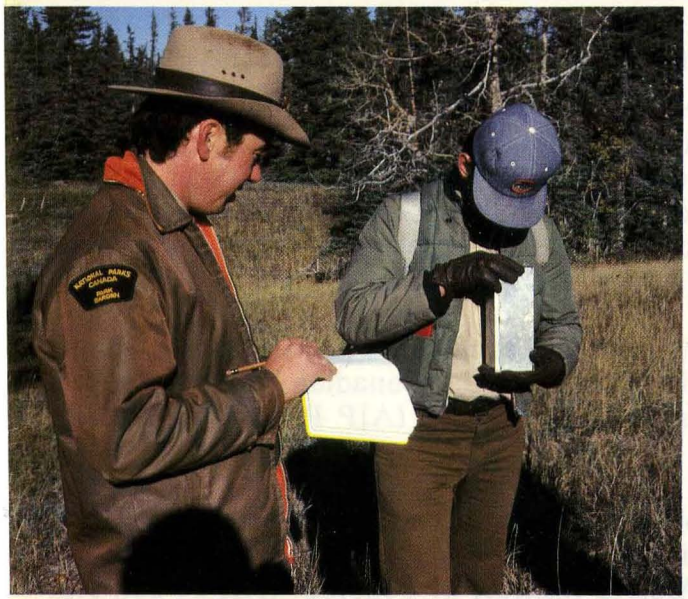
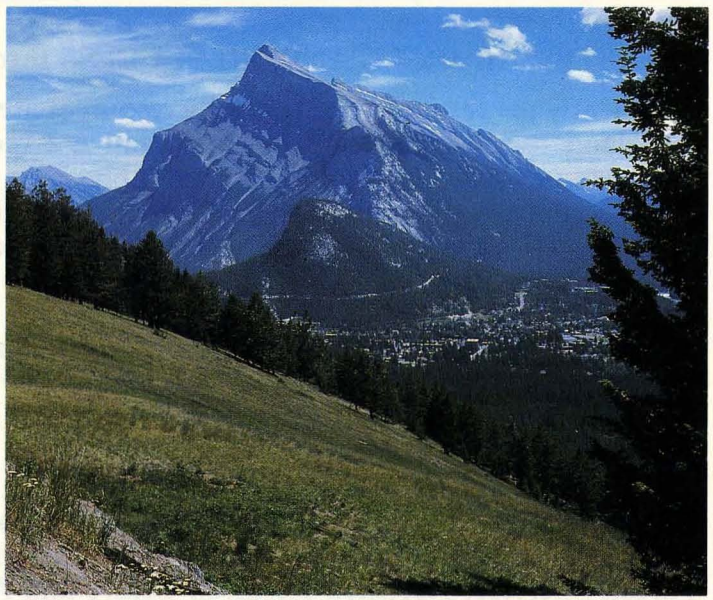
USING ECOLOGICAL RESOURCE INVENTORY

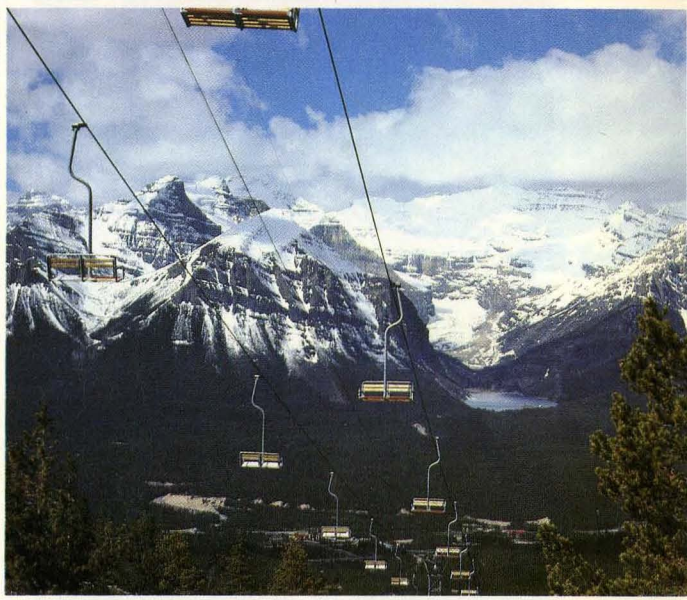
Applications of landform, soils, vegetation, and wildlife data in Banff and Jasper National Parks

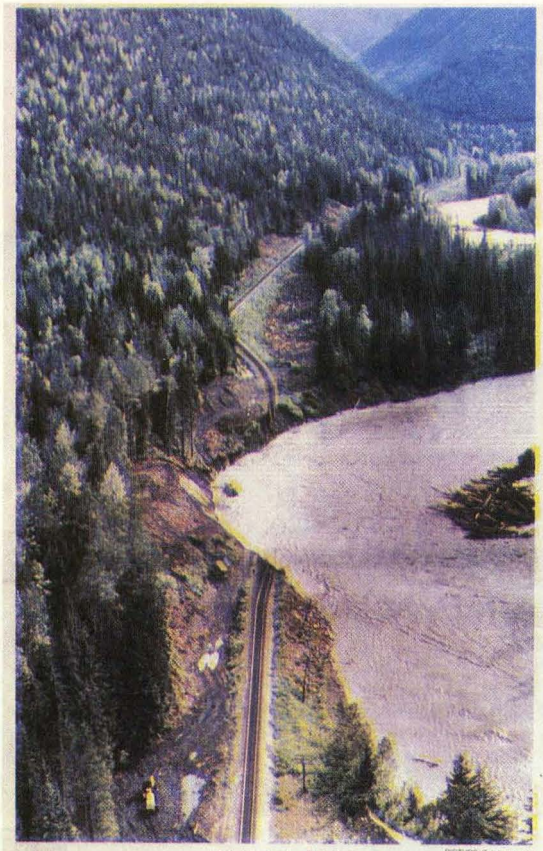
Environment Canada
Canadian Forestry Service

Environnement Canada
Service canadien des forêts









End of the line for CP Rail
...sections of track ripped out near Golden, B.C.

PICTURE: Calgary Herald

The Edmonton Journal

25 CENTS FINAL THURSDAY, JULY 14, 1983

Travel plans washed out

By The Canadian Press

Travel plans for motorists driving through British Columbia will remain unsettled for almost a week, police and Highways Ministry officials predict.

And no will the weather. Rain has been deluging southern B.C. for several days, causing mud and rock slides and washing away highway and railway beds.

Motorists heading to and from the West Coast are being told to either detour south to Highway 3 near the Canada-U.S. border (Osoyoos to Cranbrook) or north along the Yellowhead which connects Kamloops, Jasper and Edmonton.

Meanwhile, rain caused six more washouts on CP Rail's mainline between Rogers Pass and Revelstoke Wednesday, delaying a reopening of the tracks already damaged by the Illecillewaet River at 15 points since early Tuesday.

The railway was hoping to restore service by 9 p.m. today but has now had to set back train runs over the Selkirk Mountains until late Friday, at the earliest.

CP Rail spokesman Maurice Zaitlin said the river has torn away sections of track, exposed bridge abutments, toppled a signal tower and undermined part of a concrete snowshed.

The railway runs close to the Illecillewaet on its steep descents from Rogers Pass to the Columbia River. Zaitlin said the railway is transporting rock rubble from as far as the Lower Fraser River and the East Kootenay for dumping in the Illecillewaet Valley, so damaged sections of trackbed can be rebuilt.

CP Rail is diverting piggyback and boxcar traffic to Canadian National Railways, handing over trains to its competition at Edmonton and returning them back at Kamloops.

Meanwhile, crews working to repair the Trans-Canada Highway between Hope and Princeton in the Fraser Valley in southwestern B.C. said they ran into difficulty clearing debris from a huge culvert and this section was to be reopened sometime today.

And RCMP said the Rogers Pass section of the Trans-Canada Highway connecting Revelstoke and Golden will be "closed for at least a week or longer" because of a series of bridge and road washouts.

DISASTER OR OUTSTANDING SUCCESS through national park management?

Frequently the result depends on how resources are managed. Successful management requires the best land use possible, and the best land use requires the use of resource inventory data for guidance in using our resources. This publication uses examples from Banff and Jasper national parks to illustrate the application of ecological (biophysical) land classification to better land-use planning. It accompanies the reports written to complete the ecological (biophysical) land classification (ELC) of Banff and Jasper national parks. The report references follow:

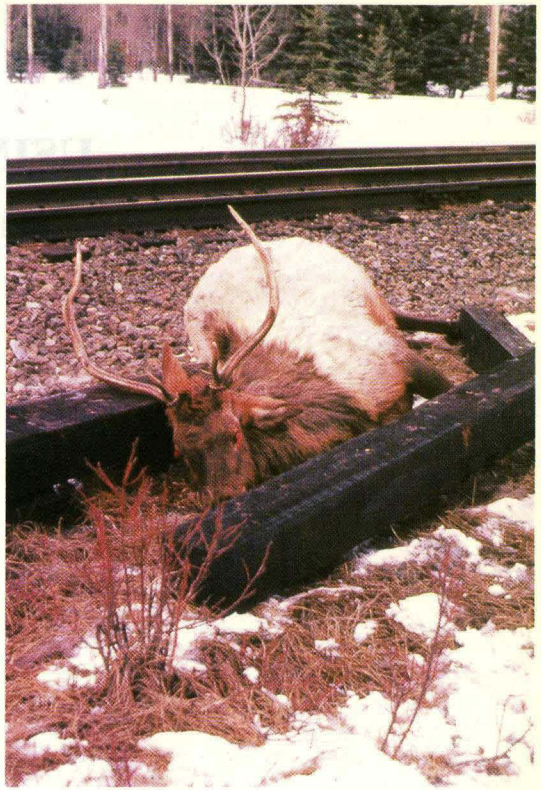
Holland, W.D.; Coen, G.M., editors. 1983. Ecological (biophysical) land classification of Banff and Jasper national parks. Vol. I. Summary. Environment Canada, Canadian Forestry Service, Northern Forest Research Centre and Alberta Institute of Pedology (AIP Publ. No. M-83-2), Edmonton, Alberta. 193 p.

Holland, W.D.; Coen, G.M., editors. 1982. Ecological (biophysical) land classification of Banff and Jasper national parks. Vol. II. Soil and vegetation resources. Environment Canada, Canadian Forestry Service, Northern Research Centre and Alberta Institute of Pedology (AIP) Publ. No. SS-82-44), Edmonton, Alberta. 540 p.

Holroyd, G.L.; Van Tighem, K.J. 1983. Ecological (biophysical) land classification of Banff and Jasper national parks. Vol. III. The wildlife inventory. Environment Canada, Canadian Wildlife Service, Edmonton, Alberta. Part A, 444 p; Part B, 247 p.

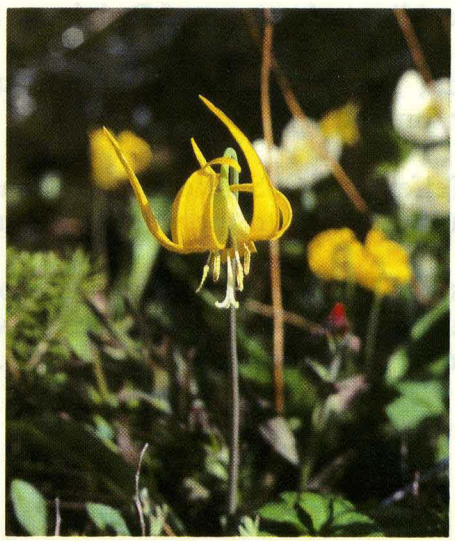
Environment Canada; Alberta Institute of Pedology; Land Resource Research Institute, Agriculture Canada. 1982. Map Supplement. Ecological (biophysical) land classification of Banff and Jasper national parks. Agriculture Canada, Land Resource Research Institute, Ottawa, Ont. 24 maps and master legend.

DISASTER



SUCCESS

Our resources can be used more wisely. Knowledge of the kind of resources we have in the national parks, and their quantity, enables the land manager to plan resource use and apply management techniques that will result in scenes indicating successful environmental compatibility.



USING ECOLOGICAL RESOURCE INVENTORY

Applications of landform, soils, vegetation, and wildlife data in Banff and Jasper National Parks.

W.D. Holland
Northern Forest Research Centre
Canadian Forestry Service
Environment Canada
5320 - 122 Street
Edmonton, Alberta
T6H 3S5

Catalogue No. F042-68/1984E

ISBN 0-662-13248-3

ACKNOWLEDGEMENTS

The assistance of the land classification team is acknowledged and appreciated, especially D.T. Allan, H.A. Dudynsky, and M.D. Fairbarns from the Canadian Forestry Service, and P.L. Achuff, S. Dupuis, W.S. Taylor, and B.D. Walker of the Alberta Institute of Pedology, Edmonton.

Assistance provided by Parks Canada, Banff and Jasper, and Western Regional Office, Calgary is acknowledged; in particular P.A. Benson and K.E. Seel.

C.L. Holroyd, K.J. Van Tighem, E. Telfer, and G. Scotter of the Canadian Wildlife Service, Edmonton, provided advice and recommendations pertaining to the wildlife resource.

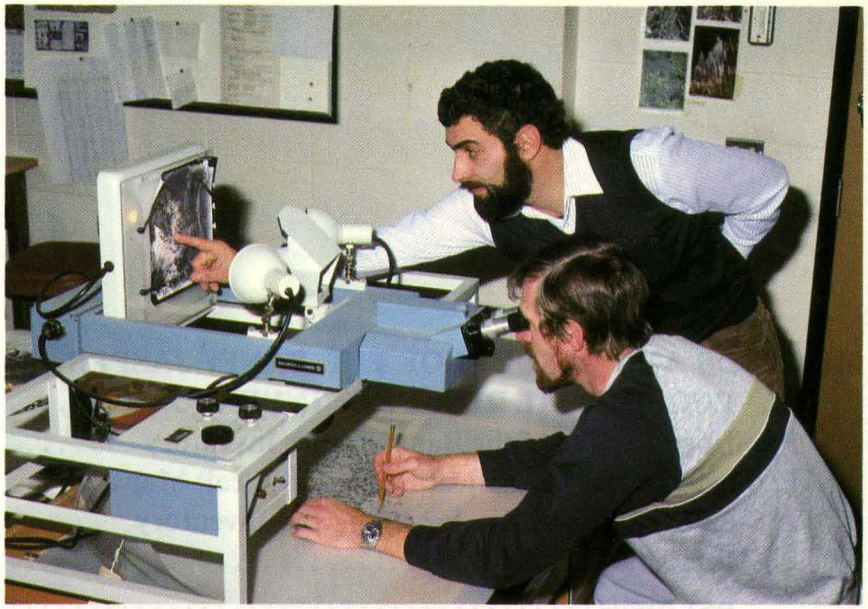
The assistance of the Canadian Forestry Service, Edmonton, is acknowledged, in particular A.D. Kiil, S.S. Malhotra, and administrative staff; I.G.W. Corns for advice on vegetation resources, to J. Samoil for editorial advice, and to P.S. Debnam for photographic assistance.

CONTENTS

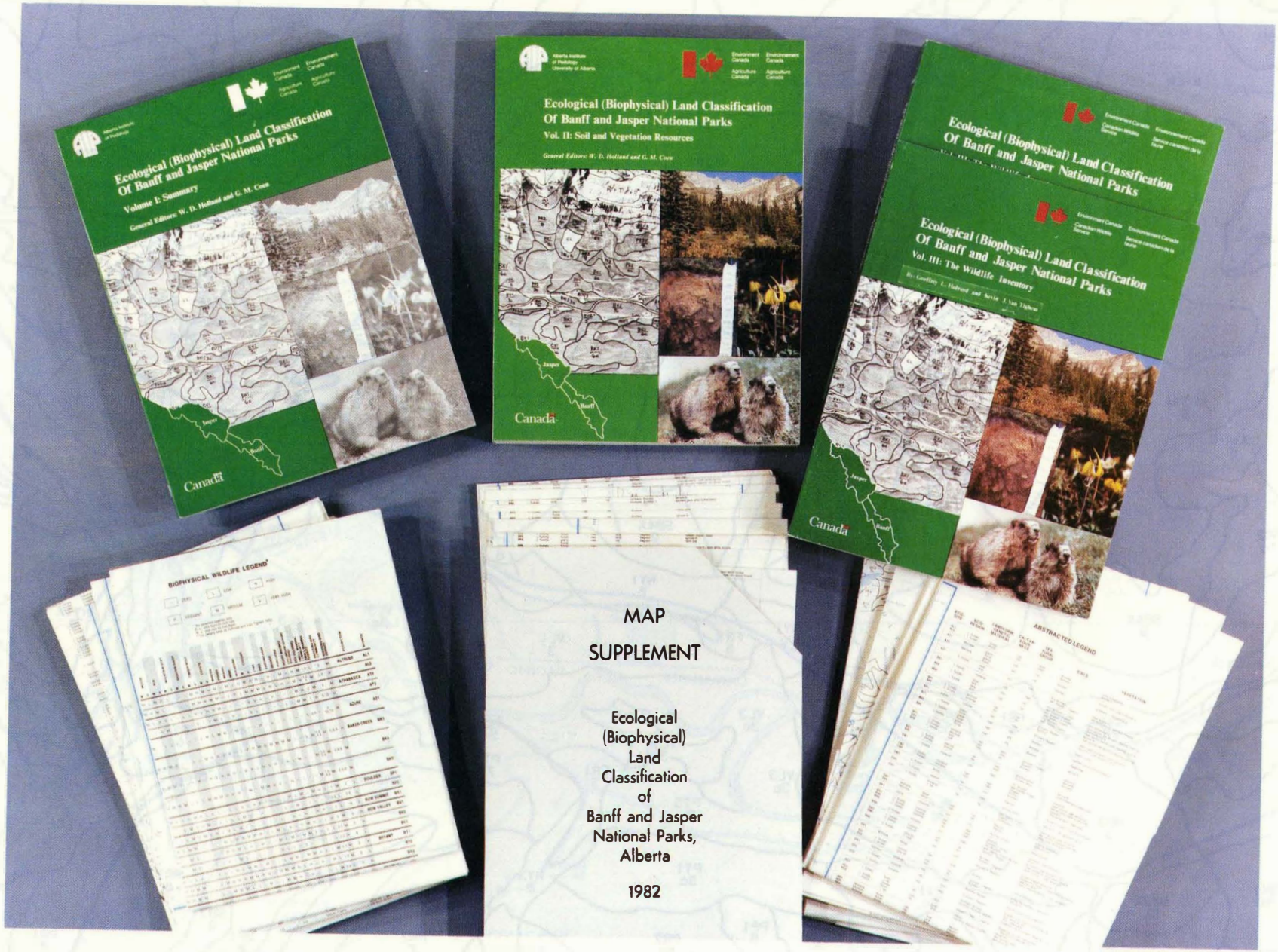
METHODS AND RESULTS OF THE BANFF-JASPER ECOLOGICAL RESOURCE INVENTORY

As part of an overall resource inventory of Banff and Jasper national parks, Parks Canada initiated an ecological (biophysical) land classification study in order to obtain a land, soil, vegetation, and wildlife inventory, including maps and reports plus interpretations of data for land use planning and management within the parks.

Air photo interpretation was used to delineate differing areas of landforms, slopes, rock, soil (especially wetness), and vegetation. Pretyped areas were then field checked and the mapping and legend refined in accordance with the findings of the field parties. Field checking was done by a soil scientist and a vegetation scientist, both recording their observations at a mutually acceptable point on the landscape. A wildlife biologist later recorded data at the same point or in the immediate vicinity. All site specific information was recorded on standard field forms and subsequently transferred to computer forms. Corrections to the pretyping and air photo delineations, along with the superimposition of detailed plots at representative sites, completed the map units. Finally, the maps and reports were published as a record of the field and laboratory descriptions of the physical and biological resource characteristics found in the parks environment.

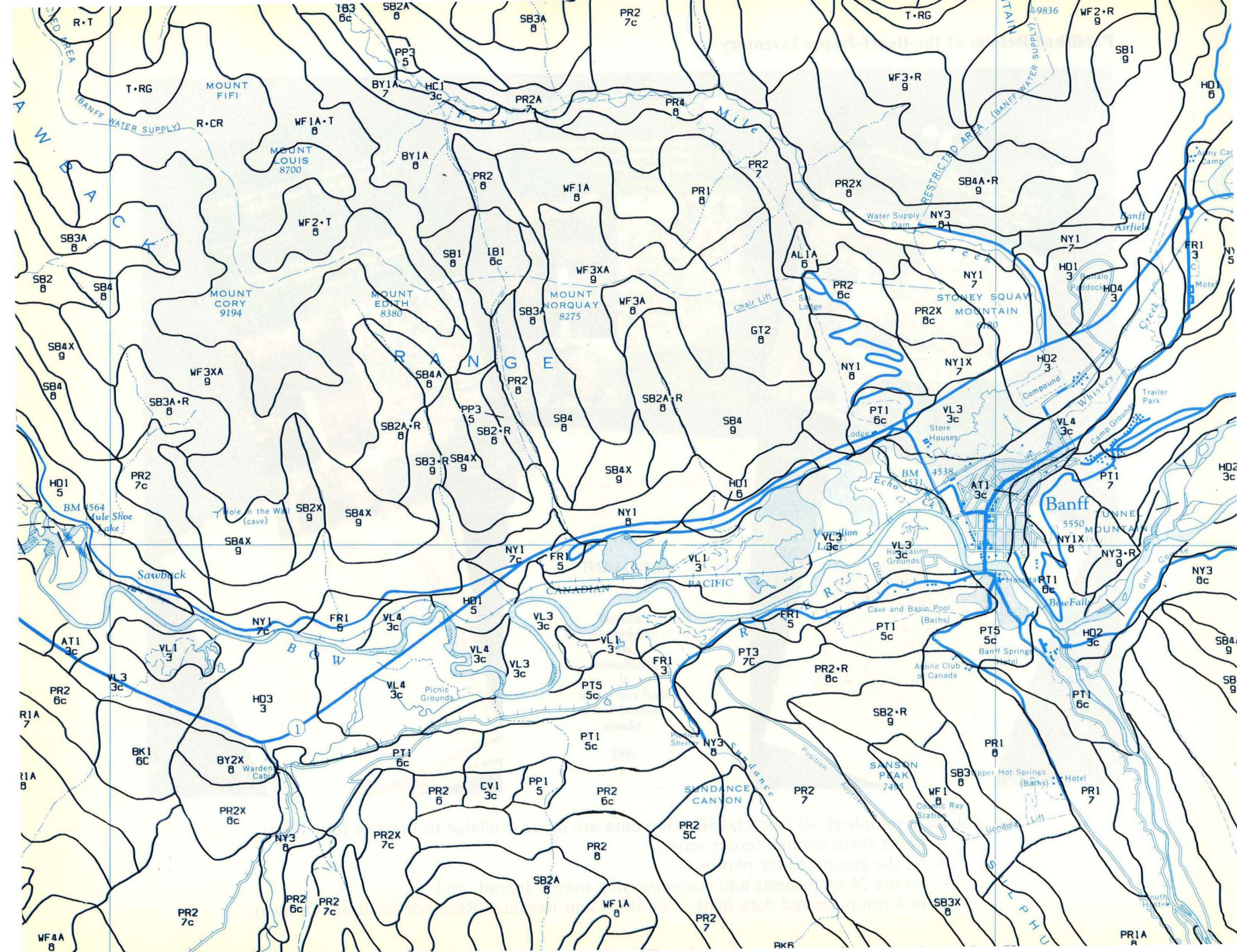


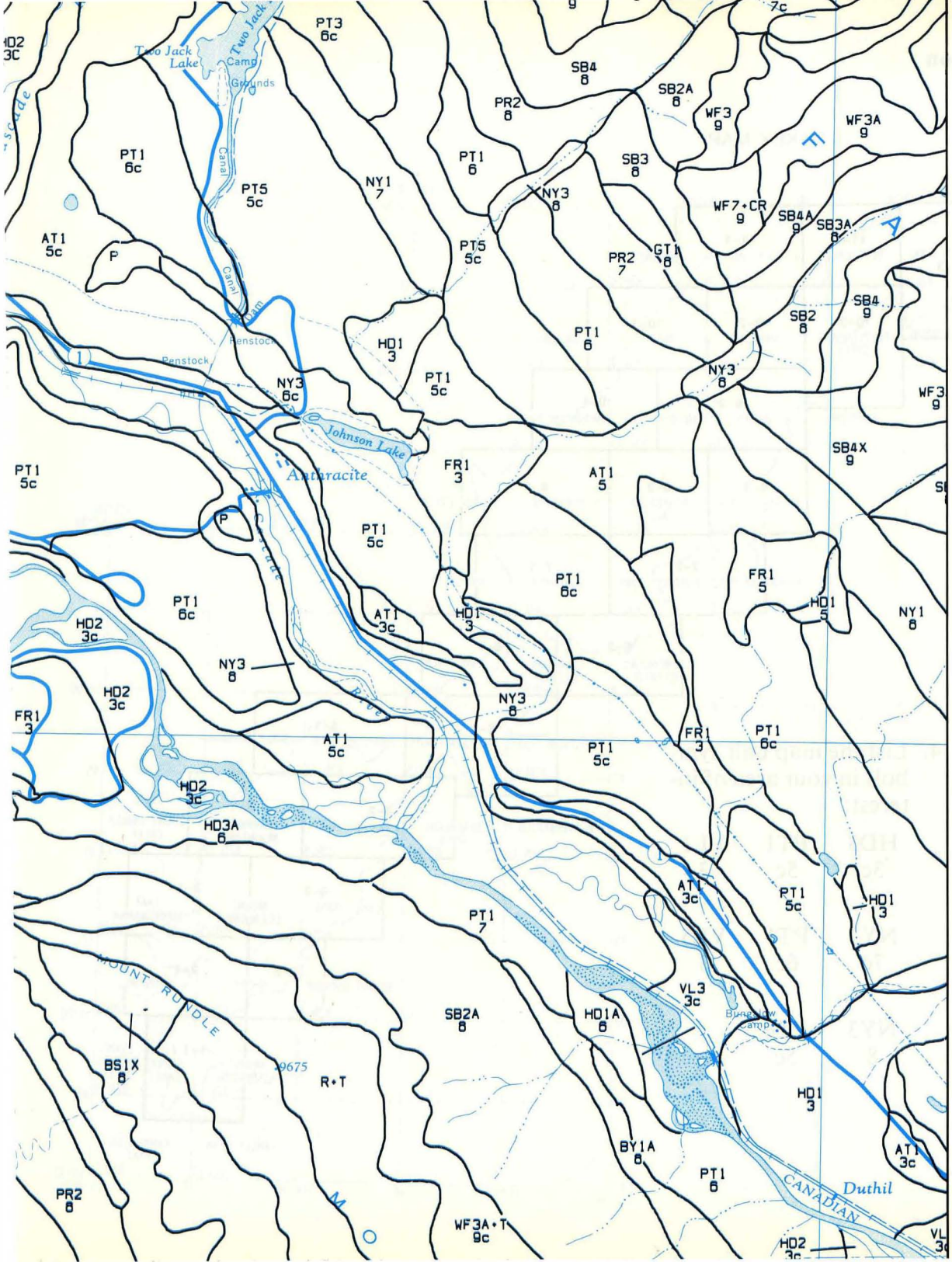
Published Results of the Banff-Jasper Inventory



The ecological (biophysical) land classification data are made available to users in four ways:

— in the three volume report series,
— on the annotated air photos,
— on the 24 map sheets and accompanying master legend, and
— in a computerized data bank (CanSIS, Land Resource Research Institute, Ottawa).


MOUNT FIFI
MOUNT LOUIS 8700
MOUNT CORY 9194
MOUNT EDITH 8380
MOUNT NORQUAY 8275
SAWBACK
RANGE
(BANFF WATER SUPPLY)
RESTRICTED AREA (BANFF WATER SUPPLY)
Forty Mile Creek
Water Supply Dam
Chair Lift
Ski Lodge
Banff Airfield
Army Cadet Camp
Buffalo Paddock
Motel
STONEY SQUAW MOUNTAIN 6160
Compound
Whiskey Creek
Trailer Park
Camp Ground
Store Houses
Lodge
Echo Ck
BM 4538
BM 4531
Banff
5550
TUNNEL MOUNTAIN
Golf Course
Vermilion Lakes
Recreation Grounds
Ditch
Hospital
Bow Falls
Hole in the Wall (cave)
BM 4564
Mule Shoe Lake
Sawback
CANADIAN PACIFIC
BOW RIVER
Cave and Basin Pool (Baths)
Banff Springs Hotel
Alpine Club of Canada
Picnic Grounds
Picnic Shelter
Warden Cabin
1
Sundance
SUNDANCE CANYON
Position Approach
SANSON PEAK 7495
Upper Hot Springs (Baths)
Hotel
Cosmic Ray Station
Gondola Lift
SULPHUR
Youth Hostel
9836
R·T
T·RG
R·CR
WF1A·T 8
BY1A 8
PR2 8
WF2·T 8
SB3A 8
SB2 8
SB4 8
SB4X 9
WF3XA 9
SB3A·R 8
HD1 5
PR2 7c
SB2X 9
SB4X 9
IB3 6c
SB2A 8
PP3 5
BY1A 7
HC1 3c
PR2A 7
SB3A 8
PR2 7c
PR4 8
WF1A 8
PR1 8
PR2 7
PR2X 8
T·RG
WF3·R 9
SB4A·R 9
WF2·R 9
SB1 9
HD1 6
SB1 8
IB1 6c
WF3XA 9
WF3A 8
SB3A 8
SB4A 8
PR2 8
PP3 5
SB2·R 8
SB2A·R 8
SB3·R 9
SB4X 9
SB4 8
SB2A·R 8
SB4 9
SB4X 9
GT2 8
AL1A 6
PR2 6c
NY1 8
NY3 8
NY1 7
HD1 3
HD4 3
FR1 3
PR2X 8c
NY1X 7
HD2 3
PT1 6c
VL3 3c
VL4 3c
PT1 7
HD2 3c
AT1 3c
HD1 6
NY1 8
NY1 7c
FR1 5
VL3 3c
VL1 3
VL3 3c
NY1X 8
NY3·R 9
NY3 8c
PT1 6c
HD1 5
NY1 7c
FR1 5
VL4 3c
VL3 3c
VL1 3
FR1 5
PT1 5c
PT5 5c
HD2 3c
AT1 3c
VL1 3
VL3 3c
VL4 3c
VL3 3c
VL4 3c
FR1 3
PT3 7C
PR2·R 8c
PT5 5c
PT1 6c
SB4A 9
SB 9
PR2 6c
HD3 3
PR1A 7
BK1 6C
BY2X 8
PT1 6c
PT1 5c
NY3 8
SB2·R 9
PR1 8
PR1A 8
PR2X 8c
PR2 6
CV1 3c
PP1 5
PR2 6c
PR2 7
SB3 8
WF1 8
PR1 7
NY3 8
PR2X 7c
PR2 5C
PR2 8
SB2A 8
WF1A 8
SB3X 8
PR2 6c
PR2 7c
PR2 7c
PR2 7
WF4A 8
BK6
PR1A 8



Ecological Land Classification (Biophysical) Maps

The ELC maps are one of the main products of the inventory. Twenty-four map sheets were compiled at a scale of 1:50 000. A master legend accompanies the map set. The maps indicate the **distribution** (location) and **pattern** of resources (shape of map units).

The **amount** of a resource is shown by the size of individual map units. Addition of the map unit areas provides the total area of various kinds of resources. Approximate areas of ecoregions, for example, are as follows:

Ecoregions and Subdivisions

Montane	99 185 ha	5.5%
Subalpine	906 020 ha	50.3%
— Lower Subalpine	(512 831) ha	(28.5%)
— Upper Subalpine	(393 188) ha	(21.8%)
Alpine	101 665 ha	5.6%
Miscellaneous Landscape	691 650 ha	38.6%

The majority of the Montane Ecoregion occurs in Jasper. Approximately 2% of Banff national park is in the Montane. The climate of the Montane is warmer and drier than the harsher climate of the other ecoregions. This more-pleasing climate, along with the attraction of Banff townsite, causes humans and wildlife to use the Montane resources more intensively than those in other areas of the park. The result is overuse of resources in a small portion of the park and underuse elsewhere. The impact can be critical to some wildlife populations and to the appearance of the park, especially along the main entryway from the east. The maps quickly indicate the location of the resources that are most in need of conservation.

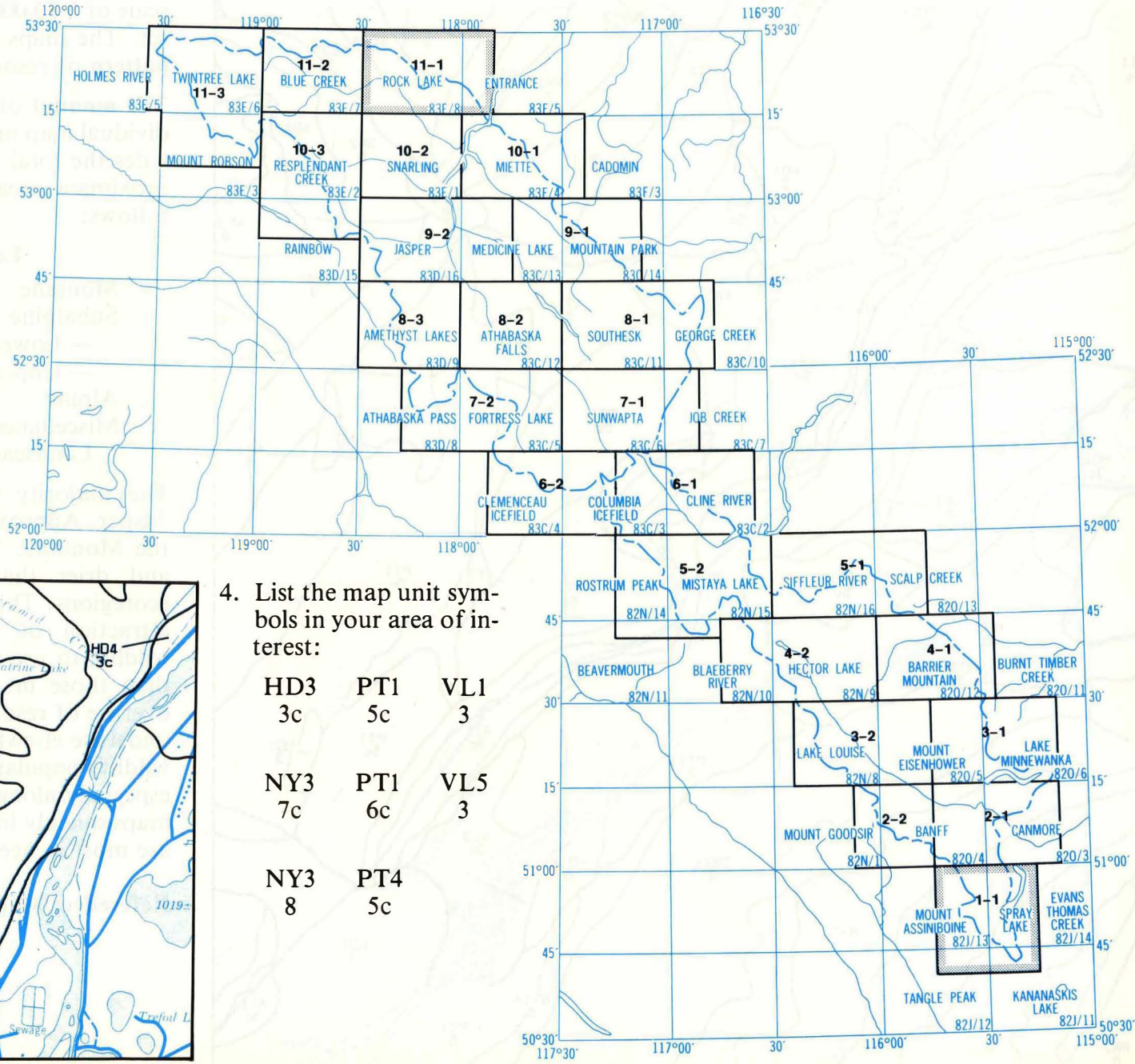
Reference: Map Supplement, Map Sheet 2-1.

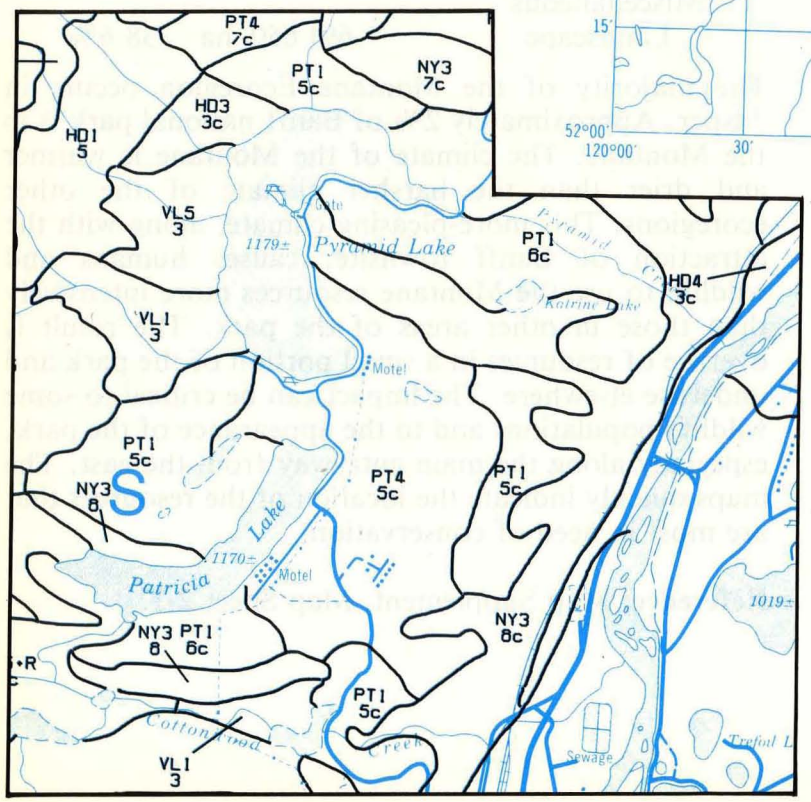
A Suggested Procedure for Using the Inventory Information

1. Locate your area of interest on the Key Map.
2. Note the number of the map sheet, and select that sheet from the Map Supplement:

   9-2.
   JASPER NATIONAL PARK
   NTS 83C/13 and 83D/16
3. Locate your area of interest on the map sheet, e.g., Patricia and Pyramid lakes.

KEY MAP

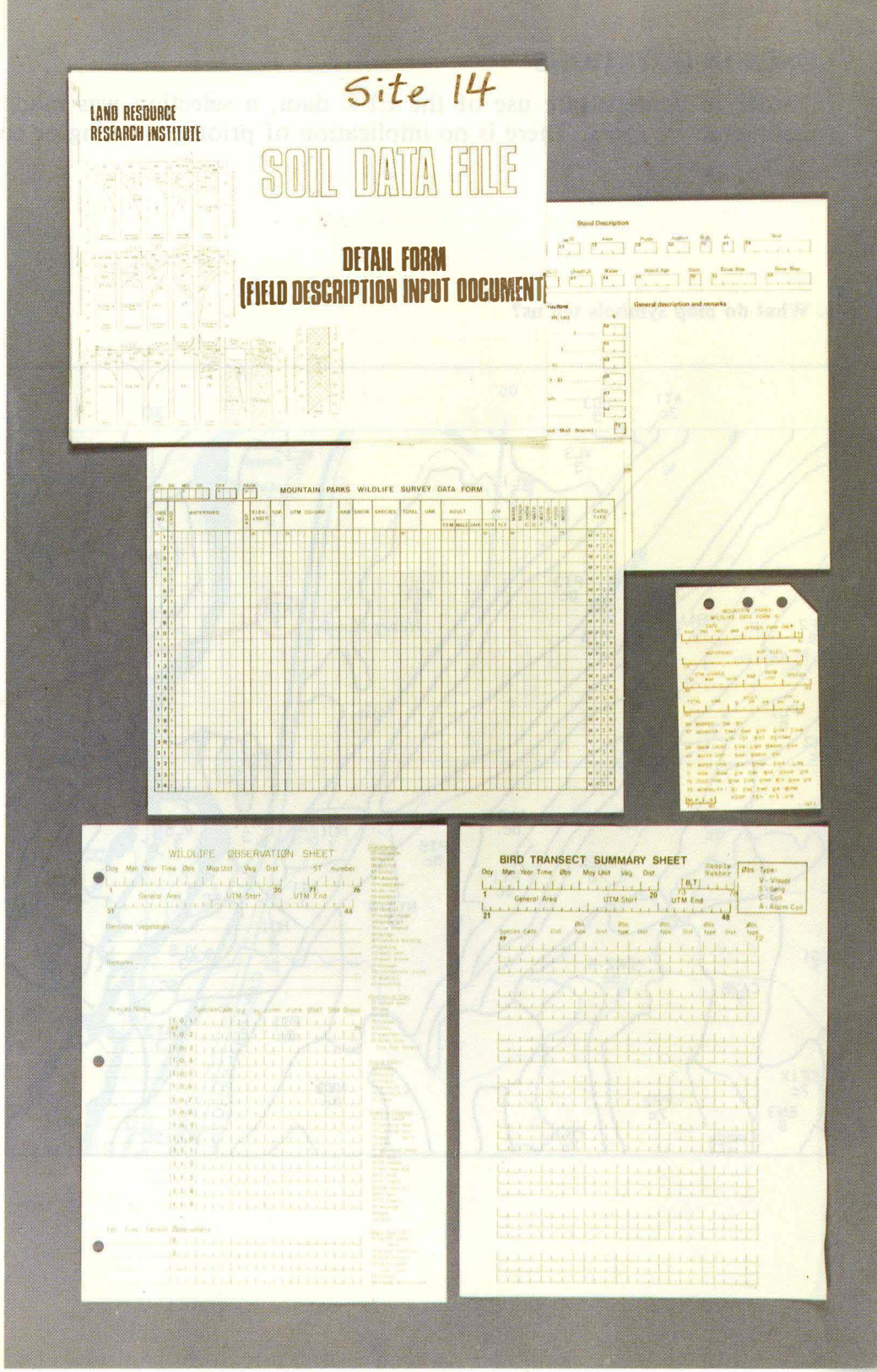




4. List the map unit symbols in your area of interest:

HD3 3c	PT1 5c	VL1 3
NY3 7c	PT1 6c	VL5 3
NY3 8	PT4 5c	

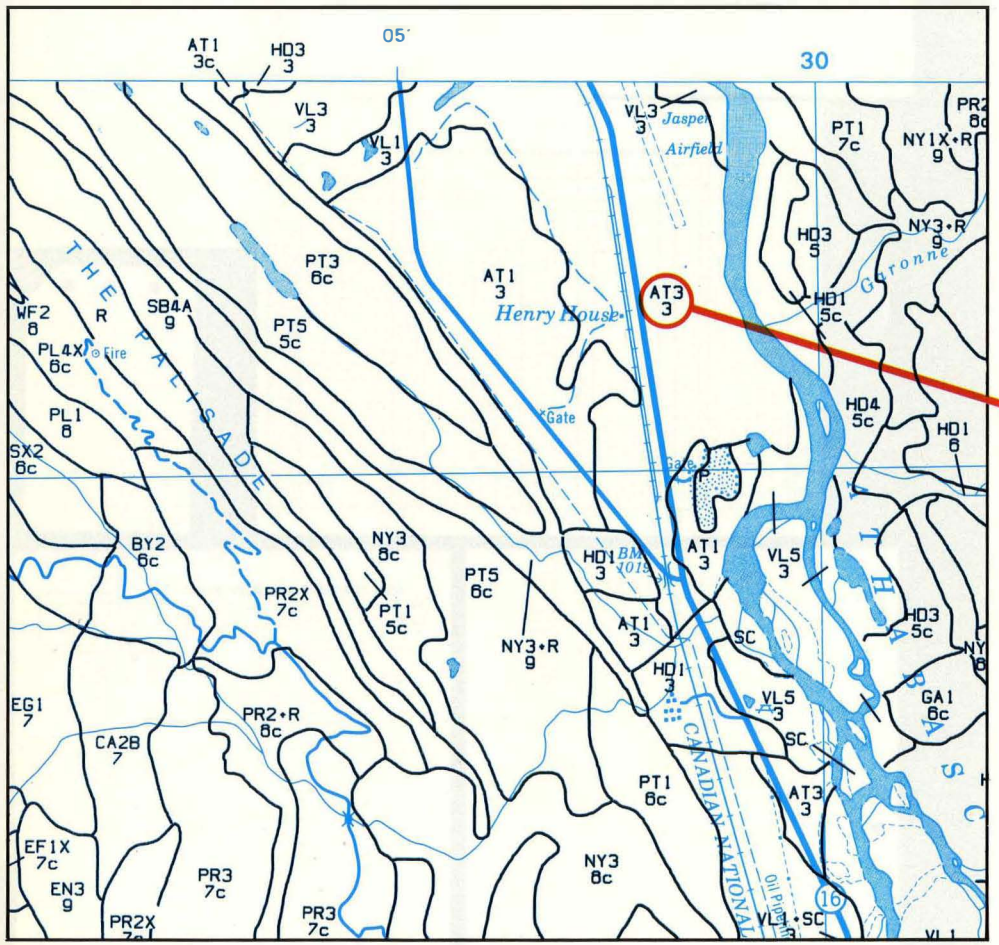
5. Resource information for each symbol can be found in the following sources:
    a) First level of information occurs in the Abstracted Legend found on each map.
    b) Second level (more detailed) information is found on the Master Legend in the Map Supplement.
    c) Third level information is in Vol. I, Summary.
    d) Fourth level: (i) For soil and vegetation see Vol. II, Soil and Vegetation Resources.
        (ii) For wildlife see Vol. III, The Wildlife Inventory.
    e) Fifth level: there is a possibility that **site-specific data** (from the fieldwork) are available for your area of interest. Access is through Parks Canada computer terminals to the Canada Soil Information System (CanSIS), Ottawa. Remember, these data are site-specific, i.e., they apply to the sample site only and may or may not be representative of the map delineation or the mapping concept. Whenever site-specific data are used, it is the user's responsibility to be aware of what such data represent and of the degree of variability encountered.
6. The acquisition of resource inventory data is followed by resource analysis description or interpretive classification of resource suitabilities and limitations for a selected list of land uses. The usual method is to select the items affecting the land use of concern (e.g., flooding hazard, susceptibility to erosion, slope, or soil texture) and rate the degree of impact each item is expected to exert on the land use selected.
7. The final step in using the results is preparation of land use management plans and application of management techniques such as zoning, land use rules, regulations, or permits.



COMMON QUESTIONS

In order to demonstrate use of the ELC data, a selection was made of questions most likely to be encountered by users. There is no implication of priority ranking or completeness of listing.

1. What do map symbols tell us?



MAP SYMBOL CONVENTION

Symbols naming delineated areas are a combination of the Ecosite symbol with or without a modifier, and the slope of the landform designated in the denominator.

Example

Ecosite symbol — modifier

AT3 B

3

slope class

Modifiers

A Snow Avalanched
B Burned
F Failed
X Lithic

AT3 = Athabasca 3 Ecosite
(map symbol = map unit name)

AT3 is the symbol representing a map unit concept describing a certain kind of landform and soil, with a particular type of vegetation, and used by a specific kind of wildlife.

From report and legend information, AT3 is characterized by

- — a Montane climate
- — a terraced landform; 0 - 5% slope
- — a coarse-textured soil
- — mostly grassy vegetation
- — use as winter range for elk and deer
- — an interpretation of high priority of conservation for wildlife.

References: Vol. I, p 97-98.
Vol. II, p 177-180.
Vol. III, p 537-538.

2. How much AT3 is there in Banff and Jasper?

Computer summation of map data indicates approximately 575 hectares, or 0.03% of Banff and Jasper mapped as AT3. AT3 is 0.58% of the Montane Ecoregion, which is 5.5% of Banff and Jasper as calculated from unedited CanSIS map index linkages.

3. Where is AT3 found?

AT3 occurs in Montane valley bottoms and is found on those map sheets containing the Montane Ecoregion.

4. How do you recognize AT3 in the field?

- stable terraced landforms with 0-5% slope
- coarse-textured calcareous soil with abundant stone fragments
- grassland with clumps of forest
- heavy use by elk, deer, carnivores, and birds.

5. What are the most suitable and least suitable characteristics for use of AT3?

Suitabilities	Limitations
— stable landform	— droughtiness
— level topography	— coarse soil texture
— warm and dry	— slow vegetation growth rate
— vegetation pattern ideal for wildlife	— dry vegetation types wear out easily
— easily accessible	— limited area
— good dry soil for trails, etc., high demand for use	— susceptible to overuse

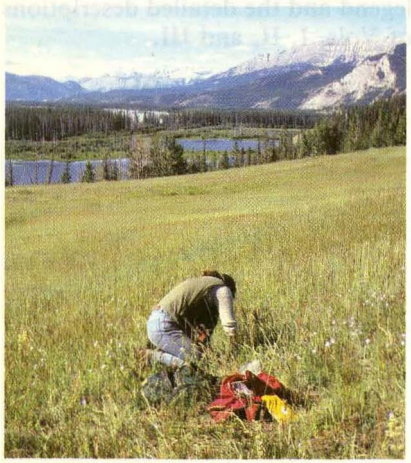
Suitabilities and limitations do not appear in the data; they are interpretations made from scientific data in order to provide answers to specific land use questions.

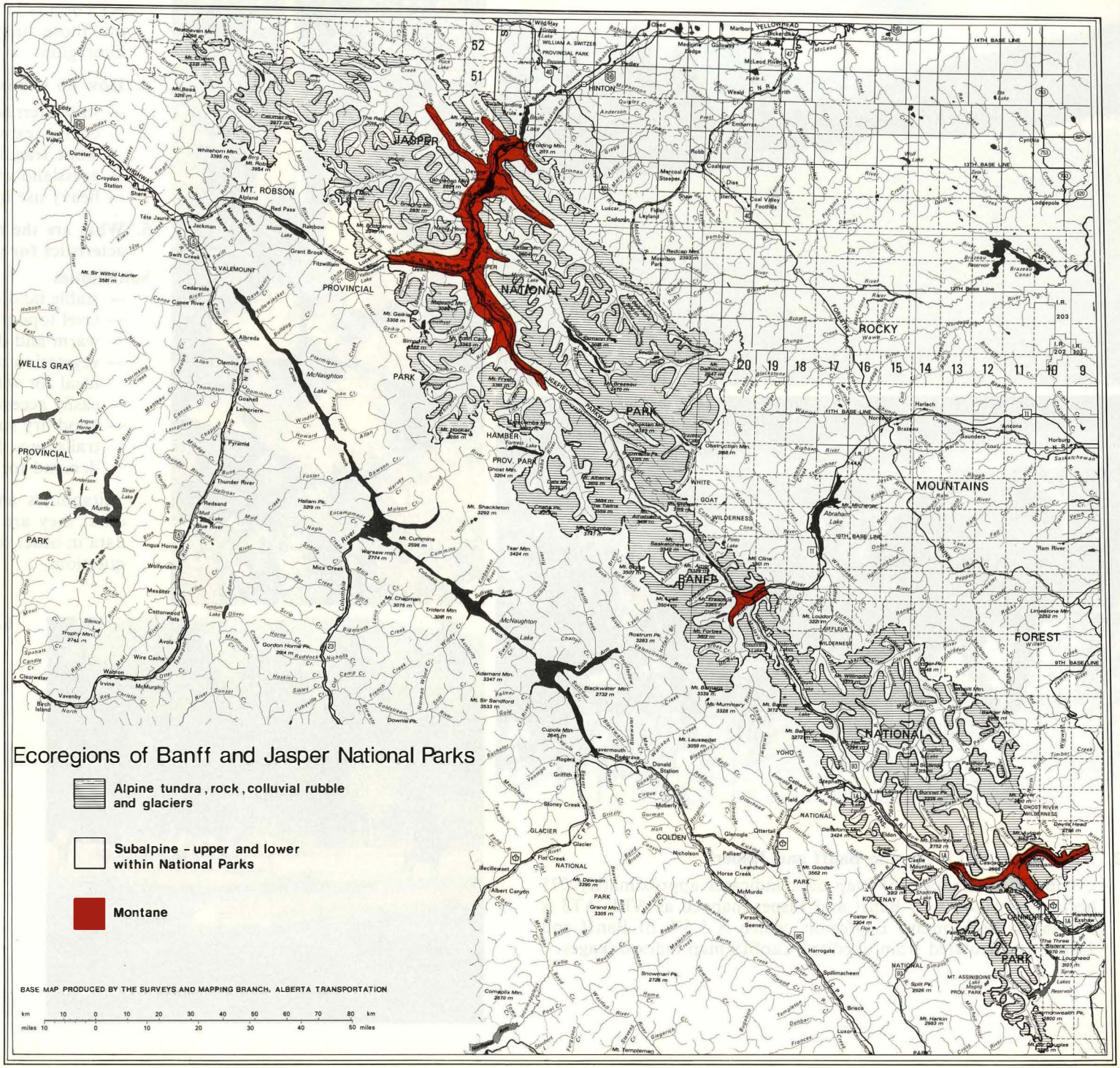
6. What ecosites might be confused with AT3?

AT3 has similarity to FR1, GA1, and TA2 in particular. The differences are described in the master legend and the detailed descriptions of Vols. I, II, and III.

CLIMATE AND ECOREGIONS

Climatic differences are easy to observe, but locating climatic boundaries is difficult. Ecoregions are broad vegetative zones reflecting macroclimatic differences. Vegetation distinctions due to slope, fire, etc., are eliminated. Thus, Ecoregions separate broad climatic influences on the parks.



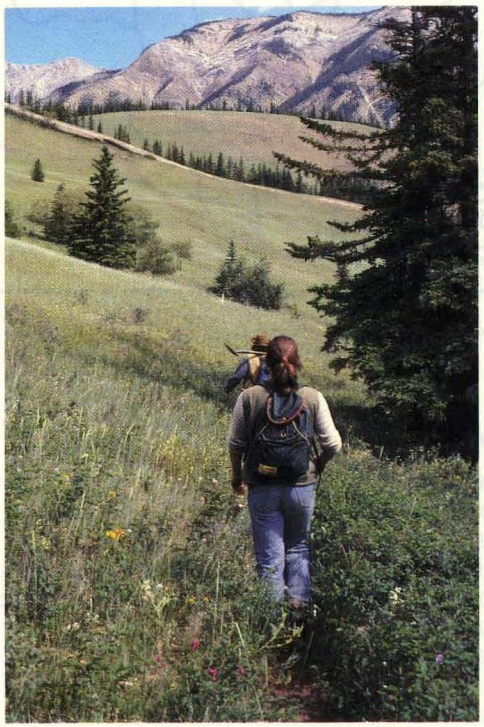


Dominant Ecoregion Characteristics

Montane

—lowest elevations
—warmest and driest
—intermittently snowfree
—dominated by Douglas fir, white spruce, aspen poplar, and grasslands

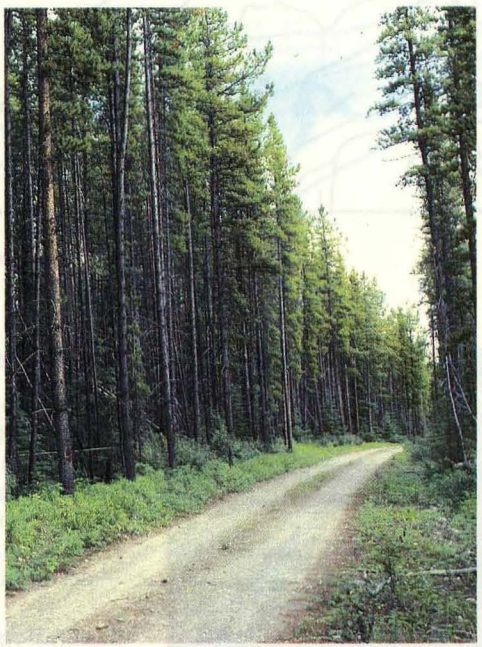
—99 185 ha; 5.5% of Banff and Jasper



Subalpine (Lower)

—moderate elevations
—closed coniferous forests of Engelmann spruce, subalpine fir, and lodgepole pine

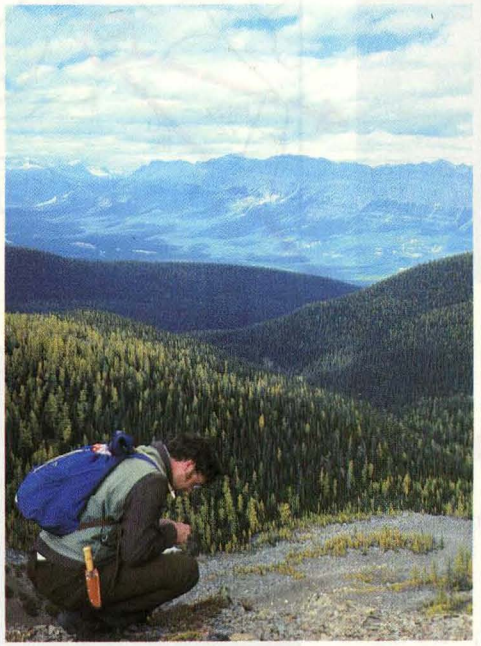
—512 831 ha; 28.5% of Banff and Jasper



Subalpine (Upper)

—moderate to high elevations
—closed to open forests of Engelmann spruce, subalpine fir, and subalpine larch (southern Banff)
—cooler and wetter than Lower Subalpine, more snow, and shorter growing season
—some Alpine plants overlap into this ecoregion

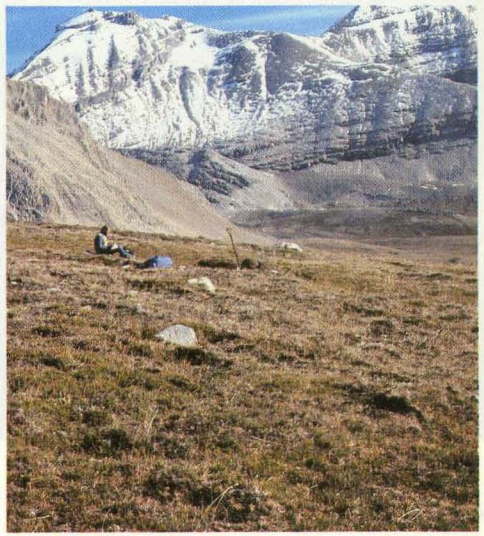
—393 188 ha; 21.8% of Banff and Jasper

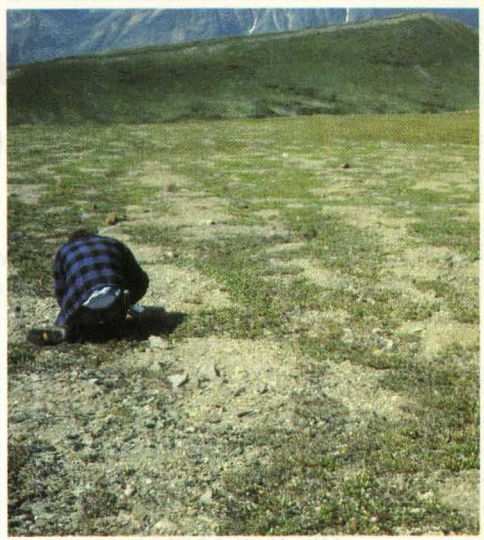


Alpine

—high elevations above treeline
—cold, harsh, windy climate
—alpine tundra vegetation

—101 665 ha; 5.6% of Banff and Jasper





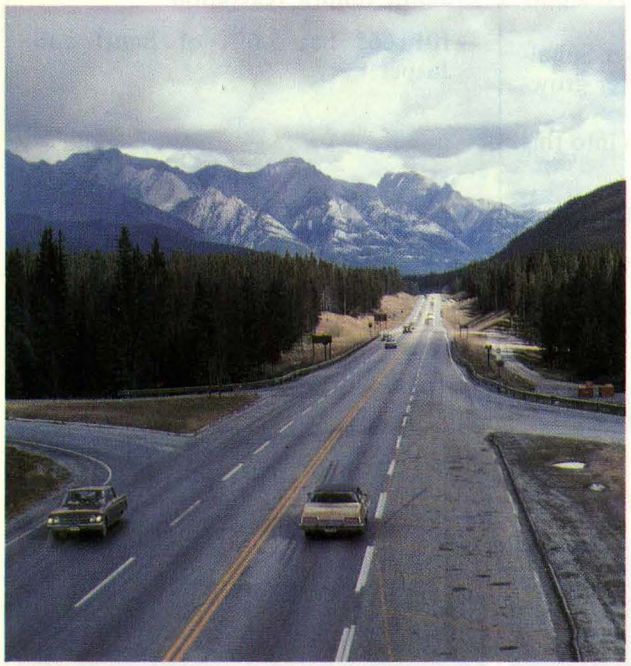
Human demand for transportation, townsites, trails, and campgrounds, as well as critical demand by wildlife for winter range and other uses, places greatest use pressure on the Montane.

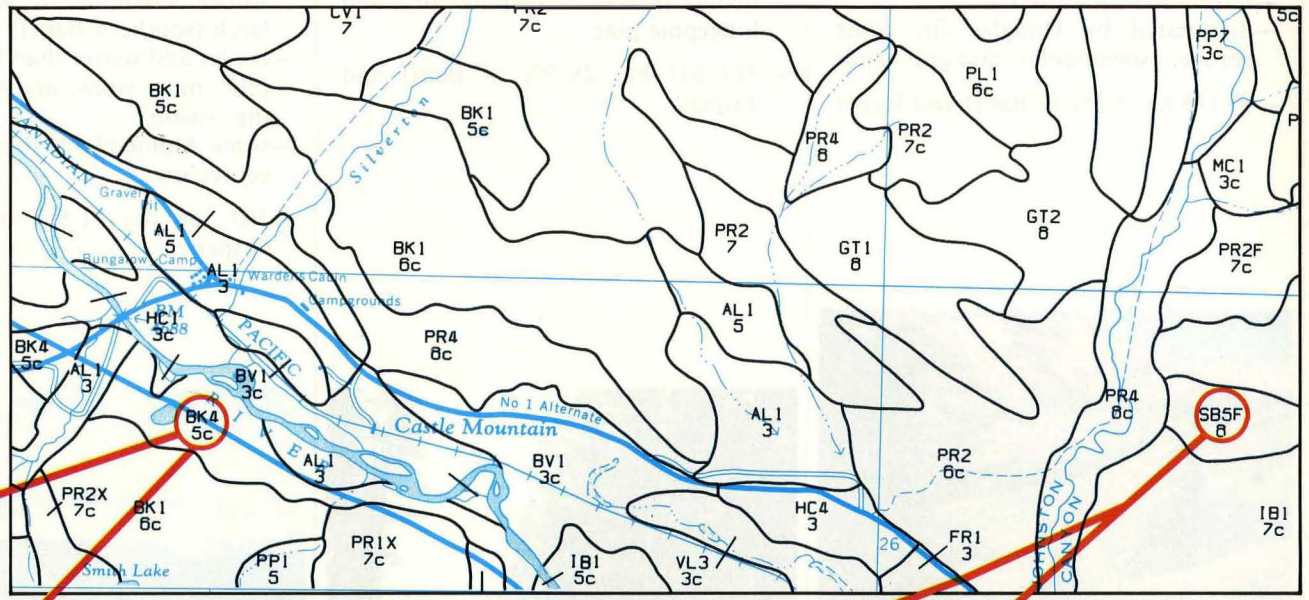
The remaining 38.6% of Banff and Jasper is in Miscellaneous Landscapes (undifferentiated; includes rock, ice, water, etc.).

References: Vol. I, p 21-26; 42-44.
Vol. II, p 6-12; 72-74.

USING LANDFORM CHARACTERISTICS

Landforms control land use through the effect of different kinds of surface expression, genetic materials, and modifying processes such as avalanching or erosion. The following example of road location is of land use controlled by landform.





Suitabilities

—valley bottom position
—stable landform
—safe from avalanches
—70% is well drained
—hummocky topography is only slight hindrance to development
—gravel present
—variety of vegetation types
—high importance to elk, deer, and moose; very high for carnivores; medium for small mammals and birds

Limitations

—30% wet pattern
—coarse textures in gravelly areas
—poor filter for sewage disposal

References: Vol. I, p 100, 101, 103.
Vol. II, p 190-193.

Suitabilities

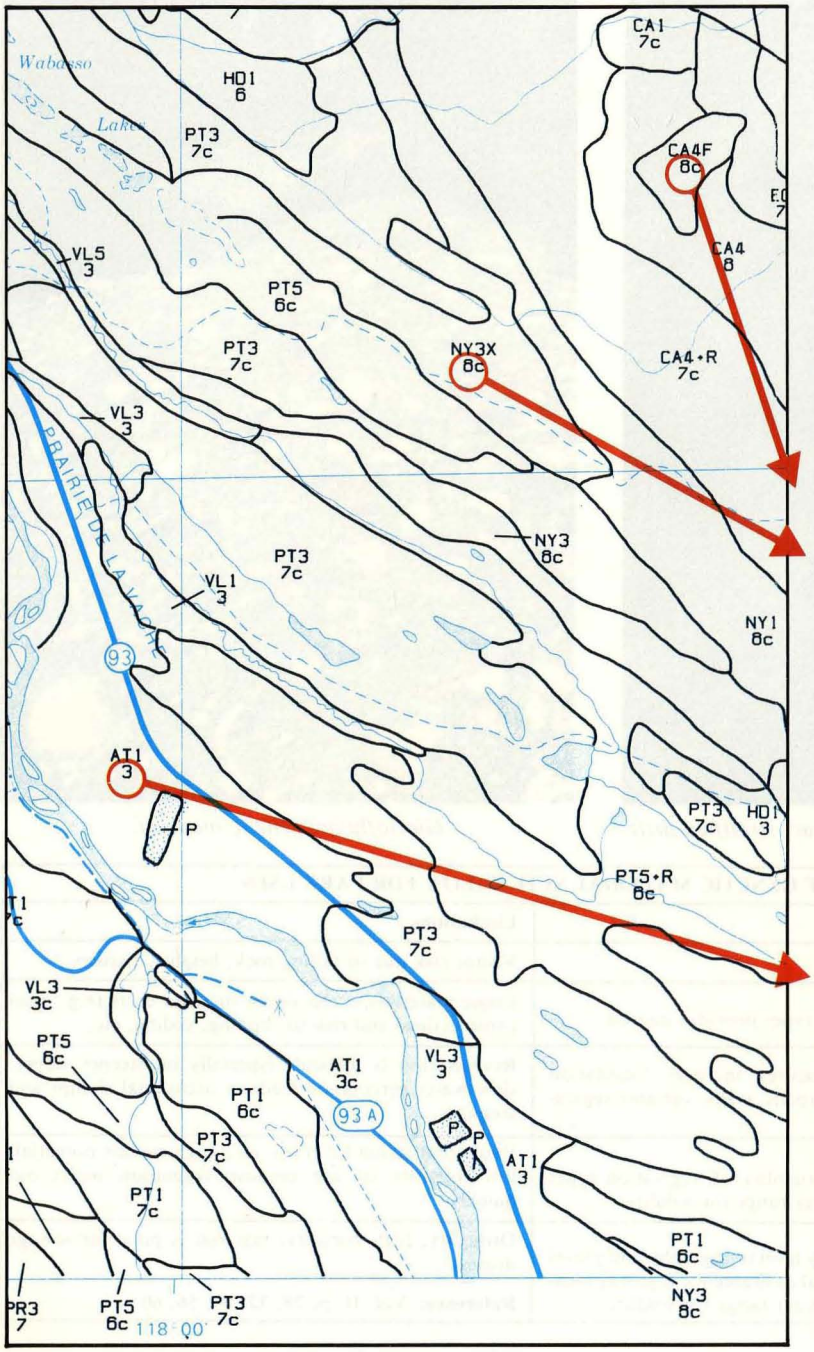
—rapid to moderately well drained
—dry southerly aspect
—medium soil texture
—very high importance to bighorn sheep, deer, elk, and mountain goat; medium for carnivores and small mammals
—aesthetically pleasing

Limitations

—loose colluvial material overlying inclined bedrock
—steep, linear slopes
—subject to soil creep and occasional slope failure

References: Vol. I, p 163, 164.
Vol. II, p 436-438.

Surface Expression, Topography, and Slope Characteristics



Surface expression

a *apron*	l *level*
b *blanket*	r *ridged*
f *fan*	t *terraced*
h *hummocky*	u *undulating*
i *inclined*	v *veneer*

Slope Classes

Symbol	% Slope
3	0-5
5	5-15
6	15-30
7	30-45
8	45-70
9	70

c after symbol denotes complex slope

Example

Ecosite symbol — modifier: PL4A
slope class: 5

Modifiers

A	Snow Avalanched
B	Burned
F	Failed
X	Lithic

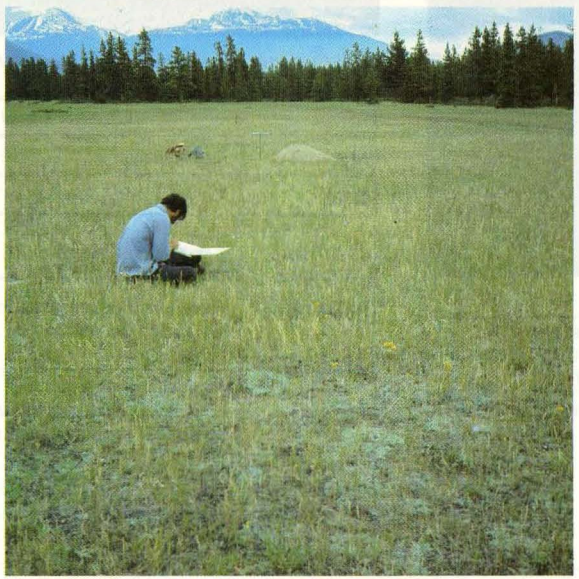
Suitabilities*

—snow skiing (usually)
—winter wildlife range where the snow blows off

Limitations

—impossible or with significantly increased cost
- playgrounds
- trails
- roads
- picnic areas
- septic tank disposal fields
- buildings

—runoff and erosion
—susceptible to slumping



Suitabilities

—most recreational activities
—most engineering
—safer for most activities
—winter range for elk and deer

Limitations

—human use competes with wildlife

* These suitabilities and limitations are mainly the result of topographic differences.

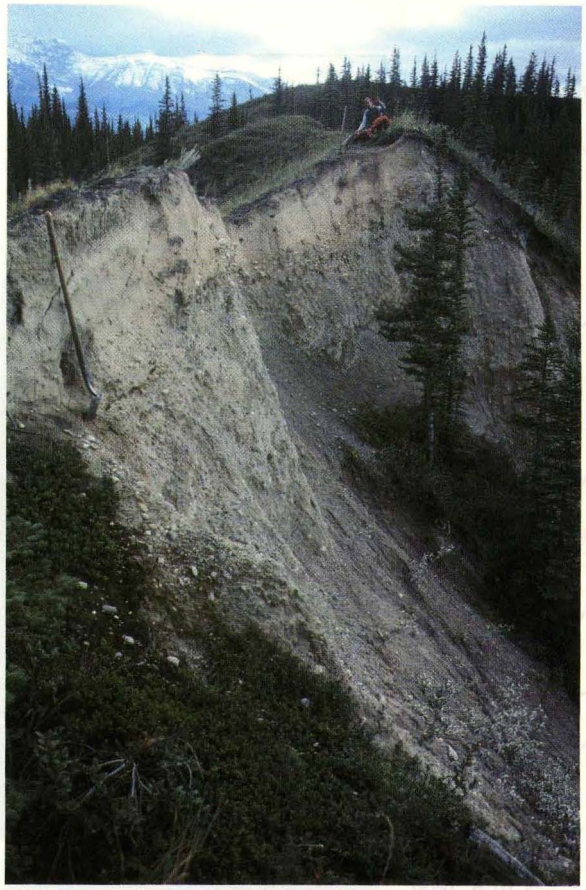
Landform — Genetic Materials (Some Examples)

Colluvial genetic materials in foreground; rock (limestone) on Mt. Richardson.

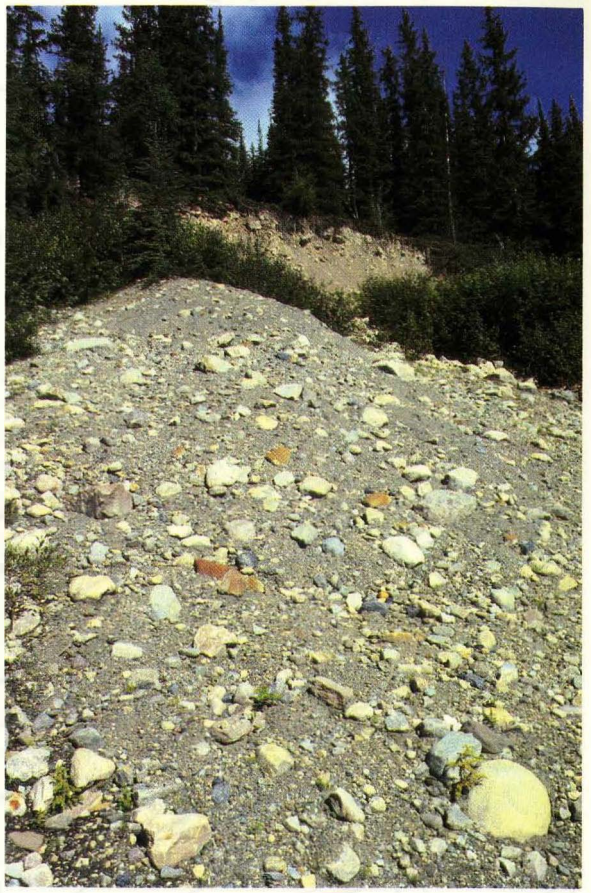
Morainal genetic material.

MINERAL GENETIC MATERIALS	
C^{A}	Landslide
C	Colluvial
E	Eolian
F	Fluvial
F^{G}	Glaciofluvial
F^{L}	Fluviolacustrine
L^{G}	Glaciolacustrine
M	Morainal
MF^{G}	Ice contact stratified drift
R	Rock
R^{U}	Residual

DOMINANT CHEMICAL CHARACTERISTICS OF GENETIC MATERIALS BY AREA	
Miscellaneous Landscapes (undivided)	38.6%
Calcareous	37.3%
Noncalcareous	15.5%
Variable (calcareous-noncalcareous mixtures or Undivided)	8.6%



Eolian genetic material over Ice contact stratified drift.



Glaciofluvial genetic material.

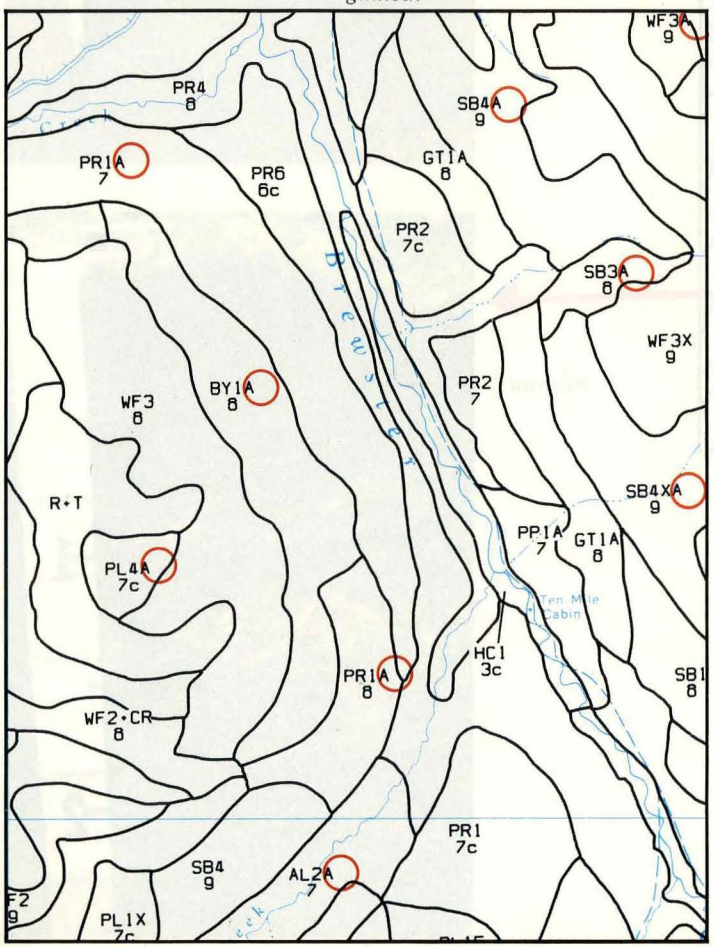
EXAMPLE OF GENETIC MATERIAL SUITABILITY FOR PARK USES		
Material	**Suitabilities**	**Limitations**
Rock	Viewing, climbing	Visitor risk due to falling rock, heights, fissures.
Colluvial	Variability of vegetation types provides interest.	Loose materials, steep slopes increase costs (e.g., trail construction) and risk to slipping, sliding, etc.
Morainal	Hard and compact features increase foundation suitability for buildings, roads, trails; variable vegetation types.	Revegetation is difficult especially on steeper slopes; slow water percolation leads to occasional slumps and seepages.
Eolian	Dry; good drainage; variability of vegetation types provide interest and winter range for wildlife.	Poor compaction for trails, etc.; high erosion potential; low intensity of use because vegetation wears out quickly.
Glaciofluvial	Dry, well drained, usually level topography and gravel supply makes this material desirable for highway location; it often provides winter range for wildlife.	Droughty; high porosity; material is poor for sewage disposal. **Reference:** Vol. II, p. 28, 37, 45, 56, 60.

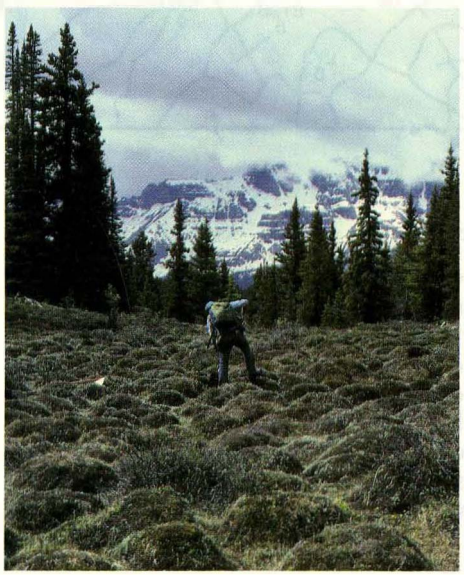
Landform—Modifying Processes

V — gullied.

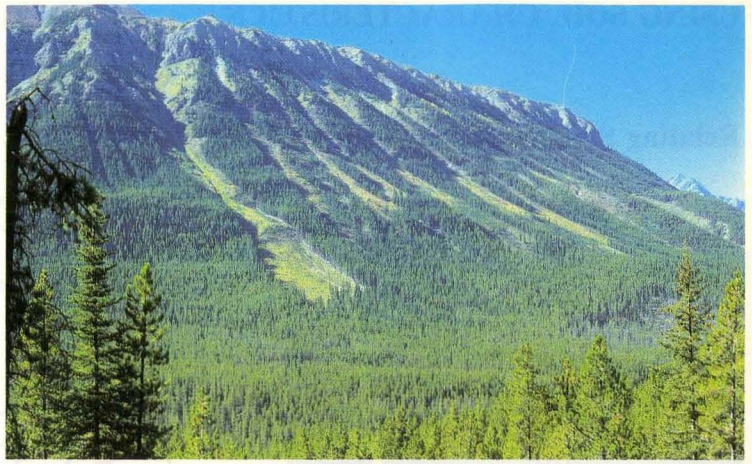
LANDFORM MODIFYING PROCESS	
A	Avalanched
C	Cryoturbated
E	Eroded
F	Failed
V	Gullied
S	Soliflucted

When one of the above symbols completes the map unit designation, it indicates that these geological processes have modified landforms or are currently modifying genetic materials and their surface expression. The most common one is avalanching, usually snow, which often crosses a number of adjacent mapping units, e.g., along Brewster Creek. Avoidance of areas dominated by these landform modifying processes can reduce cost of services (e.g., repair of trails, roads, etc.) as well as accident risk to people using the parks.



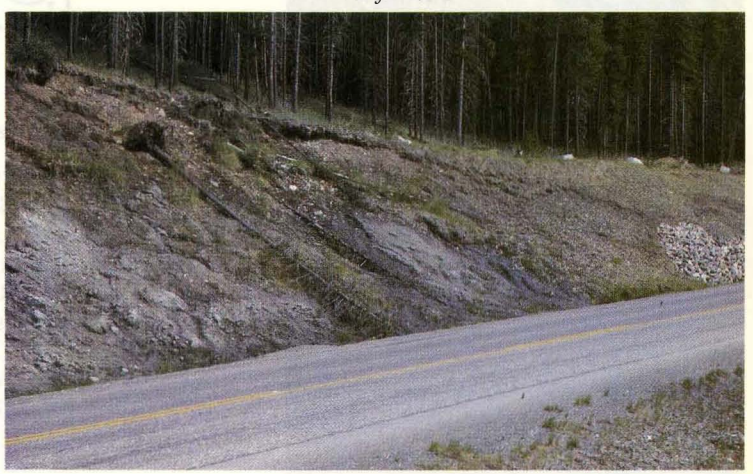


C — cryoturbated.



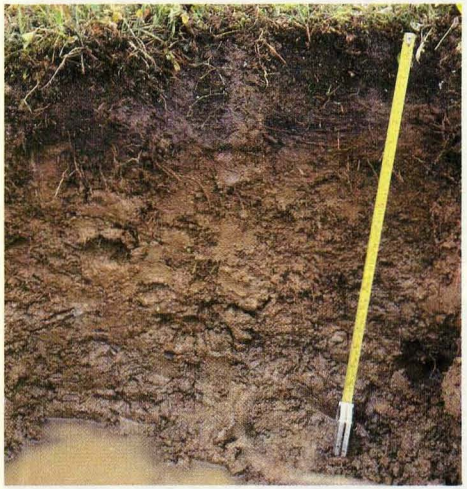
A — avalanched.

S — soliflucted.

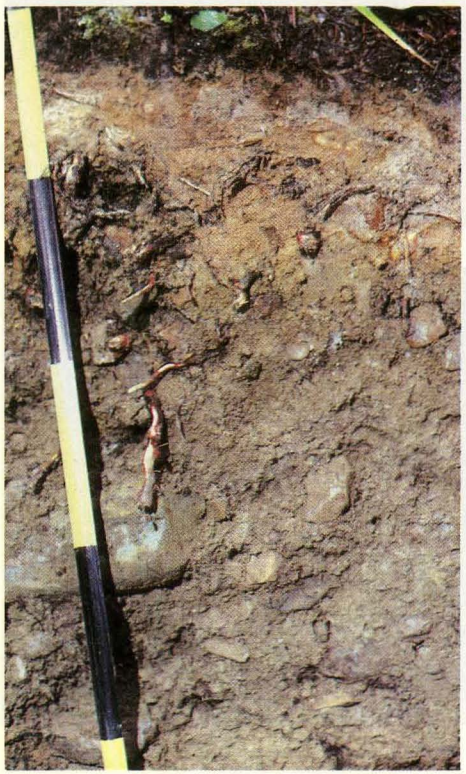


F — failed.

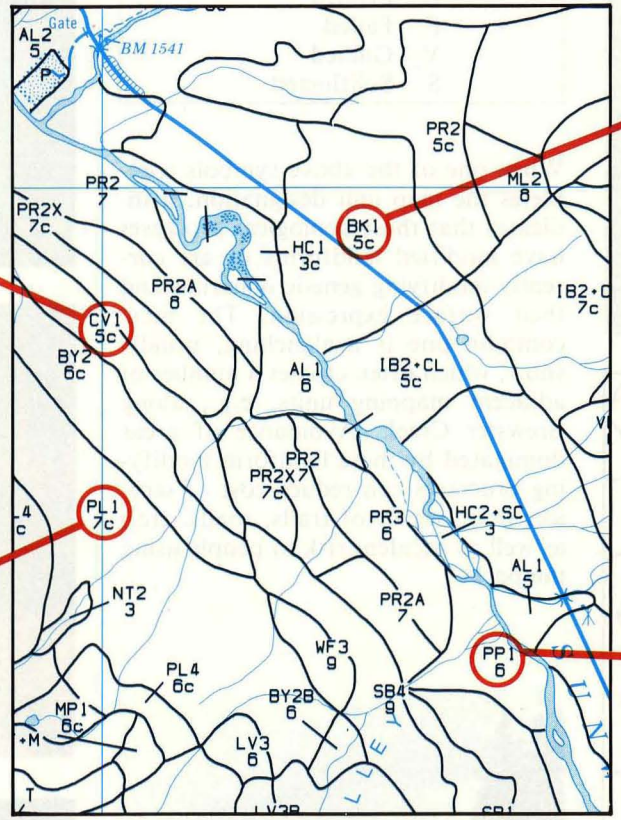
Relating Soil Taxonomy to Map Units



Gleysol



Brunisol



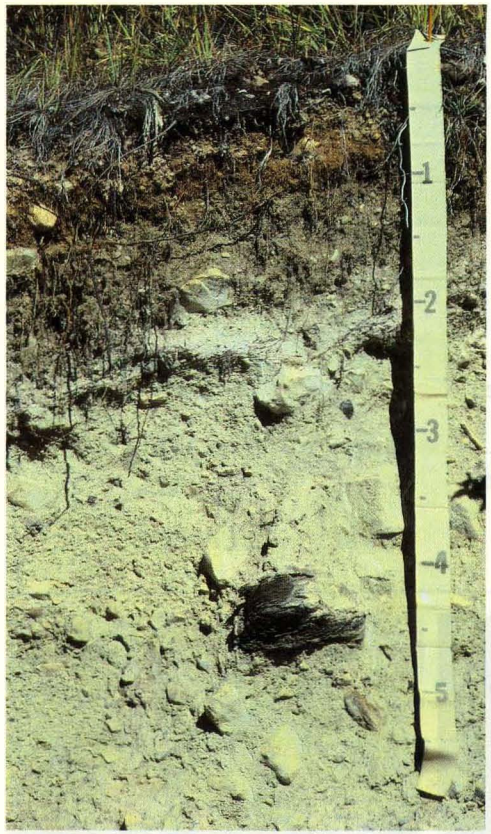
Luvisol

Regosol

References:

Weathered soils:
Brunisols — PL1; Vol. II, p 374, 375.
Luvisols — BK1, Vol. II, p 186, 187.
Recent soils:
Regosols — PP1; Vol. II, p 385, 386.
Cold soils: (occurs to southeast of above map)
Cryosols — SF1; Vol. II, p 439, 441.
Wet soils:
Gleysols — CV1; Vol. II, p 241, 242.

Soil Quality Comparisons



PR4 — Brunisolic

Suitabilities

—medium texture
—well drained
—stable if undisturbed
—moderately important for wildlife
—north slopes different than south

Limitations

—shallow rooting
—dry
—low acreage
—inclined slopes of 45-70%

Reference: Vol. II, p 405-407.

BK1 — Brunisolic

Suitabilities

—medium texture
—70% is well drained
—stable if undisturbed
—high importance to wildlife
—no soil limitations for use (except on wet areas)

Limitations

—stratified (3 materials at this site)
—wet areas poor for trails
—coarse gravelly areas not good for sewage disposal systems

Reference: Vol. II, p 186-188.

PR2 — Brunisolic Gray Luvisol

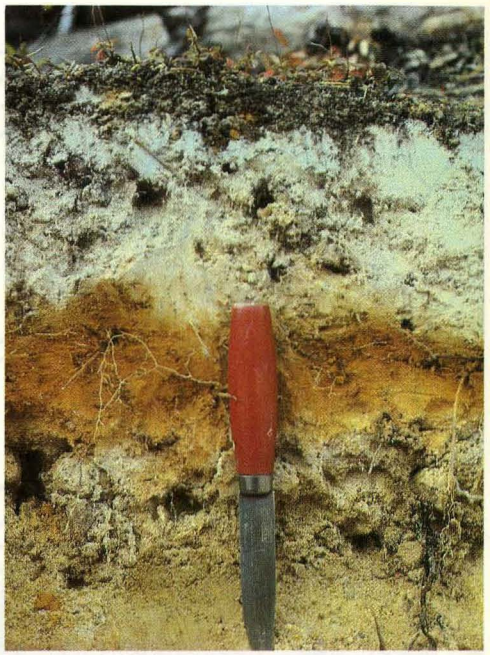
Suitabilities

—large extensive area
—well drained
—moderate importance for wildlife
—medium texture

Limitations

—strongly acid surface
—steep slopes limit trail use
—subsurface water seeps
—low importance for deer and elk

Reference: Vol. II, p 400-401.



VD2 — Eluviated Dystric Brunisol

Suitabilities

—well drained
—source of gravel
—moderately important for wildlife
—relatively stable

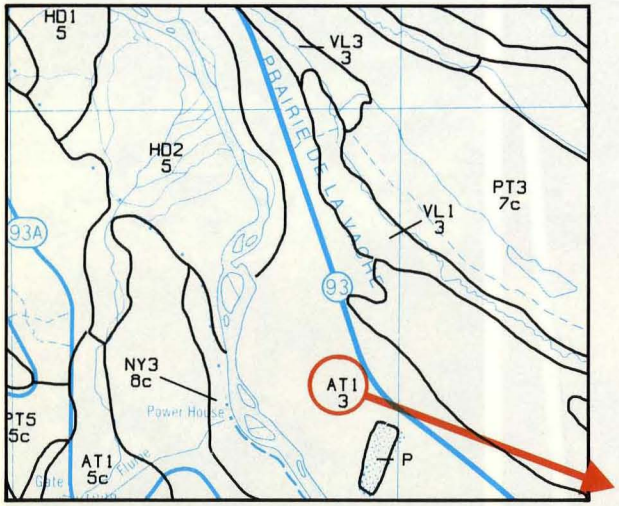
Limitations

—strongly acid throughout
—low water storage (coarse texture)
—coarse gravel not good for sewage disposal systems
—occational high water tables

Reference: Vol. II, p 473-476.

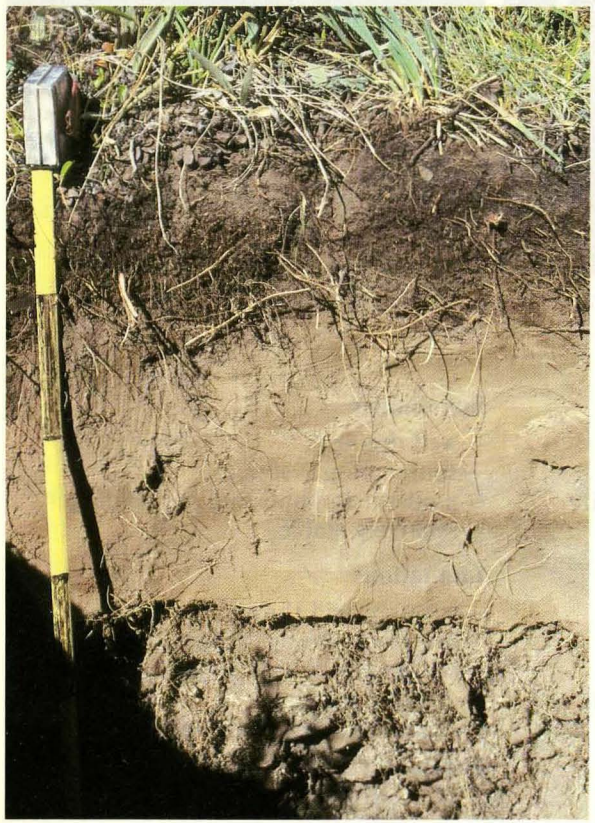
Soil Texture and Coarse Fragments

Soil texture = % of sand, silt, and clay.
Coarse fragments = % of material >2 mm in diameter.



PORTION OF MASTER LEGEND (from Map Supplement)

ECOSITE[1]	ECOREGION	LANDFORM[2]	CALCAREOUSNESS	TEXTURE	% COARSE FRAGMENTS	SOILS[3]
AL1	Subalpine (Lower)	Ff,a(-E)	Calcareous	Coarse-stratified	0-70	0.EB,E.EB
AL2	Subapline (Lower)	Fl,a(-E)	Calcareous	Coarse-stratified	0-70	0.EB,E.EB
AT1	Montane	F^{G}t(-E)	Calcareous	Coarse	35-70	0.EB,E.EB



Stratified soil profile.

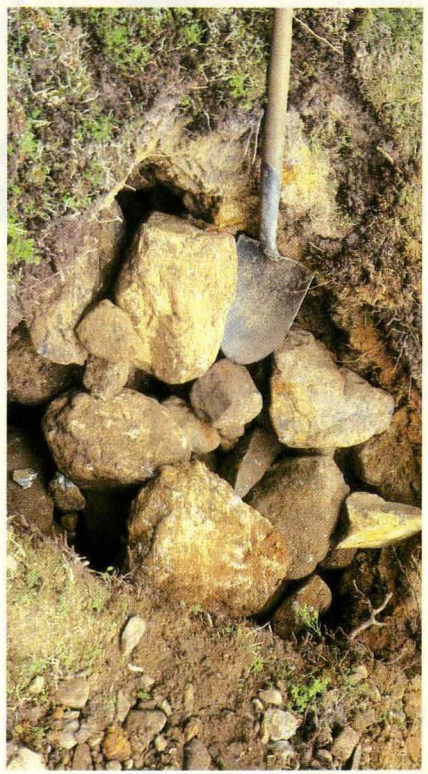
Soil texture and coarse fragment content affects

—soil water storage
—ease of drainage
—plant supporting ability
—ease of root penetration
—aeration
—retention of nutrients
—engineering (techniques and costs) of highways, trails, dams and foundations
—erodability
—compactability
—ease of reclamation.

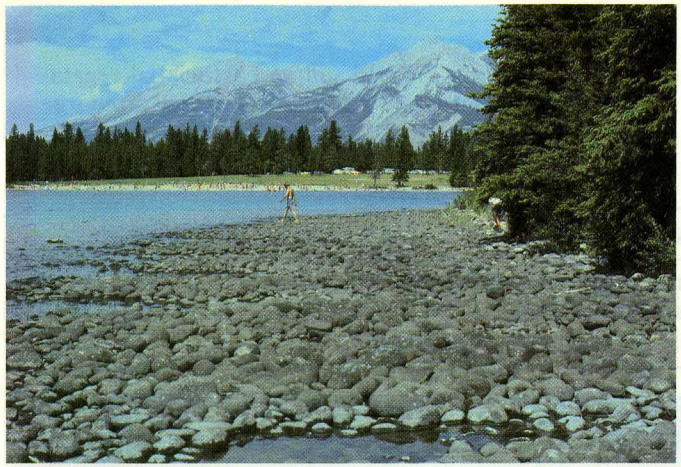
BANFF-JASPER SOIL TEXTURE BY AREA

Miscellaneous landscapes	38.6%
Coarse	6.8%
Medium	42.0%
Fine (includes fine over medium or variable)	0.3%
Stratified (coarse stratified + fine stratified)	5.7%
Variable (coarse-medium-fine and medium-coarse mixtures)	6.6%

ATI soil in place.



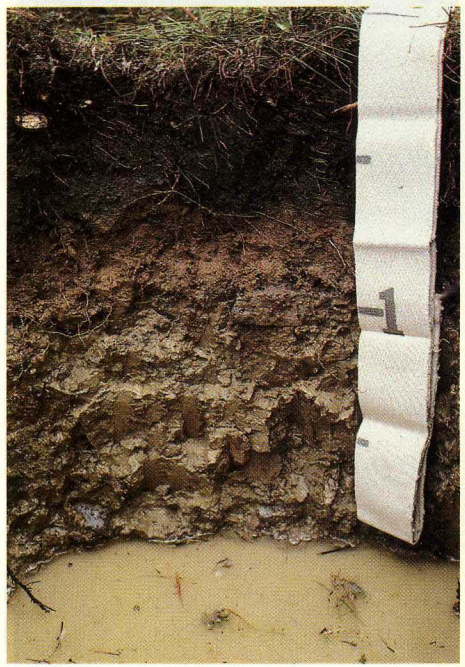
ATI coarse fragment content.



Low-intensity use occurs on a beach made of coarse fragments, but high-intensity use occurs on the sandy beach. A thrifty lodgepole pine forest grows on medium-textured soil in the left center photo, while an unthrifty lodgepole pine forest grows on a coarse-textured soil in the lower photo.

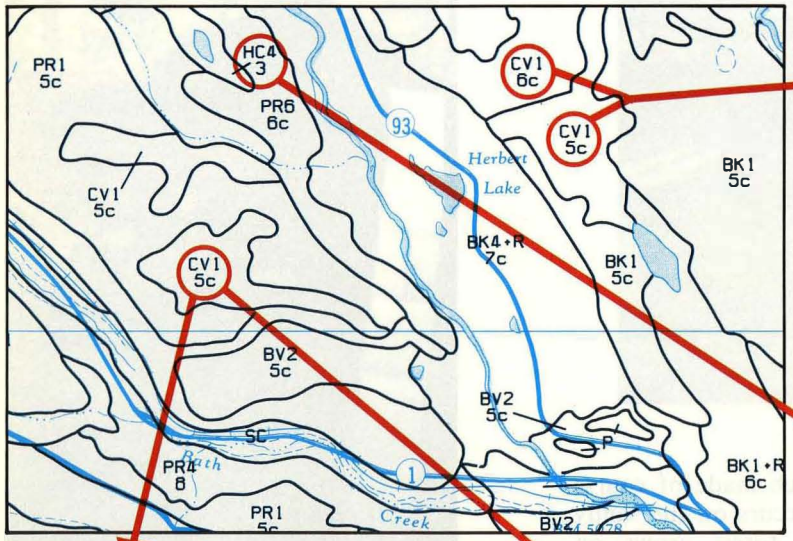
Coarse-textured soil.

Medium-textured soil.



Fine-textured soil.

Soil Drainage



CV1 is one mapping unit having poorly drained soil and associated vegetation on 80% of its area, resulting from high water tables, water discharge areas, and seeps.

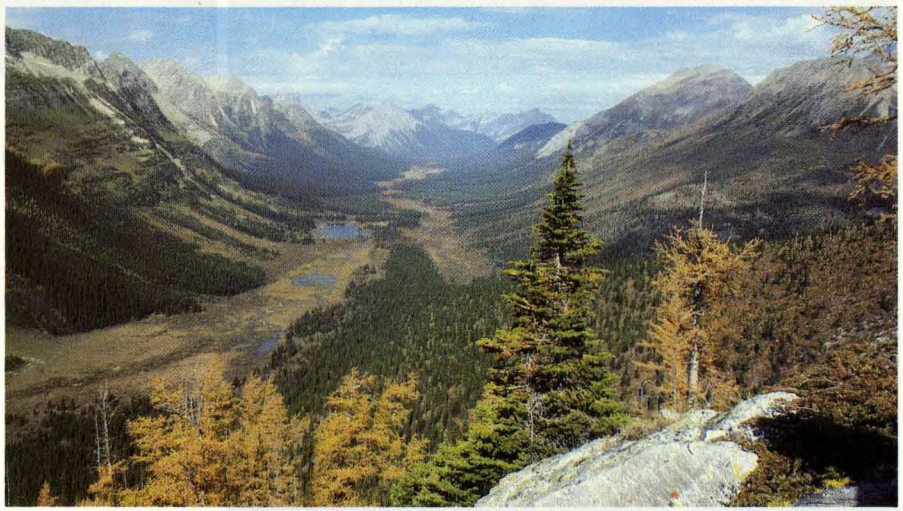
BANFF-JASPER SOIL DRAINAGE BY AREA	
Miscellaneous Landscapes (undivided)	38.6%
Wetland soils (drainage classes 5-7)	8.0%
Well-drained or upland soils (drainage classes 2-4)	53.4%

CV1 soil.

Poor drainage has the following effects:

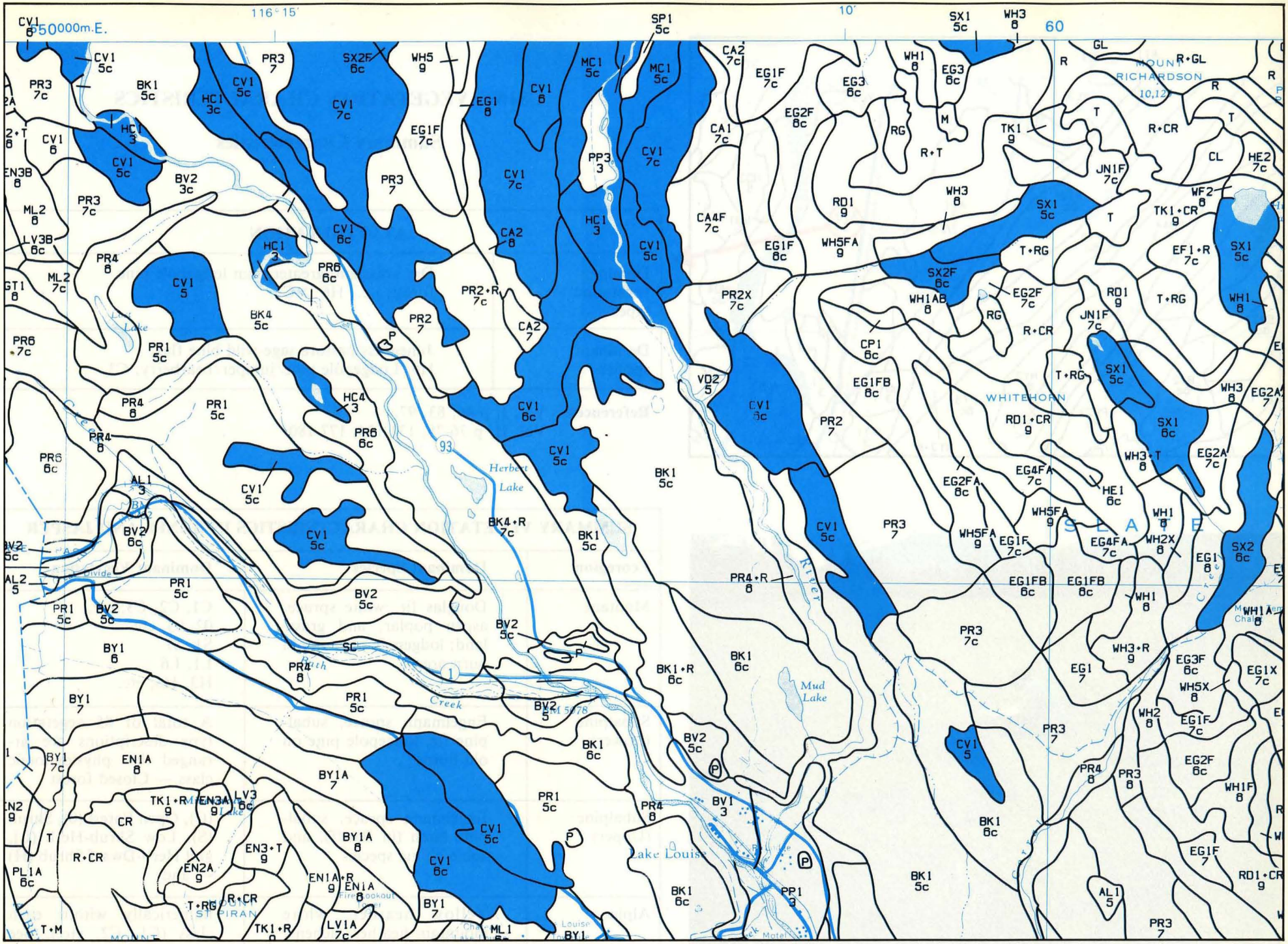
—reduced load bearing ability, i.e. trafficability
—accumulation of salts
—slumping
—poor soil aeration
—water-loving vegetation types
—engineering impact; i.e. on location, design, and costs of road and trail construction
—impact on wildlife use of the area

References: Vol. I, p 115, 130-131.
Vol. II, p 239-244, 289-298.

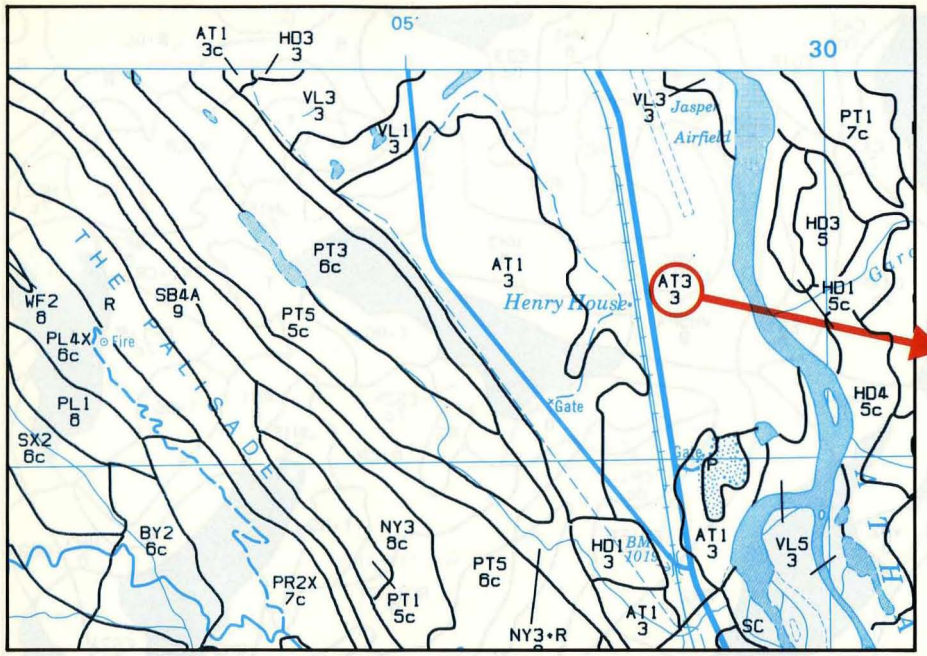


Wet area — HC4 in valley bottom.

CV1 vegetation.



The blue polygons (from Map Sheet 3-2) indicate landscapes dominated by poorly to very poorly drained soils. The impact of poor drainage on the vegetation, trafficability, engineering, and wildlife use, etc., is of prime importance to park planning. The planner can use the maps directly or can generate interpretations of resource features to guide land use decision making.



Koeleria cristata — Artemisia frigida — Linum lewissii (H6) v.t. at 1070 m in central Jasper.

USING VEGETATION CHARACTERISTICS

Summary Characteristics

AT3 VEGETATION	
Dominant vegetation types	Dry grassland greater than lodgepole pine forest; i.e., H6 >C3.
Dominant species	Junegrass-pasture sage-wild blue flax; H6. Lodgepole pine/juniper/bearberry; C3.

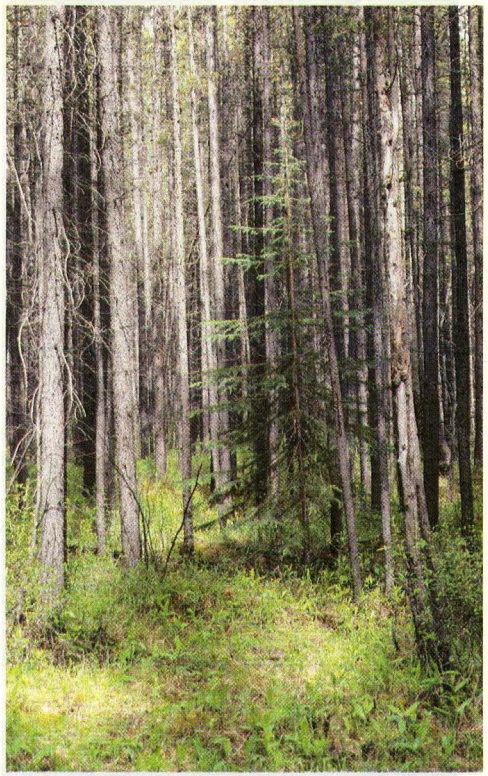
References: Vol. I, p 46, 83, 97.
Vol. II, p 76-78, 133-134, 177-180.

SUMMARY VEGETATION CHARACTERISTICS IN BANFF AND JASPER

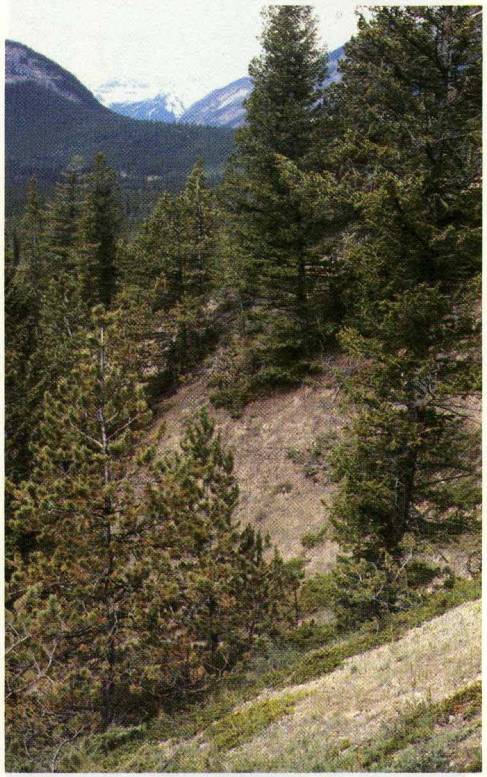
Ecoregion	Dominant Species	Dominant Vegetation
Montane	Douglas fir, white spruce, aspen poplar, and grassland; lodgepole pine on old burn areas	C1, C2, C3, etc. 02, 03, etc. S1, S7 L1, L6 H3, H6, etc.
Subalpine (Lower)	Engelmann spruce, subalpine fir, lodgepole pine on old burns	A total of 85 vegetation type descriptions are arranged by physiognomic class — Closed forest
Subalpine (Upper)	Engelmann spruce, subalpine larch (in Banff), and some alpine species	(C), Open Forest (0), Shrub (S), Low Shrub-Herb (L), and Herb-Dwarf Shrub (H) — and
Alpine	Yellow heather, white mountain heather, lichens, absence of trees	numerically within each class (C1, C2, etc.). See Vol. II.

Reference: Vol. II, pp. 71-156.

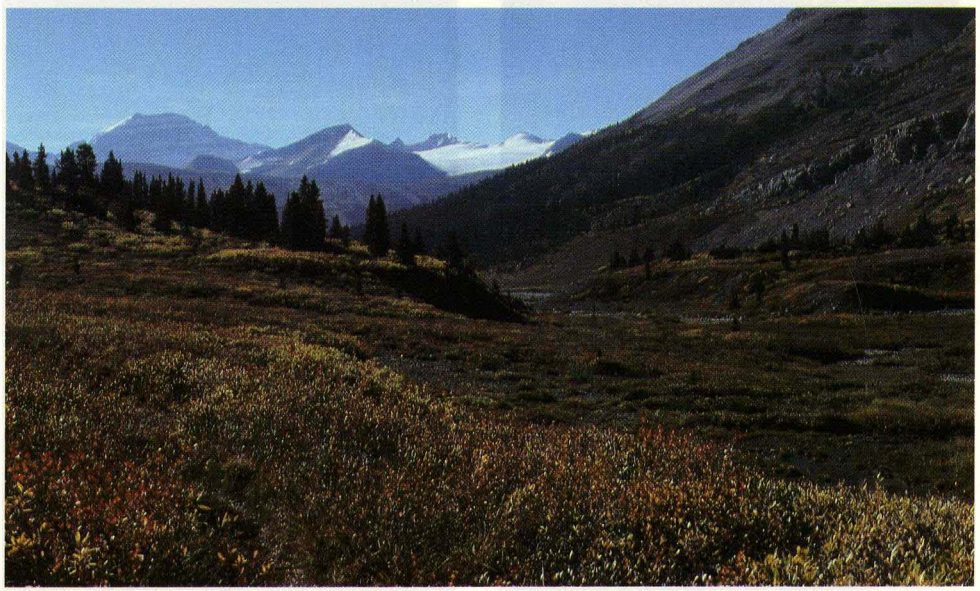
Vegetation Classification



C — closed forest.



O — open forest.



S — shrub vegetation.

Types of data in vegetation plot measurements include species, layers, cover values, dbh, age, etc.

PHYSICAL ENVIRONMENTAL FACTORS
elevation
slope
aspect
topographic position
relief shape
landform
soil subgroup
drainage class

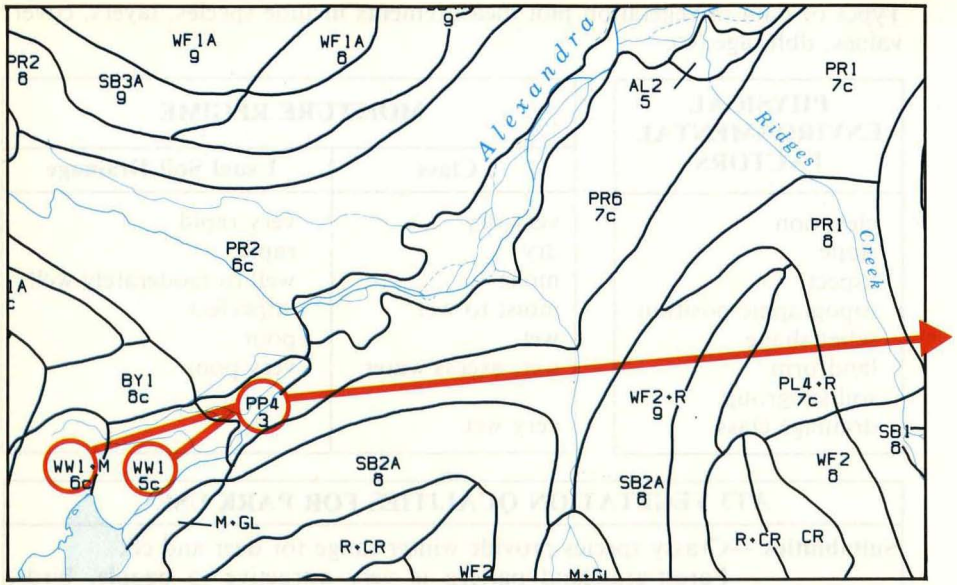
MOISTURE REGIME	
Class	**Usual Soil Drainage**
very dry	very rapid
dry	rapid
moist	well to moderately well
moist to wet	imperfect
wet	poor
wet, excess water	very poor
very wet	

AT3 VEGETATION QUALITIES FOR PARK USE

Suitabilities:—Grassy species provide winter range for deer and elk
—Forest-grassland pattern is very attractive to people, birds, small mammals, and some carnivores.

Limitations:—Grassland area is too small for the use demand.
—Gradual forest encroachment requires controlled burning if grassland area is to be maintained.
—Easy access by tourists leads to conflict of use with wildlife.
—Grassland areas are sensitive to disturbance, e.g., airport, roads, trails.
—Dryness leads to slow vegetative regeneration and slow growth rates; therefore, reclamation after disturbance is costly.

H — herb-dwarf shrub vegetation.

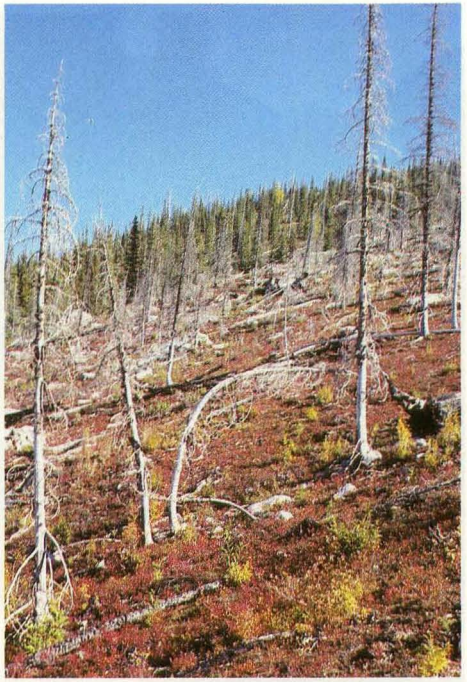


SUMMARY OF SUCCESSIONAL STAGES

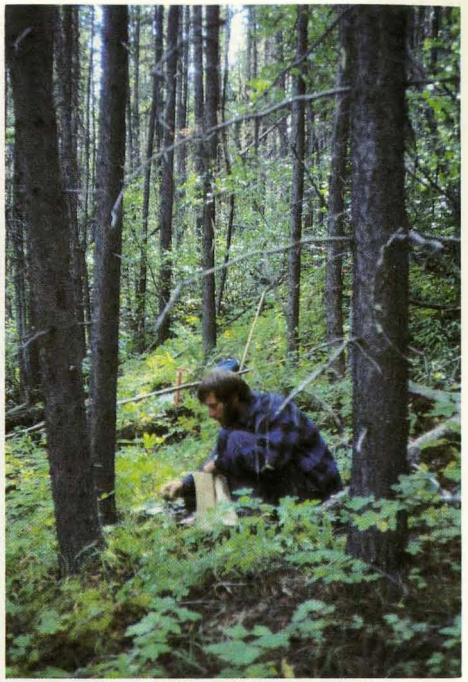
Successional Sequence	Composition	Dominant Forest Vegetation Types	Years Since Vegetation Establishment
Early	Heterogeneous and unstable	—	50
Intermediate	More uniform, moderately stable	Lodgepole pine (Engelmann spruce and subalpine fir in understory)	50-100
Advanced	Misture of successional and climax species	Lodgepole pine, Engelmann spruce, subalpine fir	80-200
Mature	Stable and self-perpetuating	Engelmann spruce, subalpine fir (Douglas fir, white spruce, lodgepole pine in Montane)	200 +

Succession measures vegetational change through time. Most of Banff-Jasper is secondary succession following disturbance by fire. Primary succession is rare. Other forms of disturbance (erosion, freezing and thawing, seepages) affect vegetation changes in the Alpine and wetland areas. Determination of vegetational history is particularly difficult in these areas. Rates of change are very slow, and vegetation types appear to be relatively stable and mature.

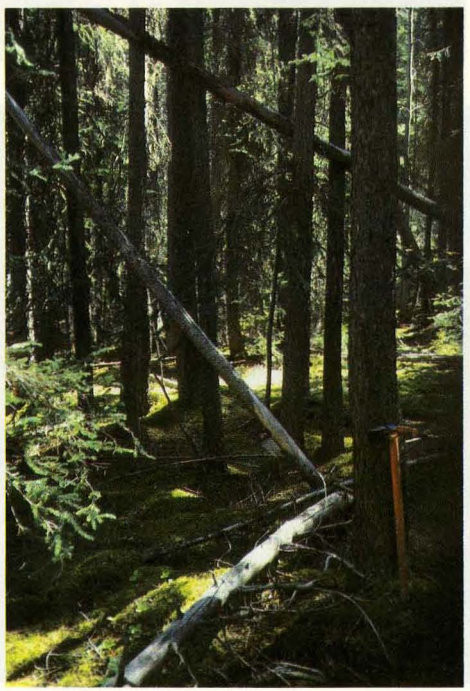
Succession and Climax



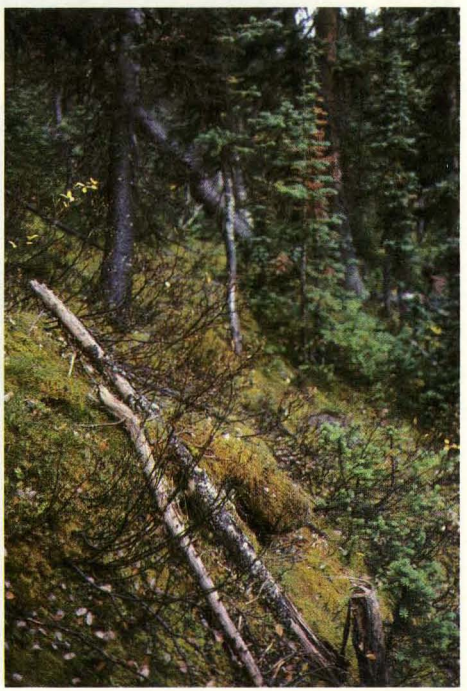
Early successional stage.



Intermediate stage.



Advanced successional stage.



Mature successional stage.

Species for Special Uses and Use Assessment

Species selection for reclamation.

Identifying stands for rejuvenation.

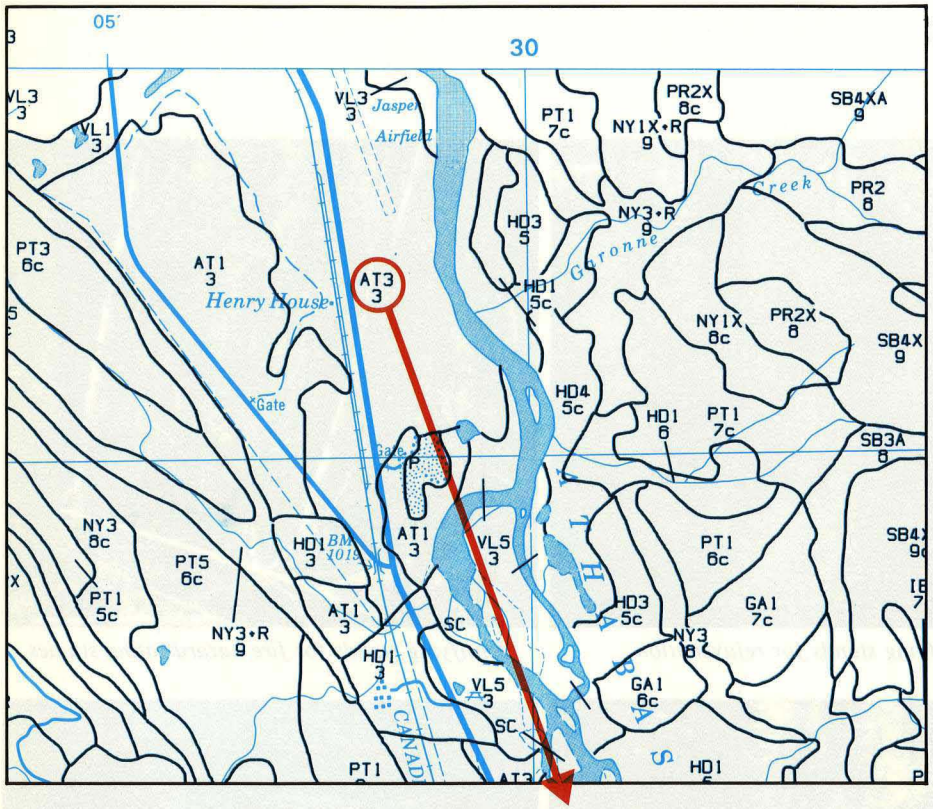
Identifying stands for fire hazard rating studies.

Species selection for conservation.

Identifying vegetation suitability for campground use.

Identifying vegetation types best suited for trail location.

WILDLIFE RESOURCE: Linkage to Map Units



SPECIES RATING FOR AT3 MAPPING UNIT				
Mapping unit	**Ungulates**	**Carnivores**	**Small mammals**	**Birds**
AT1	Very high	Very high	Medium	Medium
AT3	Very high	High	High	High

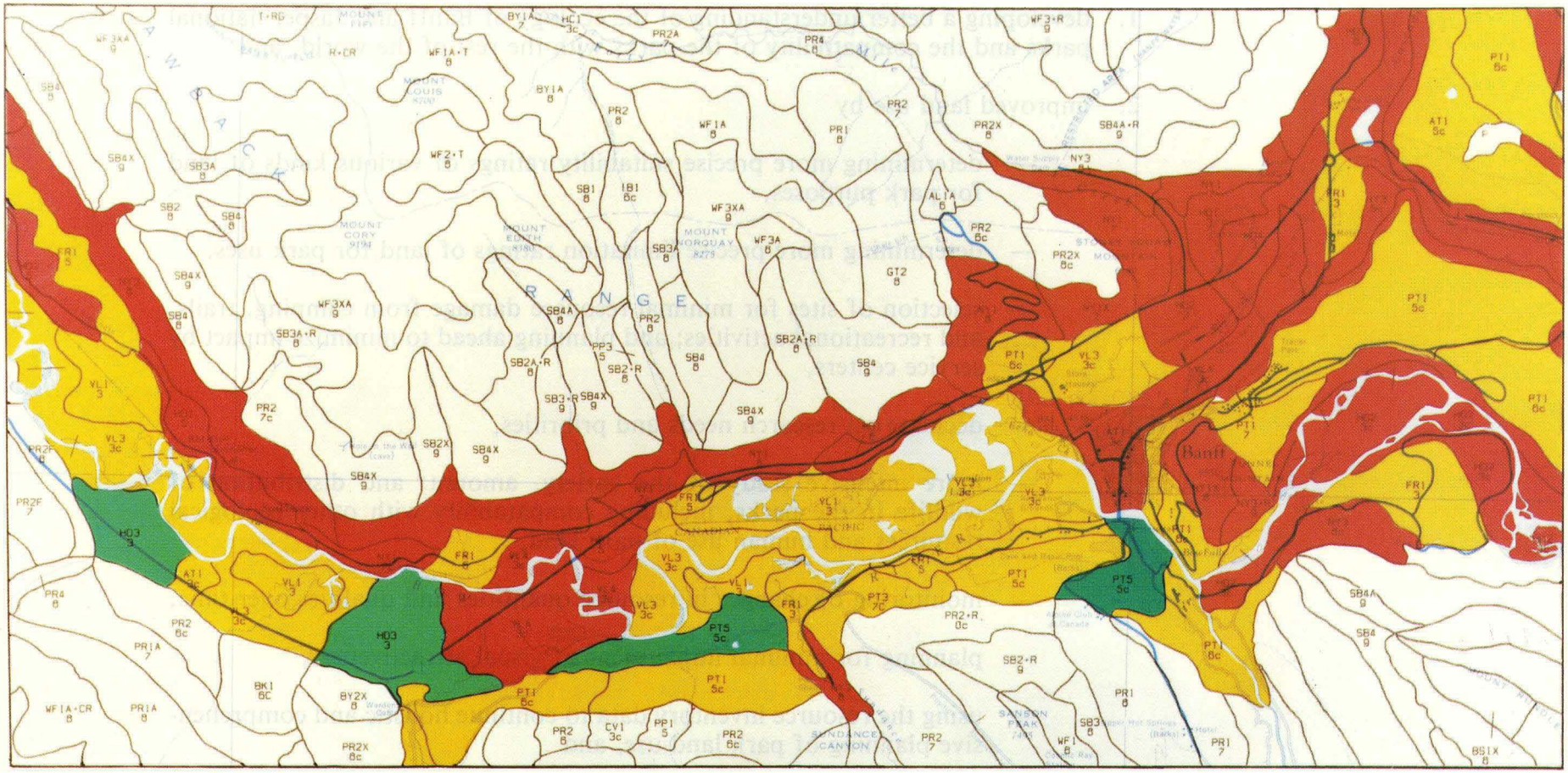
IMPORTANCE RANKING (SPECIES RATING SUMMATION)				
Mapping unit	**Ungulates**	**Carnivores**	**Small mammals**	**Birds**
AT3	Very high importance in winter	Highly important	Important	Highly important
PT3	Highly important in winter	Highly important	Highly important	Highly important
PT5	Moderately important	Highly important	Moderately important	Highly important
PR2X	Moderately important	Highly important	Moderately important	Low importance

References: Vol. I, p 98, 160, 161.
Vol. III, p 537, 579, 582, 583.

Winter Range Distribution Map for Elk

Use of ecosites by elk during fall and winter in the Montane Ecoregion near Banff townsite.

Interpreted by Holroyd and Van Tighem, CWS.



LOOKING AHEAD

The Future Is:

1. developing a better understanding of the ecology of Banff and Jasper national parks and the compatibility of the parks with the rest of the world, and

2. improved land use by

   — determining more precise suitability ratings of various kinds of land for park purposes,

   — determining more precise limitation ratings of land for park uses,

   — selection of sites for minimal resource damage from camping, trails, and recreational activities; and planning ahead to minimize impact by service centers,

   — deciding on research needs and priorities,

   — more intensive study of the variety, amount, and distribution of wildlife in the parks, including compatability with other ecological resources and human use of park land,

   — monitoring of changes in resource quantities and qualities over time,

   — planning for minimal impairment of visual attractiveness,

   — using the resource inventory data to continue holistic and comprehensive planning of park land use, and

   — application of land management techniques that are based on and assisted by the resource inventory data.

LOOKING AHEAD

More Precise Suitability Ratings

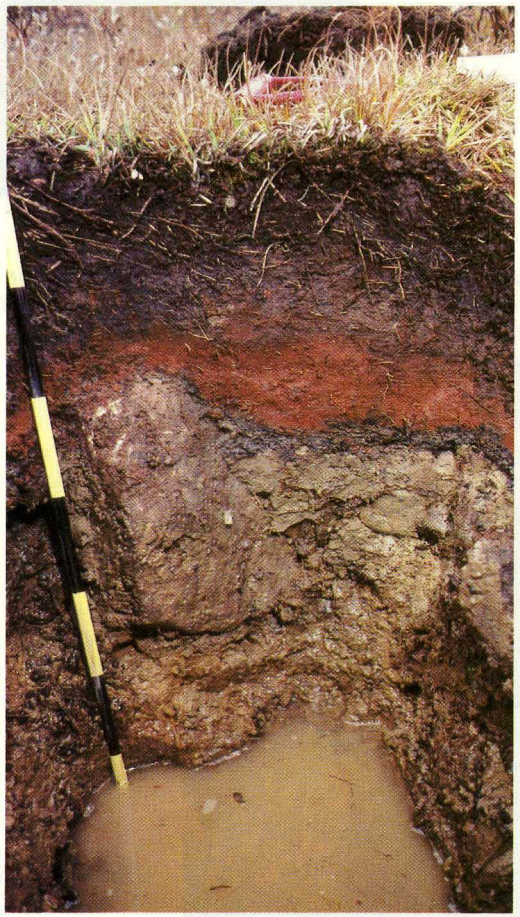
In making an interpretive classification, several principles should be observed:

1. Define clearly the purpose of each classification.
2. Classifications are generally based on the kinds and degree of limitation to a specific use. The ranges of the resource qualities that define the various classes should be defined as precisely as possible. Resource groupings are usually according to one resource quality.
3. Classifications generally contain few classes. An odd number of classes permits two extremes as well as a mean average class, three to five being most common. More classes may be needed for intensive management, but a large number of classes becomes unwieldy and does little to help simplify the information.
4. The intensity of management for a particular classification must be stated, because many limitations can be reduced by management. Thus, a factor such as high tree density, which may be severely limiting in a backcountry campsite with a low intensity of management, may present less severe limitations in a highly developed area where more intensive management permits clearing of access roads, paths, and tent pads.
5. Interpretive classes are relative — good, fair, poor. Such groupings are dynamic and can be changed as situations change, for example, an altered management practice.

Examples of these principles applied to interpretive classifications based on soil limitations are in Soils of Waterton Lakes National Park (Coen and Holland 1976).

Soil qualities such as permeability, susceptibility to erosion, productivity, etc. vary with differing soil characteristics, e.g., soil texture, soil depth, water holding capacity, chemistry, etc. Evaluation of soil resources for park purposes requires more-precise rating of soil suitabilities and soil limitations according to chemical, physical, and biological soil properties.

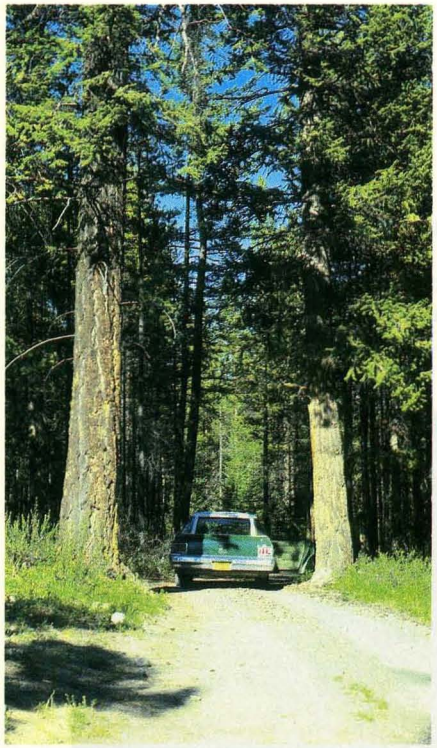
Diminutive soil resource because of low soil volume.



Drainage limitations for some uses.

High permeability and rooting volume increase the suitability of this soil for some uses, e.g., sustained production of vegetation.

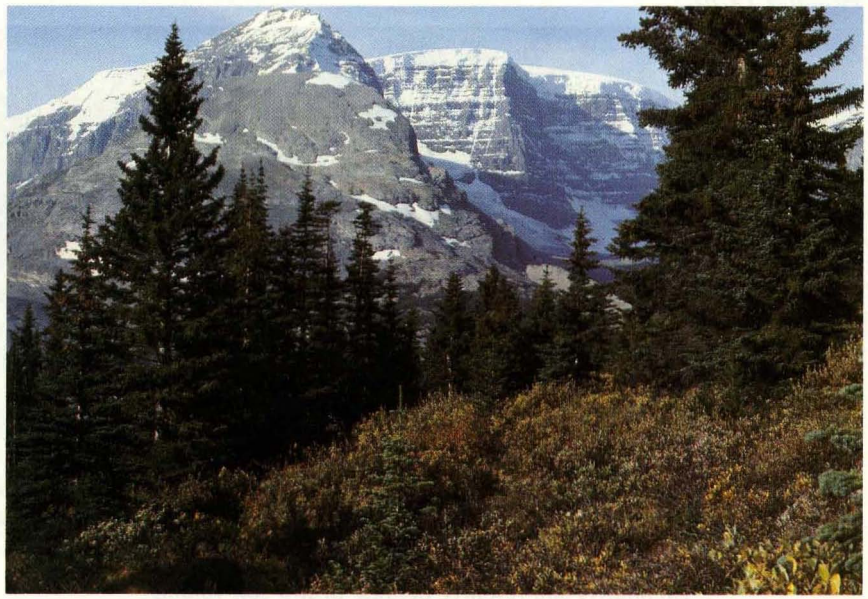
LOOKING AHEAD: Examples of Land Suitabilities and Limitations for Park Uses



Old, stable Douglas fir forest environment at left occurs in the warm, dry Montane Ecoregion and has high suitability for recreational purposes.

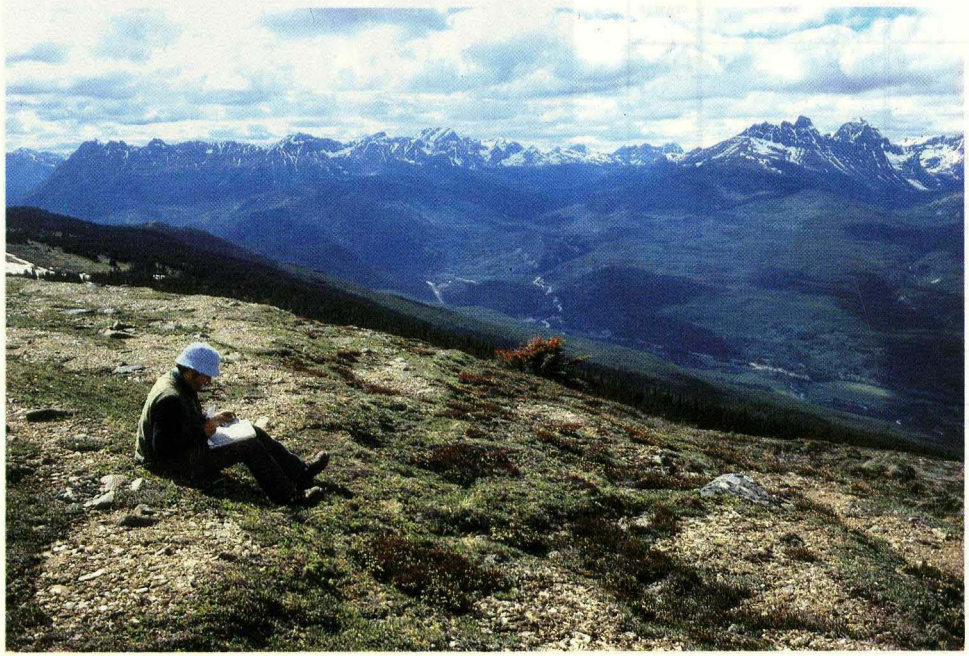
Forest-grassland interface in warm, dry Montane Ecoregion. Some slope limitations are present for recreational use of land, e.g., trails, playgrounds, and campgrounds. Highly suitable for wildlife because of protective forest habitat in close association with winter grazing range.

Some land has high suitability for very specific and unique reasons, e.g., seasonal abundance of food for grizzly bears, in this case Hedysarum roots in spring.

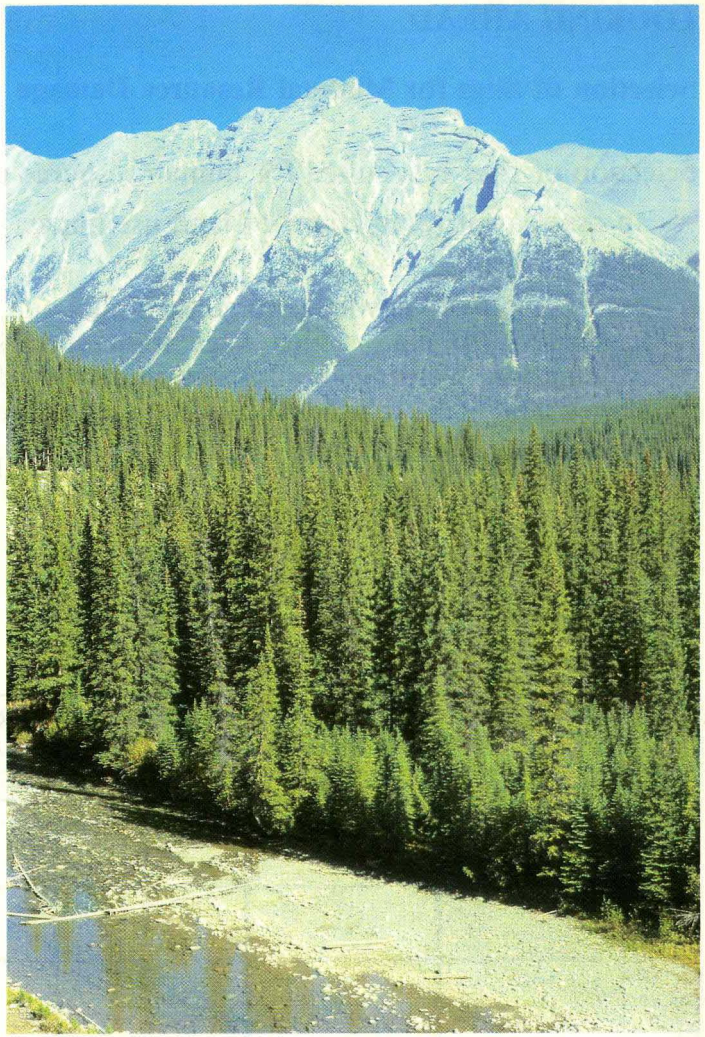


Open forest and shrubby vegetation in the Upper Subalpine Ecoregion is often limited by steep slopes and slow vegetation growth rates but has use for viewing and wildlife browsing in summer.

The wet and poorly drained foreground has limitations for campground and trail activities but is suitable for water loving plants and animals. The valley wall has severe limitations for recreational use because snow avalanching affects vegetation and soil and provides general instability of the area.



The alpine environment at left often has severe limitations resulting from a harsh climate and lack of vegetation and soil resources.



A stable area highly suitable for recreational activities such as campgrounds, trails, and picnic areas but may have some limitations because of lack of variation.

LOOKING AHEAD

Selection of Sites for Minimal Resource Damage

Selection of sites best suited for human resource use requires

— an assessment (prediction) of land use impact resulting from resource use.

— use of resource knowledge to guide design and location of human use activities, e.g., which vegetation species are suitable for reclamation planting; trail location to avoid wet areas, steep slopes, and areas that conflict with wildlife use of land; etc., and

— development of limitation ratings for selected park uses.

An example of too much trampling in too small an area.

EXAMPLE INTERPRETATIONS OF SOIL CHARACTERISTICS FOR SELECTED PARK USES IN WATERTON LAKES NATIONAL PARK (COEN AND HOLLAND 1976)

Map Units	DEGREE AND NATURE OF LIMITATIONS FOR RECREATION USES									DEGREE AND NATURE OF LIMITATIONS FOR ENGINEERING USES									Susceptibility to water erosion
	Playgrounds			Camp Areas			Paths & Trails			Septic Tank Fields				Bldgs. with Basements			Local Roads			
	Slight	Moderate	Severe	Slight	Moderate	Severe	Slight	Moderate	Severe	Slight	Moderate	Severe	Pollution hazard	Slight	Moderate	Severe	Slight	Moderate	Severe	
1 AC, 1 AD		Stony	Slope CF Moist		CF Stony	Moist		CF Stony		nil			Po		Stony		Stony			Low
1 DE, 1 EF, 1 F		Stony	Slope CF Moist		Slope Stony CF	Moist	CF	Slope Stony			Slope		Po		Stony Slope			Slope		Low
1 PG, 1 G, 1 GH		Stony	Slope CF Moist		Stony CF	Slope Moist		Stony CF	Slope		Stony	Slope	Po		Stony	Slope			Slope	Moderate
15 AB		Flood Wet			Flood			Flood				W.T. Flood			Wet Str	W.T. Flood		Flood Str	Frost	Low
17 AC, 17 AD			Moist CF		CF	Moist	nil			nil			Po		nil		nil			Low
21 AC			CF Moist		CF	Moist		CF		nil			Po		Stony		Stony			Moderate
21 F			CF Moist		CF	Moist Slope		Slope CF				Slope	Po			Slope			Slope	High
31 AB			Wet Flood			Wet Flood			Wet Flood		Perm	W.T. Flood			Sh-Sw Str Frost	Wet, W.T. Flood		Sh-Sw Frost	Wet Flood Str	Low

Abbreviations as follows: CF = Coarse fragments; Stony = Surface stoniness; Moist = Useful moisture; Slope = % slope; Po = Pollution hazard; Flood = Flooding; Wet = Wetness (soil drainage); W.T. = Depth to seasonal water table; Str = Strength of soil is rated by Unified or AASHO; Frost = Susceptibility to frost heave; Perm = Permeability; Sh-Sw = Shrink-swell potential.

How good is this area for Bighorn sheep? Many suitability ratings for vegetation and wildlife use of land have yet to be done.

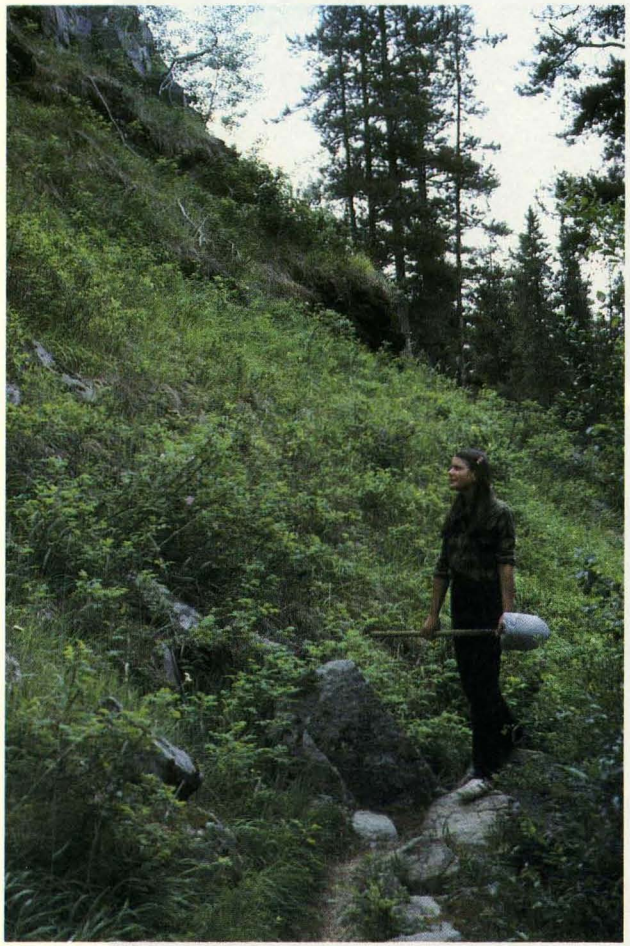
LOOKING AHEAD

Vegetational Research Requirements

Some vegetational research requirements are
—preparation of suitability and limitations of vegetation for camping, trails, roads, service centers, etc.,
—determination of vegetation fragility for various land uses,
—determination of carrying capacities for humans and/or wildlife,
—more precise determination of successional pathways and rates of vegetational change,
—determination of how and to what extent conservation of vegetation can be achieved, and
—determination of measures needed to protect unique and rare plant species.

More Intensive Study of Resource Use

More intensive study of resource use is required in order to achieve minimal impact on resources, e.g., determination of vegetational growth rates, physical impact of park land use on the resources of each map unit, and determination of cost-benefits of park land uses.



Steep slopes require a long time to become stabilized and vegetated and are best left undisturbed. Trail location on steep slopes means more erosion, slumping, etc. This area has low suitability (high degree of limitation) for trail development.

This well-located trail combines the engineering requirements of design with the aesthetics of a grand view. It has a gentle slope and occurs on materials that revegetate relatively easily. The area has a high suitability (or conversely, a minimum of limitations) for trail development.

Planning Ahead to Avoid Land Use Conflict

Undoubtedly, future land use pressure will continue to become more complex and intensive. We will continue to want both railroads and ducklings. Looking ahead to the future means development of location and design principles that will eventually avoid or reduce land use conflicts. In this example, either the railroad needs to be located in some other place (preferably during the planning stage) or the roadbed design requires more bridges and culverts to provide crossings for animals. In addition to the physical and biological concerns, the economics of action require balancing social needs and concerns with social costs and benefits.

LOOKING AHEAD: Wildlife Research Is Also Needed

1. Research is needed to avoid land use conflicts, especially between humans and wildlife.

2. Food requirements of wildlife must be determined, including how much, what kind, and in what distribution pattern.

Qualitative and quantitative food requirements, and food location, must be identified for many wildlife species. Information on Map Unit wildlife carrying capacity aids in resource management.

3. Information is needed to determine the value of rest habitat, escape terrain, and breeding habitat, and is as important as food requirements. The data can be used to determine how each Map Unit may best be managed for wildlife.

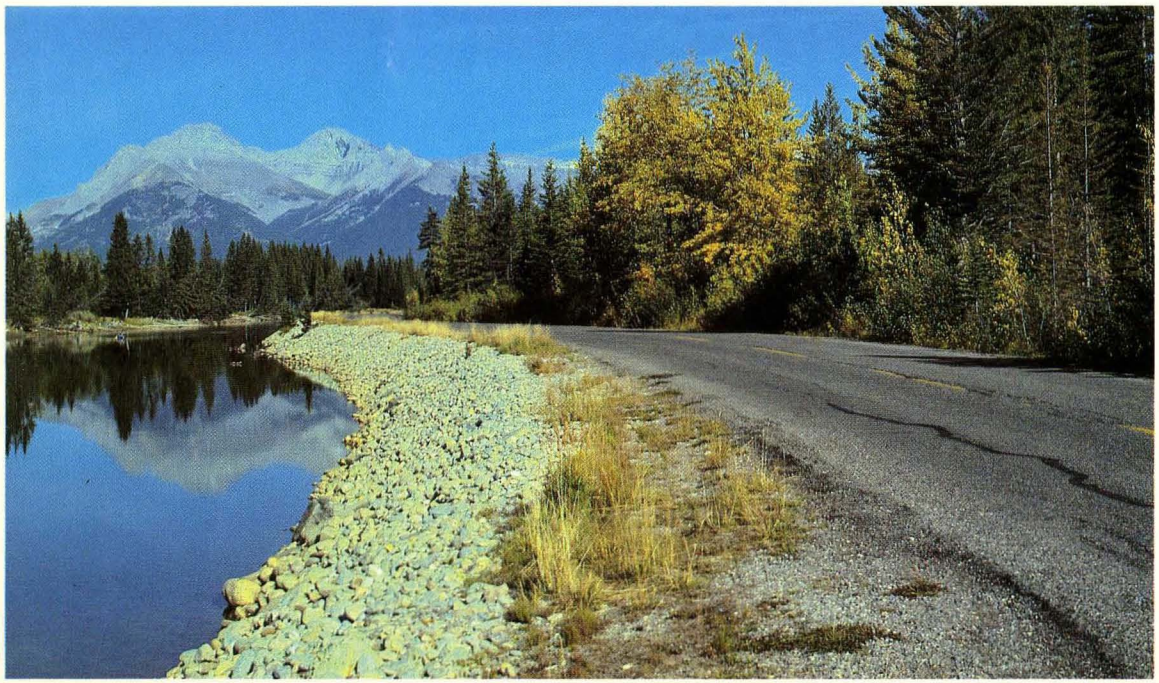
LOOKING AHEAD

Using Resource Data for Comprehensive Planning.

Resource inventory data can be used to assist in successful management of ecological resources. The provisional master plans did not have the benefit of a completed resource inventory. The resource inventory is now complete but still requires resource analysis description (resource interpretations) in order to determine resource suitabilities and limitations for each of the parks' land uses. Looking ahead to the future, then, means achieving better understanding of our ecological resources, evaluation of their suitabilities and limitations, and use of the data in holistic and comprehensive planning of parkland use. The application of land management techniques, based on resource inventory data and analysis, will assist in maintaining the parks and developing them into better parks for the future.

LOOKING AHEAD

Beauty of the Parks



The majestic beauty of the park serves to remind us that the great accomplishments of civilization are spiritual rather than physical. Thus, there is life and reason for being.