a patchy area (visually). Slope variable usually steep. A preferred skiing area. Little clearing necessary.
KRUMMHOLTZ SOUTHERN ASPECT	Cb - I / F - S	Dystric Brunisols Cooper, Beatrice, Ymir	Sparse clumps of alpine trees. Same as above except sparser + White Beargrass, Arnica and grasses.	4	Moderate windthrow hazard. Low capability forest site Regeneration poor. SEVERE Site damage can occur with harvesting. Loss of soil potential when skidding and yarding.	4	Mod. Stable	3	Construction can lead to creep and slump. Mod-steep topography. Low bearing capacity. More subject to extremes in temp. fluctuations.	3	4	Low sediment yield	2	SEVERE Adverse topography.	3	Generally a drier area than Krummholtz North. Snow melt more rapid. Preferred ski area. Patchy visual effect.
SUB-ALPINE FOREST Glacial Materials (Mainly) South Aspect	M / D - S	Ortho Hummo Ferric Podzol Kaslo Soils	Mature well-stocked Alpine fir. Spruce in wet rich lower elevation sites Understory: (BS831) Vaccinnium Mosses, sorbus sitchens.	2	Good regeneration potential. Slight windthrow hazard. Low resource damage by harvesting but can be damaged & possible siltation hazard MODERATE - SEVERE	3	Mod. Stable	1	Some seepage problems may occur. Steep slopes; boulders may be a problem.	4	2	Low - moderate in tills	4	Slight may be limited by topography. Some contamination hazard by effluent.	1	Visually a continuous textured unit. Climatic influences reduced by forest cover. Fairly well drained. Moderately steep slopes.
SUB-ALPINE FOREST Colluvial Materials Mainly North Aspect	C / E - N	Sombric Ortho-Humo Ferric Podzol	Mature well stocked alpine fir (BS 831) Rhododendron Azalea False Box	2	Mass wasting hazard Low-moderate regeneration potential. Soil damage by harvesting. Medium to high. Slight windthrow hazard. MODERATE	4	Mod. Stable		Slight. Seepage problems. Steep slopes. Large boulders. Bearing capacity.	3	3	Low - moderate	4	Moderately severe. Topography and drainage related.	2	Visually quite continuous some open [illegible]. Well drained [illegible] slopes mod-steep. Climatic influences reduced by forest [illegible].
AVALANCHE	Blue Tape Outline	Regosol Thin & rocky.	Shrubby vegetation. Slide Alder. Vaccinium. W. Rhododendron. Herbs on toe Amica.	3	No timber harvesting considered on Avalanche slopes.	N/A	Severe	5	Potential for mass movement.	5	5	Moderate	2	Not suitable.	3	Slopes may or may not be vegetatively stabilized at present. Few [illegible] damaged trees at runout. Well drained. Exposed to extremes in climate. Very hazardous area.
[illegible]	Ol - E / A - E	Organic Kaslo	Overstory alpine fir; open stand mosses, sedges, ferns. Equisetum hellebore.	4	Severe damage to site can occur with timber harvesting; serious erosion problem. Slow regen. SEVERE	5	Severe Erosion	2	Severe seepage problems. Sinking.	5	5	High	5	Poor. Potential for contamination by effluent due to poor infiltration rates.	5	Poorly drainage site a seepage hollow). Soils saturated with H_2O year round. Ponding of H_2O after disturbance, a problem. Flattish topography.
CREEKSIDE	FM - E / D - E	Podzol - Organic KO	High elevations. Lush alpine vegetation (senecio) mid elevation, cow parsnip, alpine fir, mosses, ferns, E. Spruce, Cedar Devils Club at Lower Elevations	4	SEVERE Removal of creek side trees can lead to bank slumping, therefore siltation.	4	Mod. - Severe Erosion	4	Bank stability problems. Siltation hazard. Flooding hazard.	4	4	Moderate - high	5	Very hazardous. Due to contamination possibilities.	5	Soils near creek are glacial in origin. Materials in creek bed, somewhat sorted and washed. Subject to spring flooding. Narrow V-shaped unit. Bounded by fairly steep banks.

CHART #1 (b)

KEY TO LANDFORM DESIGNATION

Landform

F.	Alluvium	Deposition of sorted material by flowing water; usually gravel and sand.
C.	Colluvium	Deposition of material by gravity and/or slope wash derived from a feeder slope or headwall of bedrock of unconsolidated material.
M.	Moraine	Deposition of glacial debris, boulders, gravel, sand, silt and clay; usually very compact and resistant to weathering.
O.	Organic	Moist depressions, around small water bodies, accumulation of plant and animal organic matter.
B.	Bedrock	Undifferentiated bedrock exposure.

Morphologic Expression

a.	apron	Coalesced fans of alluvial or colluvial origin.
b.	blanket	material over one meter deep with topographic expression controlled by underlying bedrock or unconsolidated strata.
i.	inclined	long, unidirectional slopes more than 3%.
l.	level	level to undulating topography less than 3%.
v.	veneer	material less than one meter deep.

Erosional Modifier

A	Avalanche	Active.
E	Eroded	Modified by through-flowing stream.
F	Failing	A slope modified by formation of tension fractures on the presence of large coherent masses moving slowly downslope.
I	Inactive	Superscripted to erosional modifier indicating the process is presently inactive.
M	Mass Wasted	Physical disintegration and downslope movement of loose material.

Slope Classification System

Simple Topography
Single Slopes (regular surface)

A depressional to level
B very gently sloping
C gently sloping
D moderately sloping
E strongly sloping
F steeply sloping
G very steeply sloping
H extremely sloping

of land. Elevation in the study area varies between 7780' (Mt. Ymir) and 5000'.

This alpine-sub-alpine environment within the Selkirk range is both harsh and fragile. Climatic extremes and rugged topography provide a harsh unproductive base for soil and plant development. Low temperatures, high winds, fluctuations in moisture levels (spring run-off vs winter drought) and a heavy snow-pack curtail soil development and shorten the plant growing season. The soils in the alpine environment are unstable due to steep slopes and accelerated rates of mass movement. These shallow infertile alpine soils erode easily. Rockfall, landslides, soil creep and avalanches can be initiated by man's activities.

The ground vegetation growing on these alpine soils is fragile and can easily be destroyed by trampling or construction. Once removed, vegetative cover is difficult to reestablish and the soil is even more susceptible to erosion. The net result of site damage is low productivity and slow recovery rates.

A rapid decline in environmental quality can occur if developments in mountain area proceed on an ad hoc basis. Mountain developments such as lift facilities, ski trails, buildings, sewage facilities,roads and parking lots should be planned and constructed within the stability limits that the mountain ecosystem sets.

The following biophysical description and charts explains the problems that may be associated with activities in Apex basin. (See Land Use Capabilities Chart). The management must decide what level of environmental quality is desired in Apex Basin. If a high-quality

CHART 2

LAND USE CAPABILITY CHART

UNIT	SKI DEVELOPMENT INCLUDING TOWER INSTALLATION	PARKING LOTS	SKI TRAILS AND AREAS (May include clearing)	LOGGING & ACCESS ROADS	BUILDINGS	SEWAGE DISPOSAL	GENERAL COMMENTS PERTAINING TO DEVELOPMENT
EXPOSED ROCK	Probably N/A. Hazards due to Rockfall and Rock Movement	N/A	Touring only considered. Limited by slope, weather, exposure	N/A	Mass movement. Potential when disturbed in areas of exfoliation.	N/A	Generally an unsuitable area for development on steep exposed slopes but may be suitable on level rock areas.
TALUS SLOPES	On Active Talus Downward moving rock a problem. Large boulders.	N/A	With sufficient snow pack - suitable on inactive talus. Avalanche proximity may be prohibitive.	Probably N/A. Talus movement a problem. Good bearing strength.	Not suitable due to Mass Movement potential. Proximity to Avalanche paths.	N/A	Development of any sort should be avoided on or at toe of rock glacie Lack of H_2O. Level, inactive talu far away from Avalanche paths - is suitable development area.
ALPINE	Very fragile plant community. Seepage will be a problem. Severe erosion hazard when vegetation removed. Boulders can present problem. Avoid seepage areas.	No. suitable.	With sufficient snow pack suitable although skiing may cause excessive snow packing which may lengthen snow release dates for plant community. Avalanches prohibit ski trails in this area - probably.	Topography Limitations. Erosion hazard very high. Access roads should avoid Alpine zone.	Not really suitable. Wet sites should be avoided. Seepage problems. All precautions should be taken to avoid disturbance to plant community. Visually a poor location.	Not suitable.	Excessive slope and soil moisture. Areas should be avoided. Winter and fall development, if any
KRUMMHOLTZ NORTHERN ASPECT	Reasonably tolerant to development on gentler slopes. Avoid seepage areas. Boulders may be a problem. Shallow to bedrock soils are subject to erosion.	Not suitable	Good skiing terrain (dependent on slope). Little clearing necessary. Tree clusters should be left intact to minimize disturbance of snow deposition patterns.	Access roads should be kept to a minimum as topography and erosion potential limiting	Topography is limiting, shallow to bedrock soils; wet sides should be avoided.	Considerable limitations - topography - shallow to bedrock soils	Tolerant to Ski Development in areas of gentler slopes, if cuts are minimized, most tree clusters are left intact, wet sites avoided.
KRUMMHOLTZ SOUTHERN ASPECT	Similar to above.	Not suitable.	Similar to Krummholtz Northern aspect.	Similar to above. Soil erosion problems may be worse.	Similar to above.	Considerable limitations.	Same as above.
SUB-ALPINE FOREST ON GLACIAL MATERIALS SO. ASPECT (MAINLY)	Tolerant to development if topographically suitable location can be found. Seepage areas should be avoided.	Suitable depending on topography and drainage.	Only slight limitations to ski trails. Clearing will be required. Single trees subject to blow-down. Beware of stream sedimentation. Clearing may increase fluctuations in snow melt patterns. Seepage areas should be avoided. Cleared runs should be feathered to minimize visual impact.	Erosion problems will occur. Slumping, gullying a problem; however fairly suitable location should consider slope and drainage.	Some seepage problems and stream sedimentation problems. Location should above all consider topography and drainage.	Slight limitations. Contamination hazard but effluent must be dealt with.	Generally the most suitable area for development if ground water drainage patterns are not altered and topography is suitable.
SUB-ALPINE FOREST FOREST ON COLLUVIAL MATERIALS NORTH ASPECT (MAINLY)	Tolerant to development if topographically suitable location can be found.	Topography and elevation limitations.	Same as above. Trees may be more subject to blow-down.	Fairly suitable area for a road location if consideration for topography, drainage and erosion maintained.	Suitable depending upon topography.	Shallow to bedrock soils.	Suitable for ski development if topography is suitable and clearing kept to minimum.
AVALANCHE	Not suitable.	Not suitable.	Under controlled conditions ski trails may be feasible.	Not suitable.	Hazard of being buried.	Hazard of being buried.	Hazards make this area generally unsuitable for development.
SWAMP	Extremely unsuitable.	Unsuitable - Low bearing capacity. Cars and equipment will sink.	Suitable only for cross-country ski trails with sufficient snow pack.	Low bearing capacity. Unsuitable.	Construction poses drastic problems with drainage and swamp soil disturbance. Unsuitable. Low bearing capacity.	Unsuitable.	Restricted to use except in periods of snow-cover and complete frozeness. Following disturbance area with continually erode causing severe siltation problems downstream.
CREEK SIDE	Unsuitable. Bank collapse.	Unsuitable near creek edge. Avoid movement of material towards creek.	Avoid dangerous (steep bank and crossing) situations. Avoid disturbance of vegetation. Should be adequately bridged at crossings most suitable for cross-country location.	Any access road location near Creek should adhere to stringent requirements to avoid siltation, contamination problems.	Buildings should not be located close to creek contamination by effleunt can be a problem.	Unsuitable. Hazard of Contamination.	Sensitive area - disturbance can lead to slumping and failing of banks. Siltation and contamination Problems may have concurrent effect downstream and in Nelson watershed.

environment is desired, then the management must be prepared to accept the high costs of precautionary and remedial measures to protect the environment. Such costs, if borne, are not without long-term benefits. In the long-run, site destruction will be less, and overall operational efficiency will be greater if environmental constraints are followed.

How was the biophysical environment of Whitewater analysed for our purpose? The following will give the reader some feel for the method used. A more comprehensive review is provided in Appendix A.

BIOPHYSICAL ANALYSIS

In order to analyse the large number of variables which need to be considered simultaneously in the environmental fragility picture, we chose a grid system. The grid system artificially separates the entwined environmental variable and facilitates a look at the nature and degree of impact from any given development activity. (See Environmental Impact Ranking Chart).

Placed on one axis is each biophysical unit. On the other axis are these environmental variables; landform, soil, natural stability, effects of harvest, siltation index, engineering considerations for buildings, engineering considerations for road construction, and sewage index.

In each resulting quad, a numerical ranking was assigned based on all the pertinent information we could gather. For each environmental variable a full scale of ranking was given so that <u>relative</u> fragility is indicated by the assigned number rather than an absolute status. Rankings in this chart are, therefore, not directly comparable, CHART # 3

ENVIRONMENTAL IMPACT RANKING
for
DEVELOPMENT IN WHITEWATER SKI AREA

TYPES OF DEVELOPMENT

Biophysical Units	Installation of Ski Lifts	Ski Runs & Trails	Buildings	Parking Lots	Logging & Access Roads	Sewage
Exposed Rock	2	1	2	N/A	2	N/A
Talus Slopes	3	2	5	N/A	2	5
Alpine	4	3	4	N/A	4	4
Krummholtz (Northern Aspect)	3	4	3	N/A	4	4
Krummholtz (Southern Aspect)	3	3	3	N/A	4	4
ESSF (Southern Aspect)	1	2	1	1	1	1
ESSF (Northern Aspect)	2	2	2	2	2	2
Avalanche	5	5	N/A	N/A	N/A	N/A
Marsh	5	4	5	5	5	5
Creekside	4	4	4	4	5	5

Ranking System

1 = most stable or most suitable site

5 = least stable or least suitable site

N/A = site not applicable to type of development variable to variable. For example, a fragility ranking of #1 in sewage index does not mean the same as a ranking of #1 in Siltation index. Each ranking relates only to the variable in question. The scale was set so that #1 indicates the highest relative degree of stability or suitability and that #5 is the lowest relative degree of stability.

In order to re-examine the variable in the light of specific proposed developments, the rankings were added, choosing only the environmental factors that applied to the problem in question. In this manner each biophysical unit is considered for these development possibilities; life installation; ski runs; buildings, parking lots; logging and access roads and sewage installations.

The final outcome of the analysis of biophysical units is an overall planning guide to the relative sensitivity of any land unit when considering a number of development possibilities. Details to degree and type of concerns for development constraints can be found by consulting Chart #3 . It must be stressed that information presented at this stage has not been field checked and this chart serves best as an outline of major limitations and as a methodology for processing field checked data.

Considerations:

i) Environmental Fragility Analysis: When evaluating each variable , finite qualities were examined. To understand and make use of these rankings our frame of reference is outlined below.

Natural Stability: (when no alteration has taken place) any soil loss other than surface erosion, slump and slide.

ii) Harvest of Vegetation; Erosion, (sheetrill, gully), winthrow hazard, natural regeneration capability.

iii) Situation index; Chiefly considers soil texture but also soil structure drainage pattern and landform.

iv) Plant & Habitat Fragility; Ease of re-establishment of plant community often description, sensitivity to disruption, natural diversity, function of the community in the overall system, abundance of the community.

v) Engineering Considerations;

a) Buildings (foundations) considers shear strength, shrink-swell potential, consolidation characteristics, susceptibility to liquification & piping, soil texture, soil permeability and depth to bedrock.

b) Road Building index considers, presence and thickness of organic materials, presence of stones and boulders, potential for frost heaving, erodibility, plasticity of material.

vi) Sewage index; soil permeability, depth to water table, flooding hazards, steepness of slope, depth to bedrock or impervious materials.

Proposed Developments Analysis:

All environmental variables were not considered when rating each development. Variables which had a direct link with the modification were weighed in the impact analysis. For example; sewage rating was not added into the consideration of lift installation. For each proposed development activity the following factors weighed:

a) Left installation; Engineering considerations for buildings, natural stability, plant and habitat fragility.

b) Ski trails; Effects of harvest, natural stability, engineering considerations for buildings.

c) Buildings; Plant & Habitat Fragility, natural stability and engineering considerations for road building.

d) Access & logging roads; Siltation index, engineering considerations for road building.

e) Sewage location; Engineering considerations for buildings, sewage index, plant & habitat fragility.

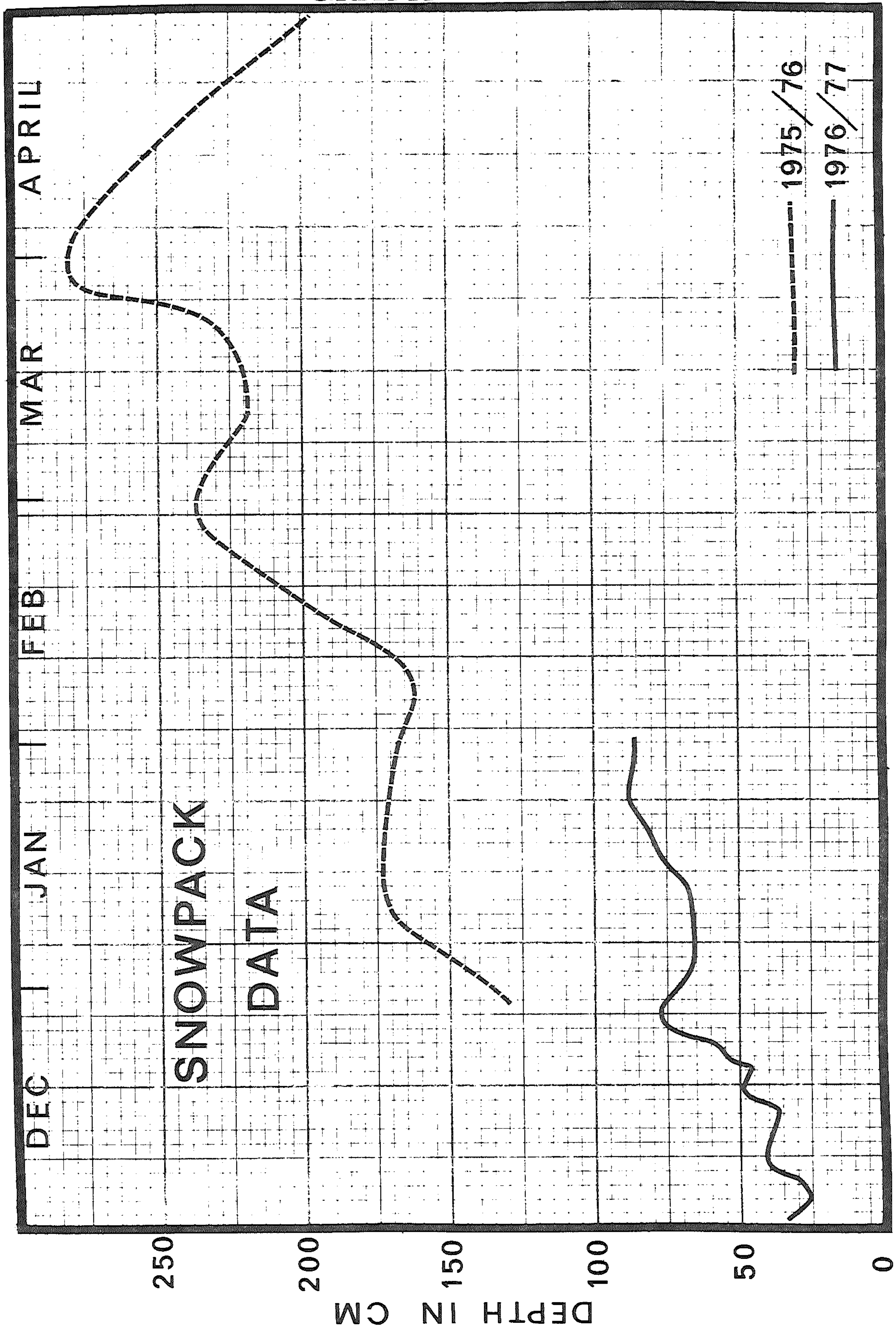
AVALANCHE HAZARD EVALUATION

Avalanche hazard in the Apex drainage has only been studied on a continuous basis since November 1975 (Graph #1). Previous to this date very little monitoring of avalanche occurrences or weather data occurred. As a result of this short study history many important questions regarding the possible size and frequency of avalanches remain unanswered.

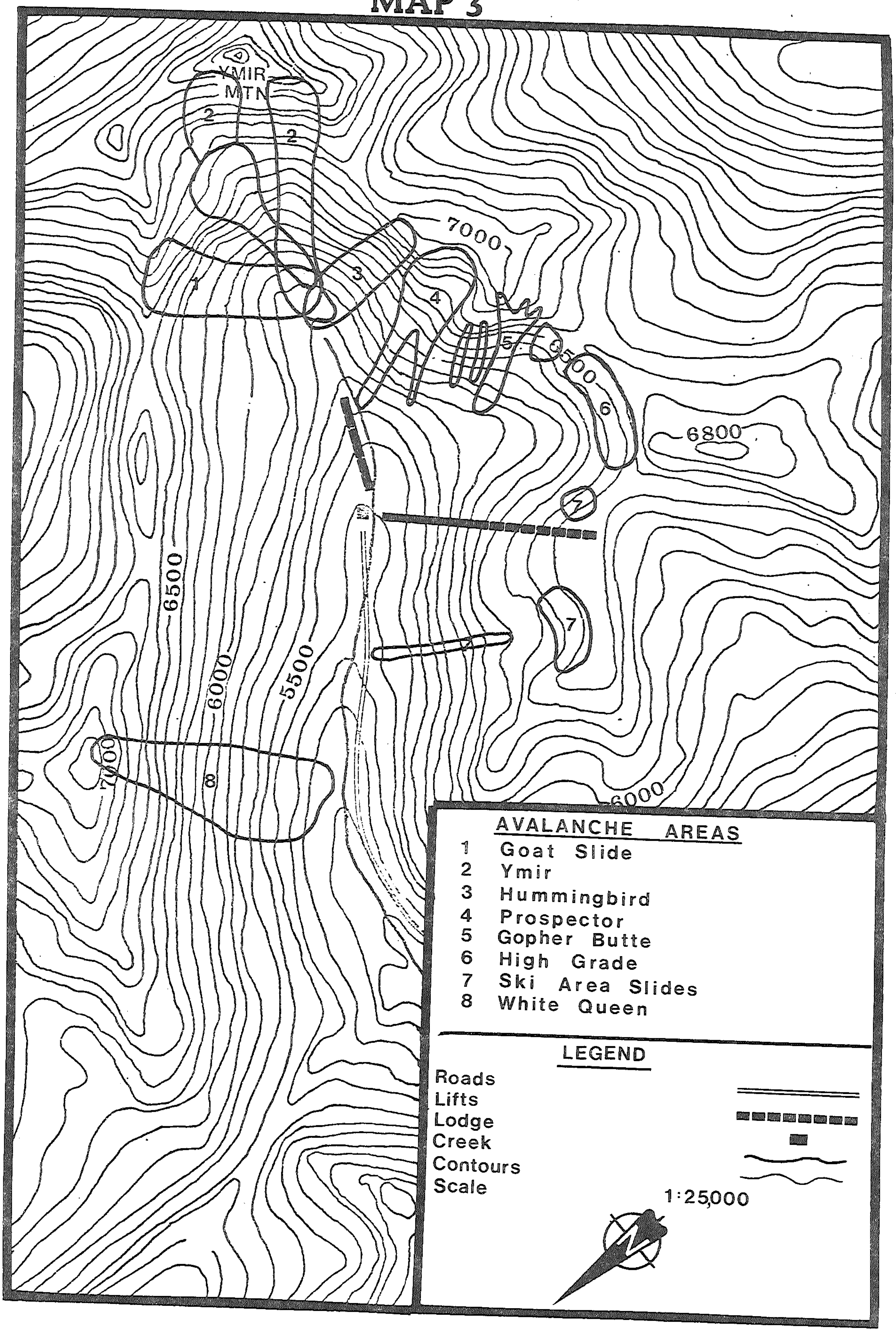
Identification of the avalanche paths in the drainage was relatively simple as avalanches remove all the larger trees in the avalanche track, leaving an obvious scar in the forest cover on the mountainside. However it is not as simple to determine the run-out zone or what could be called the bottom boundary of the avalanche path. In most cases the bottom boundary can be defined by the timber which grows along the boundary of the run-out zone. However it is difficult to be certain that this existing boundary will not change. In severe winters avalanches can overrun historical boundaries.

In the context of the Whitewater development there is one avalanche path which has a run-out zone that comes very close to the Hummingbird chairlift. The bottom boundary of the Prospector slidepath (Map #3, see also Appendix Map B) is separated from the chairlift by a small band of timber. A natural terrain barrier in the form of a deep stream gully has historically deflected avalanches away from the lift locale. However if this gully should become filled by an exceptionally deep snowpack or a series of smaller avalanches, this natural barrier would be removed. The starting zone of this slidepath is a steep cirque basin with a northerly aspect which makes

GRAPH 1


SNOWPACK
DATA
DEC
JAN
FEB
MAR
APRIL
1975/76
1976/77
250
200
150
100
50
0
DEPTH IN CM

MAP 3


YMIR MTN
7000
6800
6500
6000
5500
6000
7000
AVALANCHE AREAS
1 Goat Slide
2 Ymir
3 Hummingbird
4 Prospector
5 Gopher Butte
6 High Grade
7 Ski Area Slides
8 White Queen
LEGEND
Roads
Lifts
Lodge
Creek
Contours
Scale
1:25,000

it subject to heavy wind loading of snow by the prevailing southerly winds. All of these characteristics unfortunately point to possible disastrous consequences especially in a winter which produces abnormally large amounts of snow in the starting zone and track of this slidepath. It would seem logical to control this slidepath in order to prevent any possible future disaster. Given the existing circumstances, control of this slidepath would be a complex problem for several reasons. Firstly any control program once implemented would have to be on a continuous 24-hour a day basis. For instance, if snow build-up in the starting zone was allowed to reach dangerous proportions in a severe storm, then artillery control at that point would likely result in a very large avalanche overrunning the existing boundaries and destroying the Hummingbird chairlift. Only by frequent firing of artillery during storm periods would a large accumulation of snow in the starting zone be prevented.

Another problem is that gun towers would have to be located on the north side of the valley, far enough up the slope to gain a clear line-of-sight to the desired targets in the starting zone. The starting zone is not visible from the valley floor. One possible solution to the problem would be to build avalanche defences in the starting zone or a large earth dyke in the run-out zone to deflect any possible large avalanches.

As can be seen the Prospector slidepath presents a serious avalanche problem and should be given intensive study in the future.

Avalanche hazard also exists in the region of the proposed lift. (See Appendix Map B). Two major avalanche paths exist on the eastern boundary of the proposed expansion area. These are the Goat slidepath and the Hummingbird slidepath. Skiers access will very likely be afforded to these slidepaths by the proposed lift. However the Goat slide is separated from the proposed runs by a large area of mature timber. Those skiers who might choose to reach the Goat slidepath would have to undertake a long and tedious ski traverse in order to get there. Powder hounds are noted for their perseverance in locating untracked powder and therefore provisions should be made in the control plan for the eventuality of skiers entering these avalanche areas.

If skiers are provided access to these avalanche areas then the ski area management must control this problem by fencing and signing the area as closed to skiers due to avalanche hazard. If this method fails, then artillery control would be the other alternative. A gun tower with a clear line-of-sight to targets on the Goat slidepath and the Hummingbird slidepath could be erected in a safe location near the proposed lift. Stabilization programs could then be implemented which would make these areas safe for skiing.

In the existing ski area several avalanche paths are present which pose a threat to skiers. As can be seen from the map these areas are generally smaller than those mentioned earlier. Avalanche control measures have been taken in the past and will likely continue in the future. Most of these avalanche areas are controlled by hand-charges except for the gopher butte slides which are not easily accessible to hand-charging crews. The gopher butte slide-paths present a high avalanche hazard to skiers and control measures should be implemented in the future to prevent an accident. Avalanche control would be best accomplished with the aid of artillery or an avalauncher located near the top of the summit chairlift.

For the purpose of this development plan an avalanche hazard classification system was devised for use on the avalanche hazard map. The following levels of avalanche hazard were delineated for the avalanche paths in the Apex drainage:

High Hazard Zone: are those areas which present a high avalanche hazard to skiers based upon 3 variables:

1) the available avalanche records
2) the steep topography of the starting
3) the vegetation clues which conclusively indicate frequent avalanches in previous winters.

Moderate Hazard Zones: are those areas which present a definite hazard to skiiers but are less dangerous due to the possibility of stabilization through skiing compaction and for the anchoring effect of vegetation on the slopes.

Low Hazard Zones: are areas of potential avalanche hazard to skiers but which under normal winter conditions are generally safe due to snow compaction from skiing and/or the anchoring effect of vegetation. This classification could also apply to small natural openings in the forest cover on the steeper slopes and to any proposed runs on slopes over 60%.

Run-out Zones: are the bottom boundaries of a slidepath the extent of which has been determined by vegetation clues.

The preceding discussions of regional market, slope analysis, biophysical considerations and avalanche hazard evaluation do much to direct one's thinking regarding the scale and actual locations of specific developments. Of course, studies such as these would best have occurred prior to any development at Whitewater. Such studies, however, were not commissioned. It is appropriate at this stage to review the history of Whitewater's development.

CONCISE HISTORY OF THE WHITEWATER SKI AREA

The idea for development of the Apex Creek drainage into the Whitewater Ski Area originated in the late 1960's. At that time, the Silver King Ski Club was out-growing their Silver King Ski Hill and also feeling mounting public pressure for expanded facilities. The Silver King Ski Hill offered limited expansion opportunities, primarily due to the unsuitable topography of the area. The Club subsequently began scouting the Selkirk Range in the Nelson - Ymir area for a drainage suitable for downhill skiing development and expansion.

The Apex Creek drainage was soon deemed most suitable for development. The area has a colourful history of trapping, prospecting and mining activity; indeed, many of the features of the present ski area are named for the local mines - Hummingbird run and Summit lift, for example.

The project of development of the Whitewater basin was initiated by the executive of the Silver King Ski Club Society in 1969. Use of the land was temporarily secured in the form of a Special Use Permit issued by the B. C. Forest Service. As planning continued, the tenure was extended by a twenty year Special Use Permit which is renewable every year.

Many individuals and organizations participated in the early stages of planning and development including other ski area personnel, life companies, professionals, government agencies, local industry, Nelson Society for the Handicapped and the members of the Silver

King Ski Club Society of Nelson. In anticipation of the future, the non-profit Society soon changed its name to the Whitewater Ski Society.

Finances for the ambitious project were acquired through various means by the Society. Community donations of volunteer labour and professional services made up a large portion of the initial ski area financing. Revenue generated by the logging of the ski area runs and access road amounted to over $200,000 by 1974. The near $500,000 cost of access road construction was financed by the Department of Highways under the capital expenditures program. In addition, monies were acquired through the sale of existing Silver Ski Area facilities. A major source of financing, as may be expected, remains the bank.

Preliminary feasibility studies were carried out from 1969 to 1971. These included aerial surveys and photography, avalanche evaluation, weather studies, snow condition studies and initial surveys.

The Department of Highways cooperated in the development process by planning, designing and constructing the six mile public access road to the base area facilities. The Department has continually maintained and upgraded the road since that time.

The utilities of the area were installed over a six year period. Negotiations with the West Kootenay Power and Light Company occurred with the result that the Society signed a contract with the Company to supply power to the ski area. Construction of the three-phase power supply initially cost $52,000 and the Company is guaranteed a certain sum every year. The water supply to the lodge was surveyed, designed and installed by 1975. In early 1976, after improvement and expansion, the sewage system of the Area was complete.

The lodge was designed and planned by a local architect. Construction began in 1973 but misfortune struck in the winter of '74 when heavy snows destroyed the foundation and floor of the partially constructed building. The roof of the lodge can now withstand a load of up to 900 tons! Lockers and other improvements were added to the building in 1976. All will agree, the lodge has a rustic European-alpine appeal which is further enhanced by the glassed-in design of the upper floor.

Run feasibility studies and layouts were begun in 1972. In 1973, cruising was completed and logging contracts let to clear the runs and lift lines. Four runs were completed by 1975. Several others were added and as of 1977, the area boasts seven runs.

A Doppelmeyer t-bar lift was purchased by the Society in 1974. After a thorough economic feasibility study was completed, though, it was determined the t-bar was unsuitable for use in the Whitewater development.

Subsequently, two used Riblet chairlifts were purchased and installed. These two lifts, together, can support more skiers and thereby generate sufficient income to cover operating costs as the success of the first year of operation - 1976/77 - has proven.

The Ski Club now boasts a membership of 948 - an increase of 33 percent from the 1975/76 to 1976/77 season. The Area has experienced rapid acceptance in its short existence. In spite of the non-cooperation of the weather in the early months, the area is having a relatively successful 1976/77 season.

Much as been accomplished in the last eight years by the Whitewater Ski Society. The area stands as a prime example of a total community effort. If the past achievements and success of this dedicated group is any indication, a bright future is in store for the Whitewater Ski Area.

EXISTING DEVELOPMENT OF WHITEWATER

ACCESS

Whitewater is reached via Highway 6, a paved road which is maintained during the winter by the Department of Highways. Six miles south of Nelson, the ski area access road enters from the east. The road is approximately six miles in length and parallels Apex Creek along most of its length, crossing the creek at two locations. The access road was once an old logging road, but has been since widened and partially gravelled to accommodate the amount of use which it now receives.

During the winter, with frozen ground, the road is usually in good condition. Slippery conditions can occur after or during a heavy snowfall when the road cannot be adequately cleared and sanded before and during periods of skier traffic.

In early spring, the problem of surface thawing often results in poor road conditions (mud and washboard). Lower sections of the road may be extremely muddy as early as late February if winter conditions are mild. Poor road surface material, unstable cut-banks, disturbed drainage and the tendency of drivers to over-use their brakes (causing washboard) are the main reasons for this problem occurring. Some necessary improvements have been made to alleviate this, but undesirable conditions still occur during periods of thaw and at times spring skiing may be restricted to those with access by four-wheel drive vehicles.

BASE FACILITIES

Lodge Capacity

The lodge is currently located at the bottom of Whitewater basin and fits nicely into the scene, architecturally. It contains a ski shop, small cafeteria, locker area, and a ski patrol room. The capacity of the upper floor is 350 people and the basement is rated at 60 people, bringing the total capacity of the lodge to 410 persons at one time. This is what the building has been rated at by the Nelson fire marshall. It was designed by local architects and the roof is capable of supporting 900 tons of snow.

Parking Lot Capacity

There are presently two parking lots at Whitewater. One is located about 200' from the lodge while the other is about 800' from the lodge. The acreage of the lots was 2.2 and 2.5 acres respectively. Based on each car requiring 400 square feet the total capacity of the lots is 500. Using an average of 3 persons per car then the total number of persons who can be accommodated on the hill is 1500 persons. The parking lot will presently permit as many persons to park, as can be accommodated by the existing sewage system.

Sewage System Capacity

The sewage system at Whitewater consists of two holding tanks with a combined capacity of 8844 imperial gallons. There is presently a gravity fed line to a tile field about half a mile down the road. The daily capacity of the system is 1500 people and at peak periods, such as night occur during ski competitions with many spectators, the system could probably handle close to 2000 people, based on each person using only 5 gallons per day. Usually the flow of sewage fluctuates during the day so the system has time to recuperate somewhat during the day. The system incorporates a pulsating flush tank. This means that when the tank fills up, it empties only enough effluent to fill the tile field to its capacity. This in turn means that all of the tile field is used and thus, the field takes longer to become saturated, as the sewage is spread over a larger area more evenly.

LIFTS AND RUNS

Criteria for Calculations

In ski area planning there are certain important variables used in calculating lift and run capacities and requirements. The terms used are common throughout the ski industry but vary somewhat in definition. To avoid confusion and maintain consistency, all necessary terms will be defined for the purposes of this report and the basis of the critical variables will be stated.

Skiers At One Time (S.A.O.T.): This is the total number of skiers on the designated run at any one time who are in motion, momentarily stopped, waiting in line or riding the lift. This number is calculated by multiplying the total run acreage by the optimum skier density for that skill classification of run. Those that are stopped for long periods or skiing off the run are not included.

People At One Time (P.A.O.T.): This is the total of the skiers at one time on all the runs plus all the patrons at one time using the base facilities. This includes those not skiing designated runs. This figure was assumed to be 120 percent of the S.A.O.T. The basis for this assumption came largely from a study done by a ski area consultant. This figure was assessed by us as the reasonable minimum since there are a minimal number of people at the Whitewater facility for recreational purposes other than downhill skiing. These persons might include sightseers or cross country skiers.

Optimum Skier Density Per Acre (Chart #4): This is the optimum number of skiers per acre in a given skill classification each of whom would have a quality skiing experience. These figures vary between eastern and western North America and with proximity to major population centres. The figures on the chart were deemed acceptable for Whitewater as a regional ski hill some distance from large cities. An increase in these figures would increase the required capacity of the lifts and lessen the quality of the experience. A reduction in these figures would result in higher capital expenditures per skier. The figures for novice and low intermediate runs apply only if the slopes are regularly groomed.

CHART # 4

OPTIMUM SKIER DENSITY PER ACRE

Skier Skill	Density Per Acre
Novice	35
Intermediate	15
Advanced	5

Acreages of Runs: Acreages were calculated using planimetric maps of the runs made from recent aerial photographs (1976). Figures given are careful approximations to the nearest acre made using a planimeter.

Open areas and treed areas were not incorporated in run acreage calculations. These areas, of course, would add considerably to the total acreage but only in the advanced expert skier classification. Also, these areas would have been very difficult to define and calculate. Long traverses, also, were not included as these were considered to be holding the skier 'in limbo'. That is, the skier on these traverses is not effectively using the hill facilities. Where two or more runs intersected, the common ground was accounted for only one in the calculations.

Lift Load Efficiency Factor: In the calculation of chair capacities, these factors account for down-time during operation hours and missed chairs. This factor is largely a function of the skier skill. These factors were assessed at ninety percent for intermediate/advanced chairs and eighty percent for beginner lifts.

Lifts and Runs Form/Calculations

A lifts and runs design form was developed to aid in the calculation of run capacities and lift requirements (Chart #5). The form is self-explanatory and includes only information pertinent to the calculations. The last item on the form (#18 - Actual Capacity of Chair), is that which the chair must be capable of providing while operating at the given lift-loading efficiency (i.e. a higher lift capacity is required when operating at less than 100 percent).

The system capacity is the percentage of the actual chair capacity (#18) that the existing chair operates at multiplied by the total capacity of all the runs in S.A.O.T. This figure is the number of S.A.O.T. that the existing system can maintain on the hill.

The Summit Lift (a) The Chair

The Summit Chair is located on the south-west side of the Apex

CHART #5

WILDLAND RECREATION TECHNOLOGY		LIFTS & RUNS DESIGN FORM	Area ______ Hill ______ Date ______		
#	DATA	Lift No.	Run No.	Run No.	Run No.
1	Horizontally projected length in feet for lift				
2	Vertical Rise in Feet for Lift				
3	Average Slope Length (Hypotenuse) in Feet for Lift				
4	Classification of Slope - as to Skier Skill				
5	Optimum Density - in Skiers/ Acre - for Skier Skill				
6	Total Area of Each Run - In Acres				
7	Total Area of All Runs - In Acres ($\#6_1 + 6_2 + \ldots \#6N$)				
8	Capacity of Each Run - In Skiers (#5 X #6)				
9	Total Capacity of All Runs - In Skiers ($\#8_1 + 8_2 + \ldots . \#8N$)				
10	Estimated Average Time to Ski Down Runs (Minutes)				
11	Assumed Lift Rope Speed in F.P.M.				
12	Assumed Lift Loading Efficiency (%)				
13	Approximate Duration of Ride Up Lift (Min.) (#3/#11)				
14	Assumed Time Waiting in Lift Line (Min.)				
15	Approximate Lift & Run System Total Time - 10 + 13 + 14				
16	Number of Round Trips Possible per Hour (60/#15)				
17	Actual Required Capacity of Lift/Hr. (#16 X #9)				
18	Actual Capacity of Chair Persons (#17/#12)				

bowl (see Appendix Map A). The base of the lift is located at an elevation of approximately 5300', with the upper terminal of the lift ending on the top of Goldpan ridge at an elevation of 6550'.

The ride up the chair affords the skier an excellent view of the alpine character of the Apex drainage, the focal point being Ymir Mountain at the head of the valley. At the top of the lift a spectacular panorama of the west Kootenays unfolds. Familiar ranges such as the Valhallas, the Selkirks and the Purcells compete for the viewers' attention.

Both the chair and the ski runs it serves receive relatively little wind and sun due to the sheltering and shading effect of 7880' Ymir Mountain and the associated height of land to the south of the development.

Summit chair is of Riblet design and is operated to serve the needs of the intermediate to expert skier. The chair is located on steep terrain making maintenance of the lift relatively difficult. Steep slopes in combination with a heavy snowpack familiar to the Whitewater area create a much more serious problem. Tower movement as a result of snow creep is a very real possibility if preventive measures are not taken. At present no snow deflectors have been placed on the uphill sides of the tower foundations. Therefore the snow must be removed from the base of the towers by hand.

Other information relevent to the Summit chair is recorded on the "Lifts and Runs" data sheet which follows. (See Charts #6 & 7).

The Summit Chair has a rated capacity of 1050 skiers per hour. In order to fill the existing runs serviced by this chairlift with the optimum S.A.O.T. of 835, a lift capacity of 2412 skiers per hour is required. (The latter assumes a 90% lift efficiency).

CHART #6

WILDLAND
RECREATION
TECHNOLOGY

LIFTS & RUNS
DESIGN FORM

Area Whitewater
Hill Summit Chair
Date March 1977

EXISTING RUNS

#	DATA	Lift No.	Run No. 1	Run No. 2	Run No. 3
1	Horizontally projected length in feet for lift	2747			
2	Vertical Rise in Feet for Lift	1242			
3	Average Slope Length (Hypotenuse) in Feet for Lift	3015			
4	Classification of Slope - as to Skier Skill		Low Inter	High Inter	Advance
5	Optimum Density - in Skiers/ Acre - for Skier Skill		15	15	5
6	Total Area of Each Run - In Acres		25	23	8
7	Total Area of All Runs - In Acres (#6_1 + 6_2 + ...#6N)	71			
8	Capacity of Each Run - In Skiers (#5 X #6)		375	345	40
9	Total Capacity of All Runs - In Skiers (#8_1+8_2+....#8N)	835			
10	Estimated Average Time to Ski Down Runs (Minutes)		15	12	8
11	Assumed Lift Rope Speed in F.P.M.	500			
12	Assumed Lift Loading Efficiency (%)	90			
13	Approximate Duration of Ride Up Lift (Min.) (#3/#11)	6			
14	Assumed Time Waiting in Lift Line (Min.)	5			
15	Approximate Lift & Run System Total Time - 10 + 13 + 14	23			
16	Number of Round Trips Possible per Hour (60/#15)	2.6			
17	Actual Required Capacity of * Lift/Hr. (#16 X #9)	2171			
18	Actual Capacity of Chair Persons (#17/#12)	2412			

NOTES

*Rated Cap = 1150 system capacity feet

$\frac{1150}{2171} = .53$

.53 x 835 = 442

CHART #7

WILDLAND RECREATION TECHNOLOGY	LIFTS & RUNS DESIGN FORM	Area: Whitewater Hill: Summit Chair Date: March 1977

EXISTING RUNS

#	DATA	Lift No.	Run No. 4	Run No. 5	Run No. 7
1	Horizontally projected length in feet for lift				
2	Vertical Rise in Feet for Lift				
3	Average Slope Length (Hypotenuse) in Feet for Lift				
4	Classification of Slope - as to Skier Skill		Advanced	Expert	Expert
5	Optimum Density - in Skiers/Acre - for Skier Skill		5	5	5
6	Total Area of Each Run - In Acres		9	2	4
7	Total Area of All Runs - In Acres ($\#6_1 + 6_2 + \ldots \#6N$)				
8	Capacity of Each Run - In Skiers (#5 X #6)		45	10	20
9	Total Capacity of All Runs - In Skiers ($\#8_1 + 8_2 + \ldots . \#8N$)				
10	Estimated Average Time to Ski Down Runs (Minutes)		8	10	10
11	Assumed Lift Rope Speed in F.P.M.		NOTES		
12	Assumed Lift Loading Efficiency (%)				
13	Approximate Duration of Ride Up Lift (Min.) (#3/#11)				
14	Assumed Time Waiting in Lift Line (Min.)				
15	Approximate Lift & Run System Total Time - 10 + 13 + 14				
16	Number of Round Trips Possible per Hour (60/#15)				
17	Actual Required Capacity of Lift/Hr. (#16 X #9)				
18	Actual Capacity of Chair Persons (#17/#12)				

The Summit Lift (b) Serviced Runs

The Summit chair serves to provide access to several runs. The description of these runs is as follows: (The reader will be better able to relate to the following discussion by referring to Appendix Map A).

Run # 1 (Discovery)

Discovery is classified as a low intermediate run. It contains 25 acres of skiable terrain and can support, at an optimum, 345 skiers at one time at the low-intermediate skier-skill level. Numerous small benches break the slope into a series of short pitches ranging from 15% to 35%. These benches provide a desirable variation in terrain and allow resting areas for the tired skier.

However, a major portion of this run is not located on the fall line. As a result traverse trails and unskiable mogul formations are evident on non-fall line pitches. Slope maintenance and slope grooming problems are accentuated where side-hilling is encountered.

Trees have been left on the run to provide a more natural alpine setting for the Whitewater visitor. Unfortunately these trees seem to act as barriers, resulting in a gullying effect of the skier flow. In addition they throw-off the rhythm of the skier and present physical hazards to those whose abilities be at the low-intermediate level.

It is important to note that Discovery has the lowest skier-skill rating of all the runs services by Summit chair (low-intermediate). To accommodate the low-intermediate, however, fall line could not be followed during run design resulting in poor skiing for this level of skies. This run is the only alternative for the skier who has mastered the beginner slope.

Run # 2 (Powder Keg)

Powder Keg is classified as a high-intermediate run. It contains 23 acres of skiable terrain and can at an optimum level support 40 high intermediate skiers at one time.

The profile of Power Keg is concave in shape with slopes of 40% in the upper portions of the run and slopes of 20% in the lower portions of the run. The location of Powder Keg in relation to the natural fall line of the hill has been good and poses no difficulties to the skier.

Very little cutting has been done to create the Powder Keg run as natural open areas within the bowl were utilized and expanded upon. These natural open areas consist mainly of large talus material. As a result in years of low snowfall large scattered boulders create hazards for skiers of all levels.

Small clumps of trees have also been left in many locations throughout the run. These trees in combination with the large boulders or talus, tend to direct skier flow, break slope continuity and mogul patterns, consequently disrupting skier rhythm. These conditions also make slope grooming very difficult if not impossible.

Two relatively large islands of trees are located in the middle of the run. Together these islands effectively create two ski runs providing the skier with a greater diversity of terrain.

Run # 3 (Pay Dirt)

The Pay Dirt run has been classified as an advanced run. It contains 8 acres of terrain at the appropriate skier skill level. The optimum number of skiers at one time that can be accomodated on this run is 40. The run gradient is not constant and ranges from 60% on the steeper pitches to 30% on the easier sections. The major problem with this run is that it does not follow the natural fall line of the hill.

Run # 4 (Gold Pan)

Gold Pan is rated as being an advanced run. This run contains 9 acres of skiable terrain and can accommodate at an optimum, 45 advanced skiers at one time.

The majority of the run is of the intermediate nature with slopes ranging from 25% to 40%. However due to the last 200 vertical feet of the run where slopes reach 55% an advanced rating had to be applied. The run has few fall line problems posing little difficulty to the advanced skier.

The major problem with Gold Pan is that the run is intercepted by high and steep road cuts which traverse the slope in two places. These banks break skier rhythm and are a distinct hazard as far as skier safety is concerned.

A large number of trees remain in relatively high concentration approximately half way down the steep portion of Gold Pan. To navigate through these obstacles, a complete reduction of speed is required often resulting in a loss of the "Boogie" feeling.

The run also tends to narrow where the gradient of the slope is at its maximum. Congestion may be a problem at this point in the future.

Large amounts of downed timber and slash are present on the lower section of Gold Pan. In low snow years these obstacles break slope and become hazards to the public.

Run # 5 (Dynamite)

The Dynamite run was given as "expert" classification. It contains 2 acres of skiable terrain and can handle at optimum, 10 skiers at one time. The slopes on this run vary from 80% to 60% and follow the fall-line. Dynamite, although containing a relatively low amount of vertical (200 feet), provides excellent powder and packed skiing for the expert.

Unfortunately Dynamite is not a ski run as such, but is a natural open area created by avalanche action. Stabilization of the avalanche chute above the point where skiers enter the "run" during periods of snow instability must be maintained.

Run # 7   (Blast)

Blast begins where the Discovery run crosses under the summit chair. This run the left line has been given an expert classification and contains 4 acres of excellent terrain. The optimum number of skiers at one time is estimated to be 20. Run gradients vary from 55% to 75%. Blast follows direct fall line providing approximately 700 vertical feet of fine expert skiing. However, the width of the run tends to narrow to an unsatisfactory degree where the slope gradient reaches its maximum. It may be necessary to widen the run in this location.

Problems may also arise in heavy snow years from the Summit lift passing too close to the snow surface for skiers to safely ski directly under portions of the chair.

Open Areas

Many natural open areas accessible from the top of summit chair that have not been classified as runs afford excellent powder skiing as well as excellent packed skiing for the advanced and expert skier.

The Gold Pan bowl to the north of the Summit chairs upper terminal and the Powder Keg bowl to the south of the chairlifts upper terminal, contain the majority of the "off-run" skiing. Those taking advantage of this type of terrain have little trouble finding access into these areas and little difficulty in returning to the base of the lift.

Both these areas are subject to avalanche and therefore must be stabilized before skiers can take advantage of these very excellent slopes.

The Hummingbird Lift (a) The Chair

The Hummingbird Chair is designed to serve the beginner and novice skiers desiring to ski at Whitewater. This lift and the run it serves, Prospector, have a north-westerly aspect, receiving a relatively small amount of sun each day. This is due to the shadowing effect of the height of land directly to the east, south and west of this lift. By the same token these ridges effectively reduce wind to a minimum.

The three-minute ride up the chair focuses the skiers attention on beautiful Ymir Mountain and the sub-alpine, alpine terrain associated with this ski area development. Aesthetic values are high in this area.

The Hummingbird Chair is of Riblet design with the bottom station at an elevation of approximately 5300' and the top station located some 200' higher at an elevation of 5500'. The rope speed and spacing of the chairs allow the beginner adequate time to position themselves for loading at a fairly high efficiency level.

Due to the gentle nature of the terrain maintenance of the lift is relatively easy. However, the towers of this chair are quite low and during an average snow year may not provide enough chair clearance above the snow to permit trouble-free operation. Removal of excess snow from underneath the lift by sno-cat may well be necessary in these situations.

Other technical information relevant to the Hummingbird lift is recorded in the following "Lifts and Runs" data sheet. (See Chart #8).

CHART #8

WILDLAND RECREATION TECHNOLOGY	LIFTS & RUNS DESIGN FORM	Area Whitewater Hill Hummingbird Chair Date March 1977

Existing Runs

#	DATA	Lift No.	Prospector Run No. 6	Run No.___	Run No. ___
1	Horizontally projected length in feet for lift	1295			
2	Vertical Rise in Feet for Lift	219			
3	Average Slope Length (Hypotenuse) in Feet for Lift	1313			
4	Classification of Slope - as to Skier Skill	Novice	Novice		
5	Optimum Density - in Skiers/ Acre - for Skier Skill		35		
6	Total Area of Each Run - In Acres		7		
7	Total Area of All Runs - In Acres (#6_1 + 6_2 + ...#6N)	7			
8	Capacity of Each Run - In Skiers (#5 X #6)		245		
9	Total Capacity of All Runs - In Skiers (#8_1+8_2+....#8N)	245			
10	Estimated Average Time to Ski Down Runs (Minutes)		5		
11	Assumed Lift Rope Speed in F.P.M.	350			
12	Assumed Lift Loading Efficiency (%)	80			
13	Approximate Duration of Ride Up Lift (Min.) (#3/#11)	33			
14	Assumed Time Waiting in Lift Line (Min.)	5			
15	Approximate Lift & Run System Total Time - 10 + 13 + 14	13			
16	Number of Round Trips Possible per Hour (60/#15)	4.6			
17	Actual Required Capacity of Lift/Hr. (#16 X #9) *	1127			
18	Actual Capacity of Chair Persons (#17/#12)	1409			

NOTES

*Rated Cap = 950

The Hummingbird Chairlift has a rated capacity of 950 skiers per hour. To fill the existing beginner fun (Prospector) with its optimum S.A.O.T. of 245, a lift capacity of 1654 skiers per hour is required. This assumes an 80% lift efficiency.

The Hummingbird Lift (b) The Hummingbird Chair-Serviced Run

Run #6 (Prospector)

The Prospector run is classified as a beginner slope. It contains 7 acres of terrain. It can support, at the optimum, 245 beginner/novice skiers at one time.

The main portion of the slope is relatively uniform providing a good area for the beginner to learn. On the fringes of this run more diverse opportunities exist for the novice.

Due to the low elevation of the chair lift however, the majority of the slope directly underneath Hummingbird cannot be utilized in a normal snow year.

This run is also located in close proximity to the tip of an avalanche chute (See Appendix Map B). Doubtless, avalanche control personnel at Whitewater are acutely aware of the possibility of an avalanche overshooting the existing path and the possible consequences of such an event.

Summary of Lifts and Runs as Presently Exist

The existing development of Whitewater provides approximately 78 acres of skiing terrain. By skill classification, acreage figure breaks down as follows; 7 cares for beginners, 48 acres for low and high intermediates, and 23 acres for advanced and expert skiers. Using the figures given for optimum skier density per acre for each skill level classification, these acreages yield S.A.O.T. capacities of 245 for beginner runs, 720 for intermediate runs, and 115 for advanced and expert runs for a total hill capacity of 1080 S.A.O.T.

RECOMMENDATIONS REGARDING EXISTING DEVELOPMENT

SKI RUNS

In order to evaluate the adequacy of existing runs one must relate slope gradients and run acreages to skier skill classification levels. The theoretical distribution of skiers by skill classification is as follows:

20% of total market - Novice
60% of total market - Intermediate
20% of total market - Advanced

The present development of Whitewater shows a range of run options with an actual distribution of:

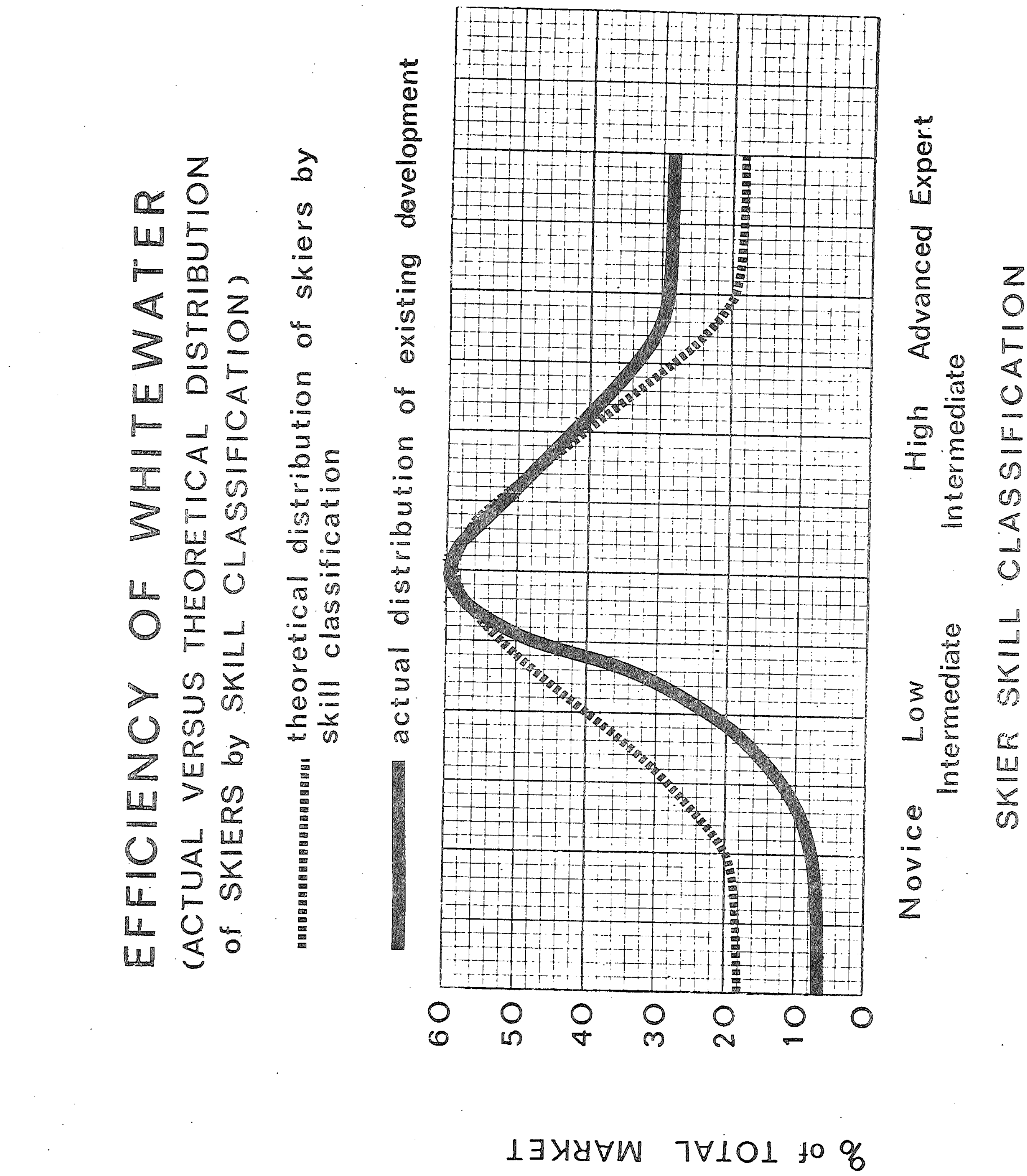
9% - Novice
62% - Intermediate
29% - Advanced

This distribution is illustrated in Graph #2.

Except for novice terrain, this skier market breakdown appears to be very similar to the desired theoretical distribution. Although the market distribution at Whitewater appears to be good, the present design of skiing terrain is very poor. Many of the runs which are classed as intermediate terrain follow extensive side slopes. This type of run does not provide a pleasurable skiing experience as the skier is continually forced to edge in one direction through the uneven terrain. If these runs were to be re-designed, on the fall-line terrain, the skier skill level would increase to the advanced classification. This is a more realistic picture of the actual range of runs available within the existing development.

In order to improve the present development, specific changes must be made so that the terrain is more suitable for maximum fall-line

CHART #2



EFFICIENCY OF WHITEWATER
(ACTUAL VERSUS THEORETICAL DISTRIBUTION of SKIERS by SKILL CLASSIFICATION)
theoretical distribution of skiers by skill classification
actual distribution of existing development
60
50
40
30
20
10
0
% of TOTAL MARKET
Novice
Low Intermediate
High Intermediate
Advanced
Expert
SKIER SKILL CLASSIFICATION

skiing. All of the recommended changes are a result of area calculations, skier skill ratings and field checks during this winter season. Before any changes do occur it is strongly recommended that field checks be conducted during the summer months in order to assess the ecological impact of each modification.

Proper cutting of stumps and trees is very important when considering both environmental impact, and good skiing terrain. Stumps, removed from present runs, and trees, cut for future cleanings, should be limbed and bucked into sections small enough to lay close to the ground. They should be placed perpendicular to the fall-line to act as water bars. Fire hazard is quickly minimized as the heavy fuels of Alpine Fir rot in a short period of time. The heavy snow pack will crush fine fuels to the ground, further reducing the fire hazard. Treating cut trees in this manner will allow earlier opening of runs and improve aesthetic appeal as brush grows up.

Many of the areas exceed the optimum skidding slopes (50% in good conditions). Skidding activity would result in the creation of more cutbanks, increasing sidecast material. For this reason, logs should not be removed unless they are taken out on top of the snow pack, or by using aerial cable hauling systems.

The re-designed existing runs have been classified and numbered in order to simplify area calculations (refer to Appendix Map B for re-designed development). These divisions also help in providing a clear picture of the natural skiing terrain in this area. The present method of dividing and naming the runs is very confusing to the skier who is unfamiliar with the area. It is recommended that the revised divisions, and classifications, be used so that each run is clearly definable, with only one name for the entire area. All of the undisturbed natural openings, such as slide paths and bowls, have not been classed as designated runs. When considering the area of each ski run, and lift capacities necessary for this demand, it was decided that natural open areas were unsuitable for these calculations. Skiers using these areas are classed as "suspended skiers". They are not using the existing development, and therefore increase available space for customers using the facilities.

The following is a description of the re-designed development. (Constant reader reference to Appendix Map B will be helpful).

Run number 1 is the "Powder Keg Bowl" with an additional fall line cut in the lower section. The skier skill classification is high intermediate due to the steeper sections immediately following the ridge traverse. Because the run tends to form a gulley in the upper sections, it is recommended that some of the larger groups of trees be cleared, leaving a more open fall-line terrain. This will cut down on the funneling effect which skiers experience at the bottom of the steeper sections. The east fork, at the bottom of the run, has been removed due to extremely poor side-hill terrain. This area is replaced with a fall line section which funnels into the lower gathering area. The total area of run number 1 is 31 acres and the optimum skiers at one time is 465.

Run number 2 begins on the original "Pay Dirt" trail, The top section has been widened, removing a dense stand of trees on the west side. This advanced run follows a natural fall line, passing underneath the Summit chairlift and joining into the existing run in the lower section. The run should be a maximum of 250 feet wide, providing as much skiing area as possible. The total area is 15 acres providing an optimum capacity of 75 skiers at one time.

Run number 3 is the remaining portion of the original "Pay Dirt" trail. Because sections of this trail follow a side slope, it is recommended that it not be classed as a major run. It should remain as an alternate fork from run number 2 with little alternation in the present development. The existing groups of trees provide an aesthetically pleasing scene, as the run blends in with the surrounding natural open areas. The area of this run is 7 acres, supporting an optimum of 35 skiers at one time. It is classed as an advanced run due to the last major pitch in the lower section.

Run number 4 is classed as advanced terrain. A great deal of the fall line terrain in the top section is not utilized due to the funneling of skiers down the existing cat track. It is recommended that the top of this run be groomed, providing a higher access point, therefore utilizing more of the available skiing area. At present, skiers traverse a great deal of this top section instead of skiing the fall line. This run should be widened in the lower sections in order to improve fall line skiing, and to provide more continuity in the presently congested lower area. The skier is forced to stop on the lower cat track, and then look for access into the lower section. The trees, in this area, should be removed in order to provide a continued fall line slope. The cat track cut banks produce areas with rapidly fluctuating slopes. The angle of these banks should be decreased, and smoothed, providing an even grade for better skiing terrain. Glading should take place in the lower section, on the east side, providing the skier with a variety of terrain on a fall line slope. The original "Discovery" cut-off should no longer be classed as a run due to its unsuitability as skiing terrain. Access to the previous "Dynamite" run is no longer included as this is a natural slide path. Run number 4 has an area of 24 acres with an optimum density of 120 skiers at one time.

Run number 5 is the original "Blast", or lift-line run. A small amount of clearing is required in the top section, providing easy access from run number 2. It is recommended that glading occur between run number 4 and run number 2. This will open up more fall line terrain as a variation in access to run number 5. This expert run should be widened, on the east side, in the steeper sections. In years of heavy snowfall the area underneath the chairlift will be unskiable, especially where the slope increases in the lower section. For this reason, the area was not calculated as skiable terrain. The steeper sections should be fenced off whenever there is a potential hazard to the skier below. The existing cat track cut banks should be modified, eliminating the present drop off on the uphill side of the road. The area of this run is 5 acres with an optimum capacity of 25 skiers at one time.

Run number 6 is the original "Prospector" run. Because novice terrain is not abundant in the Apex drainage it is recommended that this area be utilized to its maximum extent. Further grooming should take place in the upper north section. This would open up more terrain for the skier following a high traversebefore funneling into the center of the run. Skiing terrain was not calculated underneath the chairlift. Future years of heavy snowfall could create problems regarding chairlift height and potential hazard to the skier. This area should be fenced off whenever a potential hazard exists. The total area of this run is 7 acres, accomodating 245 skiers at one time.

IMPLICATIONS OF REVISIONS TO AREA CAPACITY

The proposed revisions of existing runs would result in a total of 89 acres of skiing terrain. The optimum S.A.O.T. this area would be able to support is 965. (Charts #9 and 10 indicate procedures for arriving at this result). By skill classification the acreage is broken down to 7 acres for beginner runs, 31 acres for intermediate runs and 51 acres for advanced/expert runs. Optimum skier densities per acre for each skill classification yields 245 for the beginner run, 465 for the intermediate run, and 255 for the advanced/expert runs for a total of 965 S.A.O.T.

For the proposed revision of runs, the Summit chair would require an hourly capacity of 2240 skiers in order to maintain an optimum S.A.O.T. total of 720.

The Hummingbird requirements would remain the same as mentioned for existing development.

EROSIONAL CONSIDERATIONS

Summit Chair

Cat trails which were built provide access to the top of summit chair have left steep cutbanks which exceed the angle of repose. These cuts will slump as well as change water drainage patterns by funnelling water into one or two areas. This will

CHART #9

WILDLAND RECREATION TECHNOLOGY

LIFTS & RUNS DESIGN FORM

Area Whitewater
Hill Summit Chair
Date March 1977

Proposed Revisions

#	DATA	Lift No.	Run No. 1	Run No. 2	Run No. 3
1	Horizontally projected length in feet for lift	2747			
2	Vertical Rise in Feet for Lift	1242			
3	Average Slope Length (Hypotenuse) in Feet for Lift	3015			
4	Classification of Slope - as to Skier Skill		High Inter	Advanced	Advanced
5	Optimum Density - in Skiers/ Acre - for Skier Skill		15	5	5
6	Total Area of Each Run - In Acres		31	15	7
7	Total Area of All Runs - In Acres ($\#6_1 + 6_2 + \ldots\#6N$)	82			
8	Capacity of Each Run - In Skiers (#5 X #6)		465	75	35
9	Total Capacity of All Runs - In Skiers ($\#8_1+8_2+\ldots\#8N$)	720			
10	Estimated Average Time to Ski Down Runs (Minutes)		12	8	8
11	Assumed Lift Rope Speed in F.P.M.	500			
12	Assumed Lift Loading Efficiency (%)	90			
13	Approximate Duration of Ride Up Lift (Min.) (#3/#11)	6			
14	Assumed Time Waiting in Lift Line (Min.)	5			
15	Approximate Lift & Run System Total Time - 10 + 13 + 14	21			
16	Number of Round Trips Possible per Hour (60/#15)	2.8			
17	Actual Required Capacity of Lift/Hr. (#16 X #9) *	2016			
18	Actual Capacity of Chair Persons (#17/#12)	2240			

NOTES

*Rated Cap = 1150

$\frac{1150}{2016} = .57$

,57 x 720 = 410

CHART #10

WILDLAND RECREATION TECHNOLOGY

LIFTS & RUNS DESIGN FORM

Area Whitewater
Hill Summit Chair
Date March 1977

Proposed Revisions

#	DATA	Lift No.	RUN No. 4	RUN No. 5	RUN No. 6
1	Horizontally projected length in feet for lift				
2	Vertical Rise in Feet for Lift				
3	Average Slope Length (Hypotenuse) in Feet for Lift				
4	Classification of Slope - as to Skier Skill		Advanced	Expert	
5	Optimum Density - in Skiers/ Acre - for Skier Skill		5	5	
6	Total Area of Each Run - In Acres		24	5	
7	Total Area of All Runs - In Acres ($\#6_1 + 6_2 + \ldots \#6N$)				
8	Capacity of Each Run - In Skiers (#5 X #6)		120	25	
9	Total Capacity of All Runs - In Skiers ($\#8_1 + 8_2 + \ldots . \#8N$)				
10	Estimated Average Time to Ski Down Runs (Minutes)		9	10	
11	Assumed Lift Rope Speed in F.P.M.				
12	Assumed Lift Loading Efficiency (%)				
13	Approximate Duration of Ride Up Lift (Min.) (#3/#11)				
14	Assumed Time Waiting in Lift Line (Min.)				
15	Approximate Lift & Run System Total Time - 10 + 13 + 14				
16	Number of Round Trips Possible per Hour (60/#15)				
17	Actual Required Capacity of Lift/Hr. (#16 X #9)				
18	Actual Capacity of Chair Persons (#17/#12)				

NOTES

accentuate erosion problems elsewhere. Material sidecast from these cuts is unconsolidated and will erode easily.

The Dynamite run is cut by cat trails at the top, middle, and bottom and material has been sidecast. (See Appendix Map A). The natural avalanche gully of Dynamite will magnify these erosion problems.

The cat trail through Goldpan run switchbacks near the center of the run. At this switchback spillover will create severe erosion problems down the fall line from this point. Large exposed areas and concentrations of sidecast material at this switchback will magnify erosional effects.

The bottom half of Discovery is cut along its length with a skid trail almost straight down the fall line. Sidecast and exposed material will erode into the main drainage channel from Powderkeg Bowl which will create a sediment problem in Apex creek.

Erosional Considerations

The gentle slope and moderate length of this run minimizes erosion problems.

Recommendations For Existing Erosion Problems

Existing erosion problems should be minimized by returning all streamlets to their original course. The use of french drains, water bars and culverts if necessary should be used to divert water off the skid trails into the original course. Stumps and logs for construction of water bars are available in all areas needing runoff control. Cutbanks should be groomed to reduce the angle of repose, particularly in open areas on runs. Sidecast material should be hauled back onto the skid trail using a backhoe or seeded as soon as possible. All exposed soils should be seeded upon completion of work.

BIOPHYSICAL CONSIDERATIONS SPECIFIC TO UPGRADING OF EXISTING RUNS

If the constraints listed below are followed, the proposed improvements and additions to the Summit chair will be environmentally acceptable. Additional clearing of vegetation in the north facing Krummholtz zone is a marginally sound operation. Two alterations proposed in this zone include clearing a new advanced run (at a 25 - 45% slope) and some glading in limited areas to improve an already existing run (slope of area to be gladed 60 - 100%). The reader is advised to refer to Map #2 during reading of the following paragraphs.

The proposed and existing runs of the Summit chair span three biophysical units: active talus in the highest elevation (a small part of one existing run), North facing trummholtz and North facing Engleman spruce - sub-alpine fir forest. All these communities exist on colluvial blankets (a deep layer of jagged fallen rocks). There is colluvial action presently occurring in the talus unit but the other two units are presently stable. All three units are strongly influenced by the cold, wet, Northern aspect.

Krummholtz unit (Northern aspect)

This zone is sensitive to alteration because it is a transition from a forested area to a barren one. Vegetation is slow growing and difficult to re-establish. Stability in the steeper slopes depends on the anchoring effects of existing vegetation. Alteration of stand density changes snow deposition patterns and has a net effect of disruption to the entire plant community (on which soil stability is dependent). Clearing of trees should be minimal. Removal of trees from the already wet northern aspect increases the amount of water in the soil (be eliminating effective evapotranspiration). This alteration can lead to soil slump, creep and surface erosion.

Removal of vegetation from wet areas on steep slopes should be avoided.

Snow compaction from skiing will have a limiting effect on the growth and establishment of plants in the affected area.

Talus Unit

No further removal of vegetation in this unit has been proposed.

Engleman Spruce - Sub-alpine Fir Unit (northern aspect)

This is generally a safe and stable unit for limited harvest. The proposed clearing is designed to improve the intermediate run. Slopes in this run are between 45 - 60%.

Some hydrologic limitations may arise from the wet moisture regime of the north facing slopes. Sites that remain wet throughout the year should be avoided.

ACCESS

A variety of options exist for improving the access road into Whitewater. The obvious and undoubtedly the most expensive solution would be to surface the road with asphalt and to redesign some of the steeper, often slippery sections. The economic feasibility, though, of this idea limits the practicality of such a development.

Probably the most practical recommendation would be to improve drainage off the road by increasing the number of culverts, improving ditches and by surfacing with a thick layer of gravel material. The drainage improvements would allow the water to flow in a more natural course, instead of down the road. A compacted gravel surface would provide good traction for uphill traffic and would be more resistant to flowing water and saturation than is the present surface which consists of mostly unstable, natural material.

Another recommendation would be to employ a shuttle bus service at times of poor conditions (mud or heavy snow) so as to ensure that persons wishing to get to the ski area will be able to do so. This alternative mode of transportation would be made available as an option to the use of private vehicles. Less vehicle traffic would, in theory, have less undesirable effects on the road condition.

DEVELOPMENT OPTIONS AND IMPLICATIONS

THE WHITE QUEEN SLOPE

On the north-east side of Apex bowl, directly across the valley from the summit chair, good terrain exists for intermediate skiing. On White Queen mountain the terrain is of a south westerly exposure and receives maximum sunlight. Excellent potential for the development of additional intermediate runs exists here and should be pursued. This area has both the desired terrain necessary to help fill the needs of the intermediate skier as well as the sunshine which the area of present development lacks.

Previously, runs were cut on these slopes; however no lift serves them at this time. Numerous skid roads criss-cross these cleared areas, effectively interrupting the natural slope of the area, thereby reducing its skiability. High stumps and numerous individual trees have also been left on cut areas.

POTENTIAL RUNS

Further analysis of potential runs was considered subsequent to a re-designing of the existing development. The distribution of skiers by skill classification on the redesigned area is 8% novice, 35% intermediate and 57% advanced. This is a more realistic picture of the terrain potential on the north facing slope in the Whitewater area. (See Appendix Map A).

The main objective, when proposing future development, is to enhance the Whitewater product for the novice and intermediate level skiers.

Because of the extremely low representation in the novice classification, a new area is recommended parallel to the present novice run, on the south side of Apex creek. (Refer to Appendix Map B, Run #7). The new area should be located between the two run-out zones because of the high avalanche hazard above this run. The area of this run is 6 acres, with an optimum 210 skiers at one time. This area should be serviced by a T-Bar lift situated on the south side of the run. The new beginner T-Bar would require an hourly capacity of 1207 skiers to maintain 210 S.A.O.T. on the new run. This assumes an 80% lift loading efficiency. Calculations for this lift may be seen in Chart #11.

The main reasons for choosing this type of lift are:

1) The suitable terrain and relatively low cost for installation;

2) A T-Bar serves as an excellent teaching aid for the beginning skier. The skiers spend more time on the slope --- accelerating improvement of coordination through increased experience.

In order to increase the intermediate classification it is recommended that a new chairlift service the south facing slope in the previously logged area. (Refer to Appendix Map B). The lift was placed in this general area due to the following reasons:

1) The cable will run parallel to the fall line;

2) The chairlift terminates in an area suitable for a top landing site;

3) It provides excellent access to the new intermediate terrain and the existing cleared areas.

CHART #11

WILDLAND
RECREATION
TECHNOLOGY

LIFTS & RUNS
DESIGN FORM

Area Whitewater
Hill Novice T-bar
Date March 1977

#	DATA	Lift No.	Run No. 7	Run No. —	Run No. —
1	Horizontally projected length in feet for lift	1125			
2	Vertical Rise in Feet for Lift	225			
3	Average Slope Length (Hypotenuse) in Feet for Lift	1147			
4	Classification of Slope - as to Skier Skill		Novice		
5	Optimum Density - in Skiers/ Acre - for Skier Skill		35		
6	Total Area of Each Run - In Acres		6		
7	Total Area of All Runs - In Acres $(\#6_1 + 6_2 + \ldots \#6N)$	6			
8	Capacity of Each Run - In Skiers (#5 X #6)		210		
9	Total Capacity of All Runs - In Skiers $(\#8_1 + 8_2 + \ldots . \#8N)$	210			
10	Estimated Average Time to Ski Down Runs (Minutes)		5		
11	Assumed Lift Rope Speed in F.P.M.	400			
12	Assumed Lift Loading Efficiency (%)	80			
13	Approximate Duration of Ride Up Lift (Min.) (#3/#11)	3			
14	Assumed Time Waiting in Lift Line (Min.)	5			
15	Approximate Lift & Run System Total Time - 10 + 13 + 14	13			
16	Number of Round Trips Possible per Hour (60/#15)	4.6			
17	Actual Required Capacity of Lift/Hr. (#16 X #9)	966			
18	Actual Capacity of Chair Persons (#17/#12)	1207			

NOTES

The new White Queen chairlift would require an uphill capacity of 1967 skiers per hour (with a lift loading efficiency of 90%) to maintain 570 S.A.O.T. on the new runs. Calculations regarding the new lift and the runs it will service may be viewed in Charts 12 and 13.

The new runs, serviced by this lift, vary in classification from low intermediate to advanced levels. This south facing slope will open up 12 acres of advanced terrain and 34 acres of intermediate terrain. In order to retain the intermediate classification it is necessary to continually groom these slopes. If they are not kept in excellent condition, the skier skill classification could increase to a more advanced rating, thus precluding the purpose of the proposal.

The descriptions of each run are as follows: (refer to Appendix Map B for run locations).

Run number 8 follows the natural low intermediate terrain in the existing cleared area. Clearing must take place at the top of the run providing access into the existing open sections. It is recommended that single trees, in the lower section of the cleared area, be removed. They do not serve any particularly useful purpose in the proposed run are, and are both a hazard to the skier and an obstacle to grooming. All existing stumps should be cut low to the ground. This run has an area of 14 acres with an optimum capacity for 210 skiers at one time.

Run number 9 branches off from number 8 and is rated as a high intermediate slope continuing down the fall line. The lower sections must be cleared, and single trees should be cleared from the existing open area. This run has an area of 8 acres, holding an

CHART #12

WILDLAND
RECREATION
TECHNOLOGY

LIFTS & RUNS
DESIGN FORM

Area Whitewater
Hill White Queen
Date March 1977

#	DATA	Lift No.	Run No. 8	Run No. 9	Run No. 10
1	Horizontally projected length in feet for lift	2325			
2	Vertical Rise in Feet for Lift	880			
3	Average Slope Length (Hypotenuse) in Feet for Lift	2486			
4	Classification of Slope - as to Skier Skill		Low Inter	High Inter	Advanced
5	Optimum Density - in Skiers/ Acre - for Skier Skill		15	15	5
6	Total Area of Each Run - In Acres		14	8	9
7	Total Area of All Runs - In Acres (#6_1 + 6_2 + ...#6N)	46			
8	Capacity of Each Run - In Skiers (#5 X #6)		210	120	45
9	Total Capacity of All Runs - In Skiers (#8_1+8_2+....#8N)	570			
10	Estimated Average Time to Ski Down Runs (Minutes)		12	8	10
11	Assumed Lift Rope Speed in F.P.M.	500	NOTES		
12	Assumed Lift Loading Efficiency (%)	90			
13	Approximate Duration of Ride Up Lift (Min.) (#3/#11)	5			
14	Assumed Time Waiting in Lift Line (Min.)	5			
15	Approximate Lift & Run System Total Time - 10 + 13 + 14	20			
16	Number of Round Trips Possible per Hour (60/#15)	3			
17	Actual Required Capacity of Lift/Hr. (#16 X #9)	1710			
18	Actual Capacity of Chair Persons (#17/#12)	1900			

CHART #13

WILDLAND RECREATION TECHNOLOGY	LIFTS & RUNS DESIGN FORM	Area: Whitewater Hill: White Queen Date: March 1977

#	DATA	Lift No.	Run No. 11	Run No. 12	Run No. ——
1	Horizontally projected length in feet for lift				
2	Vertical Rise in Feet for Lift				
3	Average Slope Length (Hypotenuse) in Feet for Lift				
4	Classification of Slope - as to Skier Skill		Advanced	High Inter	
5	Optimum Density - in Skiers/ Acre - for Skier Skill		5	15	
6	Total Area of Each Run - In Acres		3	12	
7	Total Area of All Runs - In Acres ($\#6_1 + 6_2 + \ldots\#6N$)		15	180	
8	Capacity of Each Run - In Skiers (#5 X #6)				
9	Total Capacity of All Runs - In Skiers ($\#8_1+8_2+\ldots.\#8N$)				
10	Estimated Average Time to Ski Down Runs (Minutes)		10	10	
11	Assumed Lift Rope Speed in F.P.M.		NOTES		
12	Assumed Lift Loading Efficiency (%)				
13	Approximate Duration of Ride Up Lift (Min.) (#3/#11)				
14	Assumed Time Waiting in Lift Line (Min.)				
15	Approximate Lift & Run System Total Time - 10 + 13 + 14				
16	Number of Round Trips Possible per Hour (60/#15)				
17	Actual Required Capacity of Lift/Hr. (#16 X #9)				
18	Actual Capacity of Chair Persons (#17/#12)				

optimum 120 skiers at one time.

Run number 10 is classed as an advanced run due to an increasing slope in the lower area. Clearing is required in the top and middle sections. The run should be separated from the chairlift cut where-ever possible, discouraging lift line skiing. The lower areas should be widened to a maximum 250 feet where the slope increases. The edges of this run should be feathered as this will cut down on wind channeling, retaining more snow and also providing a more aesthetically pleasing visual panorama. The area of this run is 9 acres with an optimum capacity of 65 skiers at one time.

Run numbers 11 and 12 are existing cleared area. A maintained cat track, from the top of the chairlift to the fall line terrain, will provide access to these runs. Because these areas do not provide a return route to the base lift it is recommended that a run out traverse be considered. Run number 11 is classes as advanced with an area of 3 acres and an optimum capacity of 15 skiers at one time. Run number 12 is in the high intermediate terrain. It has an area of 12 acres and an optimum capacity of 180 skiers at one time.

The distribution of skiers, by skill classification, on the overall proposed development is:

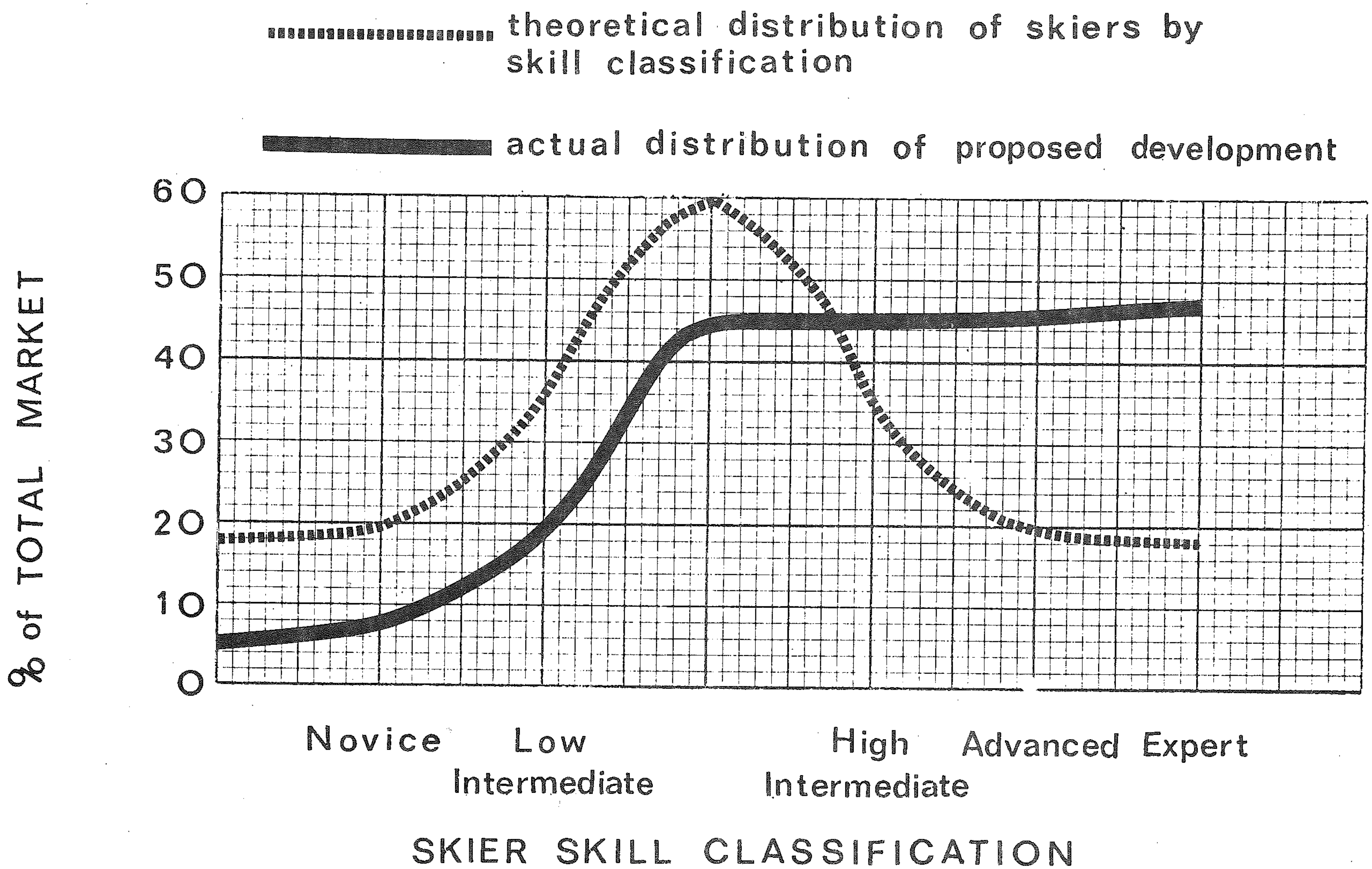
9%	-	Novice
45%	-	Intermediate
46%	-	Advanced

This distribution is represented in Graph #3. Considering the existing development, and options available for expansion, this is the best distribution of skiable terrain in the Whitewater ski area.

GRAPH #3

EFFICIENCY OF WHITEWATER

(ACTUAL VERSUS THEORETICAL DISTRIBUTION of SKIERS by SKILL CLASSIFICATION)



IMPLICATIONS OF EXPANSION TO LIFTS AND AREA CAPACITY

The new lifts and runs proposed would create 52 acres of skiing terrain. If this is considered in terms of skier skill classification, this means that 6 new acres of beginner terrain, 34 acres of new intermediate runs and 12 acres of advanced runs are available. The resulting optimum S.A.O.T. is 210 for beginners, 510 for beginners and 80 for advanced. This yields a total of 780 S.A.O.T. on the newly - available runs.

When the revised existing runs are considered along with the proposed runs, a total of 141 acres of skiing terrain are produced. The total acreages for each skill level class become: 13 acres for beginner terrain, 65 acres for intermediate terrain and 63 acres for advanced/expert terrain. These acreages, as given, would support an optimum S.A.O.T. of 1745 in total.

EROSIONAL CONSIDERATIONS OF WHITE QUEEN DEVELOPMENT

This cleared area is cut repeatedly by skid trails. Problems along all skid trails are erosion of sidecast material and slumping where cuts exceed the angle of repose. Severe problems are generated where skid trails funnel water into small water channels. These will eventually run into Apex creek, the base area, and the parking lot.

BIOPHYSICAL CONSIDERATIONS SPECIFIC TO PROPOSED NEW RUNS

The Novice Run

This lift proposal is environmentally acceptable if constraints concerning maintenance of water quality can be adhered to. Because slopes are not steep (10 - 25%), problems related to soil stability are reduced. The entire proposed lift and run are within the north facing Engleman spruce - sub-alpine fir unit. (See Map #4). The vegetation overlies glacial moraine mixed with colluvial materials. Proximity to a small stream feeding Apex creek may be a limiting factor affecting siltation levels in Apex Creek. A mutually acceptable set of water quality standards should be agreed upon by Whitewater ski management, Nelson City Council and the Water Rights Branch in order to judge the acceptability of any development which may alter water quality.

a) Effects of Harvest

Because this slope is not steep hazards due to harvest are relatively low. The greatest limiting factor is possible siltation of the nearby creek. When vegetation is removed, surface and seepage runoff will be increased. Morainal materials contain clays and silts as well as larger materials. Increase of water will tend to wash the finer materials into the creek. If vegetation along the tributary creekside is removed, bank stability will be jeopardized and silt load will be added to the creek.

Tree removal should be done by hand during dry seasons. Minor vegetation should be left intact.

b) Effects of logging and Access Roads

Interception of normal drainage pattern and loading of banks on morainal material may cause slump, creep and surface erosion. Water quality in Apex creek may be compromised due to siltation. Additional road building is not recommended.

c) Lift Installation and Foundations

The prime limiting factor is hydrology. Foundations should not be located in water accumulation areas, drainage channels, seepage areas or areas with deepest snow accumulation.

Where conditions indicate that road location would have siltation impact on the creek, lifts should be installed by helicopter.

Construction schedule should avoid periods when soil is wet.

The White Queen Chairlift And Runs It Will Service

The majority of this proposal for a new intermediate lift and run is on a relatively stable site. It is a south-facing sub-alpine forest on glacial moraine. Where the slope is low to moderate, potential for environmental damage from ski development is lower than most other units in this drainage. The upper portion of the development proposal crosses onto sub-alpine forest on colluvial veneer. This particular section is on steep ground, 45 - 100% slope. Vegetation removal in this unit should be minimal.

a) Engleman Spruce - Sub-Alpine Fir Unit (on glacial moraine)

A most important factor for site maintenace in this unit is preservation of the existing drainage pattern. The area of the proposed new run is on a slope varying from 25 - 60%. When vegetation is removed the resulting increase in water quantity and velocity (slopes are steep) tends to remove the fine particle material from the moraine causing siltation. The method of vegetation removal in this unit is therefore, important. If mineral soil is exposed during harvest, it is likely that the disturbance will cause problems with gullying, rilling and surface erosion. If soil remains intact and lesser vegetation remains on the slopes, little chance for erosion and siltation problems exist.

Where cuts are small, regeneration in this unit is good. Windthrow in this timber type is likely, but this location is relatively will protected from winds blowing down the valley.

In this forested zone, swath cutting results in a major visual impact. Where 'glading' in runs is possible these effects are minimized. On existing and proposed runs and right-of-ways 'gathering' of edges would reduce visual impact.

Many skid roads already exist in this area and could be used for access. Building of new logging and access roads is not recommended.

Location of loading terminal at the base of the lift should avoid wet sites. Care should be taken when making foundations for towers and terminals that any drainage encountered be left in its natural course.

b) Engleman Spruce - Sub-Alpine Firs (on colluvial veneer)

The upper limits (a very small section) of the new lift proposal are on steep slopes on colluvial veneer (a then layer of jagged fallen rocks over bedrock). Tree removal, proposed for the new advanced run and improvement of the existing intermediate run should be minimal. Vegetation in this unit is responsible for slope stability. The likelihood of mass movement is greatly increased when vegetation is removed. The greater the amount of windfirm trees left on the ground, the greater the slopes stability will be.

The location of the upper lift terminal in this unit is environmentally acceptable. Location of unloading station on a level area of exposed rock would create the lowest degree of environmental disruption.

CROSS COUNTRY SKI TRAILS

Criteria

Cross country skiers can travel over almost any snow covered terrain. Trails of course make travelling easier and reduce chances of becoming lost. Before any resort or agency invests the time and effort needed to establish a ski touring trail they must first know if the area itself will be attractive to skiers. The following are the criteria used in assessing trail area as they apply to the Whitewater area.

a) Climate

The main consideration here of course is snow depth. Since the area itself receives high snow packs, this makes it an excellent area for cross country skiing as far as climate is concerned.

b) Location

The Whitewater Ski Area at present is mainly used by people from the local area and this is mainly for downhill skiing. There are a number of people that use the area for cross country skiing but at present there is little attraction to the area for cross country skiers. It has the potential and if cross country trails were laid out it would make the area more attractive to cross country skiers.

c) Topography

The Ymir Basin provides for a variety of terrain features including slopes as well as moderately level areas which produces good terrain for cross country skiing. The major drawback for the area is that it is enclosed by steep slopes which would only be skiable by advanced cross country skiers.

d) Vegetation

The vegetation in the Apex drainage is varied and contributes to a variety of trails. Small open areas are interspersed among the sub-alpine type forest.

e) Other Use

Cross country skiers tend to be highly conscious of the environment and are less tolerant to intrusions on the landscape. The major concern here is that the area of cross country skiing potential is located close to the downhill ski area and the access road. It is of our opinion that the downhill ski area would have little affect on any cross country skiers in the area the present facilities may be beneficial to cross country skiers in that it would provide them with area to park as well as the convenience of the existing lodge.

Pros and Cons of Cross Country Trail Development

At present the existing cross country trail facilities provide good access to the areas of highest potential. The Nelson area in general is lacking in areas which provide for organized or developed cross country skiing facilities.

The major drawback to cross country trail development in the basin is the steepness of the topography and the narrowness of the basin itself. A second concern is that cross country skiers do not generate much in the way of funds for a ski area and they do take up room in the parking facility. In any further considerations regarding expansion of cross country skiing options, Whitewater management need to remain cognizant of the real costs of providing such opportunities.

Implicit Responsibilities in Trail Development

The major responsibilities associated with cross country trail development in the area would include the initial clearing and signing of trails as well as maintenance thereafter. In addition, safety factors need to be considered; for example stabilization of avalanche slopes uphill of cross country-designated trails, and periodic patrolling. All of this costs money, and it is our view that the costs of providing for the cross country skiers in the basin are greater than the benefits that the club would derive. However, if the management chooses to expand cross country skiing opportunities, the following map will be useful in identifying new options (Map #5). A summary of the information related to these trails follows in Chart #14. Specific details on any of these trails may be obtained in Appendix B.

IMPLICATIONS OF PROPOSED EXPANSION PACKAGE

With expansion the maximum Skiers At One Time (S.A.O.T) will be 1745. Industry standards indicate that 20% of this figure (350) will be nonskiers in the lodge or scattered in the area. Total Persons At One Time (P.A.O.T.) at the Whitewater Ski Area will be 2100.

Maximum lodge capacity according to fire safety standards is 410 persons. This limit probably will be exceeded for short periods of time in mornings and afternoons of weekends and holidays. To avoid conflicts with fire safety regulations improvements should be made according to the fire marshall recommendations.

The sewer field at present can handle 1500 people per day on a continuous basis, With improvements in field size and depth on the existing site the maximum continuous sewage capacity will be 1800 persons per day. If capacity crowds of 2100 are expected over holiday periods the present system will prove to be inadequate.

MAP 4

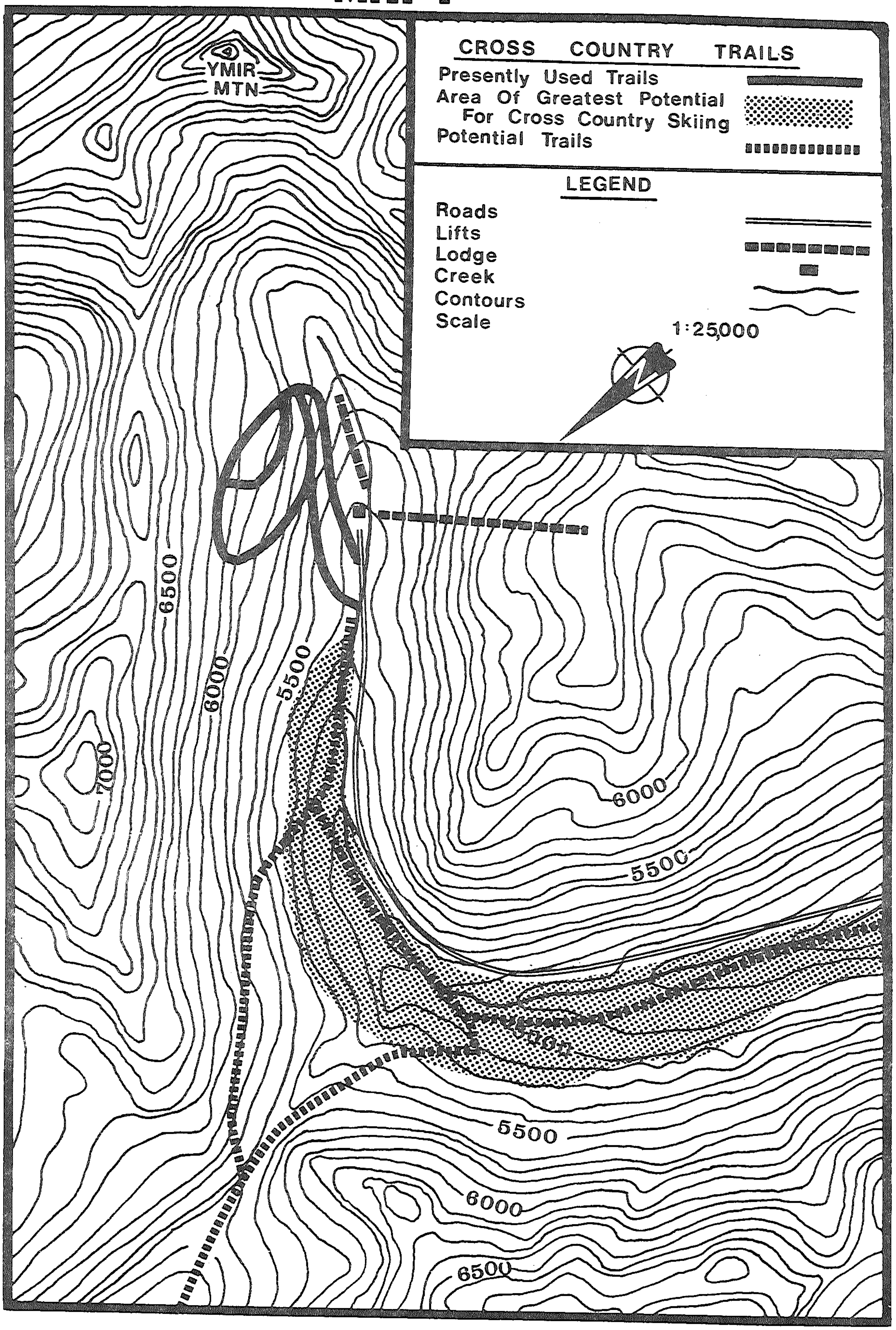

YMIR MTN
CROSS COUNTRY TRAILS
Presently Used Trails
Area Of Greatest Potential For Cross Country Skiing
Potential Trails
LEGEND
Roads
Lifts
Lodge
Creek
Contours
Scale
1:25,000
6500
6000
5500
7000
6000
5500
5500
6000
6500

CHART #14

CROSS COUNTRY TRAILS DATA				
	MARSH	SOUTH SLOPE	LOOP (TO SADDLE)	VALLEY BOTTOM
SLOPE Average Maximum Minimum	 0 3% 0	 10% 25% 4%	 20% 35% 15%	 7% 15% 0%
EXPOSURE To Wind and Sun	Low	Moderate to Good	Moderate	Low
VEGETATION Type of Clearing Necessary	LIGHTLY FORESTED Little Clearing Necessary	MODERATELY FORESTED Maj. of Trails on Existing Skid Trails	MODERATELY FORESTED Maj. on Old Mining Road Some Clearing	MODERATE TO HEAVILY FORESTED Maj. on Old Roads Some Clearing Necessary
STOPPING PLACES Vistas, Views Existence	VALLEY BOTTOM Very Short Trail	NUMEROUS VIEWS Existing Facilities and Local Sites	EXCELLENT VIEWS Valley, etc. Opportunity to Continue to Nelson	NUMEROUS VIEWS Local Area
TRAIL WIDTH	4 - 5'	8' - 10' In Most Places	8' - Mining Road 2 - 3' Elsewhere	8' - 10' Road 2 - 3' Elsewhere
TRAIL LENGTH	700' - 800'	1 - 3 Miles	Loop 2-2.5 mi.	4-5 miles One Way
Average Length of Time Necessary	Located Right Next To Facilities	Short Day Trip 1-4 Hrs.	Short Day Trip 3 hrs. to Full Day	Short Day Trip 3 to 5 Hrs.
Trail Rating Slope Easy $\leq$ 10% IWT $\leq$ 25% ADV $\leq$ 40%	Easy Good For Training and Practice	Easy to Intermediate	Intermediate to Advanced	Easy to Intermediate

Field capacity will have to be increased or arrangements made to pump out holding tanks during peak periods.

The parking lot at present will hold about 425 cars. By supplying a parking attendant to increase parking efficiency approximately 550 cars could be parked. In order to accomodate the proposed area capacity of 2100 people parking will have to be provided for 700 cars (at 3 people per car). The parking area is not balanced for the proposed area capacity. The parking lot near the Summit chair could be expanded if site studies indicate this would be feasible. An alternate transport system such as buses from Nelson could also be provided.

SUMMARY OF RECOMMENDATIONS

Throughout this analysis, quite a number of ideas and proposals concerning the planning and developing of the Whitewater Area, have been suggested. A summary of these recommendations is listed in brief, point form below:

A. <u>In General</u>:

i) For proper ski area planning, an inventory of all physical site factors should be made. These include:
   a) Slope
   b) Fall-line
   c) Avalanche Hazard
   d) Biophysical Data

ii) Recommend use of Criteria for Slope Capacity.

B. <u>Actual Skiing Area</u>:

i) Avalanche hazard - recommend use of Avalaunchers as an addition to the avalanche control program.

ii) Existing ski runs - redesign existing runs by:
   a) Widening steep areas.
   b) Removing skier obstacles (trees, rocks).
   c) Cut new sections of runs and glade some areas.
   d) Additional grooming.
   e) Install snow creep deflectors on the summit chair towers.
   f) Decrease slope of road cutbanks which intersect runs.
   g) Reclassify runs to their skier-skill levels, and these runs, in turn, be re-named and re-signed

   Summer field checks should be made prior to any actual modifications.

iii) Development Options for Potential Runs

a) A new novice run (almost parallel to the Hummingbird chairlift) which would be serviced by a T-Bar.

b) A new chairlift (across the valley) to service low intermediate to advanced terrain.
   - this would mean cutting new runs and using some of the existing cut areas as runs also.
   - feathering of run edges.
   - developing a traverse route to some of these runs.
   - filling in skid road cuts.

c) Removal of present Hummingbird chairlift if the proposed chairlift is actually constructed.

C. <u>Physical Concerns</u>:

i) Biophysical recommendations:

a) Additional roads and removal of vegetation within Apex creek not recommended on the proposed novice run.

b) Caution exercised when removing trees in fragile areas.

c) Impose set standards for water quality.

d) Site-specific studies further recommended.

ii) Erosional Problems:

a) Existing Runs
   - put water back into natural course by use of French drains, culverts and water bars.
   - back-hoe sidecast material back onto skid roads.
   - all areas should be seeded.

b) For cutting new runs or removing trees
   - trees should be bucked up, limbed, and laid perpendicular to fall line.

- trees felled could also be used for building material of water bars.

D. Facilities and Access:

i) Improve Access:

a) Resurfacing road and improving drainage.
b) Provide a shuttle bus service.

ii) Increase Parking Capabilities:

a) Employment of a parking lot attendant.
b) Provide a shuttle bus system.
c) Encourage car pools as an incentive to fill vehicles to their capacity.
d) If a new parking lot is to be considered
   - the area above the existing lot (on the west side of the valley) should be further investigated for its possible potential.

E. Cross Country Skiing:

A number of possible trail routes in the Whitewater Area have been suggested, but it is felt that a decision should first be reached as to whether or not Whitewater, indeed, wants to offer cross country skiing to the public.

F. In Conclusion:

i) If any of these recommendations are to be actually followed through by Whitewater, it is hoped that the Wildland Recreation students involved in this analysis would be contacted prior to any actual work being accomplished. In this way, the planning process would be followed to its fullest extent and, that any questions, ideas or problems regarding the previously mentioned recommendations could be further discussed.

ii) It is recommended that an analysis concerning skiing potential of adjacent basins surrounding Whitewater be undertaken.

PHASING

The recommendations proposed in this Analysis of the Whitewater Ski Area will significantly improve the efficiency and skier appeal of the development. It is desirable that these recommendations be implemented in order that the area's full potential can be realized. It must be stressed that implementation of the recommendations proceed at a slow rate taking environmental factors into consideration and that development is of the highest quality. A two-part phasing scheme is suggested.

Phase I of this scheme is primarily improving existing facilities and redesigning present ski runs. Due to the critical importance of these recommendations, they should be initiated after field checks of the recommendations are completed and as soon as economically feasible.

Phase II involves proposed expansion of the Ski Area to provide a greater variety of ski runs. Phase II may be subject to change as a result of field reconnaissance of development feasibility. The phasing scheme is outline in detail as follows:

Phase I

* Improvement of Access by resurfacing the road and improving drainage;
* Increase Parking Capacity by employing a Lot Attendant, institute a Shuttle Bus Service, provide incentives for car pooling;
* Installation of an Avalauncher near the Summit Chair Terminal as an addition to the avalanche control program;

* Improvement of existing runs including correction of erosion problems as proposed in the recommendations;
* Construction of snow creep deflectors on the Summit Chair towers;
* In addition to the above recommendations, decisions have to be made concerning further development within the drainage basin and provision of cross country ski trails;
* Evaluation of implemented recommendations and development to date.

Phase II

* Upgrade sewage system to the full capacity of the septic field;
* Subcontracting of installation of new Chair Lift and T-Bar;
* Installation of second Avalauncher to control Prospector Slides and other avalanche hazard within Apex Drainage;
* Removal of Hummingbird Chair and possible resale once new lifts operational;
* Construction of a Maintenance and Storage Shed to aid in efficient operations of the Ski Area.

Decisions must be made concerning expansion outside of Apex Drainage into adjacent drainages with due consideration to watershed, environmental impacts and economic feasibility.

* Evaluation of development.

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are highly porous are often suitable areas for road location (depending upon slope).

SOILS

"Soils are perhaps the most basic resource to consider when planning land-use activities. Proper use and management of the soil resource is required to accomodate user activities and facilities at minimal cost; both in terms of construction and maintenance and in terms of amount of impairment to the environment."

(L. Knapik, 1973)

Soils are the result of weathering of bedrock and superficial material. The type of soil varies with such factors as parent material, slope, aspect, micro climate, moisture regime and history of development. Some soil properties that affect management properties are degree of wetness, soil texture, content of gravel and cobbles, depth to bedrock, infiltration capability and cohesiveness of soil particles. By consideration of the soils in an area where specific developments are planned, interpretations on the anticipated reaction of the soil base can be made. Management activities affecting the soil can then be planned and undertaken accordingly. For specific guidelines on road construction, harvesting and sanitary facility developments considering soil properties please refer to the U. S. Department of Interior publication entitled, Forest Engineering Handbook: A Guide for Logging Planning & Forest Engineering, Bureau of Land Management, Oregon State Office. Since no soil profiles were studied, recognition of the properties of Whitewater soils can only be general in nature. Field studies are required to properly classify the Whitewater soils.

In general the soils in the Whitewater area are thin to bedrock, acidic (due to breakdown of granitic materials), rather low in nutrients, and (with the exception of the swamp organic soils) rapidly drained. The soil types established by interpretation of air photos, the B. C. Land Inventory Map and some observations of cut banks are:

Alpine Dystric Brunisols

Dystric Brunisols reasonably productive soils found in Dry Southern Aspect Krummholtz areas. These soils have some horizon development, and a turfy humus horizon. These soils are the least acid of all Whitewater soils and are well drained. Ground water seepage is not a problem. Site recovery of disturbed Brunisols occurs more efficiently than on the other Whitewater soils provided that a reasonable soil base remains.

Sombric & Ortho Humo-Ferric Podzols

These soils are found in the coniferous forest area, on moist cold sites. Podzols are acid (due to breakdown of acidic needles and granite parent material) and leached of minerals in the A horizon (layer directly beneath litter duff layer). Removal of the insulating organic (duff) soil surface and exposure of mineral soil will return sites located on Podzolic soil to stages of pioneer development.

Regosols

Regosols are thin soils found at high elevations in the Wet Krummholtz and Alpine Zone. These soils have a thin organic layer over rock and are well drained. Development of these alpine soils is limited by the active colluvial element and the length of snow-free period. Regisols are easily eroded. Revegetation on disturbed site may be very slow because removal or organic cover exposes bedrock. Site disturbance is a problem. However, siltation effects downslope are low because there is not much soil.

Organic & Gleyed Soils

Organic and gleyed soils are saturated with H_2O for most of the year. An underlying component of these soils is clay. Organic gleyed soils have poor structure, poor bearing capacity, and tend to flow. Organic and gleyed soils occur in the swamp below the lodge and in the poorly drained seepage areas.

VEGETATION

Vegetation is the integration of the environmental factors. Mountain vegetation is controlled and influenced by climate, (summer temperature, rainfall, exposure to wind and sun, snow depth, and length of growing season) elevation, soil depth, and soil moisture regimes. Vegetation is therefore linked directly with the soil base. Without soil, the vegetation will not be present. If the vegetation is removed, the soil will erode away. Care must be exercised in all developments which disturb the protective vegetative covering.

Vegetative fragility is rated on the basis of its "predicted response to human use", (L. Knapik, 1973). Response is evaluated by the estimated amount of change in the natural ecosystem. The vegetative communities in Whitewater Ski Basin described below are ranked by their fragility (low 1 - high 5).

Sub-Alpine Forest Zone

The sub-alpine forest zone comprises a major part of the study area. The climax community is characterized by Alpine fir over 120 years old and approximately 60' high. Engelmann spruce forms a major part of the canopy below the 5600' level. The understory vegetation is subject to further investigation but may well be various mosses and shrubs such as white rhododendron. Soils are generally sombric (greyed) and Ortho Humo-Ferric Podzols based upon Colluvial or Morainal blankets. The forest zone is relatively tolerant to development (disturbance) is developments proceed with due caution. The upper altitudinal limits of this zone lead into the Krummholtz zone.

Krummholtz Zone

The Krummholtz zone is the ecotonal transition between the treeless alpine zone and the forested sub-alpine zone. The Krummholtz zone has large open areas with clusters of stunted Alpine fir, Whitebark pine and Mountain larch. These trees are stable and adapted to their exposed environment. Soils are generally Regisols on colluvial veneers.

The Krummholtz zone has been divided into two sub-zones based upon aspect. The northern Krummholtz is moister, the area generally cooler, and the vegetation is thicker. This north zone is less subject to daily climatic fluctuations and has a shorter growing season than the dry Krummholtz zone.

The southern aspect Krummholtz zone has a greater exposure to sunshine and experiences daily temperature fluctuations. Drought conditions are pronounced and the vegetation is sparser than in the Krummholtz northern aspect. The soils in this zone have a shallow turfy organic layer and are generally dystric brunisols.

Krummholtz is a preferred ski area. Little clearing of trees is necessary. Krummholtz is reasonably tolerant to developments such as ski-trails and lifts if wind - snow deposition patterns, drainage, and the clusters are left intact.

Avalanche Vegetation

Avalanche slopes are common in the Whitewater Area. They are easily recognized by the presence of slide older and small and damaged trees at their extreme run-outs. The plant communities within the avalanche units are relatively stable. They are kept in a state of dis-climax by periodic avalanches. Soils vary from exposed bedrock and talus to regosols on the colluvial materials. Although the vegetation in the avalanche unit is tolerant to disturbance, the obvious hazard of avalanches excludes development in this zone.

Creekside or Riparian Vegetation

The creekside unit has varying vegetational patterns depending upon elevation. The headwaters of Apex Creek have "alpine-type" vegetation while the lower valley creekside supports the devil's club community. Soils are glacial-fluvial in origin and belong in the Podzolic or Organic order. Vegetation along the creekside stabilizes banks and acts as a catch-basin or buffer for suspended materials moving downslope. Spring run-off channels must be avoided as disturbance in these areas can cause problems downstream. Wet conditions, the possibility of spring floods, and bank erosion hazards make creekside development and vegetation removal dangerous. At all times, adequate consideration for the sensitivity of this unit and its susceptibility to contamination should be considered.

Alpine Vegetation

The alpine zone refers to the vegetated land above tree line and up to the line of barren rock and permanent snow. For the purpose of this description it is broken into 2 sub-zones:

1. Exposed rock and talus vegetation
2. Alpine Heather Community

Vegetation in the exposed rock and talus zone is sparse. Lichen is the only plant that can exist under the harsh conditions of exposure and lack of soil. Lichens take hundreds of years to grown indicating the low productivity of these alpine sites. Unsuitable topography limits development and disturbance in lichen sites.

The Alpine-Heather community grows in areas of shallow, somewhat stabilized, course-textured colluvial soil. These regisols are easily disturbed and subject to seepage and creep. Vegetation consists of heathers and varied "alpine" herbacious vegetation. Revegetation of disturbed sites is very slow in the alpine area. However due to the proximity of avalanche hazard in the alpine area, development will probably not affect this area.

Swamp

The swamp at the base of the ski lodge has a high ground water supply originating from Apex Creek and its overall restricted drainage. The soils in the swamp are organic and have very low bearing capacity. The vegetation in the swamp includes Alpine fir, sedges, horse tail and various herbs and mosses. The swamp provides an important filter for downslope moving particles from the head-water area. Disturbance of the swamp unit will lead to siltation and contamination of downstream waters. Serious erosion and engineering problems will result if development takes place within the swamp unit.

CONCLUSION

In compiling this biophysical report we have attempted to demonstrate basic guidelines for future developments in the Apex basin. By due consideration of the environmental factors involved with mountain developments; the limitations and capabilities have been assessed and related to the planned management activities. The guidelines presented are for broad units and are not intended to be site specific. It is our hope that once site specific development plans have been established a detailed site inventory will be conducted.

APPENDIX B

DESCRIPTION OF CROSS COUNTRY TRAILS

At present there are only slightly developed cross country trails in the area. The following are descriptions and possibilities for future trail development.

A. Marsh Trail

This trail is located in the valley bottom right adjacent to the lodge and between the two parking lots. It is a very small flat area and provides an excellent area for beginners to practice their technique etc. and is a suitable area for providing beginning cross country skiing instruction.

B. South Slope Trail

This trail is presently used by the majority of the present corss country skiers in the area. The trail itself follows along old skid trails and so very little development would have to occur in this trail. It may be necessary for certain areas to be cleared and signing should be undertaken. A few places along this trail exhibit slopes that would not be negotiable by novice skiers (25%) and so if desired these steeper areas could be modified to accomodate the novice skiers by providing switch back area or longer runout areas at the bottom. Some conflict may develop with this trail if proposed downhill expansion occurs in this area.

C. Valley Bottom Trail

There are two possibilities for this trail. The trail could be located on either side of the road coming up the valley. One possibility would be to put the trail along the present powerline road. This would be an already cleared wide trail. The other option would be to put the trail down along the opposite side of the road. This would be a more pleasing trail to the cross country skier and would require very little development aside from a small amount of clearing and signing. This trail could be developed almost anywhere along this side of the valley since the topography tends to be quite gentle over most of the valley bottom. The easiest placement of this trail would be along existing skid trails and old roads that are already located along this side of the valley. This trail would proceed down the valley almost parallelling the present road for about four to five miles. The terrain then becomes quite steep for the last portion and would not be passable by novice skiers. Skiers could come out to the road along any point of the trail very easily and obtain transportation to the lodge or the bottom of the hill or if desired they could return uphill to facilities on same trail or cross road to powerline.

D. Loop Trail

This trail would provide an excellent opportunity for the more advanced or intermediate cross country skiers or ski tourers. It is located about one mile down the Valley Bottom trail. At this point it goes up to the saddle in between the two ridges and comes back down via another route on the other side of the small gulley. This trail would also provide an option for further expansion for a route to Nelson. After going through the saddle itself it is about six to seven miles to Nelson.

Suggestions for Signing

Signs should be located at the beginning of the trails and should include:

a) Trail identity point of reference;
b) Trail distance (total, sectional);
c) Trail difficulty (easy, intermediate, advanced);
d) Trail layout (graphic);
e) Special hazards (turns, hills etc.);
f) Rules (no snowmobiles etc.);
g) Location fo facilities.

Some type of trail marker should also be developed that could be placed at intervals along the trail in areas where the location of the trail is questionable.