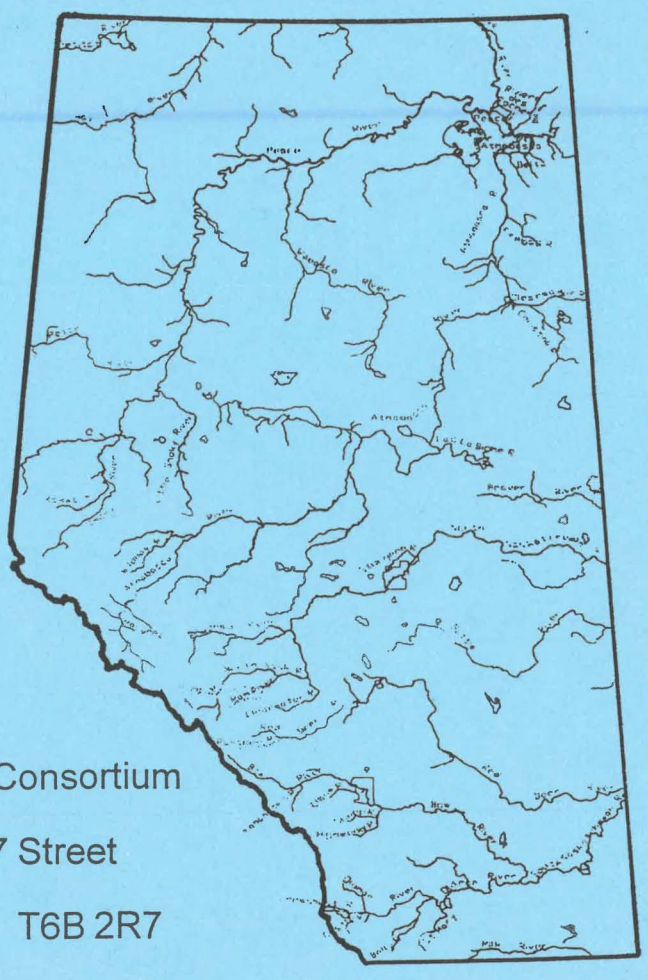
Canadian Heritage Rivers Systems

Study of Rivers in Alberta

Phase 1

Development of a Thematic Framework



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1.0 INTRODUCTION

1.1 Background

The Canadian Heritage Rivers System (CHRS) is a program developed and administered by designated departments of the federal, provincial and territorial governments to give national recognition to those Canadian rivers which best exemplify aspects of Canada's natural heritage, and recreational opportunities. The program, established in 1984, is administered by the Canadian Heritage Rivers Board, of which Alberta has recently become a member. Membership on the Board includes representatives from each of the 10 provincial and 2 territorial governments, as well as 2 appointees of the federal government. Currently, within Canada sections of 27 rivers totalling 5,802 km, have been nominated or designated to the system.

The implementation of the Canadian Heritage Rivers System study in Alberta is an important first step for the Province and the Canadian Heritage Rivers Board in undertaking a comprehensive assessment of Alberta's rivers for the purpose of identifying which rivers (or river segments) merit nomination to the Canadian Heritage Rivers System.

The implementation process adopted by Alberta in joining the Canadian Heritage Rivers Board specifies that local authorities will act as the lead agencies in recommending a river or reach for possible nomination by the Province to the CHRS system. This means that special interest groups, industries and private citizens must suggest a river from those shortlisted in this systems study to a local authority, which in turn recommends the river to the Province for further study.

1.2 Study Objectives

This systems study is intended to identify and assess Alberta's rivers and to determine those which warrant inclusion on a list of rivers and reaches to be considered as potential candidates for nomination to the CHRS. The basis of this evaluation are to be the CHRS selection guidelines for natural heritage, human heritage, and recreational values, CHRS integrity guidelines, and the feasibility of managing the nominated rivers as Canadian Heritage Rivers.

Overall, this study develops an objective method of assessing the values of Alberta's rivers, and to use this methodology to produce a shortlist of the most outstanding rivers in terms of natural and human heritage and recreational values. The shortlist of rivers or river reaches would represent those which

would merit nomination to the CHRS. To accomplish these tasks, the study was divided into three phases, which are described in more detail below.

1.3 Study Process

Each phase incorporates a number of tasks which are to be systematically completed. The three phases are outlined (*a brief description of the tasks to be accomplished within each*) below:

Phase 1:

- Create a draft framework of assessment themes describing the characteristic features of Alberta's rivers within each of the natural, human heritage and recreational value categories.
- Complete a broad scale literature review for all of the initial 72 candidate rivers put forward by the Alberta Government.
- Develop a shortlist of rivers for detailed assessment through workshops with the consulting team and the Technical Advisory Committee.
- Finalize the thematic framework and develop an evaluation system based on defining criteria for each component within the framework.
- Produce a report summarizing the development of the thematic framework and the shortlisting process of Phase 1.

Phase 2:

- Conduct a more detailed literature assembly and review
- Develop a public consultation process through local authorities, government agencies, technical experts, public interest groups and industries, to gather additional information regarding each of the shortlisted river's heritage resources.
- Apply the thematic framework to each of the shortlisted rivers to evaluate its resources, deriving a final score representing a comparative assessment of heritage values.
- Submit the framework and results of the evaluation for public and technical review, through local authorities, government agencies, technical experts, public interest groups and industries.
- Produce a draft report summarizing the river assessments and selection of candidate rivers for more detailed evaluation in Phase 3.

Phase 3:

- Develop and apply a methodology to assess the management requirements of the rivers recommended for further evaluation.
- Evaluate the final results of the assessment.
- Prepare a final report regarding the management implications of candidate rivers.
- Prepare a final report summarizing the complete study.

1.3.1 Study Rivers

From a list of 72 rivers supplied for initial review by Alberta Parks, a total of 20 rivers were shortlisted to an 'A' list, 21 to a 'B' list, and 25 to a 'C' list. These are summarized in Table 1.1 below and are shown in a provincial context in Figure 1.1.

A number of criteria were used to arrive at this shortlist. The criteria were developed based on an extensive assembly and review of existing data, research reports and field inventories pertaining to Alberta's rivers. The resulting shortlisted rivers were selected based on:

1) the amount of useful data available for each river;

2) the known historical data about each river; and

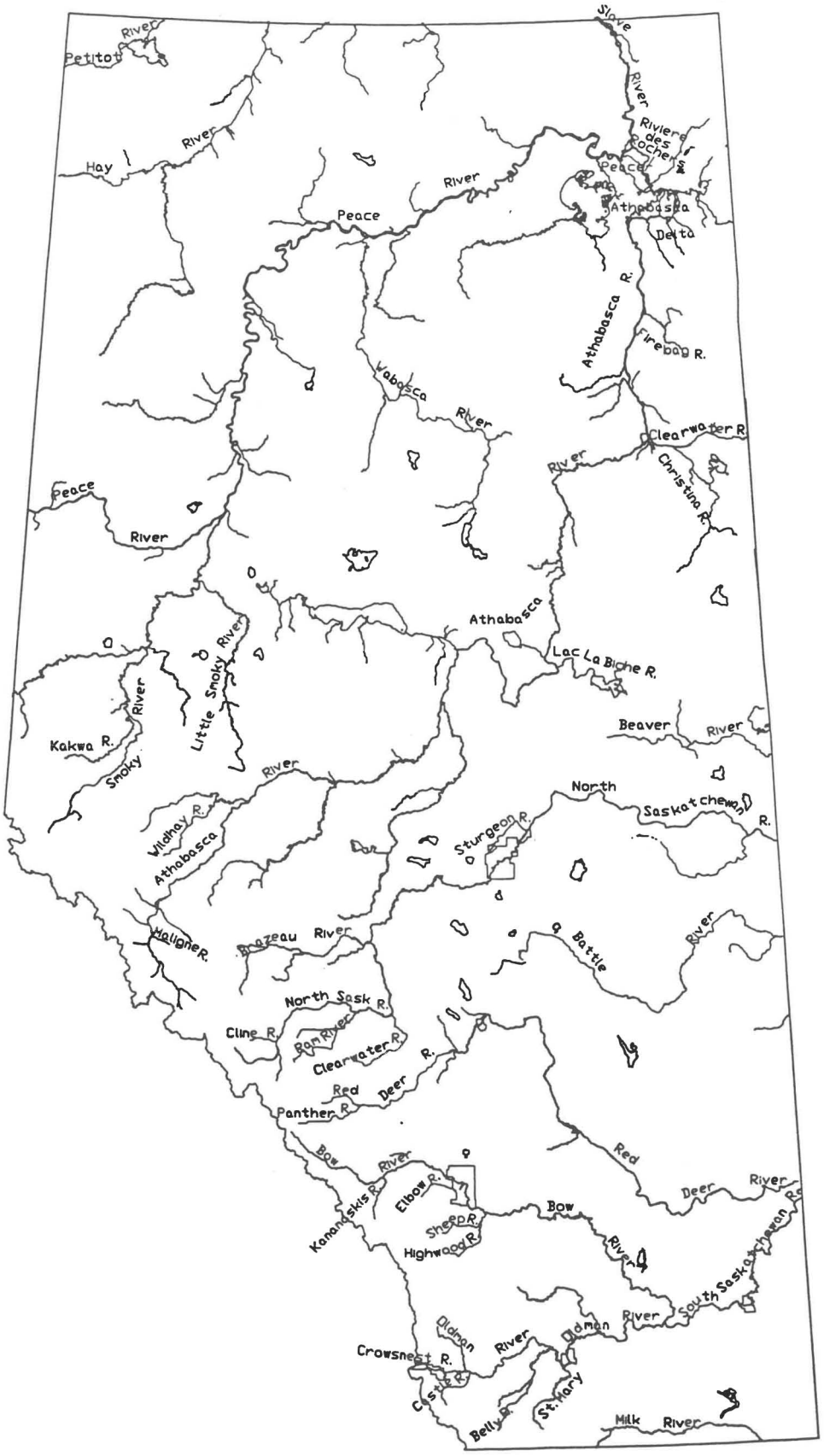
3) the number of physiographic regions through which the rivers flowed.

Those rivers included in the 'A' category had a number of outstanding features recommending them for further study (i.e., had known unique historical, environmental or recreational attributes). Those in the 'B' category had heritage values that were considered valuable, but were deemed not as significant as those in the 'A' group. This category also included rivers which were thought to require further research due to suspected significance of heritage values that needed further clarification or evaluation. Rivers were placed in the `C' category if no outstanding features were found in the review of the literature or known from professional experience of the study team and the Technical Advisory Committee. Of these three categories of rivers, only the A and B listed rivers are to be investigated in Phase 2.

Table 1.1 Shortlisted Rivers - the rivers are listed by drainage basin (basin listed in italics). 'A', 'B', and 'C' categories are defined in the text.

'A' List	'B' List	'C' List
Athabasca	***Athabasca***	***Athabasca***
Athabasca	Christina	Berland, Dover,
Clearwater	Firebag	Ells, Gregoire, House,
Maligne	Lac La Biche	MacKay, McLeod,
	Wildhay	Miette, Pelican,
		Pembina, Richardson
Beaver		***Beaver***
Beaver		Sand
Mackenzie	***Mackenzie***	***Mackenzie***
Slave	Hay	Buffalo
	Petitot	Dog River-Lelland Lake
	Riviere des Rochers	
Peace	***Peace***	***Peace***
Peace	Kakwa	Chinchaga
Peace Delta	Wolf	Leige
Smoky	Wabasca	Notikewin
Little Smoke		Ponton
		Simonette
		Wapiti
North Saskatchewan	***North Saskatchewan***	
Brazeau	Battle	
North Saskatchewan	Clearwater	
Ram	Cline	
	Sturgeon	
	Heart	
Red Deer	***Red Deer***	***Red Deer***
Red Deer	Panther	Blindman
		James
		Little Red Deer
		Medicine
Bow	**Bow**	**Bow**
Bow	Elbow	Ghost
Highwood	Sheep	
Kananaskis		
Oldman	**Oldman**	
Oldman	Belly	
Castle	St. Mary	
Crowsnest		
Mississippi	**South Saskatchewan**	
Milk	South Saskatchewan	

Figure 1.1 'A' and 'B' shortlisted rivers



2.0 THEMATIC FRAMEWORK APPROACH

In order to evaluate Alberta's rivers a "thematic" framework was developed based on CHRS guidelines defining natural, cultural and recreational "themes" was developed. This ***thematic framework*** was derived from review and modification of previous systems studies conducted by other provinces and territories as well as criteria defining the unique characteristics of Alberta's rivers. Primary references among these were the Saskatchewan 1991 Stage 1 Report (Hilderman Witty Crosby Hanna & Associates Ltd. 1991;) and the final Saskatchewan CHRS Report (Baschak 1993;) and the New Brunswick 1990 Systems Study (Washburn and Gillis Associates Ltd. 1990).

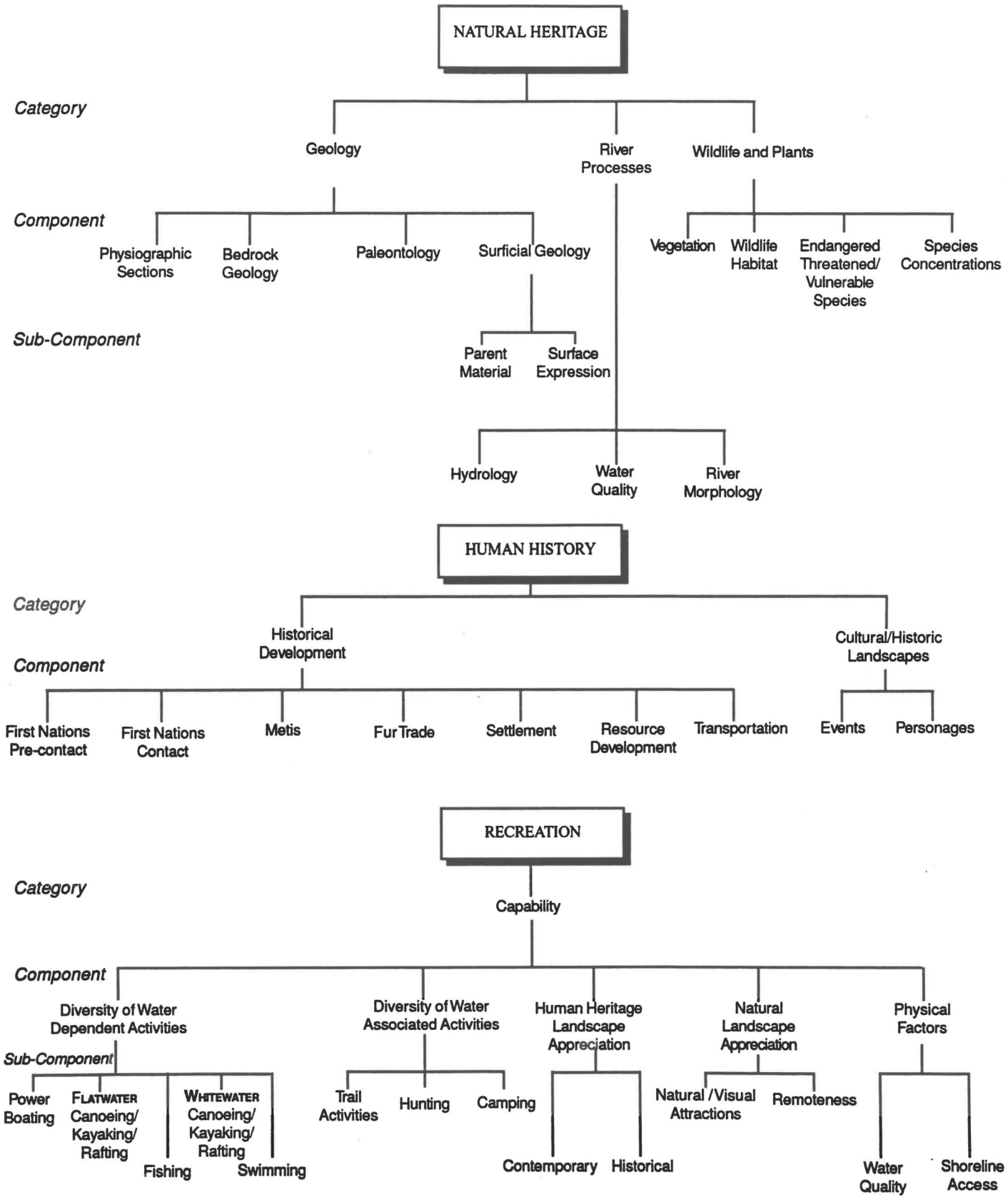
As in previous studies, the CHRS Heritage Guidelines form the first level of classification, providing the basis for **theme** identification and the development of evaluation criteria. Natural heritage, human, cultural heritage and recreational values represent the three major themes.

Each theme is then further defined by ***components*** and ***sub-components***. Classification systems such as Pettapiece's study of Alberta's physiographic regions and Alberta Culture's recent draft thematic framework for Alberta's prehistoric and historic resources (Alberta Culture no date) were used to develop the various components and sub-components within each of the theme categories. These help to address the requirements of an applicable guideline in terms of existing databases of Alberta's river resources.

The provincial frameworks and classification systems have the additional benefit of providing an existing standard at the provincial level by which to objectively compare river resource values. In this sense, existing data systems drove the development of defining criteria for the thematic framework, instead of creating a system measurable only by subjective appraisal of collected data. An outline of the thematic framework to evaluate Alberta rivers is given in Figure 2.1.

The overall classification and rating system attempts to provide a balance between the CHRS selection guidelines and criteria which specifically address Alberta's conditions.

Figure 2.1 The thematic framework used in evaluating Alberta's river resources for the Alberta Canadian Heritage Rivers systems study.



2.1 Characteristics of Alberta's CHRS Framework

In developing a thematic framework for evaluating Alberta's potential CHRS candidates, the consulting team established a number of guiding principles which are listed below:

1. Heritage river resources are assessed on their implied *current* value, not on their potential *future* value as might be achieved under different or improved river management.

2. Initial assessments are based solely on resource values. Management considerations are to be addressed at later stages of this Study.

3. River assessments will be scored on criteria derived from the thematic framework. The evaluation will result in a total "score" for each river. The final product is a list of rivers that meet CHRS criteria and can be considered for further study.

4. The framework is designed so that it can be used to re-evaluate rivers that may have been excluded or received low scoring, if additional information becomes available at a later date.

5. CHRS guidelines are the basis of the framework criteria and are reflected in the theme category level of classification in the framework. Other provincial frameworks were adapted for use with Alberta's framework where appropriate and to maintain some consistency with the original guidelines as set out by Parks Canada (1984).

6. The Alberta framework is designed so evaluations can be conducted using quantified or measured values wherever possible. The system is also designed for use by professionals familiar with the CHRS guidelines, as well as provincial heritage resources. Evaluations were based on available information in a majority of situations; however, in those circumstances in which information was lacking or incomplete, professional judgement was used to estimate the river resource value. If this estimate can not be made with confidence, the assessment of the river resource in question was deferred until additional information became available. In the meantime, the components or sub-components were designated as having "insufficient data."

7. The thematic framework for the Alberta system should be and was designed to address Alberta's river resources and existing frameworks of

resource classification. It was also designed with consideration of key features developed in previous CHRS system studies.

2.2 Framework Development

As has been acknowledged in previous studies, and by the Canadian Heritage Rivers Board itself, there is at present no framework to provide a consistent structure for assessing river resources on a national scale (Goldring 1994; CHRS Annual Report 1993). This left the study team with the problem of developing a framework which would be acceptable to the Canadian Heritage Rivers Board as well as the Alberta government and general public. The solution was to model the Alberta framework after those of Saskatchewan and New Brunswick, which have both created well-organized, objective and defensible frameworks for evaluation of river resources.

In addition, existing provincial resource assessment frameworks developed in Alberta were adapted for use in the framework. This provided a provincial level of classification and evaluation based on data that exists for much of Alberta, and which can be applied to river environments in a measurable fashion.

Adopting this method of framework development had two advantages:

- The study is comparable with previous works evaluated by the Canadian Heritage Rivers Board.
- The criteria used to define the framework is as objective as possible.

The assessment is primarily theme driven, with an evaluation of resource values within the natural heritage, human heritage and recreational themes. However, the study will also incorporate geographic and watershed representation in the application of the framework.

2.3 Scoring

The scoring system accompanying the thematic framework uses a 10 point evaluation scale primarily to be consistent with other provincial systems studies. The 10 point scale permits the scoring to be flexible enough to address the range of quality of Alberta's river heritage features.

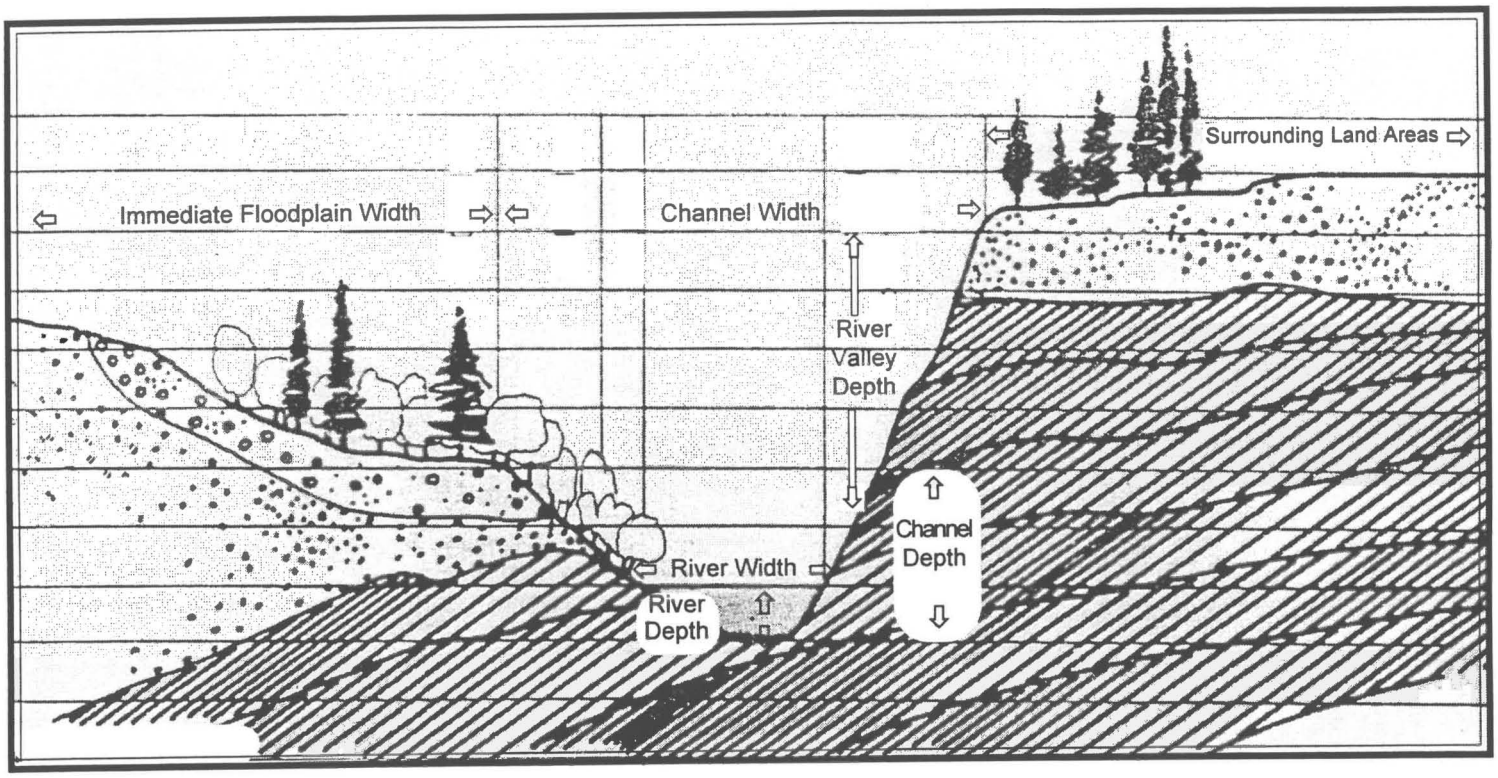
The scoring structure outlined in this report is proposed as a starting point. The system was developed with the professional judgement of the study team, nd particular emphasis was given to using data known to be available for most of the rivers.

When the framework is applied to the expanded river resources database, the scoring system will be fine tuned to enable optimal operation of the framework.

2.4 River Environment Definition

Under the CHRS program, outstanding heritage values are recognized when a river "environment" meets the criteria of the designated evaluation guidelines. The river environment is defined as the river channel encompassing the valley floor and the top of the valley walls on each side of the river, plus the landscapes, forms, features and views through which a river flows including surrounding areas up to 250 metres from the top of the bank (Figure 2.2).

Figure 2.2 The river environment as defined for the current study includes the channel width and floodplains to the top of bank. Figure adopted from Parks Canada (1977).



3.0 NATURAL HERITAGE THEME

The CHRS natural heritage value guidelines indicate that a given river environment will receive consideration for status as a heritage river if one or more of the following criteria are satisfied:

1. It is an outstanding example of river environments as they are affected by the major stages and processes in the earth's evolutionary history which are represented in Canada. This would include rivers which best represent the major periods of geological time in which the surface of the earth underwent major changes and stream modification.

2. Is an outstanding representation of significant ongoing fluvial, geomorphological and biological processes. As distinct from the periods of the earth's development, this focuses upon ongoing processes in the evolution and form of the river and its associated plant and animal communities.

3. Contains along its course unique, rare or outstanding examples of natural beauty.

4. Contains along its course habitats of rare or endangered species of plants and animals. This would also include areas where outstanding concentrations of plants and animals of Canadian interest and significance are found.

The Natural Heritage Value of a river is represented by a score attributed to a river environment based on an evaluation of the elements of the natural ecosystem as directed by the criteria outlined above in the CHRS natural heritage value guidelines. Assessment is based on the major categories which were derived from the CHRS guidelines.

A) Geology

B) River Processes

C) Wildlife and Plants

The general framework for evaluating natural heritage features is summarized on Table 3.1.

Table 3.1 Natural Heritage Theme Framework

CATEGORY	COMPONENT	SUBCOMPONENT	ELEMENTS
Geology	Physiographic Sections		- variety of physiography (Pettapiece 1986)
	Bedrock Geology		- geologic time interval exposed - including eras of material which the river traverses and through river incises - precambrian, palaeozoic, mesozoic, cenozoic
	Palaeontology		- concentration of fossils in the river environment - variety of species in the river environment - rarity of fossils in the river environment
	Surficial Geology	Parent Material	- diversity of originating sediments over which river flows and through which river incises - Glacio-lacustrine, Till, Glacio-fluvial, Fluvial, Eolian, Colluvial
		Surface Expression	- variety of land forms over which river flows - Delta, Fan, Level, Inclined, Undulating, Rolling, Hummocky, Ridged, Steeply Inclined, Terraced, Blanket, Veneer
River Processes	Hydrology		- presence and variability of natural hydrologic characteristics, conditions and features of river - variability in natural flow (i.e., slow and fast moving water) - includes deltas, wetlands, rapids, waterfalls - degree of disturbance or alteration to river environment impacting flow
	Water Quality		- based on water quality standards of Alberta Surface Water Branch - properties include: color, alkalinity, TDS, DO, pH, turbidity, temperature and various minerals (i.e., salts, sulphates, heavy metals) - water quality relative to dominant water quality of drainage basin - diversity of natural water quality along river
	River Morphology		- uniqueness of morphological features - distinct representation of general morphological features - diversity of land forms - includes forms such as: subaqueous dunes, point bars, pools, riffles, cutbanks, single vs. braided channels, meanders, floodplains, oxbows and terraces
Wildlife and Plants	Vegetation	Natural Subregions	- variety of ecological environments through which river flows
	Wildlife Habitat		- wildlife habitat diversity associated with river environment - critical habitat for river dependent species as determined by CLI
	Endangered/ Threatened/ Vulnerable Species		- COSEWIC standing - Provincial and Regional Standing
	Species Concentration		- species concentration - seasonal use (i.e., staging or spawning area) - species diversity - as determined in Poston et al (1990) and Patriquin (1993)

3.1 Geology

This category describes the physiographical and geological characteristics of the selected river environments. Numerous events and processes which have occurred throughout the geologic record are responsible for the development of the landscapes and environments present in Alberta today. Pre-Cambrian origins, Devonion seas, the Jurassic period when dinosaurs ruled, Cretaceous mountain building origins and the glacial activity of the present era all contribute to the rich geological history of this province. Three components, each of which contributes some aspect of landscape formation morphology and description, were utilized to evaluate the geological foundation of a particular river environment.

3.1.1 Physiographic Units

Both the bedrock and the surficial material are important components in determining the character of the landscape. Alberta is located amidst three major physiographic divisions: 1) Cordilleran, 2) Interior Plain and 3) Canadian Shield, all of which have very different origins and distinct associated features and land forms. These divisions are divided into 11 regions, which are further subdivided into a total of 58 sections (Pettapiece 1986). Sections encompass recurring sequences of land forms occurring within a region or land forms that have a unique topography within a specific region.

Physiographic sections have been selected as the level of physiographic resolution required to evaluate potential heritage rivers in order to provide greater definition of the environments through which the rivers flow. Assessment for this component is based on the number of physiographic sections a river crosses: the greater the number of different sections the higher the score. It is recognized that longer rivers may well score higher; however, longer rivers influence and are influenced by greater stretches of the landscape.

3.1.2 Bedrock Geology

The bedrock geology provides a framework of time during which Alberta's landmass was laid down, formed, or modified. In addition it provides information regarding origin and evolutionary processes. All of the geologic eras are represented in Alberta: Pre-Cambrian representation in the northeastern shield and southwestern cordilleran areas, Palaeozoic materials in the Rockies, Mesozoic origins for much of the foothills and the most recent, in terms of geologic time, Cenozoic origins for much of the plains. In the recent past a considerable portion of Alberta's landscape has been affected by glacial

advances and retreats. Each of these eras feature periods, during which distinct processes created unique environments and associated features.

Natural heritage value scores are correlated with the geologic time interval of the landmass through which a river flows. Assessment for this component involves not only the geological surface over which the river flows, but also the geology which is visible as a result of river incision. The greater the time frame represented the higher the score.

3.1.3 Palaeontology

Fossil assemblages provide time templates for geological events. The biostratigraphic record helps to corroborate the geological time frame. In addition, the fossil record provides information regarding the quality and nature of past environments and organic evolution. Valuable information regarding past environments and organisms can be garnered from these sites which also function as important data archives.

Natural heritage value scores are based on palaeotological records from within the river environment. Scoring is based on the:

1) concentration of fossils
2) variety of species represented
3) rarity of the fossils located at a site

3.1.4 Surficial Geology

The surficial geology relates to the material overlying the bedrock which gives rise to the land forms evident on the landscape today. Both the types of sediments and the mode of deposition contribute to surface appearance. Generalized information about Alberta's surficial geology is available from Pettapiece (1986).

Parent Material

The parent or surficial material subcomponent describes the mode of formation or deposition of the material overlaying the bedrock geology, indirectly indicating the type of sediments. Present rivers are relatively recent features on the landscape. Therefore, it should be recognized that rivers traverse landscapes and expose materials that were formed by various prior depositions including those fluvial in nature. Eight categories are recognized (definitions from Alberta Ecological Land Survey Site Description Manual 1994):

1. Colluvial - material which has been relocated as a result of gravitational forces

2. Eolian - material which has been transported or deposited by wind

3. Fluvial - material which has been transported or deposited by the actions of flowing water

4. Glaciofluvial - material transported and deposited by glacial meltwaters

5. Glaciolacustrine - materials which have been deposited in glacial lakes

6. Till - material that has been transported by glacial ice and not altered by an intermediate agent

7. Rock - material that is tightly packed and consolidated

8. Undifferentiated - a sequence of more than three types of genetic material which appears on steep eroded slopes

Assessment of this sub-component is based on the number of parent material types over which the river flows and which are exposed as a result of incision: the higher the variety of parent material the higher the score.

Surface Expression

Surface expression denotes the form of the land surface evident on the landscape today. The nature of the parent material strongly influences surface expression. The mode of material transport and deposition, whether by water, ice, wind or gravity, affects the relief and the degree, sequence and complexity of slopes on the landscape. Surface expression is a measure of the diversity and complexity of landscapes that the river flows through and interacts with. Twelve categories of surface expression are applied (Alberta Ecological Land Survey Site Description Manual (1994)):

1. Delta - deposits made by streams or rivers where flowing water enters standing water

2. Fan - fan shaped form that has a visible gradient from apex to toe

3. Level - flat or very gently sloping surface

4. Inclined - a unidirectional sloping surface; slope constant

5. Undulating - regular wavelike pattern of gentle slops; slope gradient 2 to 5%

6. Rolling - regular wavelike pattern of slopes; gradients greater than 5%

7. Hummocky - complex sequence of slopes extending from somewhat rounded depressions or kettles of various sizes to irregular to conical knolls or knobs.

8. Ridged - long, narrow elevation with steep sides

9. Steeply Inclined - slopes of greater than 70%

10. Terraced - scarp faces and the level or gently inclined surface above it

11. Blanket - layer of unconsolidated material which conforms to underlying surface and covers any minor irregularities in the surface

12. Veneer - layer of unconsolidated material which is too thin to mask irregularities in the underlying surface

Scoring for this subcomponent is based on the variety of land forms over which the river traverses; with a greater number of land forms resulting in a higher score.

3.2 River Processes

River processes refers to those geomorphic processes where running water is the major component in shaping the landscape (ie. a river valley). This category deals with those features, aspects and processes which contribute to and occur as a result of river form and evolution. These factors may fluctuate over time resulting in modifications to the river and river environment.

3.2.1 Hydrology

An excess of water on the surface or in the subsurface of a land area will result in the movement of water or stream flow away from that locale resulting in drainage. Surface and subsurface movement of water from small tributaries toward a single major river within a region constitutes a drainage basin. Three major North American drainage basins are represented in Alberta. Northern rivers drain into to the Arctic Ocean via the Mackenzie basin, rivers located in the central and southern portion of Alberta drain to the Hudson's Bay, while the remaining southern river drains into the to the Gulf of Mexico via the

Mississippi drainage basin. Nine basins of smaller magnitude form Alberta's drainage network.

Mackenzie Drainage System

1) Liard River Basin
2) Hay River Basin
3) Slave River Basin
4) Peace River Basin
5) Athabasca River Basin

Churchill Drainage System

6) Churchill River Basin
7) North Saskatchewan River Basin
8) South Saskatchewan River Basin

Mississippi Drainage System

9) Milk River Basin

Mean annual discharge, drainage area size and storage, flow type, topography, seasonality and nature and status of source, all influence flow pattern. Natural hydrologic features include deltas, wetlands, rapids and other natural features that impact flow, while natural variability in flow (slow and fast moving stretches of water) contributes to the representation of hydrologic characteristics.

Evaluation of this component is based on the representation of natural hydrologic characteristics, conditions and features of river basins in the drainage region: greater variation in representation yields a higher score. Variability in natural flow also contributes to increased scoring. A drainage basin area that has been significantly altered through agriculture, irrigation, logging or some other man-made disturbance would receive a lower score based on the degree of impact of the activity on the natural flow pattern. Similarly a river whose flow rate is regulated would yield a low score.

3.2.2 Water Quality

This component encompasses the physical, chemical and biological properties of water. Natural water quality is dependent on the original water source, be it precipitation, glacial ice or subterranean, and the bedrock and sediments through which the water flows. It is reflected in such properties as color,

alkalinity, salts, sulphates, total dissolved solids, turbidity, dissolved oxygen and water temperature.

Water quality scoring is based on the water quality assessments for each river as determined by the Alberta Surface Water Branch. The Alberta Surface Water Branch has adopted their definitions for criteria, guidelines and standards from the Canadian Water Quality Guidelines.

A guideline is generally derived from the lowest observable effects level obtained from biological tests of chronic toxicity. The lowest observable effects level obtained from the criteria data is then multiplied by a safety factor to provide for long term protection of important sensitive fish, plant, and animal species or other water uses. A guideline for any one contaminant may suggest a range of acceptable numerical values based on multiple uses (Alberta Ambient Surface Water Quality Interim Guidelines 1993).

3.2.3 River Morphology

The action of water flowing over a landscape results in a variety of flow patterns and in the development of fluvial and associated land forms. These fluvial land forms are a consequence of the varying degree of resistance to the movement of water found within the landscape, to variable flow rates, as well as transport and deposition of sediment. In shield areas where the granitic bedrock is highly resistant to erosion, the geology controls river channel shape and pattern. In contrast, areas where limestone or dolomite is prominent, fluctuations in discharge play a major role in determining channel shape and environment. Fluvial processes continually modify the environment, resulting in a variety of in-channel forms (subaqueous dunes, bars pools, riffles, cutbanks), channel forms (single vs. braided) and lateral activity (meandering, floodplains, oxbows and terraces). Together, hydraulic geometry and the channel environment are major determinants of the processes and land forms that may result within a river environment.

Value for river morphology is assessed based on the following criteria:

1) the uniqueness of morphological features,
2) the distinct representation of general morphological features and 3) the diversity of land forms associated with the river environment.

3.3 Wildlife and Plants

With the encroachment of human activities into more diverse environments, wildlife and vegetation alike have come under increasingly more stress. The

presence of suitable habitat for any particular activity (food, reproduction, etc) may result in variable spatial distributions. Loss of critical habitats has resulted in diminishing numbers in various species. Limitations in favourable habitats for various activities may also result in increased species densities.

3.3.1 Vegetation

Numerous vegetation zones have been delineated in Alberta based on complex interactions of climate, physiography and soil parameters. In river environments these factors become even more pronounced due to the river's impact on the land surface. This results in increased complexity in vegetation, which in turn increases habitat diversity. The variety and quality of natural habitat sub-regions as they pertain to the river environment are emphasized in this component.

Natural Sub-regions

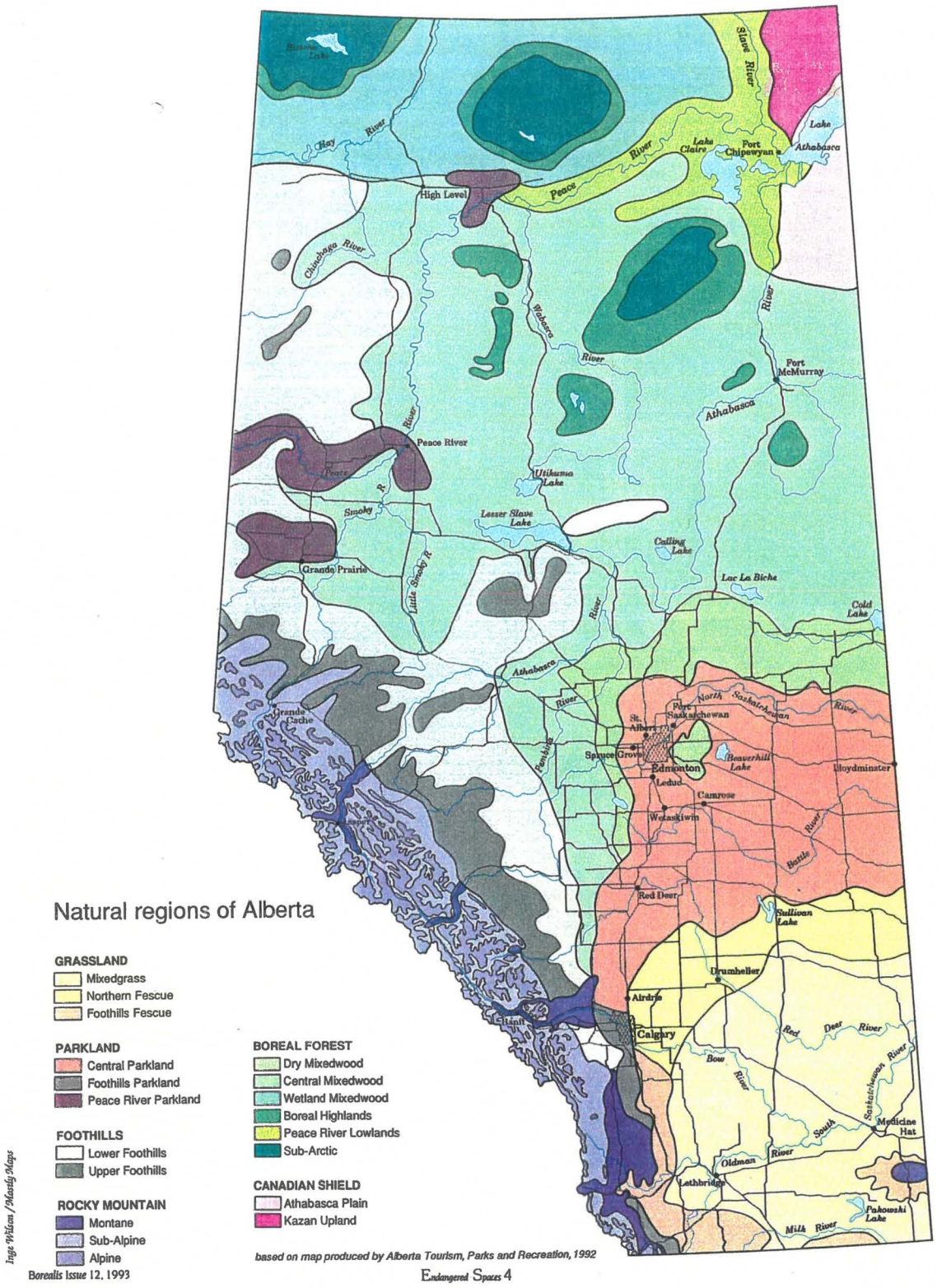
Alberta is divided into 6 natural regions (Figure 3.1) based on the interaction of vegetation, soils, landform and climate:

1) Boreal Forest
2) Rocky Mountain
3) Foothills
4) Canadian Shield
5) Parkland
6) Grassland

These regions are further divided into 20 subregions (Alberta Environmental Protection 1994). Plant communities in river environments represent a very diverse floral spectrum as a result of the local channel induced topography. Variability in slope, aspect and substrate increase the potential for diversity in vegetation.

The greater the number of subregions that a river flows through the higher the potential ecological diversity. Values for this sub-component are assessed based on the number of natural subregions through which the river flows.

Figure 3.1 Natural (ecological) districts and zones of Alberta



3.3.2 Wildlife Habitat

The term wildlife is utilized to refer to fish, mammals, birds, amphibians and reptiles. Many species of wildlife are often closely associated with particular communities upon which they rely for habitat. These communities provide preferred conditions for food, shelter and reproduction sites.

Evaluation for this component is based on the degree of representation of wildlife habitat diversity associated with river environments. The Canadian Land Inventory land capability ratings will be utilized as the basis for this evaluation.

3.3.3 Endangered/Threatened/Vulnerable Species

This subcomponent recognizes those species which, based on current populations, have been categorized as endangered, threatened or vulnerable, by federal, provincial or regional agencies. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and Alberta Fish and Wildlife monitor species nationally and provincially, respectively. These species may occur at a location throughout the year or seasonally (ie. migration or spawning).

Assessments for this sub-component are based on the status of wildlife species from a federal, provincial and regional perspective. Should there be a species represented in 2 different categories in the two classifications, in all instances the COSEWIC ratings shall veto provincial standings. River environments which harbour species whose numbers have become critical are scored higher than environments which host common species.

3.3.4 Species Concentration

Species concentration relates to the seasonal and spatial distribution of populations. Species density and distribution may be impacted by a lack of favourable habitat in other areas and seasonality (ie. winter yarding of ungulates, fish spawning beds, waterfowl staging areas). Species diversity relates to the variety of species which can be identified with a particular river environment.

This component is scored based on the significance of species densities and species diversity within the river environment utilizing Poston et al. (1990) and Patriquin (1993): both of whom have analyzed concentrations and species presence/absence.

Table 3.2 Natural Heritage Rivers - Value Scoring

Category	Component	Sub-component	Classification	Score
Geology	Physiographic Sections		- representation in 5 or more physiographic sections	10-9
			- representation in 3 or 4 physiographic sections	8-6
			- representation in 2 physiographic sections or very distinct representation in one section	5-4
			- representation in 1 physiographic section	3
	Bedrock Geology		- traverses and incises 3 or more geologic eras	10-9
			- traverses and incises 2 geologic eras	7
			- traverses and incises 1 geologic era	5
	Palaeontology		- contains several unique and/or rare fossils in the river environment	10
			- contains a unique and/or rare fossil in the river environment	8
			- contains several types of common / interesting fossils in the river environment	5
			- contains one type of common fossil in the river environment	3
			- has no known fossils in the river environment	0
	Surficial Geology	Parent Material	- traverses and incises a diversity of originating sediments (at least 5 types of parent material)	10-9
			- traverses and incises 4 types of parent material	8
			- traverses and incises 3 types of parent material	6
			- traverses and incises 2 types of parent material	4
			- traverses and incises 1 type of parent material	2

Category	Component	Sub-component	Classification	Score
Geology...		Surface Expression	- traverses 5 or more types of surface expression	10-9
			- traverses 4 types of surface expression	8
			- traverses 3 types of surface expression	6
			- traverses 2 types of surface expression	4
			- traverses 1 type of surface expression	2
River Processes	Hydrology		- excellent representation of unusual or significant hydrological characteristics of large rivers with natural flow; excellent representation of variable hydrologic conditions; excellent hydrologic features strongly associated with rivers	10-9
			- good representation of natural hydrological characteristics of rivers in a drainage basin; good representation of hydrologic features associated with rivers; disturbances to drainage basin have minimal impact on natural flow pattern	7-5
			- little variability in hydrologic characteristics; characteristics poor representation of river associated hydrologic features; disturbances to drainage basin have impact on natural flow patterns	4-2
			- features altered by humans; flows regulated; disturbances to drainage basin have significant impact on flow pattern	1-0
	Water Quality		- excellent representation of natural water quality characteristics of surface waters in the drainage region; water quality exceeds Alberta Ambient Surface Water Quality Guidelines in all categories (excluding spring run-off water quality)	10-7
			- good representation of natural water quality characteristics of surface waters in drainage region; water quality meets or exceeds Alberta Ambient Surface Water Quality Guidelines in most categories (excluding spring run-off)	6-3

Category	Component	Sub-component	Classification	Score
River Processes...			- representative of natural water quality characteristics of surface waters in drainage region; water quality falls below Alberta Ambient Surface Water Quality Guidelines in one or more important categories and becomes a limiting factor	3-0
			- insufficient data available for assessment	N/A
	River Morphology		- excellent representation of outstanding or regionally unique fluvial land forms; has excellent representation of diverse morphological features associated with rapidly moving or slow moving rivers	10-8
			- good representation of a variety of morphological features associated with rapidly moving or slow moving rivers	7-5
			- representation of some morphological features typically associated with rapidly moving or slow moving streams	4-2
			- little variety of morphological features	1-0
Plants and Wildlife	Vegetation	Natural Subregions	- representation of 4 or more natural subregions	10-8
			- representation of 3 natural subregions	7-5
			- representation of 2 natural subregions	4-2
			- representation of 1 natural subregion	1-0
	Wildlife Habitat		- 75 - 100 percent of the lands along the river are Class 1 and 2 for 2 or more species	10-8
			- 50 - 75 percent of the lands along the river are Class 1 and 2 for 2 or more species	7-5
			- 25 - 50 percent of the lands along the river are Class 1 and 2 for 2 or more species	4-2
			- <25 percent of the lands along the river are Class 1 and 2 for 2 or more species	1-0

Category	Component	Sub-component	Classification	Score
Plants and Wildlife . . .	Endangered/ Threatened/ Vulnerable Species		- known presence of one or more endangered species in or adjacent to the river environment (COSEWIC and Alberta Red status)	10-9
			- known presence of one or more threatened species in or adjacent to the river environment (COSEWIC and Alberta Red status)	8-7
			- known presence of one or more vulnerable species to river environment (COSEWIC and Alberta Red status)	5-6
			- species locally significant, no classified status	3-4
			- no species of significance	0
	Species Concentrations		- seasonal and/or spatial concentrations that are nationally significant for identified river dependent species and species strongly associated with the river	10-7
			- has concentrations that are provincially significant for species	6-3
			- has concentrations that are locally significant for species	2-0

4.0 HUMAN HISTORY THEME

4.0 Human Heritage Themes

Human heritage themes include the historical associations and the artifacts and remnants of inhabitants of the land from periods prior to the first contact with European explorers, through more recent times of exploration, settlement, and resource development. The CHRS human heritage guidelines outline the criteria by which a river will be recognized as a Heritage River. The criteria requires that the river:

1. Is of outstanding importance owing to its influence, over a period of time, on the historical development of Canada through a major impact upon the region in which it is located or beyond; this would include its role in such significant historical themes as native people, settlement patterns and transportation.

2. Is strongly associated with persons, events, movements, achievements, ideas or beliefs of Canadian significance.

3. Contains historical or archaeological structures, works, or sites which are unique, rare, or of great antiquity.

4. Contains outstanding examples or concentrations of historical or archaeological structures, works, or sites which are representative of major themes in Canadian history.

Two **theme categories** were used to incorporate the CHRS guidelines in the human heritage theme framework. These are:

A) Historical Development

B) Cultural Landscapes and Resources

Table 4.1 summarizes the framework organized around these theme categories.

Table 4.1 Human history theme framework

CATEGORY	COMPONENT	SUBCOMPONENT	ELEMENTS
Historical Development	First Nations Pre-contact	Temporal/Cultural Affinities	Horizon/cultural markers for Early, Middle, Late Prehistoric and Protohistoric Periods (e.g., Clovis, Folsom, Osbow, McKean, etc.).
		Resource Exploitation	Exotic materials, work shops, quarries, kill sites (pounds, jumps, kills, etc.), clay source, paint source, plant collection sites, plant processing sites. etc.
		Habitation	Stone circles, buried camps, surface camps, earthlodges, pit houses, etc.
		Ideology	Sacred sites (dream beds, cairns, effigies, markers, medicine wheels, ribstones, pictographs, etc.), burials.
	First Nations Contact	Fur Trade	Trade goods, fisheries, fur post plantations, adapted European goods.
		Rebellion / Treaty	Battle fields, significant camps, e.g., Big Bear's Camp, etc. Significant localities, e.g., Blackfoot Crossing, home farms, industrial schools, supply farms, reserves, etc.
		Traditional Land Use	Sacred geography, modified trees, prints, cairns, etc.
	Metis	Habitation	Cellar depressions, trading establishments, cemeteries, `villages,' river lot settlement, etc.
		Provisioning	Bison kills, winter settlements, etc.
		Rebellion	Battle sites, graves, etc.
	Fur Trade	Contact (1670-1778)	Trading establishments, outposts, etc.
		Rivalry (1774-1821)	Parallel trading establishments, outposts, etc.
		Monopoly (1821-1859)	HBC trading establishments, outposts, etc.
		Free Traders (1850-1920)	HBC trading posts, free trade posts, etc.
	Settlement	Exploration	Camps, cairns, markers, etc.
		Legal Survey	Camps, cairns, trails, boundary markers, etc.
		Missionizing	Missions, cemeteries, fisheries, etc.
		Agrarian Settlement	Homesteads (burdai, sod houses), farmsteads, cellars, foundations, ethnic villages, etc.
		Ranching	Ranch houses, stables, blacksmithing, etc.
		Law and Order	NWMP posts, patrol trails, field force camps, military camps (e.g., Suffield, Wainwright) internment camps, etc.
	Resource Development	Lumbering	Sawmills, stump forests, camps, etc.
		Fishing	Weirs, canneries, processing stations, etc.
		Mining	Mines, mining equipment, processing facilities, living quarters, dams, etc.
		Petroleum (oil, gas)	Well sites, processing plants, drilling/processing equipment, etc.
		Clay products	Quarries, kilns, living quarters, etc.
		Water	Irrigation facilities (canals, aqueducts), power facilities (dams, penstocks).
	Transportation	River communication	Landings, docks, portages, barges, boats, canoes, etc.
		Land communication	Trails, roads, bridges, stopping houses, railroads, construction camps, sidings, trestles.
		Telecommunication	Telegraph lines, telegraph office, equipment.
Cultural/Historic Landscapes		Events/personages 1. war 2. disasters 3. etc.	Battle fields, sites of treaty signage (e.g., Blackfoot Crossing) epidemic locations, disasters (e.g., Frank Slide).

4.1 Historical Development

This category incorporates elements of human heritage guidelines 1, 2, and 3. It includes not only the elements relating to development of societies such as native peoples, settlement patterns or the fur trade, but also, the association with key persons or concepts contributing to Canadian cultural heritage.

The category includes 6 **components**:

A) First Nations (pre-contact)
B) First Nations (contact)
C) Metis
D) Fur Trade
E) Settlement
F) Resource Development
G) Transportation

4.1.1 First Nations (Pre-contact)

According to oral traditions of the First Nations they have inhabited Alberta since time immemorial. Archaeological evidence demonstrates that native cultures, typified by sustainable resource exploitation within a rich social/cultural milieu, have thrived in Alberta for at least the last twelve thousand years, and potentially much longer. This **framework component** has been divided into **sub-components** describing aspects of this period of human activity.

Temporal/Cultural Affinities

Archaeological research has resulted in the formulation of a temporal/cultural sequence for the province, in which the pre-contact era is divided into a series of three periods, known as the Early Prehistoric Period (10,000 - 6,000 B.C., Middle Prehistoric Period (6,000 B.C. - 200 A.D.), Late Prehistoric Period (200 A.D. - to contact). Within each period are a series of named cultural complexes, such as Clovis, Folsom, Osbow, or McKean, which are typified by changing patterns of resource use, habitation sites, technological attributes and ideological constructs. The period between the introduction of European trade goods such as the horse and gun and the first European settlement is known as the Protohistoric Period. Reconstructing the past lifeways of these Pre-contact cultures through examination of their material remains is the primary goal of archaeology. Rich archaeological sites which were re-used many times in the past tend to be concentrated and preserved within river valleys.

Resource Exploitation

During the Pre-contact era, First Nations peoples exploited a wide variety of natural resources to sustain their hunting and gathering lifestyle. Particular varieties of rock were quarried from different deposits to make different types of stone tools such as arrow heads and knives. natural mineral deposits were used to obtain pigments for paints and dyes. Clay sources were exploited to make ceramic vessels. Different land forms were used to obtain buffalo - for example cliffs, box canyons, abandoned river channels or active channels could be used in a variety of indigenous methods to procure large numbers of buffalo for their meat and hides. Plants were also collected and processed both for dietary and medicinal purposes. Evidence for these and many more types of resource exploitation can be found along Alberta's river valleys.

Habitation

First Nations used a wide variety of different dwelling types in the past. Habitation sites vary a great deal across the province in terms of the types of dwellings used, the size of individual settlements, their placement in relation to rivers, and the length of occupation. For example, in the summer in southern Alberta, people often set up hide teepees along the high bluffs overlooking river valleys, where they could get good views and the wind would help to dry meat and keep away insects. In the winter they might move into river bottoms and construct brush dwellings in sheltered locales with good access to fire wood. Some of the different types of habitation sites found along rivers in Alberta include stone circles, buried camps, surface camps, earthlodges and pit-houses.

Ideology

The Pre-contact era was typified by a strongly spiritual dimension to the interaction of people with the landscape. many different types of sacred sites can be found today which still retain the spiritual aspect of past beliefs. These include medicine wheel complexes, rock art, stone effigies, dream beds, vision quest structures, cairns, ribstones, burials and sacred landscapes/areas.

4.1.2 First Nations (Contact)

European contact with First Nations was a process, rather than an event. Initially, contact consisted of the introduction of foreign goods and diseases via established native trade routes. The acquisition of horses and firearms drastically changed native lifeways, initiating the period known as the Protohistoric. As European traders began to explore further inland along the major river valleys in search of furs, the Historic period began.

Fur Trade

The fur trade era saw the introduction of European goods, diseases and technology, resulting in the movement and displacement of native peoples, as well as extensive depopulation and realignment of population concentrations in relation to trade routes, posts and provisioning areas. For example, native people began constructing log houses adjacent to fur trade posts for summer use, and settlements often were concentrated in areas with reliable fisheries.

Rebellion

The Rebellion of 1885 ushered in sweeping social and political changes in the Canadian West. For First Nations, some of the significant types of sites relating to this sub-component include battle locations such as the Frog Lake Uprising site and camps of participants in the rebellion such as Big Bear's camp.

Treaty

Signing of the numbered treaties was a pivotal event in the history of each of Canada's First Nations. Related sites include key locations of signing ceremonies such as Blackfoot Crossing, and treaty related sites such as reserves, residential schools, home farms, etc.

Traditional Land Use

Each of the First Nations retains knowledge of traditional land use areas outside of the modern reserve boundaries. These areas are used for certain traditional practices such as hunting, trapping, collecting plants and for spiritual awareness and renewal. For example, certain mountains may have spiritual significance, or trails and traditional meeting places along rivers still have relevance to First Nations.

4.1.3 Metis

The mingling of First Nations and Europeans in the burgeoning fur trade resulted in the formation of a new nation in Canada. The Metis were key supporters and participants in the fur trade and subsequent development of the west.

Habitation

Metis habitation sites include villages, river lot settlements, cemeteries, trading establishments, isolated cabins, etc.

Provisioning

Metis undertook much of the responsibility for providing provisions to the fur brigades. Bison kills, fishing settlements, haying camps, overwintering sites, etc. relate to this sub-component.

Rebellion

Metis participation in the Rebellion is commemorated by such sites as graves and battle locations.

4.1.4 Fur Trade

Contact (1670-1778)

Early fur trade expeditions were undertaken with native guidance by Hudson Bay Company traders such as Knight, Kelsey, Henday and Pink. Native guides and interpreters such as Thanadelthur and Matonabbee were the key to establishing successful trade. Expeditions by the French regime headed by la Verendyre were responsible for some of the earliest posts in the west (e.g., Fort La Jonquiere). Early peddlers from Quebec such as Peter Pond, Cuthbert Grant and Jean-Ettienne Wadden built some of the oldest documented fur trade posts in Alberta, such as Pond's Post.

Rivalry (1774-1821)

This period saw intense rivalry between the HBC and North West Company. The establishment of Cumberland house by Samuel Hearne in 1774 set the stage for bitter rivalry between the competing firms which only ended with the amalgamation in 1821. As each company moved further inland and established a post, the other company would often build a competing post

immediately adjacent to it. Rival posts such as Buckingham House/Fort George, Fort Edmonton/Fort Augustus, Paint Creek House / Fort Vermilion and Rocky Mountain House / Acton House were established during this period, as well as numerous supply depots, fishing stations and pemmican production camps. The role of the new Metis Nation in supplying the fur brigades with pemmican was crucial.

Monopoly (1821-1859)

Amalgamation of both fur trade companies heralded abandonment of some posts due to rationalization, and construction of new posts as the trade moved into new areas. Some older posts were rebuilt and trail networks, farms and supply camps became more permanent. In 1859 the trading lease expired and government interest in settlement intensified.

Free Traders (1850-1940s)

As missions and associated settlements began to appear, and settlement gradually increased, small, independent fur traders, began to compete with the HBC. Smaller trading houses and outposts with ties to local communities and groups became more common in this period.

4.1.5 Settlement

Settlement of the Canadian West began slowly after initial exploration relating to the fur trade. Completion of the railway, formation of the mounted police and increasing population pressure from the east resulted in a surge of settlement in the late 19th and early 20th century.

Exploration

Early explorers visited many parts of Western Canada, often leaving vivid written accounts of their journeys. Many sites were visited, mapped and recorded by explorers like David Thompson or the Palliser Expedition. Sites relating to exploration may include camps, cairns, trails, etc.

Legal Survey

Prior to settlement in the west, passage of the Dominion Lands Act resulted in legal survey of many areas. Sites relating to the Dominion Land Survey include camps, cairns, boundary markers, etc.

Mission Activity

Most European religious denominations had a strong mandate to proselytize and convert First Nations. Missions for many different denominations, especially mainstream faiths such as Catholic, Anglican, Methodist and Presbyterian were built across western Canada. Such missions might include a church, cemetery, housing, convent, school, shops, farms, etc.

Agrarian Settlement

The settling of the west resulted in the construction of towns and farms across the agricultural belt. Related sites include homesteads, cellar depressions, wells, sod houses, barns, etc. Often different ethnic communities would settle in different areas, with resultant distinctive architectural styles.

Ranching

A major policy of the MacDonald government in reference to western settlement was for formation of a ranching elite. To this end large ranching leases were granted. Part of the impetus for the large western ranches was to meet treaty obligations for provisioning the reserves which required meat supplies due to the extinction of the bison. Ranching sites include headquarter buildings, bunkhouses, stables, blacksmith shops, etc.

Law and Order

A variety of different sites relate to this sub-component. These include early NWMP posts, patrol routes, field camps and the whiskey posts the police were organized to help combat. Other law and order sites include internment and prisoner of war camps relating to the two World Wars, as well as military camps such as Suffield and Wainwright.

4.1.6 Resource Development

A number of different natural resources have been exploited in western Canada since settlement. Many of these resources are exploited according to "boom and bust" cycles, resulting in ghost towns and abandoned industrial facilities.

Lumbering

Forest resources have played an important role in resource development in Alberta. Large and small sawmills, logging camps, road networks, and stump/regrowing forests relate to this theme.

Fishing

In Alberta, fishing was important, especially on deep water lakes and major rivers in the northern part of the province. Fishing sites include docks, canneries, weirs, processing stations, ice-houses, etc.

Mining

Industrial development and the growth of the railroads lead to speculative and extensive development of mines, particularly coal mines in the early twentieth century. For example, coal mining towns sprang up along the eastern slopes of the Rockies in areas like the Crowsnest Pass and the Coal Branch, and smaller developments appeared in areas like Drumheller. Site types include towns, mine workings, coke ovens, tipples, mine facilities, rail spurs, dams, etc.

Petroleum Production

Oil and gas exploration and development represent a major sub-component of resource development in Alberta. Wells, production facilities, abandoned rigs and equipment all attest to this key industry.

Clay Products

Clay was mined and converted into pottery for domestic use and export beginning in the early 20th century. For example, Medalta pottery from Medicine Hat was widely used across the prairies for many years. Related sites include quarries, kilns, drying sheds and the growth of towns.

Water

Control of water, initially for irrigation and subsequently for hydroelectric power is an important aspect of resource development in Alberta. Water control facilities include canals, aqueducts, dams, penstocks, powerhouses, etc.

4.1.7 Transportation

The settlement and development of Alberta is intrinsically tied to the development of transportation and communication networks. Transportation has become increasingly sophisticated since the turn of the century.

River Communication

Rivers were extremely important transportation routes in the past, especially during the fur trade. Sites of interest along rivers include landings, docks, portages and derelict vessels such as barges and canoes.

Land Communication

Land routes include trails, roads, fords, bridges, ferries, stopping houses, railroads, construction camps, siding, trestles, etc.

Telecommunication

Telegraph lines and assoicated structures were historically important in communication development.

4.2 Cultural / Historic Landscapes

Certain landscapes within Alberta are significant as backdrops for key events in the past. These landscapes are intrinsic to our appreciation for the past, even though they may contain little tangible evidence for the past activity which occurred there. For example, portages, trails, fords and landings may have direct associations with important people or key events in Canadian history. This **theme category** acknowledges the existence of such areas on Alberta's rivers.

4.2.1 Events / Personages

Numerous events and persons are commemorated by cultural / historic landscapes. For example, Blackfoot Crossing commemorates Crowfoot, Bullhead, other Chiefs and Colonel MacLeod as well as the signing of Treaty Seven. Disasters such as the Frank Slide and Hillcrest Mine disaster are commemorated in the Crowsnest Pass. Armed conflicts are remembered in areas such as Battle Park and Massacre Butte, and conflict resolution in areas like Peace Point or the Neutral Hills. Fur trade portages such as Portage La Biche were used by many famous personages during the fur trade, such as Laderotte, Thompson, Fidler, Ogden, McLoughlin and Tulibii. In some areas of the province, specific landscapes such as hills or a natural amphitheatre are associated with periodic gatherings for preaching by persons such as Lacombe, Aberhart, Gordon, or the MacDougalls. A number of different epidemics, such as the smallpox epidemics of 1781, 1837 and 1869 are remembered at abandoned campsites and mass graves.

Table 4.2 Human Heritage Values Scoring

Category	Component	Subcomponent	Classification	Score
Historical Development	First Nations Pre-Contact	Temporal / Cultural	- contains evidence for at least three mutually exclusive components from the Prehistoric Periods and the Protohistoric Period or `exceptional' or classic remains of at least three temporal/cultural horizons	10-8
			- contains evidence for at least two mutually exclusive components from the Prehistoric Periods Protohistoric Periods and the Protohistoric or `exceptional' or classic remains of at least two temporal/cultural horizons	7-5
			- contains evidence for the Prehistoric era / Protohistoric Period or exceptional remains of any temporal/cultural horizons	4-2
			- no recorded sites but potential may exist	1
			- no recorded sites, no potential	0
		Resource Exploitation	- contains the source locality for the `type site' for a particular raw material; contains `classic' evidence for a variety of characteristic methods of any particular type of resource exploitation (i.e., bison jump/pound; quarry); exhibits `exceptional' or classic remains of a single temporal / cultural horizon relating to resource exploitation	10-8
			- contains sites with substantial amounts of a particular raw material; contains 'classic' evidence for any particular type of resource exploitation (i.e., bison kill, quarry)	7-5
			- contains either sites with substantial amounts of a particular raw material or `classic' evidence for any particular type of resource exploitation (i.e., bison kill, quarry)	4-2
			- no recorded sites but potential may exist	1
			- no recorded sites	0
		Habitation	- contains sites with a substantial number of habitation structures or large scale habitation areas; contains either exceptional or `classic' evidence of any particular habitation type or variety of habitation types	10-8
			- contains a substantial number of habitation structure or large scale habitation areas	7-5
			- contains exceptional or `classic' evidence of particular habitation types or variety of habitation types	3-2
			- no recorded sites but potential may exist	1
			- no recorded sites	0
		Ideology	- contains elements pertaining to spiritual connotations used by both large groups of people and individuals; figures prominently in First Nations traditional knowledge	10-8
			- contains isolated cairns and burials	7-5
			- contains `ceremonial' features with no known ideological interpretation	4-2
			- no known sites but potential may exist	1
			- no known sites	0

Category	Component	Subcomponent	Classification	Score
Historical Development	First Nations Contact	Fur Trade	- is exceptional by containing a historically documented native fur trade site	10-8
			- contains substantial evidence for a native fur trade site (i.e., lithic items with fur trade goods)	7-5
			- contains any evidence for a native fur trade site	4-2
			- no known sites	1
		Rebellion	- contains a variety of recorded sites relating to the Rebellion	10-8
			- contains sites of an ephemeral nature relating to the Rebellion	7-5
			- contains any site temporally related to the Rebellion	4-2
			- no recorded sites	1
		Treaty	- contains the locality where treaty was signed; contains sites resulting from treaty	10-8
			- contains any site where treaty negotiations / discussions took place	7-5
			- contains any site which is directly related to the treaty and reflects the results of signage of treaty	4-2
			- no recorded sites	1
		Traditional Land Use	- contains any site which figures prominently in current traditional land use knowledge relating to spiritual and/or medicinal practises	10-8
			- contains any sites which figure prominently in current traditional land use knowledge relating to daily economic pursuits	7-5
			- contains sites of ephemeral/random traditional land use	4-2
			- no recorded sites	1
	Metis	Habitation	- contains a well documented settlement with substantial structural/cultural remains	10-8
			- contains evidence of any well documented settlement	7-5
			- contains evidence of ephemeral Metis sites	4-2
			- no recorded sites	1
		Provisioning	- contains a well documented bison processing site	10-8
			- contains any site containing evidence of bison provisioning activities	7-5
			- contains any sites with evidence of provisioning activities	4-2
			- no recorded sites	1
		Rebellion	- contains a recorded site playing a significant role in the events of the Rebellion	10-8
			- contains a recorded site relating to the Rebellion	7-5
			- contains sites temporally related to the Rebellion	4-2
			- no recorded sites	1

Category	Component	Subcomponent	Classification	Score
Historical Development	Fur Trade	Contact (1670-1792)	- contains any well documented sites/associations of early fur trade incursions into Alberta with substantial structural / cultural remains	10-8
			- contains less well documented sites / associations of early fur trade incursion into Alberta	7-2
			- no recorded / associated sites	1
		Rivalry (1794-1821)	- contains any pairing of well documented fur trade settlements or strategic post (NWC or HBC) with substantial structural / cultural remains which played a major role in this period	10-8
			- is significant because of its association with sites attributed to this period	7-5
			- contains evidence for ephemeral fur trade related sites	4-2
			- no recorded sites	1
		Monopoly (1821-1859)	- contains any well documented Hudson's Bay post with substantial structural / cultural remains that played a major role in this era	10-8
			- contains any well documented minor Hudson's Bay post with associated ephemeral features	7-5
			- contains ephemeral remains associated with the Hudson's Bay Company during this era	4-2
			- no recorded sites	1
		Free Traders (1850-194-)	- contains any well documented Free Trader sites with substantial structural / cultural remains that played a major role in this era	10-8
			- contains any well documented Free Trader sites with associated ephemeral remains	7-5
			- contains any ephemeral remains associated with the Free Trader era	4-2
			- no associated sites	1
	Settlement	Exploration	- associated with landmark expeditions such as Mackenzie's Peace River passage	10-8
			- associated with later scientific expeditions relating to scientific exploration of the province	7-5
			- associated with more recent legal survey	4-2
			- no associated sites	1
		Legal Survey	- associated with landmark legal survey of the province such as the boundary survey, meridian survey, river lot, etc.	10-8
			- associated with legal survey of homesteads	7-5
			- associated with more recent legal survey	4-2
			- no associated sites	1

Category	Component	Subcomponent	Classification	Score
Historical Development	Settlement	Missionizing	- contains substantial structural / cultural remains of any prominent permanent mission which had a significant impact on the beliefs and lifestyles of the First Nations and early settlers	10-8
			- contains the remains of smaller missions of lesser duration which had a major impact on the beliefs and lifestyles of the First Nations and early settlers	7-5
			- contains or is associated with sites relating to the missionizing movements	4-2
		Agrarian Settlement	- contains substantial structural / cultural remains of early farmsteads or villages which were integral to the development and expansion of the agrarian movement	10-8
			- contains or is associated with major agrarian developments in Alberta	7-5
			- contains or is associated with agrarian development in Alberta	4-2
			- no associated sites	1
		Ranching	- contains substantial structural / cultural remains of early ranches which were integral to the development of ranching in Alberta	10-8
			- contains or is associated with major ranching developments in Alberta	7-5
			- contains or is associated with the development of ranching	4-2
			- no associated files	1
		Law and Order	- contains sites relating to or is associated with the inception of the NWMP; contains sites or is associated with law and order of national significance; contains sites or is associated with sites relating to significant world events	10-8
			- contains significant sites directly associated with maintenance of law and order	7-5
			- contains sites of secondary significance associated maintenance of law and order	4-2
			- no associated sites	1
	Resource Development	Lumbering	- contains sites or is associated with significant permanent lumbering facilities or activities	10-8
			- contains sites or is associated with 'mobile' lumbering facilities or activities	7-5
			- contains ephemeral sites associated with lumbering activities	4-2
			- no associated sites	1
		Fishing	- contains sites of major commercial fishing/fish processing activities	10-8
			- contains sites associated with one element relating to major commercial fishing activities	7-5
			- contains sites of small scale fishing/fish processing activities	4-2
			- no associated sites	1

Category	Component	Subcomponent	Classification	Score
Historical Development	Resource Development	Mining	- contains remains of significant, landmark, mining facilities and associated communities	10-8
			- contains remains associated with major mining activities	7-5
			- is associated with isolated or undeveloped early leases	4-2
			- no recorded sites	1
		Petroleum	- contains or is associated with landmark sites (discovery wells, early pipelines, processing facilities); contains sites illustrative of specialized extraction technology	10-8
			- contains or is associated with sites relating to early exploration or drilling activities	7-5
			- is associated with major producing leases	4-2
			- no associated sites	1
		Clay Products	- contains or is associated with early landmark collieries	10-8
			- contains sites of major collieries	7-5
			- contains sites associated with colliery production	4-2
			- no associated sites	1
		Water	- contains or is associated with early landmark water based developments such as power production, irrigation; contains remains of facilities illustrative of technological development	10-8
			- contains or is associated with early intensive use for transportation and communication; is associated with use by important historical personages (explorers, fur traders, surveyors, etc.)	7-5
			- is associated with other commercial usages	4-2
			- no recorded sites	1
	Transportation	River Communication	- contains or is associated with early intensive use for transportation and communication; is associated with use by important historical personages (explorers, fur traders, surveyors, etc.)	10-8
			- contains or is associated with remains illustrative of technological innovation/development of water based communication	7-5
			- is associated with more recent commercial transportation	4-2
			- no associated sites	1
		Land Communication	- contains or is associated with early intensive use for transportation and communication; is associated with use by important historical personages (explorers, fur traders, surveyors, etc.)	10-8
			- contains or is associated with remains illustrative of technological innovation/development of water based communication	7-5
			- is associated with more recent commercial transportation	4-2
			- no associated sites	1
		Tele-communication	- is associated with landmark telecommunication construction / operation / maintenance	10-8
			- contains or is associated with remains illustrative of technological innovation / development / maintenance of telecommunications	7-5
			- no associated sites	1

Category	Component	Subcomponent	Classification	Score
Cultural / Historic Landscapes	Events		- is associated with events of international/national significance	10-8
			- is associated with national/provincial local interest	4-2
			- is associated with events of provincial/local significance	7-5
			- no associated sites	1
	Personages		- is associated with important historical internationally/ nationally known personages	10-8
			- is associated with personages of national/provincial/ local interest	4-2
			- is associated with important provincially/locally known personages	7-5
			- no associated personages	1

5.0 RECREATION THEME

In order for a river to be considered of outstanding recreational value, the CHRS guidelines indicate that the river must meet both of the following:

1. Possess an appropriate combination of recreational opportunities and related natural values which together provide the capability for an outstanding recreational experience:

    - recreational opportunities include such activities as boating, rafting, kayaking, fishing, canoeing, hiking, swimming, camping, wildlife viewing, and human heritage appreciation;

    - natural values relate to the natural and visual aesthetics of the river environment related to such factors as sufficient flow, navigability, rapids, accessibility, suitable shorelines and surrounding landscapes.

2. Be capable of supporting recreational uses without significant loss of or impact on its natural, historical or aesthetic values.

The recreational value of a river is dependent on physical conditions which provide the potential for recreational use, the river's setting to allow enjoyment of recreational activities, and the quality and diversity of recreational opportunities which can be enjoyed by humans.

A river environment with outstanding potential for recreational use should provide good opportunities for a range of appropriate activities or excellent opportunities for a few activities. A river can receive a high evaluation in this theme if it offers excellent potential for two or more activities, or good potential for several different activities at various points along the river.

Under the Recreation Theme, one **theme category** has been chosen:

A) Capability

The general framework for evaluating recreational activities is summarized on Table 5.1.

Table 5.1 Recreational Theme Framework

CATEGORY	COMPONENT	SUBCOMPONENT	ELEMENTS
Capability	Diversity of Water Dependent Activities	Power Boating	- river width / sufficient depth / suitable flow regime / navigable distances / launching / docking / hazards or obstructions service and overnight accommodation facilitator
		FLATWATER canoeing, kayaking, rafting	- river depth / gentle flow / sufficiently long stretches without major obstructions, campsite availability
		WHITEWATER Canoeing, kayaking, rafting	- river flow allows for mix of class II to Class III rapids as well as gentle paddling, sufficiently long unobstructed stretches, campsite availability
		Sports Fishing	- fish variety, fish population
		Swimming	- water quality (within safe standards for water contact), water clarity, debris, flow, temperature, depth
	Diversity of Water Associated Activities	Trail-based Activities	- length of suitable shoreline, multi-use capability, access, camping
		Hunting	- variety of species, access and regulations
		Camping	- auto access, docking, launching, extended trail activities, servicing
	Human Heritage Landscape Appreciation	Contemporary	- number, quality and diversity of land use activities including elements like bridge structures, pastoral setting, field crops, lumber operations, river settlements, etc.
		Historical	- number, quality and diversity of historic landscapes
	Natural Landscape Appreciation	Natural / Visual Attractions	- number, quality and diversity of striking land forms, forest types, wildlife viewing, concentrated ecosystems, hydrological features
		Remoteness	- relative length of river which runs through areas that are void of man-made influences / solitude / remoteness
	Physical Factors	Access / Shorelines	- capability to support a mix of water associated activities / level of access / launching opportunities / frequency and variety of area
		Water Quality	- suitability for contact and non-contact recrational use.

The following provides a more detailed description of the components and subcomponents.

5.1 Capability

Under the capability category five **components** were evaluated to determine which river environments may be considered outstanding from a recreation perspective.

The components selected for Alberta's rivers expand on those previously used in other CHRS studies, in order to more fully reflect Alberta's unique river characteristics and include:

5.1.1 Diversity of Water Dependent Activities

Relates to the possible range of activities and in the case of boating the implied navigability the river can support directly dependent on the water quantity, quality and flow characteristics. **Sub-components** under this category include:

- Power boating, including jet boats, propeller driven boats; with the evaluation focusing on the length of trip that is possible, the length of time the river can support this type of activity (i.e., only in the spring run-off, vs. all summer and fall).

- Non-power boating activities including FLATWATER canoeing, kayaking and rafting; with the evaluation focussing on length of trip, challenge and variety of skills required, the presence of portages where needed.

- Non-power boating activities including WHITEWATER canoeing, kayaking, rafting with the evaluation focussing on the length of trip possible, the challenge and variety of whitewater and the presence of portage where needed.

- Fishing, focusing on the variety of sport fishes the river supports and the capability of the fish population to support angling / rare or threatened species to protect habitat.

- Swimming, evaluating the potential for the river to allow this activity in a "safe," clean environment (i.e., uncontaminated) with easy access for swimmers (based on water contact guidelines set by Alberta Environment).

5.1.2 Diversity of Water Associated Activities

Relates to the range of "recreation" activities that aren't necessarily dependent on the water, but are enhanced when undertaken within the river environment. **Sub-components** evaluated under this category include:

- Trail-based activities - evaluates the opportunity for various trail-based activities including motorized (trail bikes, ATVs), non-motorized (hiking, horseback riding) and seasonal variations (snowmobiling, cross-country skiing). The focus is on the length of trail, its accessibility and passibility, and potential to accommodate different trail uses with minimal conflicts.

- Hunting - with the evaluation focusing on the quantity and variety of species (large and small game, water fowl) and the extent to which the river provides appropriate conditions to support the activity.

- Camping - evaluates the physical potential for the development of formal/informal campsites along the river's edge or within the river valley confines.

5.1.3 Human Heritage Landscape Appreciation

This component focuses on the number and diversity of human heritage sites along the river and their potential for visitor appreciation. As such, the evaluation considers both the "historical" landscape and the contemporary landscape as presently developed by man (i.e., agricultural, industry). The 2 **sub-components** are further defined as:

- Historical - evaluating historical landscapes which demonstrate land use activities which once occurred but are no longer active (Indian camps, pioneer settlements, etc.).

- Contemporary - evaluates man's "present" day land use.

5.1.4 Natural/Visual Landscape Appreciation

The natural / visual environment through which a river flows is integral to the river recreation experience. Learning and increased appreciation of the flora, fauna and surrounding landscape can add an important dimension to the experience, as can the perception of wilderness solitude or remoteness. Indeed, such factors can be the primary motivation for river recreation. In addition, the mere existence of spectacular or beautiful scenery, vistas, land

forms, plants or animals can add significantly to the overall recreation experience.

Based on this premise, natural landscape appreciation examined 2 **sub-components** including natural attractions and remoteness experience.

- Natural Attractions - focusses on the variety and/or uniqueness of land forms, opportunities for viewing rare or endangered species, land forms and/or unique flora or fauna.

- Remoteness - provides an evaluation of the opportunities for, and the perception of solitude, as reflected by the absence of man made structures, roads and the absence of pollution or garbage.

5.1.5 Physical Factors

Several physical factors play a role in determining whether a river environment has potential for pursuing recreational activities. Spring flooding and rains or summer drought can completely change the nature of a river from year to year, or from season to season. Obstacles such as rocks, trees, or sand bars can make a river impassable, and litter or pollution may make the river and its environs undesirable to potential users. In order to sustain recreation activities and attract recreation use during at least a part (if not the entire) year, physical factors such as; water flow, water quality, navigability, access and the attractiveness of the shoreline and existing conditions like campgrounds must be of suitable quality.

Sub-components addressed in this category include:

- Water Quality - evaluating restrictions to recreation use from contamination or pollution.

- Shoreline/Access - focuses on the dispersal of access points along the river course, the suitability of potential launching sites and the suitability of the river shoreline to sustain water associated recreational activities.

Table 5.2 Recreational Heritage Rivers - Value Scoring

Category	Component	Sub-Component	Classification	Score
Capability	Diversity of Water Dependent Activities	Power Boating	- sufficiently long stretches of river that are navigable by propeller driven or jet driven craft; suitable for extended trips (>150 km) with launching, docking/mooring facility, fuel services and overnight accommodation (either camping or fixed roof) at 150 km intervals; river widths are sufficient to allow for passage without conflict to other river users	10-8
			- stretches of the river are accessible and navigable to allow for half day journeys without the need for overnight accommodation or service facilities (<150 km). Launching is available but mooring facilities are not. Widths are sufficient to allow for passage without conflict to other river users	7-5
			- stretches of the river are accessible and navigable for localized use and will permit boat touring for up to one hour. Widths and depths are variable, require slow speeds and caution at points	4-2
			- little to no access for launching; large width vessels require extreme caution and depths will only permit jet powered vessels. Chances of conflict with other river users is highly likely	1-0
		FLATWATER Canoeing / Kayaking / Rafting	- sufficiently **long stretches** of river to allow for extended trips (>75 days); void of rapids; campsites evenly dispersed along river; portages are unnecessary and river can be accessed at intermittent locations for hand launching of water craft	10-8
			- **several stretches** of river allow for trips of 3 to 5 days in length predominantly calm water; portaging where necessary; campsites are sometimes available along the river as are launch access points	7-4
			- some stretches of the river are sufficient to sustain flat water boating for day use activities but no overnight facilities are available and launching areas available but poorly accessible; the river has few flat stretches, obstacles and rapids are frequent thus portaging is necessary	3-0

Category	Component	Sub-Component	Classification	Score
Capability	Diversity of Water Dependent Activities	WHITEWATER Canoeing / Kayaking / Rafting	- sufficiently long stretches of river allow extended trips; campsites evenly dispersed along river; several sets of Class II through IV rapids challenge most intermediate and advance canoeists; some stretches of river with no rapids for the beginner and leisurely paddler; portaging, where necessary, possible for all canoeists	10-8
			- several stretches of river allow for trips of three to five days in length; campsites are sometimes available along the river; occasional sets of Class II to III rapids challenge most intermediate canoeists; several stretches of river with no rapids for the beginner and leisurely paddler; portages, where necessary, are usually possible for all canoeists	7-5
			- few stretches of the river allow trips of more than one day in length; campsites may not be available; little variety in rapid sequences; or no fast water at all; some locations where portages may be necessary but difficult	4-2
			- overnight canoe/kayak trips rarely, if ever, possible; campsites rarely or not available; no fast water; portages usually not available	1-0
		Fishing	- opportunities for fishing very good to excellent; adequate fish population to support sport fishing and contains two or more of the common sport fishing species for that river	10-8
			- good opportunities for fishing; fish population is adequate to support sport fishing in some sections of the river and contains at least one of the common sport fishing species for that river	7-4
			- opportunities for fishing poor; does not have an adequate fish population to support fishing and/or does not contain any common sport fishing species for that river	3-0
		Swimming	- river provides numerous locations that can provide a mix of experiences for beginner to average swimmers and where negative impacts such as floating debris, cool temperatures or overall water contaminants are within tolerable levels for safe water contact	10-8
			- river provides some locations which can provide safe and healthful activity for average to advanced swimmers	7-4
			- river conditions for swimming are questionable due to flow regime, water quality, health risks and generally unknown hazard potential	3-0

Category	Component	Sub-Component	Classification	Score
Capability	Diversity of Water Associated Activities	Trail Activities	- sufficiently long stretches of river valley/ shoreline which provide extended over-night trips for motorized or non-motorized trail activities. Campsites are frequent and continuous movement is not severely impacted by natural or manmade occurrences. Has the capability to sustain several types of trail activities with minimal or no conflict.	10-8
			- some stretches of river valley which provide extended trips for up to 5 days. Some impediments exist for motorized trail use and campsites occur occasionally	7-5
			- fewer stretches of river valley capable of supporting non-impeded lineal movement; some stretches of trail are located outside of the valley and campsites are few to none	4-2
			- natural or man-made occurrences do not allow for multi-use trail design and extended lineal movement	1-0
		Hunting	- opportunities for hunting very good to excellent; many sections of the river provide access to remote areas where large game may be found, or facilitates the hunting of large or small mammals, waterfowl, or other game	10-8
			- good opportunities for hunting; some sections of the river provide access to remote areas where large game may be found; or facilitates the hunting of large of small mammals, waterfowl, or other game	7-4
			- opportunities for hunting poor or non-existent; few, if any, sections of the river provide access to hunting areas, or hunting is prohibited	3-0
		Camping	- river environment provides a number of serviced, multi-use campsites near or adjacent to the water's edge; access for automobiles is available, boat docking for river users is available, provide good staging for extensive recreation opportunities	10-8
			- river environment provides for serviced river access campground areas and trail heads for localized trail activity. Auto access by non-powered or ATV only	7-4
			- river environment provides for primitive, non-serviced camping opportunities, trail opportunities are limited	3-0

Category	Component	Sub-Component	Classification	Score
Capability	Human Heritage Landscape Appreciation	Contemporary	- outstanding potential and diversity of contemporary cultural landscapes appreciation in four or more developed locations along the river (pastoral settings, river settlements, railroad bridges, logging operations)	10-8
			- good potential for contemporary cultural landscapes and two or three developed locations along the river	7-5
			- good potential for contemporary cultural landscape appreciation; no existing development	4-2
			- poor potential and no existing contemporary landscapes are planned	1-0
		Historical	- outstanding potential for cultural historic landscape appreciation; developed sites or regions of culturally historic landscape significance and interest exist at a minimum of two different locations along river (prehistoric and historic sites, historic designed landscapes, historic vernacular landscapes, ethnographic landscapes)	10-8
			- very good potential for culturally historic landscape appreciation; developed sites or regions of culturally historic landscape significance and interest exist at one location along the river	7-5
			- good potential for culturally historic landscape appreciation; no existing development of significant sites or regions of cultural landscapes	4-2
			- poor potential for culturally historic landscape appreciation; few or no sites of cultural landscape significance exist	1-0
	Natural Landscape Appreciation	Natural / Visual Attractions	- many stretches of the river exhibit varied and striking land forms, pattern changes, and concentrations of natural phenomena; excellent opportunities for observing a wide variety of flora and fauna	10-8
			- few stretches of the river exhibit varied and striking land forms, pattern changes, and concentrations of natural phenomena; good opportunities for observing a wide variety of flora and fauna	7-4
			- land forms and natural phenomena are interesting but typical on most stretches of the river; few opportunities for observing a wide variety of flora and fauna	3-0

Category	Component	Sub-Component	Classification	Score
Capability	Natural Landscape Appreciation	Remoteness	- provides a sense of remoteness and opportunities for solitude, most stretches of river have an absence of roads, structures, power lines, litter, etc.; few, if any contact with other people	10-8
			- several stretches of the river provide feelings of remoteness and opportunities for solitude; roads, power lines structures, etc. may be visible but unobtrusive; contact with other people will occur infrequently	7-6
			- occasional opportunities for experiencing solitude; contact with other people is likely; structures will be in evidence, human intervention is non-industrial and rural in nature	5-4
			- few opportunities for experiencing solitude; contact with other people frequent and occasional crowding may occur; structures may be both rural and industrial in nature.	3-2
			- no opportunities for experiencing solitude; many permanent structures in evidence, and industrial in nature; is often over-crowded	1-0
	Physical Factors	Water Quality	- appearance of the water in terms of colour, contaminant loading, odour, aquatic vegetation, and turbidity is acceptable for both contact and non-contact recreational use	10-8
			- appearance of the water in terms of colour, contaminant loading, odour, aquatic vegetation, and turbidity is acceptable for non-contact recreational use	7-4
			- appearance of the water in terms of colour, contaminant loading, odour, aquatic vegetation, and turbidity is unacceptable for any type of recreational use	3-0
	Physical Factors	Shoreline Access	- road access and launching points good to excellent; access points appropriately dispersed along the river; launching areas suitable for recreational river crafts and adjacent lands are suitable for three or more water associated activities	10-8
			- road access and launching points fair to good, access points available along some stretches of the river; launching areas suitable for both small to mid-sized crafts and adjacent lands are suitable for one or two water associated activities	7-4
			- road access and launching points poor; access limited or non-existent; launching points, where available, are suitable only for small boats and adjacent lands are suitable for one or less water associated activity	3-0

6.0 FUTURE STAGES

As mentioned in the introduction, this study is comprised of three stages. This report summarizes the results of Phase 1 and provides the background necessary for Phase 2.

In January, Phase 2 will begin. Public review will be solicited for the shortlisted rivers; feedback will be sought from a wide range of organizations including special interest groups, municipalities, provincial government agencies, native groups and settlements, and the general public (if requested). In this round of public contact, the purpose and requirements of public feedback will be clearly outlined, so as to gather information specifically related to the river heritage values. As suggested by the Technical Advisory Committee, a long time period will be allowed for comments (eg. 6 weeks), to ensure that the request can be addressed appropriately by each group. Promotional information pertaining to the advantages of the CHRS designation and more detailed information regarding the system study methodology could also be included in this package to foster a better understanding of the CHRS process.

A more detailed literature review will also be conducted at this point. Data gaps identified in historical, natural history, and recreational values for each river will receive more intensive review, and the listings of the 'B' rivers will be re-evaluated in light of new data.

Following both public and literature review, the shortlisted rivers will be assessed and ranked with the thematic framework established in Phase 1. The final product of Phase 1 will be a list of the rivers and their final scores.

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GLOSSARY OF TERMS

AHRS	Alberta Heritage Rivers Study
ATV	All-Terrain Vehicle
biostratigraphic	the life forms occurring within a sequence of geological strata or layers
blacksmithing	working iron on an anvil and using a forge
burdai	subterranean early pioneer house
CLI	Canada Land Inventory -- map system displaying land capabilities for various activities and habitats
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
cutbanks	the land form occurring as a result of water action incising or cutting into river banks
Devonion	a period of geologic time (approximately 406 to 360 million years ago) within the paleozoic era
DO	dissolved oxygen
earthlodges	conical structure covered with earth
era	an extended period of time reckoned from some fixed point in the past and used as the basis of a chronology
erode	to wear away gradually by constant friction
flatwater	slow moving river (no rapids)
floodplains	low flat ground on one or both sides of a river which may be subject to periodic flooding
glaciofluvial	material transported and deposited by glacial meltwaters

glaciolacustrine	material which has been deposited in glacial lakes
kayak	a hunting canoe of Arctic America, made of seal skins streatched over a frame, with a hole amidships where the user sits
meltwaters	water derived from the melting of glacial ice or snow
missionizing	a special program or series of religious services or exercises for stimulating piety or converting unbelievers
NWMP	North West Mounted Police
physiography	pertaining to physical geography; natural features and processes on the landscape (vegetation, land forms, drainage, climate, etc.)
provisioning	to provide with food or clothing
ribstones	sacred object - large rock carved with rib-like features
signage	a board, placard, etc. generally bearing an inscription conveying information of some kind
subcomponent	a division of components which further defines major aspects which constitute components
surficial	the surface expression of the landscape
TDS	total dissolved solids
wetlands	marshy land
whitewater	fast moving river (rapids)