Including Aboriginal Values In Resource Management Through Enhanced Geospatial Communication

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Abstract

First Nations use contemporary maps and mapping tools in resource management and planning. Maps and Geographic Information Systems (GIS) reflect the values, perceptions, and priorities of a Western-based Scientific worldview (WBSW). Traditional Aboriginal values are based in a traditional Aboriginal worldview (TAW), which can be very different from a WBSW. Therefore, maps and GIS may impede the communication of a TAW to resource managers and planners. The goal of this thesis was to evaluate and enhance the capacity to incorporate a TAW in mapping and GIS.

I developed the Geographic Valuation System (GVS) in collaboration with research participants from the Halfway River First Nation (HRFN) and the University of Northern British Columbia (UNBC). Before the GVS could be built, we first had to identify why the HRFN needed a new approach to communicating their values. Community research methods were used to identify HRFN requirements. Iterative feedback methods supported testing of alternative approaches to geospatial representation, namely: review and use of hardcopy maps and multimedia; investigation of buffer and weighted polygon approaches; development of GIS capacity and introduction of a hyperlink tool; creation of areas derived from visibility analysis; and consideration of three-dimensional terrain models.

The research resulted in fourteen principles that directed the creation of the GVS: 1) incorporate community-based research methods to identify characteristics of the geospatial approach; 2) identify and address threats to sustainable use of geospatial tools; 3) use a mapping approach that is preferred by HRFN to support and increase their familiarity and comfort level with maps; 4) identify and incorporate dominant modes of

communication amongst HRFN (e.g., oral language); 5) cultivate an environment where Elders and other members will recall events, experiences and values, particularly during times of the year when they may not experience the land the way they used to directly (e.g., in winter); 6) identify and record characteristics of Traditional Environmental Knowledge (TEK) while recognizing that knowledge and values may change over time and vary between individuals and family groups; 7) accommodate goals for knowledge beyond resource management through flexibility in collection, storage, and presentation; 8) situate decision-making power in the community and empower elected decision-makers to make decisions that complement traditional decision-making processes; 9) control access to TEK and awareness of the locations of significant locales through collection, storage, and application of recorded knowledge; 10) maintain ability to incorporate relevant information from disparate sources; 11) enable HRFN to assess potential impacts of multiple resource management projects across space and time; 12) provide for compatibility with extant geospatial systems and management approaches; 13) provide supporting information to HRFN decision-makers, such as wildlife habitat polygons, in a way that does not subsume TEK to WBS Knowledge; and 14) use computer systems and software that serve the other principles and have the potential to grow with changing HRFN, industry, or government requirements. Released as Open Source software, the GVS is freely and openly available to other First Nations who may wish to adapt it to their own needs and requirements.

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Acknowledgements

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I am indebted to my supervisor Dr. Alex Hawley for starting this work and his overall intellectual contributions. Alex created a supportive environment, saw me through challenges, and provided invaluable life lessons. My experience has truly been one of heart, head, and soul. Roslyn Pokiak has forever influenced my outlook and I appreciate her valuable contributions towards the operational, applied, and intellectual development of the project. HRFN participants were generous with me and I will be forever grateful for their invitation to share in their world. Geoff Hughes and Amy Barnes receive my gratitude for working on this project. Aaron Koning shared his passion as well as his work. Insights from committee members Drs. Kathy Parker, Jim McDonald, Gail Fondahl, and Roger Wheate on my methodology and thesis drafts were greatly valued.

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Forward

This thesis is based on research that resulted from labours beyond my sole intellectual, operational, and applied efforts. The first person plural is used in this thesis to recognize the contributions of others. Dr. Alex Hawley served as my supervisor and guided the intellectual development of this project. Roslyn Pokiak served as a mentor and intellectual partner in the creation of the Geographic Valuation System (GVS). Roslyn was the main community liaison for HRFN at the beginning of this project. She was Chief of the Halfway River First Nation (HRFN) between December 2003 and December 2005, during the core period of data collection, analysis, GVS design, feedback, and community testing. Aaron Koning was instrumental in adapting the Flexible Internet Spatial Template (FIST) for use as a software platform. Scott Emmons shared his views on Open Source software development and was generous with his time in discussing Geographic Information System (GIS) and FIST-related matters. Dr. Erin Sherry played an integral role as a mentor in community project research and design, and in training the initial group of HRFN community researchers. As well, Dr. Sherry participated in the collection of community information until early 2004. My committee members, Drs. Gail Fondahl, Katherine Parker, Jim McDonald, and Roger Wheate also contributed meaningfully to the formation and direction of this project and thesis.

Even with this collective effort, I alone am responsible for the content of this thesis.

CHAPTER 1: INTRODUCTION

1.0 Background

First Nations[1] use contemporary maps and mapping tools in resource management and planning and as part of a larger strategy to oppose encroachment on their traditional territories (Brody 1988; Tobias 2000a; Candler et al. 2003; Gibson 2003; Chambers et al. 2004). Maps and Geographic Information Systems (GIS)[2] were designed to represent the world schematically for specific applications reflecting the values, perceptions, and priorities of Western-based Science (WBS) and a WBS worldview (WBSW). This worldview can be very different from a traditional Aboriginal worldview (TAW)[3] as discussed and defined by Hawley et al. (2004). The current approaches used by mapping and GIS may therefore fail to include First Nation values in resource management without first manipulating and altering the content and context of Traditional Environmental Knowledge (TEK), the life-time accumulation of knowledge about First Nations' traditional land use, history, and culture. The result is that First Nation participation in resource management may be constrained and maps and GIS may contribute to hindering the communication of a TAW to resource managers and planners. Central to this thesis are ideas about how each worldview generates, collects, and

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[1] Halfway River First Nation members indicated preference for use of the term "First Nation" in reference to their community and thus "First Nation" is used when discussing community research with the Halfway River people. "Aboriginal" is used in this thesis when referring to Aboriginal rights and title as well as when discussing Aboriginal worldview. The terms "Aboriginal", "Indigenous", and "Indian" are used as appropriate when quoting authors of primary materials and secondary literature who employed these expressions. Also, "Aboriginal" is used to refer to First Nations and Inuit collectively. "Indians" refers to Indigenous people of North America who are not Inuit or Métis. The term "Indians" is considered to be dated; since the early 1970s it has gradually been replaced by "First Nation".

[2] The term itself can apply to one system (as in 'the GIS') or to the generalized application of the technology (as in 'GIS perform…'), and therefore is singular or plural. Abbreviations appearing in the thesis are presented in Appendix 1 for reference.

[3] The term itself can apply to one TAW (as in 'a TAW') or to more than one TAW (as in 'TAW mapping'), and therefore is singular or plural.

transmits data (discrete facts, no context), information (processed and organized data), and knowledge (state of knowing, insight).

1.1 First Nation Community Mapping Studies

The Traditional Use Study (TUS),[4] which demonstrates Aboriginal territorial use and occupancy,[5] emerged during the 1990s as a fundamental component of land-use research in British Columbia (B.C.) (Weinstein 1997; Olive and Carruthers 1998; Weinstein 1998; Tobias 2000b; Chambers et al. 2004). Related approaches to TUS are identified by similar terms, with two of the most commonly recognized being Traditional Land Use and Occupancy Studies (TLUOS) and Land Use and Occupancy Studies (LUOS).[6] Land use and occupancy research originated in the 1970s with projects that mapped Aboriginal knowledge of Canada's arctic and sub-arctic, and characteristically employed community-based research methods to collect and record knowledge with Elders and other knowledge holders (Freeman 1976; Brody 1988; Robinson et al. 1994; Robinson and Ross 1997; Duerden and Kuhn 1998; Weinstein 1998; MacKinnon et al. 1999; Roddan 2000; Tobias 2000a). The foundation of the TUS approach is the map biography method, which uses interview questions designed with and by community members to achieve project goals by identifying and recording sites (e.g., burial places, campsites, game hunt locations), pathways (e.g., trails, water routes), and extents (e.g.,

[4] Throughout this thesis, the acronym TUS represents the singular or plural form of this term.
[5] Tobias (2000a: 3) differentiates between "use" and "occupancy" by clarifying that a traditional use area is one where activities occur and a traditional occupancy area is one containing habitation locations and burial sites, and where a First Nation has a stronger knowledge of culture. Typically, use is broader than occupancy and overlaps to a greater extent with neighbouring First Nations.
[6] Throughout this thesis, the acronyms TLUOS and LUOS represent the singular or plural form of these terms.

fishing locales, trapping regions) on map overlays[7] as points, lines, and areas. Other participatory research methods such as traveling on the land to significant sites may complement map biographies.

First Nations may also map their data, information, and knowledge for other uses and reasons beyond use and occupancy studies. Chambers et al. (2004) identified three overlapping reasons to describe why First Nations create maps: 1) to ensure survival of knowledge; 2) to communicate information about land and people; and 3) to contribute towards managing and planning traditional lands. The process of collecting knowledge creates other benefits for communities, including generating opportunities for training and employment, increasing political awareness of Aboriginal rights, passing of knowledge from Elders to youth, heightening understanding of traditional relationships to the land, and affirming the value of TEK and its knowledge holders.

1.2 Evaluation by First Nations and Resource Managers

Reviews in B.C. and Alberta evaluated the level of success of land use and occupancy research measured by its effectiveness to increase TEK in communities as well as its facility to provide information valuable for resource management and planning (Robinson and Ross 1997; Thom and Washbrook 1997; Weinstein 1997; Weinstein 1998; MacKinnon et al. 1999; Dickerson and Ross 2000; Tobias 2000b; Markey 2001; Alberta Traditional Use Study Cross Ministry Committee 2004). Robinson and Ross (1997) reviewed four Alberta TLUOS and concluded that while each made effective contributions towards preserving TEK through identifying significant sites, recording

[7] A map overlay is a mylar sheet placed on top of a paper base map. Each interviewee marks, with interviewers, their data, information, and knowledge on the mylar.

ethnographic data, and strengthening relationships between Elders and youth, each fell short of its goal of generating information that could be used in resource management and planning processes. Dickerson and Ross (2000) determined that the process of data collection for TLUOS studies has created positive outcomes for First Nations, but they found that participating industry resource managers considered that a method to make First Nations' information useful by industry and government for planning was non-existent. Resource industry interviewees in MacKinnon et al. (1999) also concluded there was still a need to develop a suitable approach to include TEK in resource management. Thom and Washbrook (1997) expressed that TUS can contribute towards identifying cultural areas that are in potential conflict with resource management activities, but that the governmental practice of regarding TUS as completed and static studies resulted in the omission of valuable community information. Community-based researchers expressed the view that the process of overlaying TUS on government and industry spatial data should only be the starting point of collaborative planning between First Nations and external resource managers (Thom and Washbrook 1997; Sharvit et al. 1999). At the inauguration of this study, there was not an effective geospatial approach to including Aboriginal values in resource management.

1.3 Objectives of the Present Study

The goal of the present study was to evaluate and enhance the capacity to incorporate a TAW in mapping and GIS as part of a joint project involving participation of researchers from the Halfway River First Nation (HRFN) and the University of Northern British Columbia (UNBC). This collaborative project aimed to increase HRFN capacity to address proposals for oil and gas development in the Halfway-Graham Pre-

Tenure Planning area of the Muskwa-Kechika (MK) Management Area (MA). Project implementation was designed to demonstrate to policy-makers, other First Nations, and resource planners that the HRFN possesses TEK that is a legitimate source of knowledge which should be incorporated in resource management and planning. Through its focus on enhancing geospatial capabilities to communicate Aboriginal values to industry and government, this thesis contributes directly to the achievement of this overall goal. Additionally, this thesis contributes to the literature on First Nations mapping in resource management by describing a way in which First Nations can use TEK successfully in planning processes.

A product of this effort was the Geographic Valuation System (GVS). We gave the word 'values' a dominant role in the name of the geospatial approach because to be effective the method had to provide a means to capture and reflect HRFN values. It was HRFN traditional Aboriginal values, a central component of TAW, which HRFN-elected decision-makers identified as not being adequately included in decision-making processes. When referring to a TAW in this thesis, it is not my intent to suggest that there is one TAW amongst First Nations, or even amongst HRFN participants. Rather, the goal of the GVS was to enable the values within the TAW held by Elders and others to be reflected in the community's geospatial approach to resource management issues. As such, the GVS adds to, rather than operates at the expense of, other community voices, systems, and processes. The focus of this study was to provide a voice for community members, HRFN Elders, and other traditional knowledge holders, who otherwise were not well represented in resource management decision-making.

Before we could build the GVS, we first needed to identify what the HRFN

required and to test whether or not elements of existing approaches would appropriately represent these needs and values. Thus, the approach in developing the GVS was formulated during the study itself as results were integrated with methodology in an iterative fashion.

The GVS is not a one-off, HRFN-only system. It is designed and structured to be used by any First Nation that wishes to use it. The application of the GVS involves a method developed with a First Nation for First Nations and as a methodological approach and system, exceeds the accompanying software package. We planned the GVS so that it could be freely and openly available, a key factor contributing to its use among First Nations.

1.4 Study Timeline

I began thesis design in 2002 and attended my first community meeting at HRFN in February 2003. I worked with HRFN participants until December 2005 to evaluate whether (a) the geospatial methods used in resource management impede the embodiment of a traditional HRFN worldview into the process of resource management and planning; and (b) alternative methods of geospatial communication could be developed that would more accurately articulate traditional HRFN worldviews to non-Aboriginal planners and managers. Work on the GVS by the primary project members Roslyn Pokiak, Alex Hawley, and myself continued even after the termination of HRFN community work at the end of Chief Pokiak's elected term in December 2005.[8]

[8] Pokiak's involvement with this project began as HRFN Research Coordinator in the spring, 2003. She served as elected Chief between December 2003 and December 2005. Comments or references to input to this thesis made by Roslyn Pokiak while elected Chief refer to the source as "Chief Pokiak". When discussing her participation as a research partner in the creation of the GVS approach, she is referred to as "Roslyn Pokiak".

Permission was given by HRFN Chief, Council, and Elders for UNBC researchers to have access to HRFN TEK during the project.[9]

1.5 Structure of Methodology and Format of Dissertation

This work had three stages:

1. Identifying and characterizing problems in the participation by HRFN in resource management that related to geospatial communication;
2. Determining if existing geospatial approaches addressed those problems;
3. Characterizing and developing a geospatial approach that enhanced communication if existing systems were not suitable.

The interdisciplinary Ph.D. in Natural Resources and Environmental Studies at UNBC is a fitting context within which to undertake this work because this project is not just about GIS, it is not just about ethnography, and it is not just about resource management: it includes elements of all these subjects. Fundamental to the success of this project was the ability of the primary research team, Roslyn Pokiak, Alex Hawley, and myself, to apply theoretical knowledge, operational undertakings, and practical skills from many areas. Thus, this work was interdisciplinary in both its orientation and development.

1.5.1 Chapter Organization

Context and background are described in Chapter 1, highlighting the need in this work for effective and meaningful collaboration with HRFN and the utility of results to

[9] Simulated data, comprised of TEK which contains authentic characteristics of HRFN TEK but for which the full content and location are withheld, are used in examples throughout this thesis to preserve confidentiality of authentic HRFN TEK.

HRFN. The research effort started with thorough familiarization of the principles, procedures, and protocols of relevant research and methodology. This included review of literature related to First Nations' maps and mapping (Chapter 2) and a review of community-based research pertinent to this effort (Chapter 3). This was followed by an evaluation of resource management issues and practices facing the HRFN and an evaluation of present constraints (Chapter 4). Following confirmation that there were problems related to existing geospatial tools that impeded the participation of HRFN in ways considered suitable to the community, a selective but thorough evaluation of existing geospatial methodology related to those problems was conducted (Chapter 5). This led to the conclusion that no presently available system was suitable to address these problems. As a consequence, a new system, the GVS, was designed and developed as described in Chapter 6.

1.5.2 Contributions of Author

My frequent use of the first-person plural pronoun in describing this work is an honest and respectful reflection of the collective effort that comprises this work. However, it is useful in understanding the nature of this collaborative effort and for thesis review purposes to have a brief overview of some of the specifics of my role. In consideration of this role, it is important to recognize that at all stages I reviewed my findings and conclusions with the other members of the research team.

Relative to the above, I gathered, compiled, and reviewed the literature on First Nations' maps and mapping and community-based research. We enlisted the aid of Erin Sherry in initiating a community education program that included training of community researchers. I then oversaw and supervised the implementation of community-based

research. I compiled and collated all community-generated data. With Erin Sherry, I obtained and introduced the community to all relevant data obtained from outside sources (e.g., archival materials consisting of past research with HRFN). I conducted the evaluation of the existing system of participation of HRFN in resource management by personally observing and examining various aspects of the system and by obtaining, compiling, analyzing, and assessing community input on that system. I reviewed existing geospatial technology and systems relevant to HRFN and selected those for consideration by the community. I collaborated on the design and development of suitable training procedures and taught those to HRFN participants so that we could usefully evaluate existing systems. I worked closely with HRFN participants to evaluate those systems, compiling and interpreting all community input and participation. I identified the principles underlying design and development of the GVS. Based on my findings with the HRFN, I contributed to the development at UNBC of the software that would form the core of the GVS and directed and oversaw the customization of that software for the GVS. I created training materials and provided training to HRFN staff, wrote scripts, created the base TEK database for HRFN, collected feedback from HRFN participants, and joined Roslyn Pokiak and Alex Hawley in making presentations to industry, government, and other First Nations.

1.5.3 Communication of Research Results

Fourteen principles were identified leading up to the development of the GVS. This approach of developing principles was taken for two reasons.

First the successful collaboration of this work was based on open and honest communication, respect, and trust. This relationship was established through concerted

effort by all participants to communicate fully, including a full and honest dialogue between myself and HRFN participants in which I continually communicated and vetted the findings of my research and the material that would be presented in this thesis. This was most readily and effectively achieved by identifying principles at each stage of the work that clarified for all participants what was found and how it would influence further development. In this way, HRFN participants could readily follow what was happening, see how their input and concerns were being addressed, and feel comfortable and satisfied with the whole process. Conversely, I was able to feel secure in my conclusions, confident that the issues and concerns of the HRFN were being addressed, and optimistic that the approach would lead to a successful redress of the constraints on the community in the participation in resource management.

Second, the creation of the particular research team involved in this project afforded an excellent opportunity to document the steps and processes that would lead to this type of successful collaboration. The principles therefore serve as a blueprint for HRFN and others who might undertake similar efforts. As a consequence, the principles are a mixture of protocols for interaction, characteristics of an operational system, and guidelines for systems development.

CHAPTER 2: LITERATURE REVIEW: FIRST NATIONS' MAPS AND MAPPING FIRST NATIONS

2.1 Introduction

In Canada, the outcome of *Delgamuukw vs The Queen* (1993) requires governments to ensure that Aboriginal rights are not infringed upon where resource development or extraction occurs on traditional lands. The Crown is also obliged to recognize Aboriginal rights during treaty negotiations. To fulfill this responsibility, the B.C. government reasoned that it required an inventory of traditional Aboriginal activities. As a consequence, the B.C. government's TUS project was developed, with the eventual participation of 59 First Nations (Weinstein 1997; Markey 2001; British Columbia Ministry of Sustainable Resource Management 2003). The provincial government funded the program with an expected outcome that a confidential version of the data would be shared with the government for use in planning (British Columbia Ministry of Forests n.d.; Weinstein 1997; Weinstein 1998; Roddan 2000; Tobias 2000a; Tobias 2000b; Markey 2001; British Columbia Ministry of Sustainable Resource Management 2003).

There is disagreement on whether mapping and existing mapping tools empower First Nations to address resource management issues or impede them by restricting First Nations' ability to communicate their values, and the TUS program has received part of that scrutiny. Some First Nations believe TUS are geared towards benefiting government and industry rather than First Nations (Weinstein 1997; Weinstein 1998; Tobias 2000b; see: Alberta Traditional Use Study Cross Ministry Committee 2004). First Nations displayed concern over maintaining the confidentiality of their knowledge under the B.C. government TUS project model (Weinstein 1998; Markey 2001). First Nations also

expressed apprehension over the practice of predominantly recording cultural information as sites, which took precedence over delineating pathways or areas (Weinstein 1997; Weinstein 1998; Roddan 1999; Roddan 2000; British Columbia Ministry of Forests 2001; Markey 2001; see also Alberta Traditional Use Study Cross Ministry Committee 2004). Sites were recorded on maps as points (Markey 2001). Weinstein (1997) observed that the emphasis on site-specific data may meet the needs of First Nations whose link to traditional lands is primarily historic, but fails First Nations whose use and occupancy of territory is part of their living culture (Weinstein 1998). Community researchers also found that a site-specific representation of TEK contravenes traditional ways of describing relationships to the land and ignores the reality that resource development impacts generally extend beyond site-specific locations (Thom and Washbrook 1997; MacKinnon et al. 1999; Roddan 2000; Markey 2001; Carrier Sekani 2006; Nicholas 2006). At the root of this dialogue are notions of worldview, and this chapter begins by discussing WBS and TAW and their differing perceptions of maps and mapping tools.

To further help inform this debate and the present work, a comprehensive literature review was conducted on Aboriginal use of maps and mapping technologies and on the application of geospatial communication tools that include traditional Aboriginal values in various applications including GIS within resource management and planning. Government and industry documents, policy reports, conference materials, workshop papers, and relevant websites were included. A number of dominant themes are apparent. This chapter also summarizes existing approaches to mapping First Nations' data, information, and knowledge for the purposes of examining the characteristics of each approach for potential application with the HRFN. Conclusions identify the first of

the principles that directed development of a geospatial approach to including HRFN TAW in resource management.

2.2 Worldviews and Approaches to Geospatial Representation

Worldview is defined as a particular philosophy, view of life, or conception of the world, and is at the root of our perception of cosmology and general ideas (Kearney 1996; Oxford 2005). Worldview defines the filter through which the world is interpreted, and a First Nation's concept of the world underlies their TEK. The worldview that resource management in industrialized cultures is predicated upon is WBS, which is characterized as being reductionist, objective, and positivistic (Thomas 1995; Casti 2001). A TAW is different from WBS and has been described as dynamic, cumulative, long-term, primarily qualitative, inclusive, spiritual, and subjective (Sherry and Vuntut Gwitchin First Nation 1999; Hawley et al. 2004; Menzies and Butler 2006). WBS Management (WBSM) tends to emphasize selective attributes of the system or items of interest. TEK may perceive that every element of the environment has a spirit, or anima (Sherry and Vuntut Gwitchin First Nation 1999; Hawley et al. 2004). TEK is community-based and although not everyone is a holder of knowledge, every member of the community can potentially be one. Knowledge may also be held collectively. TEK may be acquired through teaching involving oral storytelling and other ceremonies, and taught through experiential learning. People are typically directly involved in the events which contribute to TEK collection and comprehension (Johnson 1992; Sharvit et al. 1999; Sherry and Vuntut Gwitchin First Nation 1999; Hawley et al. 2004). In contrast, WBSM resides in a written culture where one type of specialist, those who collect information and data, are frequently spatially and temporally distant from another group of specialists,

those who analyze and make decisions (Johnson 1992; Schoenhoff 1993; Duerden and Kuhn 1998; Berkes 1999; Sharvit et al. 1999; Sherry and Vuntut Gwitchin First Nation 1999; Hawley et al. 2004).

The labeling of TEK as 'traditional' is a misnomer when it implies that TEK belongs to static, primitive, or dying cultures (Johnson 1992; Duerden and Kuhn 1998; Sherry and Myers 2002; Hawley et al. 2004). In fact, TEK is none of these things, but is cumulative, and as new generations add to it from their experiences, also evolving (Johnson 1992; Mitchell 1997; Berkes 1999; Sherry and Vuntut Gwitchin First Nation 1999; Hawley et al. 2004). Further, TEK is primarily qualitative, which is difficult to combine with the quantitative data that dominate WBSM. Data and information for WBSM may be collected much more quickly than TEK, and when used for resource management, generally focus on short-term issues, relative to TEK (Mitchell 1997; Berkes 1999; Sharvit et al. 1999; Sherry and Vuntut Gwitchin First Nation 1999; Hawley et al. 2004). Because TEK does not easily fit into the analytical structures of WBS, its potential contribution is undervalued in resource management (Robinson and Ross 1997; Robinson and Kassam 1998; Berkes 1999; Calamia 1999; MacKinnon et al. 1999; Michel and Gayton 2002; Sherry and Myers 2002; Menzies 2004).

Despite the extensive literature illuminating differences between WBSW and TAW, there are also some similarities, and it is simplistic to only examine their discriminating characteristics (Hawley et al. 2004; Menzies and Butler 2006). Both attempt to predict what will happen in their surroundings and gather data or information through empirical observation, which are then put into context and turned into knowledge. In addition, TEK holders may perform controlled experiments to increase

their knowledge of environmental variables and interactions (Tsuji 1996; Duerden and Kuhn 1998; Berkes 1999). TEK holders may be distrustful of the scientific method and the management system that it supports, just as some WBS specialists are skeptical of TEK (Hawley et al. 2004).

There is increasing interest in integrating TEK and WBS within one management system. In Canada, this interest is mainly a reflection of evolving legislation, including Sparrow (*R*. vs. *Sparrow* 1990), Delgamuukw (*Delgamuukw* v. *British Columbia* 1997), Haida (*Haida Nation* v. *British Columbia Ministry of Forests*. 2002a 2002b), and Taku (*Taku River Tlingit First Nation* v. *Tulsequah Chief Mine Project*, 2002), which requires governments to consult with First Nations during resource management (Sherry and Myers 2002; Hawley et al. 2004; Marsden 2005). Generally, efforts are made to integrate TEK within the governing management structure or, less frequently, through co-management agreements. How TEK is accommodated determines how management processes operate and whether they are successful (MacKinnon et al. 1999; Sherry and Myers 2002; Hawley et al. 2004).

Both structural and ideological barriers exist to combining TEK and WBS. Most resource management models propose integrating TEK or local knowledge with science in a manner that subsumes TEK to WBS (Duerden and Kuhn 1998; Hawley et al. 2004). When attempts are made to put TEK into WBSM, contextual knowledge is reduced to bits of information or data and TEK becomes selectively included within the planning process. Hawley et al. (2004) presented the idea that WS resource managers may consider ‘sound’ information to be science-based, and by corollary, ‘unsound’ information exists from other sources. With characteristics differing from WBS, TEK

may be considered to be a source of 'unsound' information. Further, some First Nation cultures may not even subscribe to the notion that natural resources can or should be managed (Parsons and Prest 2003; Hawley et al. 2004). MacKinnon et al. (1999) argued that because of existing barriers, "The objective is not to reconcile the two worldviews … [but explore whether] a framework [can] be created that allows for agreement on certain issues without creating … de-contextualization or compromise," (MacKinnon et al. 1999: 28).

2.2.1 Map Images and Mapping are Worldview-Embedded

WBS mapping, GIS, and other geospatial technologies originate from WBS knowledge systems (Turnbull 1989; Belyea 1996; Raper 2000) and represent worldviews in space and time (Harley 1990; Smith 1999; Raper 2000). Harley and Woodward (1987: xvi) defined maps as, "graphic representations that facilitate a spatial understanding of things, concepts, conditions, processes, or events in the human world." This thesis will adopt a definition that modifies Harley and Woodward's definition by removing the word 'graphic' because many traditional Aboriginal as well as non-Aboriginal maps are expressed through non-graphic media. In particular, cognitive or mental maps represent spatial knowledge stored and structured in the mind. Further, McCall (2006) wrote that mental maps can be represented using 'memoryscapes' of sounds, smells, and views that generate memories of places. Maps are communication devices between the map-maker and user, but spatial information also has been communicated orally through mechanisms such as song and dance (Aberley 1993; Lewis 1998; Smith 1999; Turnbull 2000; Morantz 2002).

WBS more often than not dismisses the value of traditional Aboriginal maps since

they are difficult to interpret from outside the map-maker's culture (Turnbull 1989; Belyea 1996). While both TAW and WBSW maps come in a variety of forms, all of which express how people communicate, view, and envision their world, locations of significant features, places, and animals are not only central to enabling Aboriginal peoples to sustain their livelihoods, but may also contain spiritual meaning (Brody 1988; Belyea 1996; Turnbull 2000; Chambers et al. 2004). Examples of different types of TAW maps include maps created by the Micronesians of the Pacific, who used stick charts to illustrate connections between islands, emphasizing currents and swell lines (Aberley 1993; Cogswell and Schiotz 1996; Calamia 1999; Turnbull 2000; Ehrenberg 2005). The Inuit used beach sand and rocks to create replicas of their land, scaled by sticks to depict how far one could travel in a day (Turnbull 1989; Aberley 1993). The Beaver prophets of northeastern British Columbia produced maps from dreams detailing trails that led to successful hunts or that reached heaven (Brody 1988; Ridington 1988b; Ridington 1990a; Ridington 1990b).

At one time, WBS maps were widely considered to be value-free and objective in their ability to communicate information, but today there is significant opposition to this view (Harley 1989; Turnbull 1989; Harley 1990; Monmonier 1996; Wood 1992; Aberley 1993; Johnson 1995; Mark 1995; Sheppard 1995; Morantz 2002). Maps represent reality in a way the cartographer or map-maker chooses and thereby represent the worldview of the map-maker in space and time (Harley 1990; Mark 1995; Montello 1997; Smith 1999; Raper 2000; Montello 2002). The determination of who collects data and information, the manner in which it is represented, and how a map is used underlies the power relationships between map-makers and map users (Raper 2000). Former HRFN Chief

Bernie Metecheah recognized that maps reflect the views of the worldview that create them when he wrote the following about maps produced by the B.C. government to depict boundaries of the Halfway River Critical Community Area:

> The territories depicted in these maps have supported our people for generations and must do so for generations to come. Because of this fundamental fact and because maps of this kind *reflect particular cultural and technical biases*, we believe it necessary to respectfully impose restrictions on the way these maps may be used (Metecheah 1998: 1; emphasis added).

Maps have been used to impose European concepts of space on Aboriginals and to dissemble and destroy the traditional Aboriginal connection to the land (Brealey 1995; Sparke 1998; Morantz 2002; Morris and Fondahl 2002). For example, re-naming features and areas of the landscape with European names proved an effective way for the dominant culture to claim ownership of the land. Smith (1999: 51) considered that maps were a tool used by Europeans to colonize space itself, where 'the line' was used to establish boundaries and partition the landscape into separate entities, and, "… space was appropriated from indigenous cultures and then 'gifted back' as reservations, reserved pockets of land for indigenous peoples who once possessed all of it." Willems-Braun (1997: 13-14) reinforced the idea that European maps drew up categorical divisions for North America as a way of creating the nation. He depicted the nation as a body, which was given flesh to its skeleton as non-native settlement occurred:

> The divisions of the survey introduced categories by which the land could be known and appropriated. … by constructing discrete entities – minerals, tree, Indians – these could be apprehended entirely *apart* from their surrounding, displacing and resituating objects within quite significant, but very different, orders of significance.

The portrayal of blank spaces on WBS maps is also important. Maps portraying areas as blank or white, empty spaces become interpreted as land deemed available for

exploitation by WBS resource managers unless this view is countered through other maps (Turnbull 1989; Brealey 1995; Johnson 1995; Belyea 1996; Duerden and Kuhn 1998; Olive and Carruthers 1998; Sparke 1998; Roddan 2000; Tobias 2000a). But even maps displaying TEK through the use of WBS mapping tools may under-represent First Nations use and occupancy of the land. For example, a map may show where salmon harvesting occurs but not the spawning area (Tobias 2000a).

2.2.2 The Role of GIS in Aboriginal Mapping

The dichotomy between WBS and traditional Aboriginal maps is intensified by the professional appearance of maps produced with a GIS, which can make any representation of data, information, or knowledge appear authoritative and convincing. Layering of thematic data in a vector data approach is viewed by many as an effective way to integrate First Nation information with WBS information, specifically by enabling First Nation, industry, or government decision-makers to evaluate First Nations land-based information in a form understood within the dominant WBS worldview (Duerden and Keller 1992; Poole 1995; Connery et al. 1996; Johnson 1997; Harmsworth 1998; Calamai 1999).

Inclusion of TUS, TLUOS, or LUOS information in a GIS has become a widely-established methodological step in land and occupancy use mapping (Johnson 1997; Tobias 2000a; Candler et al. 2003; Alberta Traditional Use Study Cross Ministry Committee 2004; Chambers et al 2004; Honda-McNeil et al. 2006). The B.C. government's TUS program included digital data as a central component of project deliverables (British Columbia Ministry of Sustainable Resource Management 2003). Many First Nation mapping practitioners continue to favour GIS over paper maps since

information held on paper maps is difficult to compare with data from elsewhere, and computers allow the user to produce other maps and add visualization if available. Other benefits to GIS use include the ability to provide decision-makers timely access to information, educating First Nation youth about resources, and enabling First Nations to maintain a database of their own information (Roddan 2000; Canada-BC 2001).

In contrast, others consider that GIS represent data, information, and knowledge of those users rooted in WBS dominant to that of others because of the inherent positivism on which GIS is founded (Rundstrom 1995; Chambers et al. 2004). Rundstrom (1995), for example, argued that a GIS promotes the further assimilation of First Nations into mainstream society because it only enables representation of First Nations information with WBS approaches, and actually constructs, through its analytical capabilities, a version of reality which precludes Aboriginal representations of space. Some First Nation practitioners have also expressed uncertainties concerning GIS use (Canada-BC 2001; Candler et al. 2003). GIS may not be consistent with Aboriginal views of the world, is not always considered to be value-neutral, leaves confidential information vulnerable through centralized storage, and may rely excessively on predictive modelling (Canada-BC 2001; Candler et al. 2003; Chambers et al. 2004). Data quantity is frequently emphasized over culturally accurate representation of TAW, and noteworthy debate exists over the ability of GIS to capture and represent Aboriginal values (Belyea 1996; Sheppard et al. 2002; Chambers et al. 2004). Further, GIS analysis typically does not represent temporal variation well, which may be in conflict with the dynamic nature of a TAW. A few First Nations even wonder if GIS should be abandoned in favour of paper maps because then their communities can achieve distinct aims, including maintaining

better control of their information and promoting community discussion of values without being constrained by computer representations of knowledge (Candler et al. 2003).

Some First Nations have experienced difficulties maintaining GIS use over the long-term. Issues include: the expense of updating software licenses, financial barriers to acquiring government spatial data, the costs of long-term training when most staff act in generalized as opposed to specialized roles, problems maintaining personnel, and the isolation of First Nations communities from a mapping support network (Johnson 1995; Canada-BC 2001; Williamson and Goes in Center 2001; Candler et al. 2003; Wilson and Graham 2005; DeRoy 2006). Robinson and Kassam (1998) stressed that communities need to thoroughly evaluate their current as well as projected costs. There may be a lack of capacity in communities to perform more complicated analysis tasks (Canada-BC 2001). Corbett (2003) further identified the risk that a community member may become hired outside the community once trained as a competent GIS operator.

2.2.3 Sources of Error and Perceived Error

A consideration of error also illuminates differences of approaches to mapping (including use of geospatial data) between WBS and traditional Aboriginal perspectives. Geospatial error, from a WBS perspective, is measured referencing accuracy, precision, and resolution. First Nations' mapping adopts these notions, although they are frequently incompatible with a TAW. Accuracy reflects the degree of correlation between real-world objects and their mapped counterparts. Mapping stresses locational accuracy, both horizontal and vertical. The application of a WBS map may render representations of relative distance unimportant, such as in the case of maps illustrating subway routes, but

many mapping practitioners consider that the very definition of a map involves the application of scale and scale-dependent relationships (Johnston et al. 2000). In a GIS, where a database may contain feature descriptions, accuracy of the descriptors may also be of interest to data users. Precision expresses the exactness of measurements. Within a WBS worldview, precision requirements vary from application to application. For example, in drafting or engineering work, high precision maps reflect values that record and display the measurement of an object's existing or proposed location to within millimeters. Analysis categorizing data by zip code locations require less precision. Highly precise data do not always indicate highly accurate data, although precise recordings may obscure inaccurate information. Resolution measures the smallest size discernable at a particular scale (Aronoff 1993; Lo and Yeung 2002).

The act of digitizing points and lines from paper maps or overlays can introduce errors through technological constraints or operational errors of omission or commission. Locational error as little as 1 mm on a 1:20,000 base map will introduce an additional 20 m error in recording of location (Tobias 2000a; Ministry of Forests 2001; Candler et al. 2003). B.C.'s Terrain Resource Information Mapping (TRIM) is reportedly accurate to within 10 m 90% of the time (British Columbia Ministry of Environment, Lands, and Parks 2001), although accuracy is variable across the province.

Issues of accuracy and precision also arise when producing maps. Paper maps created using digital mapping software are printed out at a designated scale. Feature representation on a paper map may or may not accurately represent the real-world size of that feature; for example, a 1/4 cm circle on a 1:250,000 map would cover 62.5m of the ground in the real-world. From a WBS perspective, where a feature like a grave covers a

specific portion of the ground which can be measured, 62.5 m may be too large.

In the WBS worldview, the greater uncertainty with data, the more suspect are decisions made based on it, and in WBS mapping and GIS data that are questionable are labeled as 'fuzzy' data. However, defining what constitutes error may be culturally based (Calamia 1999; Weiner and Harris 2003; Gibson 2004). Gibson (2004) observed that the accuracy of mapping boundaries reflected perceptions of location determined by the varying social values of participants. Therefore, there can be marked differences between WBS and TAW on the interpretation of accuracy and precision. Words used to communicate location, such as near or far, can also have cultural allusions (Brody 1988, Rundstrom 1995; McCall 2006). Further, traditional Aboriginal maps may seem to be confusing to people schooled in the WBS way of looking at spatial representation because geometry, scale, direction, or topology may appear distorted (Belyea 1996; Calamai 1999; Whitridge 2004). Features of great significance in a TAW may be depicted disproportionably to communicate their value within the Aboriginal culture. For example, the Ojibway people drew lakes with extraordinary spiritual or ecological meaning on larger scales than their real-world counterparts (Calamai 1999). Similarly, some Inuit traditional maps have shown places of greater significance larger than other places, irrespective of their real-world scale (Morantz 2002). Belyea (1996) also observed that traditional Aboriginal maps focus not on specific points but rather on connectiveness and pattern between features. Adhering strictly to WBS concepts of error may lead to a distortion of TEK and a loss of cultural context, and the ability to record locations with greater precision may reinforce the notion in resource management that specific areas are more valuable than the indistinct territory in between them.

TAW mapping may not emphasize the need for spatial accuracy, but First Nations' mapping within a WBS context must; research methods may end up being scrutinized during a court case in our judicial system, which is itself dominated by a WBSW (Tobias 2000b; Honda-McNeil et al. 2006; McCall 2006). In TUS or LUOS, the comparison of individual participants' map overlays can be used to suggest that location is communicated and recorded relatively accurately when points representing the same site are recorded near each other (Arima 1976; Union of British Columbia Indian Chiefs 1980a; Brody 1988; Tobias 2000a). Researchers contend that there is little incentive for members of an Aboriginal hunting culture to lie since information and knowledge are required for basic survival within a TAW (Union of British Columbia Indian Chiefs 1980a; Brody 1988; Rundstrom 1990; Tobias 2000a; Chambers et al. 2004). Non-literate peoples may also have been trained to store information in their memories for future recall, much more so than literate peoples (Arima 1976). This implies that information gathered is 'accurate', or at least not intentionally spurious. Blackstock and McAllister (2006: 26) discuss the implications of, "scale of interpretation," where Elders' recollections provide a mixture of location-specific information as well as a general sense of the landscape as a whole. Tobias (2000a) presented the view that the level of accuracy that is acceptable in community mapping projects can vary depending on the nature of the feature, since elements of knowledge vary from the site-specific, such as a cabin, to more pattern-specific, such as animal hunt sites (see: Weinstein 1997).

Researchers may use a Global Positioning System (GPS)[10] to improve the accuracy and precision of First Nations' locational data. Aporta (2003) recorded details

[10] Within this thesis, the acronym GPS represents both the singular or plural forms.

on 400 Inuit place names and 37 trails with a GPS. Robinson and Kassam (1998) noted that the collection of feature locations in the field using a GPS is an important step in validation of local knowledge, but that even without a GPS, projects can still produce useful maps. Further, Weiner and Harris (2003) observed that restricted access to traditional territories may prohibit collecting GPS and other field data. Although some First Nations consider that the confidentiality of significant or sacred features may be placed at risk when precise locations are recorded in a spreadsheet or other computer document, these risks may be mitigated through the use of buffer zones around points, lines, and polygons (see below) (Candler et al. 2003). The dimensions of a buffer, however, are drawn in a WBSW and thus are largely irrelevant to what the mapped features represent in a TAW.

2.2.4 PGIS and PPGIS

Participatory GIS (PGIS) and Public Participatory GIS (PPGIS) are approaches to combining WBS mapping tools and methods with community-based information and policy structures, and may assist in representing data, information, and knowledge with accuracy and precision reflective of local interpretations (McCall 2006). As indicated by the Open Forum on Participatory Geographic Information Systems and Technologies (ppgis.net), PGIS, "is an emergent practice [developed] out of participatory approaches to planning and spatial information and communication management." PPGIS is a related term that examines, "how GIS technology could support public participation for [a] variety of possible applications." In the literature as a whole, the two terms PGIS and PPGIS are frequently used interchangeably, and depending on the practitioner, the definition may underscore practice with or without emphasis on the technical

representation of community information. One of the major characteristics of PGIS/PPGIS is a significant degree of community participation, although it is noted that project outcomes are not always more successful given increased community participation (Sieber 2006). Schlossberg and Shuford (2005) state that the terms 'public' and 'participation' have not yet been categorically defined (see: Craig et al. 1999; Tulloch 2003).

PGIS/PPGIS has employed ethnographic methods to record community use of the land, including map biography interviews; interviewing people on tape and/or video; sketch mapping; satellite image and air photo interpretation; forest transect walks; mental mapping exercises; geovisualization; Participatory Action Research (PAR); Bioregional Mapping; and Cultural Mapping (Aberly 1993; Corbett 2003; Harris and Weiner 2003; Poole 2003; Tripathi and Bhattarya 2004). Much of the PGIS/PPGIS comes from projects in so-called developing countries (Gonzalez 1995; Harris and Weiner 1998; Cinderby 1999; Craig et al. 1999; Jordan 1999; Puginier 2000; Craig et al. 2002; Flavelle 2002; Hoare et al. 2002; McConchi and McKinnon 2002; Rambaldi and Callosa-Tarr 2002; Rambaldi and Van Lanh 2002; Mbile et al. 2003; Tripathi and Bhattarya 2004). PGIS/PPGIS distinctly emphasize bottom-up or grassroots planning (Craig et al. 2002; Harris and Weiner 2003). North American PGIS/PPGIS projects share commonalities with Third World projects in that the 'participating public' are on the periphery of centralized power and decision-making frameworks (Craig et al. 2002).

It is widely accepted that the next step in a PPGIS is loading the mapped data into a standard GIS (Rambaldi and Callosa-Tarr 2001; Nunez and Gonzalez 2003). In this approach, cultural information and knowledge then becomes treated like other forms of

data, such as roads, water features, and proposed buildings (Harmsworth 1998; Tripathi and Bhattarya 2004). Although some practitioners indicate that the strength of PGIS/PPGIS is its emphasis on conducting high-quality, social-based community research rather than a focus on technology, the limitations of using a GIS to represent or model qualitative information and knowledge is noted (Craig et al. 1999). Tripathi and Bhattarya (2004) argued that a true participatory process will consider the impact of representing data through a GIS at the beginning of the project.

2.3 Geospatial Representation, Manipulation, and Modelling of First Nations' Data, Information, and Knowledge

GIS approaches to representing Aboriginal data, information, and knowledge have been implemented by First Nations, academics, consultants, industry partners, and government agencies with the aim to: a) capture and reflect First Nation cultural context, and b) include TEK in a meaningful manner in decision-making contexts. Methodologies include combining PGIS/PPGIS methods with multimedia representations of TEK in GIS and Internet-based mapping, database modelling, buffers and site-based overlay, ranked and weighted modelling, and visualization. The following section summarizes and reviews approaches to mapping First Nations' data, information, and knowledge.

2.3.1 Linking Multimedia to GIS and Internet-based Mapping Approaches

To counter application of a 'top-down' technology to 'bottom-up' social processes, some researchers have developed approaches to capture and communicate community knowledge effectively using multimedia (Weiner and Harris 1999; Craig et al. 2002; Krygier 2002; Corbett 2003; Harris and Weiner 2003; Native 2003; Kingston et al. 2005). Multimedia are defined in this thesis as photographs, video, text, or audio

material that are used to express or communicate a viewpoint. A central component of Community-Integrated GIS (CiGIS) is the application of multimedia to capture and convey community knowledge from a community perspective (Weiner and Harris 1999; Harris and Weiner 2003; Weiner and Harris 2003). Weiner and Harris (2003: 63) argue that:

> Linking narratives, oral histories, photographs, moving images, and animation to GIS provides enormous capability to increase not only the richness and diversity of the information available but also more closely parallel the manner in which communities know or conceive their space.

Researchers also found that multimedia elements effectively supported the capture and communication of data, information, and knowledge presented in qualitative forms and used the GIS software ArcView 3.x to display multimedia elements and to digitize polygons originally created by participants on paper maps during mental-mapping exercises.

Corbett (2003) studied and evaluated empowerment in Indonesian communities through application of a Participatory Geographic Information and Multimedia System (PGIMS).[11] A PGIMS is defined as, "a system for managing, referencing, and accessing digital information stored in textual image, video, and audio format, using [a] … Cartesian map interface as the primary organizational tool," (Corbett and Keller 2005: 27). Multimedia capturing community knowledge was accessed through HyperText Markup Language (HTML) links superimposed on an Internet-based static map.[12]

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[11] In his Ph.D. thesis, Corbett uses the term PGIS. In other publications, for example Corbett and Keller (2006), the term Community Information System (CIS) is used to describe the approach used in Corbett's thesis work. CIS is defined as: "digital map-based multimedia information system" (Corbett and Keller 2006: 22).

[12] Static maps are posted in .jpg, .gif, .tif or .png formats and are not interactive unless additional software tools enable users to modify data and create a new image.

Corbett suggested that any multimedia data that were stored in the computer could be included within the terminology of community geographic information, given that some participants opted not to use the Cartesian map image, instead discussing spatial concepts through reference to the multimedia records exclusively. Corbett (2003) concluded that multimedia were an effective way to represent cultural features, particularly where oral communication comprised cultural practice. For example, images of territorial boundaries and community members discussing them proved a successful way to encapsulate local knowledge. The PGIMS was used by the communities to present documentary evidence of significant events, communicate local information to future generations, and inform outsiders of community perspectives (Corbett 2003). Weiner and Harris (2003) and Corbett (2003) concluded through their work with computer multimedia and Indigenous peoples that multimedia enable communities to express the way in which they envisage their space.

GIS software was not used by Corbett in PGIMS because of the expense associated with it, and also because of the intensive training GIS requires. By using freely distributed Internet browser software, there were no licensing costs incurred by the communities involved. The software differed further from most proprietary GIS in that it did not georeference map images and provided no computer analytical or query capabilities. Corbett and Keller (2006) recommended that part of the participatory process should involve the design of an appropriate base map with community members since the map image they used was not wholly representative of the community's perception of the land.

Researchers using multimedia in other projects observed that the use of

multimedia increases the familiarity of locations for users. RezMapper incorporated georeferenced layers, aerial photographs, and remote sensing images with Lakota songs, stories, and historical photographs (Native 2003; SGU 2004). Other First Nations use web-based mapping tools to record, store, and access information on their communities and traditional lands. Static maps can easily be posted on a website in an image format (similar to posting a photograph) and are common on the Internet.[13] For example, Ecotrust Canada posted a map showing overlapping B.C. 'Statement of Intent' boundaries in support of the treaty process (Boundary n.d.). The federal government posted a map showing historical First Nation treaty boundaries (Historical n.d.). The Gixtsan displayed a map of house territories (House n.d.).

Some Internet maps use static images with links to other files to communicate data, information, or knowledge. The Kitikmeot Heritage Society produced a place name atlas which linked files providing translation in syllabics, a summary of its meaning, and connections to audio files demonstrating pronunciation for each place name (Kitikmeot 2003). The Tuulliq Map Project used a static image enhanced with a hillshade image for its map, and linked files containing information on place names (Tuulliq n.d.). The Alaska Rural Systemic Initiative Cultural Atlas Project (Alaska n.d.; Angoon 1999; Organized 1999) also combined multimedia files to display collections of related First Nations materials.

A few sites use web-based mapservers, which create options for increased

[13] During the research phase of this thesis, static maps were the dominant type of map on the Internet. As this thesis was being written and edited, interactive maps, particularly from interfaces using Google Maps (or digital earths including Google Earth), became more widely used as ease of use and availability of tools enabling users to place their own data on Google Maps increased. In addition, the availability of high-speed Internet, which supports the display of larger files such as the image files used in Google Maps, has become more widespread.

interactivity (Mitchell 2005). For instance, Haisla First Nation (Haisla 2003) employed both Arc Internet Mapping Server (ArcIMS) and SmartMap to display its cultural layers with government geospatial information. The Red Roads HIV/AIDs Network GIS project used web-mapping technology in its efforts to serve First Nations with treatment and other information (Lindenbaum 2006).

Many First Nations offer open access to their sites, while some are password-protected to maintain confidentiality, and others operate exclusively on a community Intranet (Alaska n.d.; Angoon 1999). There may be risks to a First Nation that displays its TEK publicly over the Internet regardless of whether or not information and knowledge is geospatially linked or appears in forms of multimedia. Carpenter and Feldberg (2005), in their paper on using publicly available information to assess and manage Aboriginal risks, identified avenues to information that may aid industry during their consultations with First Nations. Noteworthy is their identification of websites which display First Nations cultural information as a valuable means for industry to make, "an initial assessment of the Aboriginal risks of potential development," (Carpenter and Feldberg 2005:2). Industry representatives may therefore use community sanctioned and posted information to inform themselves about First Nation culture and values, and use this information to formulate preconceived notions of risk, before face-to-face consultation over proposed resource management projects with a First Nation begins.

2.3.2 Database Modelling

Approaches to representing First Nations' data, information, and knowledge have also focused on database modelling and manipulation. GIS store their data in a database containing georeferenced coordinates as well as descriptive information about each

feature. Inclusion of data into a GIS may require flattening or simplifying data to fit the database template and lead to loss of information. 'Data mining', to identify information amongst different layers, is a widely-practiced form of GIS analysis and may lead to extraction of fragments, largely void of context. A few projects with First Nations have implemented more complex database structures as methods to represent cultural linkages between elements, for example by using key terms to reflect basic relationships between cultural features (Karjala 2001; Lheidli and McGregor 2001; Saab 2003; Karjala et al. 2004). However, a contextual disparity remains between TEK and its representation in these databases because the databases do not capture the full cultural meaning of TEK (Karjala 2001; Lheidli and McGregor 2001; Saab 2003; Karjala et al. 2004).

The challenge to including worldview in a WBS database is not necessarily limited to a TAW, because representing human knowledge with a computer is difficult under any circumstances. Schoenhoff (1993: 130) observed that knowledge is, "contextual, situational, existent, incorporative, simultaneous, experiential – a long list of adjectives that do not apply to the way in which knowledge is acquired, stored, and retrieved on the computer." However, when WBS data are accessed and used for decision-making from a WBSW, the person doing so brings with her/him WBS understandings that become significant to interpretation. Furthermore, abstraction tends to increase across cultures (Schoenhoff 1993). Translation from original research materials, including interview or video transcripts of Elders' oral narratives, results in abstraction of data, information, and knowledge and loss of meaning or context (Mensah 1996; Duerden and Kuhn 1998; Candler 2000; Candler et al. 2003). First Nations may have traditional ways of classifying, but they may be different from the WBS approach.

For example, Classen (1999) observed that the Desana classify plants by odour. Blackstock and McAllister (2004) recorded that the Secwepemc language contains words linking plant communities with elevation change, and that these classifications were communicated as part of the Secwepemc oral history tradition. Davidson-Hunt (2003) recounted being told by an Elder that it would be disrespectful for him to classify plants since the Elder knows each plant individually through his dreams.

TUS, TLOUS, and LUOS stored within a GIS typically use relational databases to store condensed versions of collected knowledge. The B.C. government TUS projects required that data be recorded using one or two word descriptors for each site, for example moose, beaver, village, and dry meat (Weinstein 1998; Roddan 1999; Roddan 2000; British Columbia Ministry of Forests 2001). Interview design was left up to the communities; however, the government encouraged collection using points rather than lines or areas and TUS categories were largely determined by the government and provided to First Nations (British Columbia Ministry of Forests 1996; Weinstein 1998; Roddan 2000; Markey 2001; British Columbia Ministry of Forests 2001). From her work with the Sliammon First Nation, Roddan (2000) found site classifications developed by the government too numerous and not very meaningful to community members. Weinstein (1998) further observed that the databases may provide a means for the government to have access to First Nations information without having to talk to the First Nations who hold this knowledge, thus potentially enabling the government to make decisions on behalf of First Nations without fully understanding their cultural context.

Calamai (1999) argued that community members must actively participate in the development of data structures so as to include their views and values. Categories chosen

by First Nations may be related directly to their cultural views and differ from WBS classifications (Saab 2003). Few projects have developed database categories interactively with First Nations. In his work with two Indonesian communities, Corbett (2003) reported that categories selected by participants using local land use types proved to be an effective way to include Indigenous cognition of the land.

Aboriginal linguistic descriptions may reflect an understanding of space and place that differs from WBS resource management (Fossett 1996; Calamai 1999; Morantz 2002; Aporta 2003; Whitridge 2004). One success in representing TAW through WBS databases has been through the recording of Aboriginal place names, which reflect components of Aboriginal knowledge. Place names describing knowledge of topography and associations that occur with each place, such as caribou migration, can readily be included in a typical database (Burch 1998; Stewart et al. 2004; Auld and Kershaw 2005). Links to audio recordings that demonstrate pronunciation enhance preservation and recognition of cultural values (Corbett 2003; Harris and Weiner 2003; McCall 2006).

2.3.3 Buffering and Site-based Overlay

The use of buffer zones is prevalent in GIS. Buffers are typically feature-based polygons that are created around a point, line, or polygon spatial entity. The use of buffers is promoted in resource management since buffers may satisfy First Nations requirements to restrict information of the exact locations of significant features; a First Nation with GIS capabilities is able to release information to government, industry, or the public on only the buffers, and not the actual points, lines, or polygons (Tobias 2000a; Honda-McNeil and Parsons 2003; Chambers et al. 2004). Individual buffers can also be joined so that a large land area is placed within the buffer, obscuring location specifics.

The buffers can then be used to estimate impact on recorded Aboriginal land use and occupancy sites through spatial intersection analyses conducted in a GIS (Figure 1).

The use of buffers for protecting confidentiality of sites so easily fits the way that WBS mapping systems function that government and industry have come to expect buffers from First Nations, despite the fact that some First Nations have raised concerns about their application (Candler 2000; Candler et al. 2003). Buffers preclude taking into account any value that is expressed outside the predetermined buffer width. For example, values such as the view from gravesites will not necessarily be protected even if a buffer is placed around the graves themselves. Buffers enable First Nations' data to be removed from a community, where it can be used by industry and government to make and implement land use decisions on behalf of a First Nation.

The buffer distance assigned to features may be arbitrarily chosen. Elders typically have little or no experience in working with computers and might not fully understand what is being asked when they are approached to select a buffer width. The buffer width may also be determined as an operational distance and imposed by the government with no input from First Nations. Further, the standard approach to calculating buffer distance in a GIS is over Euclidean distance. Creating buffers that use frictions as weights might improve the buffering process (Ebert 2003); for example, buffers could be weighted by topography which affects the way sound travels.

Strongly interrelated with buffering is the practice of using a GIS to perform spatial overlays. For example, TUS sites are buffered out to some predetermined distance and then intersected with proposed management features, including roads, well sites, cutblocks, and seismic lines. Locations where the TUS and management features

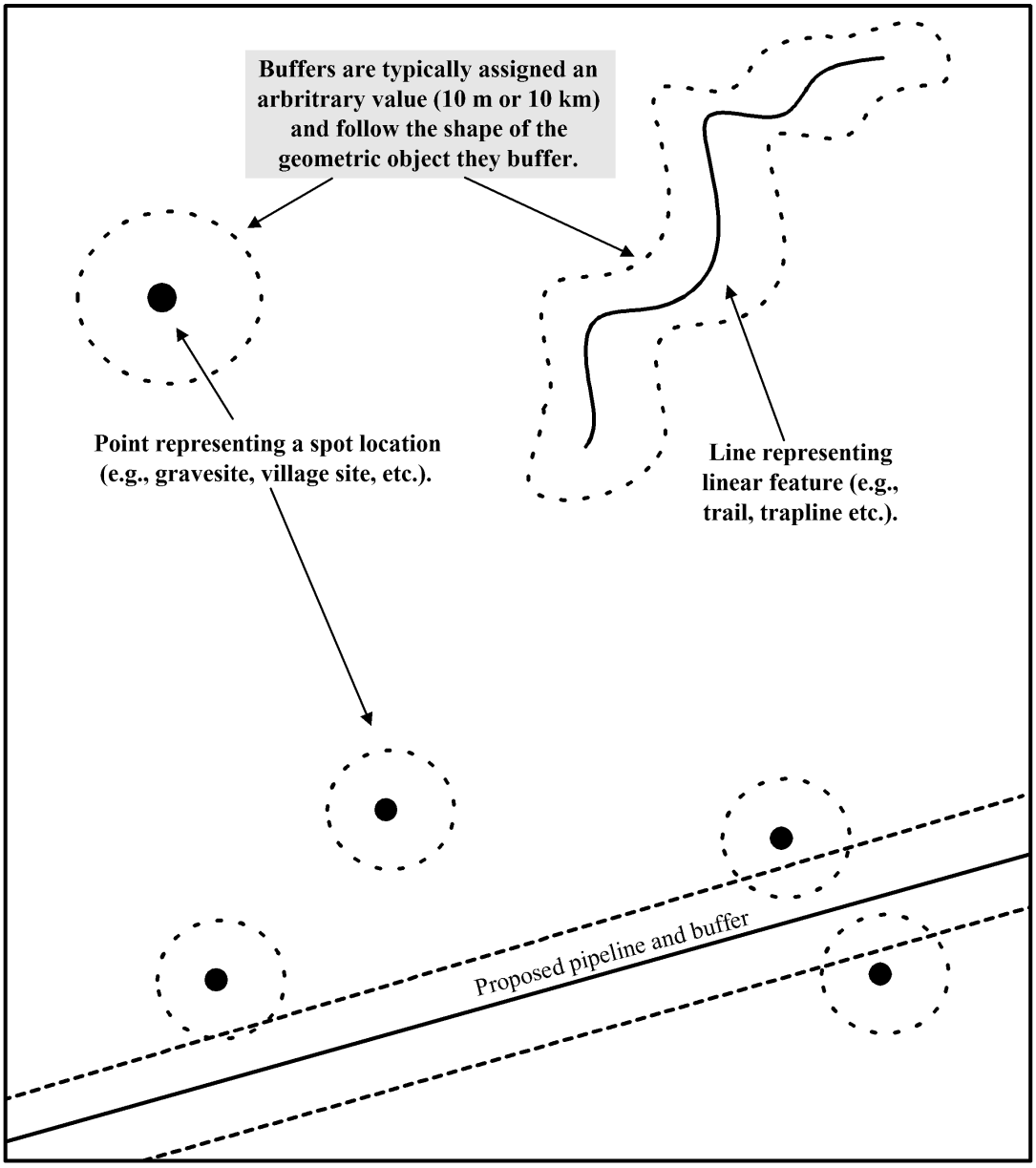

Figure 1: Buffering spatial objects and analyzing for intersections is prevalent in resource management and planning. In the example, resource managers focus on the intersection of the point buffers representing cultural values with the buffer around a proposed development. Points and buffers falling outside this intersection are considered to be largely irrelevant to WBSM concerns, although their values may still be impacted by the development. In this case, resource managers use only presence and proximity to define significance.

intersect are flagged for mitigation (Figure 1). This approach to management is not new and was practiced using paper maps and overlays long before computer mapping tools

were popular. For example, Sneed (1978) used paper maps to represent the zone around the proposed Alaska Highway Pipeline right-of-way (approx. 4 km or 2.5 miles) and to create a probability model of impacted archaeological sites by highlighting the intersection of known and predicted sites within the buffered corridor.

2.3.4 Ranked and Weighted Modelling

Ranked and weighted models are also used to include First Nations' values into resource management decision-making frameworks. The Coast Information Team (CIT) Conservation Area Design (CAD) had the goal to provide management information to support ongoing planning processes in the Central Coast, North Coast, and Haida Gwaii Regions of B.C. (Lee 2004; Rumsey et al. 2004). First Nations' values, originally recorded as points, were included as weighted polygons with third-order watersheds used to define polygon extents. Each polygon was given an attribute reflecting the number of points, or land use and occupancy site locations, per hectacre (Lee 2004; Rumsey et al. 2004) (Figure 2).

The approach was criticized by researchers involved in the project. For example, Lee (2004) concluded that the method insufficiently depicted First Nation cultural values, since the relative significance of each feature was not represented. Menzies (2004: 15) reported that the, "over-all buy-in of First Nations was limited," because of general worldview-based barriers in integrating TEK and non-Aboriginal information, and these barriers, "raise[d] concerns about the…overall methodology and process of implementation."

The Taku River Tlingit Traditional Territory CAD involved interviewing Tlingit hunters and recording their knowledge relating to focal animal species as a means to

supplement weighted polygons representing landscape and ecological values (Heinemeyer 2003; Taku River and Round River 2003). Interviewees also communicated their preferred land use objectives and strategies and identified broad land use zones.

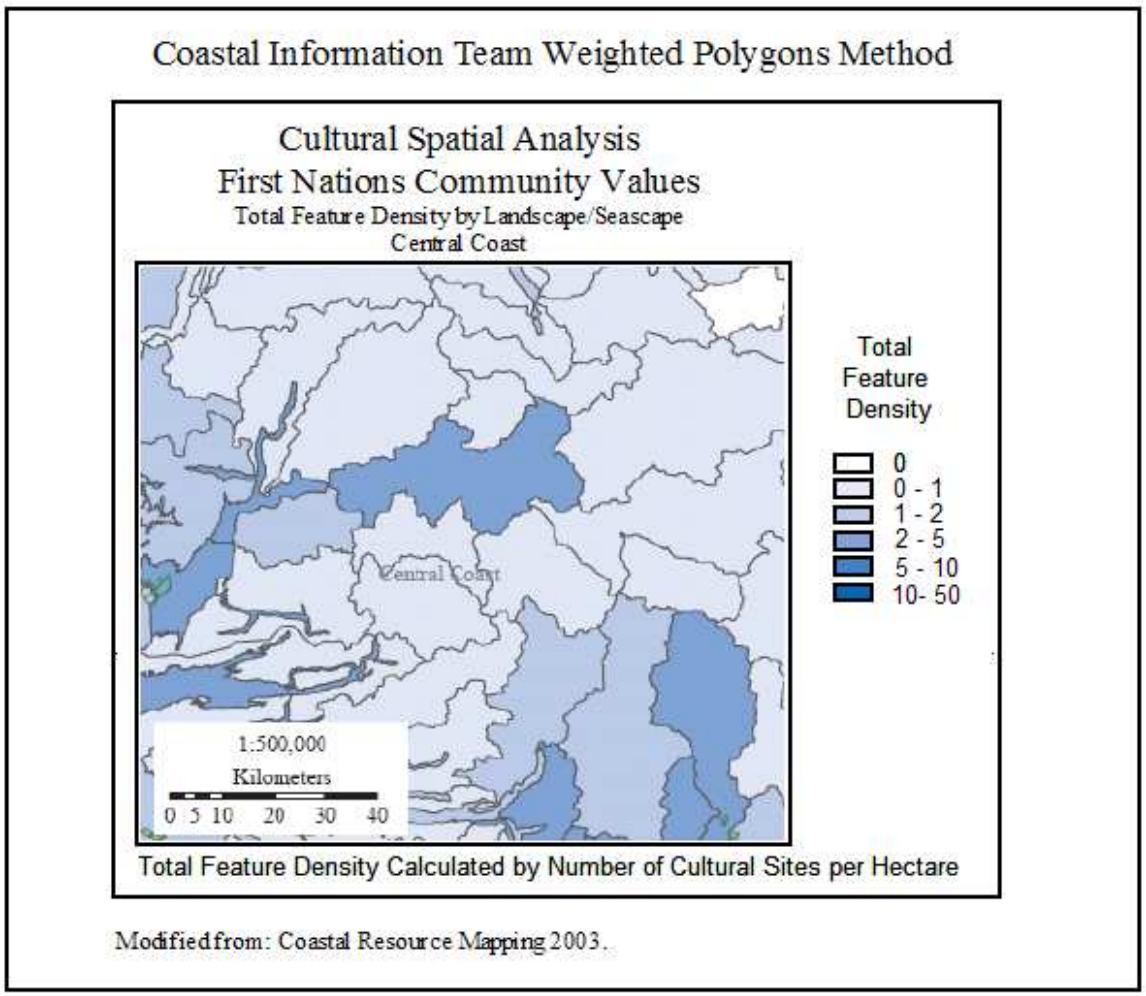

Figure 2: Using third-order watersheds as boundaries, the Conservation Area Design (CAD) developed by the Coastal Information Team (CIT) weighted polygons by cultural values (Lee 2004; Rumsey et al. 2004). Shading represented data density, calculated as the number of cultural sites per hectare. The approach was criticized for failing to capture and communicate the relative significance of each site (Lee 2004; Menzies 2004).

Conclusions were that the project could have been improved by incorporating more extensive mapping of significant and special places (Taku River 2003). Further, researchers reported that collected TEK knowledge was seen to be, "patchy," and did not

address issues of ecosystem connectivity as well as WBS methods (Round River 2003: 16).

Norwegian and Cizek (2004) used land use and occupancy interview information to create weighted polygons depicting the number of land use activities per km^2 in the Deh Cho Territory in south-western Northwest Territories. Two main approaches, the quadrat and kernel estimation methods, were applied to create weighted polygons representing density of TEK values across the landscape. The quadrat method tallied the number of individual LUOS points falling within each cell of a grid using two grid sizes: 1,000 m (1 km^2) (Figure 3A) and 10,000 m (100 km^2) (Figure 3B). The kernel approach calculated the number of points falling within a radius placed around each grid, using a grid size of 1,000 m (1km^2) and a search radius (or buffer) of 10,000 m (Figure 3C).

Both the quadrat and the kernel methods were successful in providing output which protected the confidentiality of individual First Nation site locations. The results could also be combined with non-First Nations' data within a GIS. However, the analyses resulted in considerable variance, as shown in the end map products (Figure 3) and summarized in Table 1. Bailey and Gattrel (1995) criticized the quadrat method since it reduces the detail level of data from its original source through the process of converting points to areas. Norwegian and Cizek (2004: 11) reported that, "many people admired the aesthetics of the kernel density analysis, [but] it was not relied upon in the [land] negotiations as the actual number of land use activities in a particular cell could not be counted using simple arithmetic." To update the resultant maps, extensive knowledge of GIS would be required.

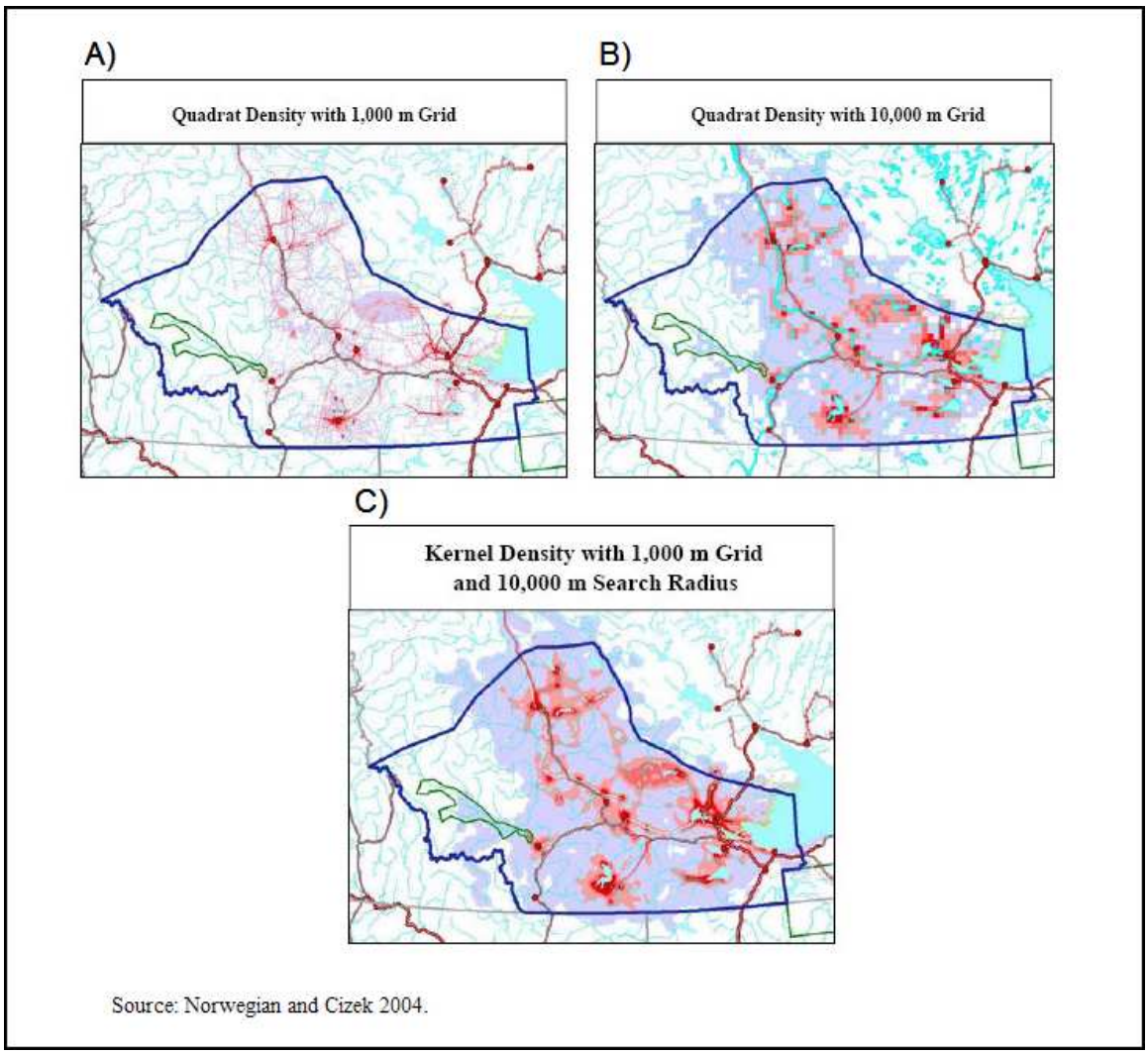

Figure 3: Maps from Norwegian and Cizek (2004) in which darker shades represent higher LUOS values. The spatial extent of TEK values was displayed variably depending on which method was used for ranking TEK density under the quadrat and kernel approaches. The quadrat approaches result in the smallest areas whereas the kernel density approach results in the largest area. Table 1 provides a numerical summary of these visually presented data. No scale bar was provided in original source but each frame is approximately 850 km wide.

Table 1: Summary statistics of quadrat and kernel approaches to calculate density of land use activity. Grid area calculates km^2 with land use activity for each method. The first quadrat approach uses a 1 km^2 grid size and records the smallest overall area at 56,534 km^2 (Figure 3A). The second quadrat approach, using a 100 km^2 grid size, reflects a larger land area (Figure 3B). The inclusion of the 10,000 m search radius in the kernel approach results in the largest area recording the presence of land use activities (Figure 3C). The search radius acted to smooth out variation between cells, and thus the variation of the kernel method falls between the two quadrat approaches. The 1,000 km^2 quadrat approach shows the greatest range between minimum and maximum values and demonstrates the greatest variation because its finer grid size captures higher density areas (Norwegian and Cizek 2004: 9-10).

Number of Land Use Activities Per Square Kilometre (Density)						
Type of Density Analysis	**Grid Area (km^2)**	**Min**	**Max**	**Mean**	**Median**	**Std. Dev.**
Quadrat 1,000 m (1 km^2) Grid	56,534	0.0001	116.34	2.77	2	4.29
Quadrat 10,000 m (100 km^2) Grid	169,200	0.01	15	0.92	0.41	1.49
Kernel 1,000 m (1 km^2) Grid, with 10,000 m Search Radius	199,590	0.000001	20.92	0.78	0.31	1.36

2.3.5 Visualization

Computerized three-dimensional (3-D) visualizations of the landscape may create a more realistic depiction of the landscape than GIS alone and may also permit community members to consider visual approximations of past or future landscapes (Lewis 2000; Sheppard et al. 2002; Lewis et al. 2004; Sheppard et al. 2004). Visualization models can trigger participants' memories, and studies have indicated that Elders who cannot readily read planar maps may recognize places on 3-D representations of the land (Duerden and Keller 1992; Lewis 2000; Sheppard et al. 2004). Visualizations may also empower Elders whose health compromises their ability to travel on the land by enabling them to participate more fully in community discussions.

Software to produce computer 3-D visualizations for First Nations in B.C. includes ArcMap 8.x or 9.x (or ArcView 3.x) with its 3D Analyst module, Ecomodeller,

and World Construction Set. Lewis and Sheppard (2005), for example, used World Construction Set scenarios (static images) to collect community input from the Cheam First Nation on spiritual and other values as they related to forest management. The process to create visualizations may have a steep learning curve and skills are best maintained through regular use. Most First Nation mappers have other responsibilities in their jobs, so generally First Nations rely on outside contractors to do more complicated visualization work (Canada-B.C. 2001; Brooks, C. Pers. Comm. 20 Nov. 2003; Sheppard et al. 2002; Sheppard et al. 2004).

Computer technology has also been used with First Nations to create large-scale visualizations depicting land use and community change over time. These large-scale projects are not necessarily maps, but may support efforts to map First Nations' data, information, and knowledge through their encouragement of community discussion around values related to place. Two such projects are the Digital Songlines project with Australian Aboriginals (songlines.interactiondesign.com.au) and the University of British Columbia (UBC) Ancient Spaces program, which has the goal of reconstructing an ancient Nisga'a Village (ancient.arts.ubc). Both projects require significant computer infrastructure and a high level of computer knowledge. The Digital Songlines project uses proprietary software whereas Ancient Spaces uses Open Source software. Each project aims to use 3-D images as a way of stimulating community discussion and possible recounting of stories and memories by Elders.

2.4 Summary and Conclusion

The communication of TAW by First Nations to external resource managers and planners is hindered by the practice of representing traditional Aboriginal knowledge

through WBS maps and mapping tools. Although excellent community-based research methods exist to collect knowledge, the inclusion of TEK with WBS geospatial tools results in TEK having to conform to WBS rules of representation and communication. Maps are subjective based on the map-makers worldview. Cartographic messages communicated from the dominant WBSW will likely reinforce notions of power to the detriment of other views, a practice that is strengthened when First Nations' data, information, and knowledge are represented independent of their cultural context and meaning. Moreover, concepts of validating the usefulness of map content, namely accuracy, precision, and resolution, originate in a WBSW. Data, information, and knowledge that do not easily conform to WBS measurements of credibility are liable to be misunderstood, are technically difficult to incorporate with other forms of data, and may be discounted.

Existing approaches to representation, manipulation, and modelling of First Nations' data, information, and knowledge were summarized and reviewed for possible application within this project. It is clear that no one approach is definitive in its ability to include TAW and TEK in WBS planning processes. Some potential impediments to the successful implementation of a geospatial approach with the HRFN were identified from existing challenges with First Nations, including: costly software licenses; training and maintenance of skills; requirement to have outside parties complete more complicated work; abstraction of knowledge to a format incompatible with a TAW; potential issues over First Nations' ability to control and update recorded data, information, and knowledge; risks associated with sharing TEK; and reliance on existing concepts and approaches. But to participate fully in resource management, First Nations must present

their views in a format understood by the dominant worldview.

2.5 Principles identified from the literature review central to the creation of a geospatial communication system:

2.5.1 Principle 1: Incorporate community-based research methods in working with the HRFN to identify characteristics of the geospatial approach.

Community-based research methods should be employed when working with the HRFN. These methods may include ones that are already familiar to HRFN from previous community studies and should be determined with HRFN members during the planning stages of the project. In addition to providing new or additional information to guide the development of the geospatial approach, community-based research methods have the potential to contribute towards the creation of trust and sharing between external researchers and community members, and may create other benefits for community members, including opportunities for members to visit culturally significant locations and for the transfer of knowledge from Elders to youth. Community-based research methods should also be used to receive feedback from participating members on the representation of their TEK in existing and newly developed geospatial approaches.

2.5.2 Principle 2: Identify and address threats to sustainable use of geospatial tools, where feasible (e.g., identify and address training and capacity concerns and issues over costly software licensing).

Where possible, threats to sustainable use of the geospatial approach and its supporting technical tools must be identified and mitigated. Recognition of threats may occur when identified overtly by First Nation members, or through observation of past and present patterns of GIS use. Formulation of strategies to mitigate threats should become an active part of the implementation of the geospatial approach, for example through HRFN participation in the development of training methods and materials.

CHAPTER 3: 'WHERE WE WALK FROM': UTILIZING PRINCIPLES AND PRACTICES OF COMMUNITY-BASED RESEARCH TO CREATE A GEOSPATIAL APPROACH FOR INCLUDING FIRST NATIONS' VALUES IN RESOURCE MANAGEMENT

3.0 Introduction

A portion of the title for this chapter, 'Where we walk from', comes from a question asked at or near the beginning of each research interview, when interviewers would ask Elders 'Where are you from?' A rough translation from the Beaver language to English of the phrase, *Je dots'eh annach'ę*, is 'Where did you walk'.[14] The fact that Beaver language can conceptualize one's place of origin as the place where one walks from epitomizes a dominant cultural practice of the HRFN people, who were traditionally nomadic. The impression of walking underlies how HRFN attachment to place, which is conceived from knowledge gained while using their traditional territory,[15] is central to HRFN TAW. Different family groups retain strong experiential knowledge of those areas most familiar to them.

This chapter summarizes methods undertaken to identify and describe characteristics of traditional HRFN values. These steps were taken as part of the overall goal of designing a geospatial approach that would accurately communicate these values. Accordingly, this chapter begins by defining values. Next, literature relevant to methods and historical background on the HRFN are summarized. Community research methods

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[14] Other translations discussed amongst Beaver speakers included 'Where do you come from?' and 'Where are you from?'

[15] The 'traditional territory', or geographic area and natural resources historically used and occupied by a First Nation is typically much larger than a First Nation's reserve lands. Reserve lands are defined as a tract of land, the legal title of which is held by the Crown, set apart for the use and benefit of a First Nation (Department of Indian and Northern Affairs Canada 2003). Campbell (1996) presents the view that reserves, unlike the traditional territory, were not designed to sustain a First Nation economically, but to contribute towards the assimilation of First Nations into the mainstream population by eliminating their ability to live off the land.

employed with HRFN participants are described. Main themes identifying and discussing HRFN views on the land are used to summarize results. Finally, characteristics relevant to the description of HRFN values within a spatial context are identified and discussed. The chapter concludes by identifying principles central to the development of a geospatial approach to communicate Aboriginal values in a resource management context.

3.1 Defining Values

The Oxford English Dictionary defines a value as something having worth or worthiness (Oxford 2005). Morford et al. (2003: 3) defined values as, "core beliefs that form the basis of individuals' attitudes and actions." Defining values is subjective, variable, and dependent upon one's viewpoint. Values may be intrinsic or extrinsic (Morford et al. 2003; Hawley et al. 2004) and vary over time or as the opinions of the value-holder change (Parsons and Prest 2003). Community values may differ from those of an individual.

A TAW encapsulates knowledge that indicates what the important beliefs and elements of a culture are (Chambers et al. 2004; Hawley et al. 2004). It may not be possible for those from outside a First Nations' culture, or a First Nations person who does not have strong ties to her/his cultural practices or language, to identify with some or all traditional values. The literature, however, stresses that many Aboriginal values are closely connected to the land or traditional territory (Parsons and Prest 2003; Chambers et al. 2004; Hawley et al. 2004; Wilson and Graham 2005). Treaty 8 Tribal Association (T8TA) participants attending the Muskwa-Kechika Advisory Board's (MKAB) 'Incorporating First Nation Values' workshop asserted that the land is at the very core of

First Nation values (Cross Country 2003). Treaty 8 participants also identified traditional knowledge, revenue sharing, co-management, archaeological sites, animals, carving stones, place names, and traditional routes amongst their values (Cross Country 2003). Some participants emphasized that traditional values cannot be assigned a monetary equivalent (Cross Country 2003).

Resource management practices in British Columbia are undertaken with direct reference to specified values, for example, of individual species, resource industries, conservation, habitat preservation, Aboriginal culture, economic growth, recreation opportunities, and sustainability of local communities. Joint planning exercises, in particular Land and Resource Management Planning (LRMP), were designed to integrate values from private individuals, industry, commercial enterprises, First Nations, and government in consensus-based decision-making. These processes resulted in identifying the values that now form the foundation of provincial resource management planning (British Columbia Ministry of Sustainable Resource Management 1997). Subsequent planning procedures and documents to the LRMPs refer to the specific objectives and strategies determined by each LRMP on a zone-by-zone basis.

3.2 Security and Release of HRFN Traditional Knowledge

This project was only possible because HRFN community members shared sensitive cultural information. From the outset, an agreement existed that records of TEK would remain in control of and be returned to the community. This was formalized in the Research Agreement (Appendix 2) formulated between external researchers and Chief and Council and HRFN research participants. Three levels of communication, representing increasing detail and confidentiality of HRFN TEK, existed within this

project. The first level reported the fewest specifics on HRFN TEK. The second level consisted of TEK released under strict conditions from the community for reference in particular circumstances. For example, the community or individual members may have openly communicated TEK at this level in the form of reports, books, information provided to consultants, or during presentations on this study. The third level TEK was confidential material kept within the community. Characteristics of TEK from the second and third levels were described in this thesis when necessary to demonstrate how the geospatial approach successfully encompassed them. However, where examples in this thesis refer to second or third level TEK, simulated data, which preserved authentic qualities but had been manipulated to conceal identity and location, were substituted.

3.3 Literature Review

To prepare for research with the HRFN community, a literature review was conducted on community-based research methods. Published information on the HRFN was also reviewed to provide background and is summarized below.

3.3.1 Literature Relevant to First Nations Community-Based Research Methodology

Literature relevant to community-based research includes ethnographic research methods, ethics in community research, selection of sample size and method of sample selection, validity and reliability, and approaches to data analysis.

3.3.1.1 Ethnographic Research

Ethnographic literature provides direction on methods to collect knowledge on what people think, know, and have experienced. Ethnography is defined as, “an approach to learning about the social and cultural life of communities, institutions, and other settings,” (LeCompte and Schensul 1999: 1) and it may address beliefs, attitudes,

perceptions, emotions, verbal and nonverbal means of communication, social networks, behaviours of groups or individuals, use of tools, and patterned use of space and time (Ervin 2000). Ethnographic methods have been used in land claims negotiations, environmental assessment, resource management, cultural preservation, and other projects important to First Nations (Duerden and Kuhn 1998). LeCompte and Schensul (1999: 9) identified key characteristics of an ethnographic study:

- Takes place in a natural setting as opposed to a laboratory;
- Involves face-to-face contact with participants;
- Presents an accurate reflection of participants' perspectives and behaviours;
- Uses inductive, interactive, recursive data collection, and analytical strategies to identify local cultural theories;
- Uses multiple data sources, including both quantitative and qualitative data;
- Frames all human behaviour and belief within a socio-political and historical context; and,
- Uses the concept of culture as a lens through which to interpret results.

Research attaining the greatest level of success for both external researchers and internal participants involves local participation in the planning and design of studies and methodology as well as ensuring that rigorous methods are used (see: Freeman 1976; Johnson 1992; Bernard 1995; Bird 1995; Mitchell 1997; Association of Canadian Universities for Northern Studies 1998; LeCompte and Duerden and Kuhn 1998; Rahman 1998; Bryman and Burgess 1999; Calamia 1999; Schensul et al. 1999a; Schensul et al. 1999b; Schensul et al. 1999c; Seale 1999; Sherry and Vuntut Gwitchin First Nation 1999; Smith 1999; Bernard 2000; Ervin 2000; Round River 2003; Toupal 2003). Examination

of secondary sources, including books, journals, reports, maps, and aerial photos, may provide researchers with related background information (Bernard 1995; Ervin 2000).

Participatory Action Research (PAR) is a specific kind of ethnographic method that supports building community capacity to conduct research, generate knowledge, transfer skills through training and experience, and create partnerships between non-Aboriginals and Aboriginals (Robinson et al. 1994; Robinson and Kassam 1998; Sherry and Vuntut Gwitchin First Nation 1999). A community project employing PAR methodology develops within a, "unique local context," with, "The key to successful PAR research [being] the maintenance of flexibility, innovation, and sensitivity to the needs and lifestyles of the community that the … project serves," (Sherry and Vuntut Gwitchin First Nation 1999: 46-7). Duerden and Kuhn (1998), in their examination of traditional knowledge in the Canadian North, found that land use planning exercises that were the most successful were those that involved local people in the planning and design of both studies and methodology. Projects using PAR methodology begin when a community identifies a research need. Community members typically participate in directing all aspects of the project. Robinson and Kassam (1998) note that a community advisory committee may partner with an outside organization, for example a university, whose researchers provide or guide training and project methods. Sherry (2002: 41) identified central components of participatory research, namely:

> establishment of a co-operative research venture…; meaningful involvement of participants at major research stages (e.g., research design, verification, and evaluation); broad community involvement (e.g., use of local research advisors, disseminating of research results using newsletters and oral presentations); employment of community-based researchers, interpreters, translators, and co-ordinators; provisions of training for project staff; guaranteeing community ownership of information and control of its uses; promoting self-sustaining capacity for local research; and efforts to nurture self-identity and promote

empowerment….

PAR is considered an integral element of TLUOS methodology and practice (Candler 2000; Roddan 2000). TLUOS comprise a specific approach to recording traditional knowledge that employs principles of ethnography and uses open-ended interviews and map biographies (Robinson and Ross 1997; Robinson et al. 1994; Robinson and Kassam 1998; Roddan 2000; Tobias 2000a). Tobias (2000a: 2) identifies categories of knowledge that are typically mapped in land use and occupancy studies:

- Places where animals are harvested for food, clothing, medicines, tools and other purposes;
- Places where plant materials are harvested for food, clothing, medicines, tools, shelter and fuel;
- Ecological knowledge of habitats and sites critical to the survival of important animal populations;
- Animal migration corridors;
- Legend and other accounts about specific places;
- Travel and trade routes; and
- Aboriginal place names and their significance.

The map biography method can be complimented with field visits to significant sites and areas, where ground-truthing and the recording of geographic coordinates with a GPS can improve the geographic accuracy of mapped locations (Tobias 2000a).

TLUOS may emphasize the collection of information from different time periods. For example, Freeman (1976) mapped Inuit land use by collecting information for three periods: before establishment of a trading post, after the establishment of the post but before people lived in its immediate vicinity, and the modern period. Brody (1988) recorded use of the land by the Beaver Indians during his study in the late 1970s. The

maps produced showed that hunting covered generally large areas, reflecting the fact that the Beaver Indians hunted as they traveled and encountered animals at various locations. Brody observed that this method of collecting data emphasized spatial extents but not temporal intensities, reflecting the fact that a map is usually a 'snapshot' in time.

In an ethnographic study, the researcher remains objective while becoming involved in the day-to-day life of the community through participant observation. Field notes of observations and experiences kept by the researcher supplement other research methods. These records may reflect information about relationships, patterns, and facts gathered while in conversation with community participants, on walks, or participating in other day-to-day activities. Casual conversations may also offer avenues to confirm or verify research theories (Schensul et al. 1999c; Sherry and Vuntut Gwitchin First Nation 1999; Ervin 2000). Participant observation indirectly supports the overall research undertaking since, "the camaraderie and appreciation for pitching in often lead to more open and trusting responses from the participants," (Ervin 2000: 149).

Interviews may comprise a central component of an ethnographic study. Given participants' permission, interviews are tape-recorded and later transcribed and, when required, translated. Moderators or interviewers may also jot down notes during the interview process (Bernard 1995; Ervin 2000). Researchers and participants can increase what is accomplished during an interview if an interview environment is used where community participants feel comfortable and secure (Neuman 1997; Sherry and Vuntut Gwitchin First Nation 1999).

Interviewers employing semi-structured or open-ended questions will likely learn much more than if they adhere to a predetermined narrow focus: "The rule is: Get an

informant onto a topic of interest and get out of the way. Let the informant provide information that he or she thinks is important" (Bernard 1995: 212). Interviews can occur one-on-one or in focus groups, which consist of engaging knowledgeable people of roughly the same status, characteristics, and shared knowledge in conversation using semi-structured questions as a guideline (Neuman 1997; Schensul et al. 1999c; Ervin 2000).

The inclusive approach of ethnography also allows for modification of the study design as the researcher learns more about the community. LeCompte and Schensul (1999) emphasize that often a researcher will formulate new questions once preliminary data and information are gathered, because then the researcher is provided with a clearer idea of 'what is going on'. Field research then becomes an iterative process whereby data collection methods are refined and updated as preliminary analysis raises unanticipated questions.

3.3.1.2 Ethics in Ethnographic Research

Collaboration cannot be a true partnership without mutual respect and understanding (Association of Canadian Universities for Northern Studies 1998). Central to an ethical study is the act of balancing knowledge collection with appreciation and respect for study participants, and to conduct oneself openly and honestly (Neuman 1997; LeCompte and Schensul 1999). Local research needs are incorporated into research design and practice (Association of Canadian Universities for Northern Studies 1998). Tenets of ethical research practice included informed consent, ensuring participants identify and understand risks, and the right to privacy and confidentiality or anonymity (LeCompte and Schensul 1999; Ervin 2000). Further, research partners should discuss how results are disseminated within subsequent publications, and recognize contributions

of participants (Association of Canadian Universities for Northern Studies 1998; LeCompte and Schensul 1999; Ervin 2000).

3.3.1.3 Sample Size and Method of Sample Selection

It is difficult to discern *a priori* the size of a sample, particularly when it is not known how large or variable the population is (Neuman 1997). Two principles are appropriate to determining sample size when a researcher has the goal of ensuring that the data are representative of the population. The first principle involves completeness, defined by Rubin and Rubin (1995) as a process where interviewees are added until the interviewer reaches a point where adding additional interviews do not result in substantially new information (see: LeCompte and Schensul 1999; Ervin 2000).

The second principle involves interviewing people in similar and dissimilar situations or places to the other interview(s) to discern if themes are similar or dissimilar. Approaches to determining if data collection is comprehensive may also include reading studies undertaken by other researchers to compare and contrast their findings with the present study. Additionally, interviews may be conducted with interviewees who are defined by slightly different characteristics than the core population (Rubin and Rubin 1995).

A different approach to sampling within an ethnographic study is to identify and interview key informants. Key informants are people who are knowledgeable about certain topics. They may also have other desirable qualities, including the ability to communicate well and the willingness to participate (Neuman 1997; LeCompte and Schensul 1999; Schensul et al. 1999c; Ervin 2000). It is important to recognize that while all members of a First Nation community may be knowledge holders, not all members possess equal or similar knowledge (Hawley et al. 2004), and thus identification of key

informants may be central to the collection of accurate information. Sherry (2002) noted that key informants may have standing in the community as well as recognized expertise, for example from their non-traditional education with Elders. The ability of a key informant to communicate cross-culturally may make a key informant an invaluable contributor to an ethnographic study. Key informants may also provide essential information towards a more complete understanding of themes. If possible, researchers should involve key informants who represent a cross-section of the population. Several key informants, knowledgeable to some extent about the same subject, may provide a level of verification for research findings (Schensul et al. 1999c).

3.3.1.4 Validity and Reliability

Validity informs the researcher whether captured data are dependable as well as measuring whether the research represents the population as a whole (LeCompte and Schensul 1999). Validity in ethnographic research is ensured in a number of ways. The researcher confirms her/his interpretation of synthesis of information with the people of the First Nation themselves to see if (s)he has got it right. Keeping a journal of thoughts about the research is valuable, and later these research musings can be compared with initial assumptions and original research concepts to see how the experience of collecting data has moved beyond initial assumptions, or verified or refuted them. Additionally, research notes can be compared and contrasted with others working on the same project to check for divergences, additional information, and alternate interpretations (LeCompte and Schensul 1999; Ervin 2000).

Reliability provides information about data consistency (Neuman 1997). Each time a study or component is carried out using identical methods, similar results should be returned. Low reliability can be consistent with high validity if there is constant flux

within the community or research situation. Putting two different accounts together might result in a better understanding of the whole than evaluating either one separately, even though the consistency between those two accounts might be at the outset rather low. Together, two very different accounts—reflecting low reliability—can produce even higher validity after the integrated examination. Taking a sample of the work and having an experienced and trained researcher review it can act as a check (Neuman 1997; LeCompte and Schensul 1999).

Triangulation is a process whereby the accuracy of data is confirmed by comparing and contrasting data from different sources (LeCompte and Schensul 1999). Where there are competent instances of convergence or agreement, assumptions can be made that the data are accurate. When divergence is detected, it does not necessarily imply that one source is wrong. Consideration must be given to the source itself and the data gathering process, for example, by evaluating whether other participants consider the source (interviewee) to be communicating reliable knowledge of the subject (Bernard 1995; Neuman 1997; Bryman and Burgess 1999; LeCompte and Schensul 1999; Seale 1999; Bernard 2000). Verification can also occur by asking participants to review transcripts of their interviews, reviewing the interview transcript with the interviewee in a one-on-one setting, or during community presentations on overall research findings (Neuman 1997; LeCompte and Schensul 1999; Sherry 2002).

3.3.1.5 Data Analysis

Preliminary data analysis occurs during the study when results inform the formulation of new research questions (LeCompte and Schensul 1999). One type of data analysis is content analysis. Content analysis of raw data can reveal thematic patterns using qualitative or quantitative approaches. Content analysis is defined by Holsti

(1969:14) as, “any technique for making inferences by objectively and systematically identifying specified characteristics of messages.” It may provide a researcher with a generalized picture of data relationships, or reveal underlying connections (Holsti 1969; Carley 1993; Palmquist et al. 1997).

By applying objective methods, the researcher is able to distinguish characteristics between data elements, identify criteria used to define categories, and make deductions during the final analysis stage (Holsti 1969; Palmquist et al. 1997). Blackstock and McAllister (2004: 26) define three main steps in the thematic analysis process: 1) label each theme within the text; 2) create a map or diagram of the themes emphasizing how they connect; and 3) analyze recurring as well as anomalous themes. Analysis remains systematic through the development and application of rules for coding text (Holsti 1969; Palmquist et al. 1997). Multiple passes over data ensure that data are coded appropriately (Holsti 1969; Neuman 1997). Computer software can assist in what has previously been a completely manual practice.

3.3.2 Background to the HRFN

3.3.2 1 Traditional Territory of the Halfway River First Nation

The traditional territory of the HRFN is centred on the Halfway River watershed (Figure 4). The Peace River to the south, and the Sikanni River to the north, are also significant to HRFN history and traditional culture. HRFN are hunters of the dry interior plateau and the Rocky Mountain foothills, areas defined ecologically by two primary zones, the boreal white and black spruce, and the alpine zone. The transition between these two zones is dominated by lodgepole pine with some aspen. Winters are long and cold with monthly average temperatures in the boreal white and black spruce zone below

0°C for up to seven months of the year. Summers are short and warm, and the temperature averages above 10°C for only two to four months (DeLong et al. 1991; Cannings and Cannings 2004; British Columbia Ministry of Forests and Range 2006). The MKMA overlaps with the HRFN traditional territory.

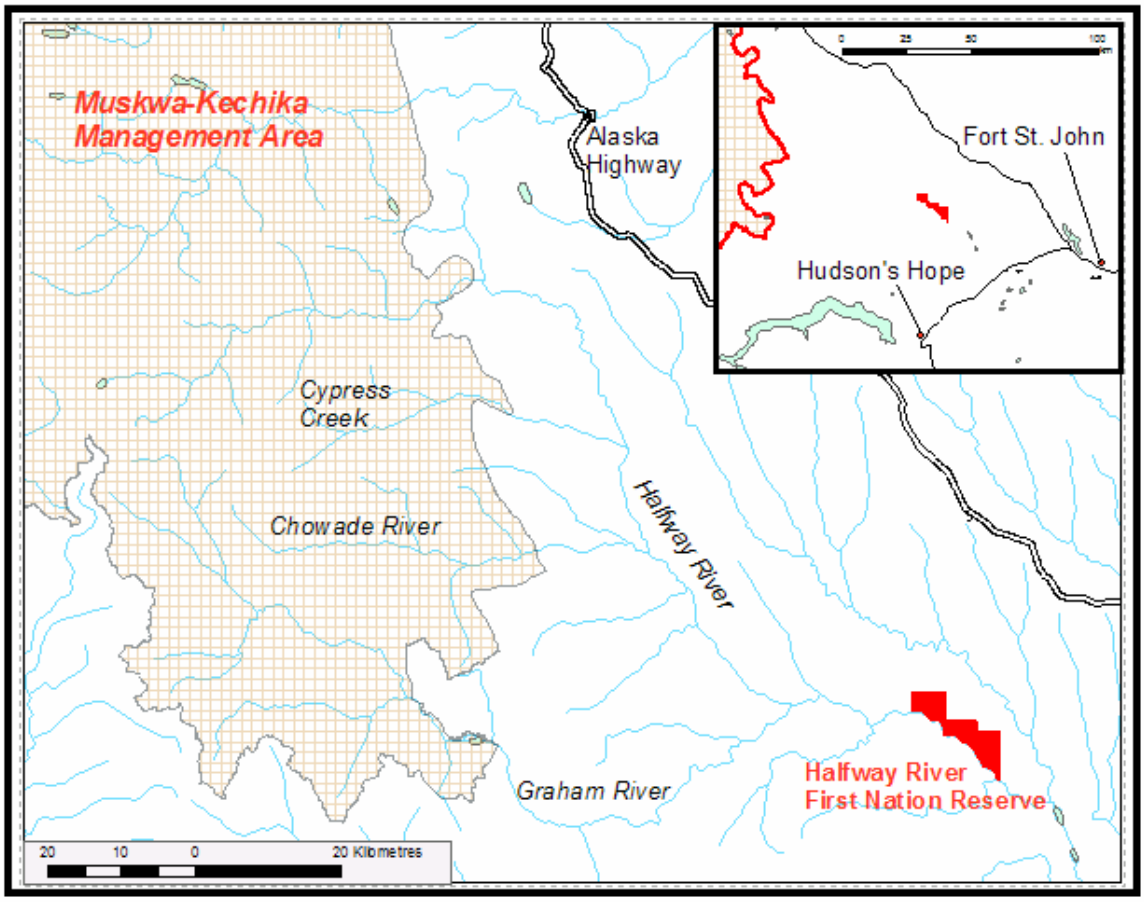

Figure 4: Location of HRFN reserve, relative to the Halfway River and its tributaries and the Muskwa-Kechika Management Area in northern British Columbia. The inset map shows the location approximately 140 km northwest of Fort St. John. It is my impression from working with HRFN members that the HRFN are reluctant to support delineation of their traditional territory, so therefore their territory is not shown on the map.

3.3.2.2 Historic HRFN

First Nations of the Peace River area came into direct contact with European fur traders and explorers in the late 1700s (Goddard 1916). The area played a prominent role in the fur-trading economy, and trading posts were established at Hudson's Hope (1805),

Fort St. John (1794), and Fort Nelson (1805). Annual visits to the trading posts were incorporated by First Nations in their nomadic seasonal patterns, and relatives to the contemporary HRFN traded primarily at Hudson's Hope. By the time of the Klondike gold rush, First Nation walk trails, renamed by non-Aboriginal users, were regularly used by miners, settlers, and other travelers as a means to access areas outside the main settlements (Godsell 1912; Madill 1986; Brody 1988).

Interaction between First Nations and the newcomers was not without strife. In June 1898, First Nations at Fort St. John blocked access to trails and sent prospectors' wagons down a large hill as a means to express their anger over prospectors stealing their horses, destroying their traps, and scaring away game (Godsell 1912; MacGregor 1952; Jackson 1979; Union of British Columbia Indian Chiefs 1980a; Madill 1986; Leonard 1995; Clare 1998). Concerned that violence between Aboriginal and non-Aboriginals would escalate, the federal government created Treaty 8 (Madill 1986).[16] In 1898, an order-in-council was issued that established the boundaries of the Treaty 8 area and appointed a team of Commissioners to meet with First Nations in various settlement and trading areas to sign the Treaty (Treaty 8 1899; Duhamel 1966).

The first Treaty 8 signing between First Nations and government representatives took place at Lesser Slave Lake in 1899 (Fumoleau 1975; Madill 1986; Leonard 1995). In subsequent years the Treaty Commission held seasonal trips to meet with First Nations at other locations in present-day Alberta and B.C. In 1913, Treaty Commission reports indicated that of the approximate 300 First Nations who went to Hudson's Hope or Fort

[16] Another reason for the creation of Treaty 8 cited in the literature was the concern for the health and well-being of First Nations after severely cold winters in the 1890s (Fumoleau 1975; Madill 1986). It has also been suggested that the government wanted to secure access to petroleum resources in northern Saskatchewan (Madill 1986).

St. John to trade, only 150 had signed the Treaty (Madill 1986). The influx of non-Aboriginal settlers to the area heightened concerns of further conflict and in 1914 all First Nations meeting at Hudson's Hope for trading received treaty payment and were admitted to the Treaty without actually being required to sign it (Madill 1986: 26; see: Calverley n.d.; D.I.A. 1915; Sneed 1978; Union of British Columbia Indian Chiefs 1979). Individuals, not groups, signed or were admitted to the Treaty, and relatives of today's HRFN were originally administered by the federal government with the present-day West Moberly First Nations (WMFN) as the Hudson's Hope Band. HRFN was recognized as a distinct First Nation in 1975 (Union of British Columbia Indian Chiefs 1980b). The actual present-day HRFN reserve land (Figure 4) was first surveyed in 1914, but because of their nomadic lifestyle and the relative isolation of their traditional territory to outside influences, the first house was not built on the reserve until 1961 (Northern Pipeline Agency 1979b; Union of British Columbia Indian Chiefs 1980b). Prior to this, a generation of HRFN members travelled back and forth from traditional winter villages to the reserve so that the children could attend school for three months of the year.

3.3.2.3 Life on the Land

Central to their traditional movement on the land was HRFN's use of an extensive trail network. Trails are essential for people whose survival depends on game animals and are more than just pathways between locations (Union of British Columbia Indian Chiefs 1980a; Brody 1988; Ridington 1990d). The HRFN are Beaver peoples, and trails play an important role in Beaver spiritual life (Brody 1988; Ridington 1988b; Ridington 1990d). For example, as an essential component of a successful encounter with prey, hunters dreamed the hunt, enabling them to recognize the paths they would take to be successful. As Christianity was incorporated into Beaver spirituality, prophets dreamed the path to

heaven (Brody 1988; Ridington 1988b; Ridington 1990b).

HRFN travelled in family groups from winter villages to a series of seasonal camps, stopping at points in-between to hunt, gather, and make dry-meat and grease. Some family groups would travel from winter villages along a circuit of rivers until they arrived back at the village in the fall. The use of horses was adopted around 1860 (Ridington 1968). Several family groups would join up in the summer (Ridington 1968; Ridington 1981). In times when food was plentiful, other First Nations were permitted to use HRFN territory; when food was scarce the HRFN looked to the mountains for emergency food reserves of mountain goat and Stone's sheep (Vreeland 1912; Union of British Columbia Indian Chiefs 1980b; Brody 1988). Annual trips to Hudson's Hope or semi-annual trips to smaller stores to trade furs for supplies were also made (Union of British Columbia Indian Chiefs 1980b; Ridington 1981).

Land use was viewed collectively, with family groups holding recognized rights to certain territories (Ridington 1981). The trapline institution is an exception to this as individuals hold trapline rights (Brody 1988). The right to use land provided access to survival food. Bison played a significant role in the HRFN traditional diet until approximately the mid 1800s, and since then moose have been a primary food source as well as the dominant cultural species (Goddard 1916; MacGregor 1952; Ridington 1968; Union of British Columbia Indian Chiefs 1980a; Union of British Columbia Indian Chiefs 1980b; Ridington 1981; Brody 1988). Moose, found singly or in small groups, can take considerable amounts of time and travel to track and hunt, with hunters being successful only 25% of the time (Ridington 1968). There were no formal social classes amongst the Beaver people, with groups organized loosely at the family level in small

enough sizes that a successful moose hunt would support the group (Goddard 1916; Ridington 1968). Ridington (1968a; Ridington 1981) observed that groups of approximately 30 people in size could be sustained on one moose a week. Leadership on a hunt was informal, with Elders being consulted, the person leading the way through the bush making the decisions, and individuals deciding whether or not they followed (Goddard 1916; Ridington 1968; Brody 1988).

Brody (1988) observed that traditional activities varied not only spatially but also temporally (see: Union of British Columbia Indian Chiefs 1980a). Depending on the time of year, different species and plants played different roles in the lives of the HRFN people. For example, caribou hunting was important in July and August, and fish were gathered from lakes late in summer (Union of British Columbia Indian Chiefs 1980b; Brody 1988). Brody summarized the temporal land use pattern into categories: the fall dry-meat hunt, early winter hunting and trapping, late winter hunting and trapping, the spring beaver hunt, and summer slack (e.g., short trips taken from summering sites).

Spatial patterns were modified when the influence of outsiders became prominent. For example, when certain watersheds were allotted to non-Aboriginal trappers, then HRFN members avoided these areas during their rounds (Union of British Columbia Indian Chiefs 1980b; Brody 1988). In addition, some headwater areas were taken over by guides and outfitters and were similarly circumvented during the seasonal round (Union of British Columbia Indian Chiefs 1980b; Brody 1988). In later years, as short-term wage employment became a notable part of HRFN economic life, traditional gathering practices shifted to accommodate these changes. Further, when the HRFN population made the reserve its permanent base, the centrality of seasonal camps was replaced by the

reserve as the dominant spatial location year-round (Union of British Columbia Indian Chiefs 1980b; Brody 1988). Prior to moving to the reserve, the HRFN did not practice agricultural activity, but have managed, intermittently over the years, a small ranch on reserve lands (Goddard 1916; Brody 1988).

3.3.2.4 The Present-Day Halfway River People

Indian and Northern Affairs Canada (INAC) (2006) recorded 227 people in the HRFN 2006 population, with 131 living on the HRFN reserve. Statistics Canada (2002) reported a median age of 28.5 in 2001. Of the reserve population, Statistics Canada summarized the three largest age groups, in descending order, as age groups 25-44, 5-14, and 15-19. Males outnumbered females by 40% in the 25-44 age group (25 males to 15 females), were recorded as numerically equal in the 5-14 age group (5 and 5), and were 50% more in the 15-19 age category (10 members to 5). The oldest members of the population represented in the Statistics Canada census were 5 males in the age 75-84 category. Beaver language speakers in the total population comprised 85 people (50 men, 35 women).

Previous work concluded that HRFN is the most traditional of the B.C. Treaty 8 communities (Union of British Columbia Indian Chiefs 1980b; Brody 1988) with participation of different-aged people involved in bush activities considered to be, “an extremely significant indicator of a living [traditional] economy,” (Northern Pipeline Agency 1979a: 1735). Today, the HRFN traditional territory remains the least impacted of B.C. Treaty 8 lands from industrial development. Further, hunting, gathering, and traditional practices remain important to the HRFN people.

Over the course of the 20th century, the HRFN became more impacted from external influences as people from outside the community moved into the region. One

matter that became of significant concern to HRFN was the increasing number of non-Aboriginal trappers. Trapline registration, introduced by the provincial government in the 1920s, was portrayed as protectionist for First Nations and was purported to reduce conflict between First Nations and the increasing number of non-Aboriginal people trapping on First Nations' traditional territories (Union of British Columbia Indian Chiefs 1980a; Union of British Columbia Indian Chiefs 1980b; Brody 1988). However, Brody (1988) wrote that registration was actually designed to limit First Nation land use until other viable activities made trapping obsolete as an economic activity. Although trapline registration in B.C. allotted only trapping rights, many First Nations perceived that trapline registration would result in rights for cultural land use also being protected (Northern Pipeline Agency 1979a; Union of British Columbia Indian Chiefs 1979; Brody 1988). The importance of trapline rights to HRFN members was underscored in 1979, when one HRFN Elder described his trapline serving the same role in his life as a bank would in a non-Aboriginal person's world (Northern Pipeline Agency 1979a; see: Brody 1988).

The result of external influences has been that HRFN use of their traditional territory has become increasingly restricted. The Union of British Columbia Indian Chiefs (UBCIC) (1980a: I-24) identify six distinct stages of cumulative 'Land Alienation' periods to 1980 in northeastern B.C.:

- pre-1928, arrival of first farmers;
- 1929-41, agricultural and urban expansion occurring before the Alaska highway (Highway 97), and trapline registration;
- 1941-52, expansion occurring with and because of the Alaska highway;

- 1952-60, commencement of oil and gas activities;
- 1960-70, continuation of oil and gas and significant expansion of the forest harvest;
- 1970-79, intensification of all above influences.

Post-1979, these influences have continued, with oil and gas development, forestry, recreation, hunting, and other activities resulting in an accumulation of impact on HRFN traditional lands. Although falling oil prices in 1980 ended that period's frantic rush to develop oil and gas (Mair 1980), a boom with many of the same characteristics has occurred since the late 1990s and is again putting pressure on HRFN's traditional territory, much of which is considered to have high to very high potential for natural gas (Ministry of Sustainable Resource Management 2004).

3.4 Methods

3.4.1 Community-based Research with the HRFN

Community-based research methods developed and applied with HRFN participants are summarized below.

3.4.1.1 Project Initiation

Dr. Alex Hawley (Professor, UNBC) presented a preliminary concept for this research to the Muskwa-Kechika Advisory Board (MKAB) members during a MKAB sub-committee meeting in July 2002. Guidance provided by some members of the MKAB and interaction with other researchers in the Muskwa-Kechika led us to identify the Halfway River First Nation as the First Nation with whom to initially explore this project. Alex Hawley and I went to HRFN in February 2003 to meet with HRFN Chief, Council, Elders and other community members and to ask them if they saw the need for

research and work in creating a geospatial approach to communicating their values to outside resource managers, which they did.

Dr. Erin Sherry (UNBC), an expert in community research methods, was hired to initiate community training and to assist with research design and implementation. Community project goals and an agreed-upon approach to project implementation between HRFN and UNBC researchers were established (Appendix 2). A collection of existing primary and secondary material on HRFN traditional knowledge and land use relevant to the study was identified, accessed from T8TA, UBCIC, and the UBC archives, and local and regional libraries, and stored safely in locations at HRFN and UNBC. Existing TUS data (from 1999-2000) were acquired and examined by HRFN and UNBC researchers for potential contribution to this project. HRFN assigned a Research Coordinator, Roslyn Pokiak, to oversee the project. To familiarize herself with GIS concepts and gain a foundation in geospatial concepts, Pokiak studied GIS through the Continuing Studies program at UNBC.

3.4.1.2 Building Respect and Trust

The key to success of this project was maintenance of a flexible, innovative, and sensitive approach to the needs of the community. On a group and individual level, building respect and trust involved giving respect and trust. From the outset, UNBC researchers learned from HRFN participants. During training workshops with HRFN community researchers in research methods, UNBC researchers learned that HRFN members considered research important as a means to protect treaty rights, preserve language, improve communication with industry and government, protect their way of life, and teach their young people about spirituality and how to live on the land. The

UNBC researchers were provided with guidance on cultural conventions, including how to act around men in camp (UNBC field researchers were women) and how best to communicate with Elders (for example, not to make long eye contact and not to press the Elders if they were not forthcoming with information at a particular time). Following Elders' requests, the practice was to ask permission before taking photographs of people, events, or places. One Elder indicated that no photos were to be taken of her and this person appears only once in photographs taken by outside researchers, in a group photograph, for which special permission was granted.

On a community level, building respect and trust involved formulating research plans with HRFN representatives, committing time to research, write, and revise a Research Agreement between HRFN and UNBC researchers, and establishing interview and field research questions that best met the needs of the HRFN. HRFN formed an Elders' Advisory Committee, through which Elders came to a consensus on project-related issues. Modifications to the research plan were made in an iterative fashion as necessary from feedback gathered during the study.

In May and June 2003, project methods were reviewed and revised with the UNBC Research Ethics Board. The Research Agreement was formulated with input from HRFN Elders, Chief and Council, and UNBC researchers. Issues of confidentiality and mechanisms to limit access rights to final data products were determined. Revisions were made to the first draft based on Elders' concerns about external use of images of spiritual and sacred places. Discussion with Elders also established how participants would be referenced in the thesis. Researchers and HRFN members agreed that confidentiality would be maintained by using numbers to identify individual participants (e.g.,

Participant 1, Participant 2, etc.). The table of names and numbers is stored in a separate location from thesis copies.

Involvement in the community increased through participation in activities that were not formally a part of research. I was able to stay on the reserve in July and August 2004 and thus spent time in the community when not out on the land with Elders. These opportunities not only enriched my personal experience but allowed me to become accustomed to the manner in which individuals expressed themselves, a great advantage which allowed incorporation of feedback and appraisals from research participants.

3.4.1.3 Field Data Collection Equipment

UNBC researchers advised HRFN in choosing and acquiring equipment for audio and visual recording (e.g., video camera, 35 mm camera, tape recorders, and microphone). The community also obtained a digital still camera from the oil and gas industry, and the MKAB research grant supplied an additional memory card. A total of five GPS units were purchased between 2003 and 2005 for use by community members from the MKAB research grant.

3.4.1.4 Interviews and Field Data Collection

HRFN participants and the Elders' Advisory Committee determined that the priority for TEK collection during this study was to gather Elders' knowledge as opposed to interviewing community members of different ages and experience. In addition, community members determined that the geographic focus of the study was the traditional territory west of the HRFN reserve. In 2003, a training program in research methods was developed and implemented by Erin Sherry and provided to three HRFN community researchers. Four Elders' camps and one horseback trip were held during July

and August 2003. TEK collection took place using five data collection methods: interviews, map biographies, participant observation, forest walks, and trips to significant sites. Relationships between youth and Elders were strengthened by including youth in camp and research activities. Traditional knowledge and skills were passed between Elders and youth.

In 2004, four HRFN students were hired as community researchers under a First Nations Education Steering Committee (FNESC) grant. They received training in basic community research, interview methods, plant collecting, GPS use, and still and video camera operation. The community research and interview methods were adopted from materials delivered in 2003, and I developed sessions on plant collecting, GPS use, and still and video camera operation. In 2004, I trained the youth participants. There were different challenges to building trust with the youth. For example, for most of the participating youth, this was their first paying job and they did not initially fully believe that they would receive a pay cheque for their work. The students kept journals of their experiences, and produced articles for the HRFN summer newsletter. There were three Elders' camps in 2004, and the youth interviewed Elders using the map biography method (see detail below), and took video and photographs.

Community researchers and youth participants were selected by Chief and Council with input from the Elders' Advisory Committee. With the exception of the FNESC grant, HRFN participants were compensated monetarily by HRFN administration for their contributions. Potential interviewees, all Elders, were also identified by Chief and Council and the Elders' Advisory Committee and invited by Chief and Council to participate. Individual HRFN members were given the opportunity to determine whether

or not they desired to partake in the research. Elders also recommended which community members UNBC researchers should speak with about specific areas or topics.

As HRFN Research Coordinator, Pokiak discussed the concept of consent with participating Elders in 2003. An informed consent page, formulated with Chief and Council, was read at the beginning of each taped interview and identified how the interview material would be used, the study purpose, the role of participants, and the funding agencies. This was done to reduce the response burden at the beginning of each formal interview since many Elders read little English or Beaver (although most speak fluent English and Beaver). Elders were asked verbally if they agreed and if they had any questions. Participants were provided with traditional gifts, purchased from the MKMB research grant.

Interview questions were developed in an iterative fashion with Chief and Council during 2003 (Appendix 3). Of particular interest to HRFN Chief and Council was obtaining information on connections or linkages between sites, as well as identifying which families had travelled together and where. Community researchers conducted interviews in English and in Beaver in 2003, and UNBC researchers conducted interviews in English. Interviews conducted in the Beaver language in 2004 used a Beaver-speaking translator. This required that the Beaver translator understood the questions and their intent. This was achieved as I discussed the interview questions with the translator before an interview. Some wording was refined as interviews progressed, for example, I was told that the word ‘spiritual’ does not translate into Beaver well, and so translators adapted by explaining the idea of special place and by providing interviewees with an example of a known sacred area. In particular, youth assisted in the

selection of appropriate words for interviews and conversation with Elders.

Twenty formal interviews were undertaken with 17 individual Elders. Two interviews were conducted on the reserve as part of training with the youth researchers in 2004, four interviews took place on the reserve one morning when we had just returned to the reserve from camp, 10 interviews took place at camps in 2003 or 2004, and one interview was held at an Elders' house located off the reserve. Most Elders were nervous during the formal interview process and were not as forthcoming as they were in casual conversation. Trust thus became an important element in the study since most information was learned through conversations around the campfire, on trips to significant sites, or when out gathering berries or hunting. As well, opportunistic moments presented themselves, as when transporting Elders or community members between camp and the reserve. Of particular importance were trips we took as a group to significant locations, identified by HRFN participants, within the HRFN traditional territory. I made notes during or after these times to assist me in remembering facts related to what had been discussed. Communication in this way also contributed to lessening the response burden on Elders during the formal interviews. Elders stated that visiting different places helped them remember details from the past about those places, so when possible we arranged group visits to particular locations. Photographs and video were taken to supplement interview records. Overall, HRFN participants were generally eager to communicate their knowledge, and during the visits to significant sites it became apparent that the Elders appreciated the opportunity to discuss the values and knowledge at a given area because community members recognized that no individual Elder holds all the information of the community.

Data was derived primarily from women because camps were divided by gender and therefore I was not included in much of the men's camp conversation (see: Chapter 5). Further, camp tasks are gender-oriented and as a woman I participated with the women. Twice, however, I was taken on hunts with the men, and once I was asked to video and photograph the harvesting of a moose. This enabled me to observe how hunters are respectful of the animal.

3.4.1.5 Interacting with Community Members Using Paper Maps

Paper maps were used formally during the interviews with Elders and were also brought out during informal discussions at camp. Mapped information was recorded using mylar overlays and paper maps during individual interviews or group discussions, employing the map biography method (Brody 1988; Tobias 2000a). Additional areas and features were recorded on mylar overlays from information gathered during trips to significant sites or other places in the HRFN traditional territory, as spatial coordinates were recorded with GPS. Field notes and participant observation with Elders and other community participants also provided approximate locations of significant areas and features.

3.4.1.5.1 Designing a Base Map with HRFN Participants

A base map, used for spatial reference during project work, was created collaboratively with HRFN participants. Initially, research plans included using 1:50 000 National Topographic System (NTS) maps as base maps, following the example set by the T8TA TUS (1999-2000) and from the literature (Candler 2000; Tobias 2000a). However, while working with community members to plan the first field season in 2003, it became apparent that NTS maps were inadequate because they did not show all the

features the HRFN participants required when describing the landscape and when using a map to orient themselves. To develop a suitable base map, four potential map types, each containing a combination of potential features (e.g., roads, wells, rivers) to include on the base map, were identified with HRFN researchers: a hillshade-based map, a plain white map using vector symbols, the NTS map, and a map produced and distributed by the British Columbia Oil and Gas Commission (OGC). These maps were shown to HRFN

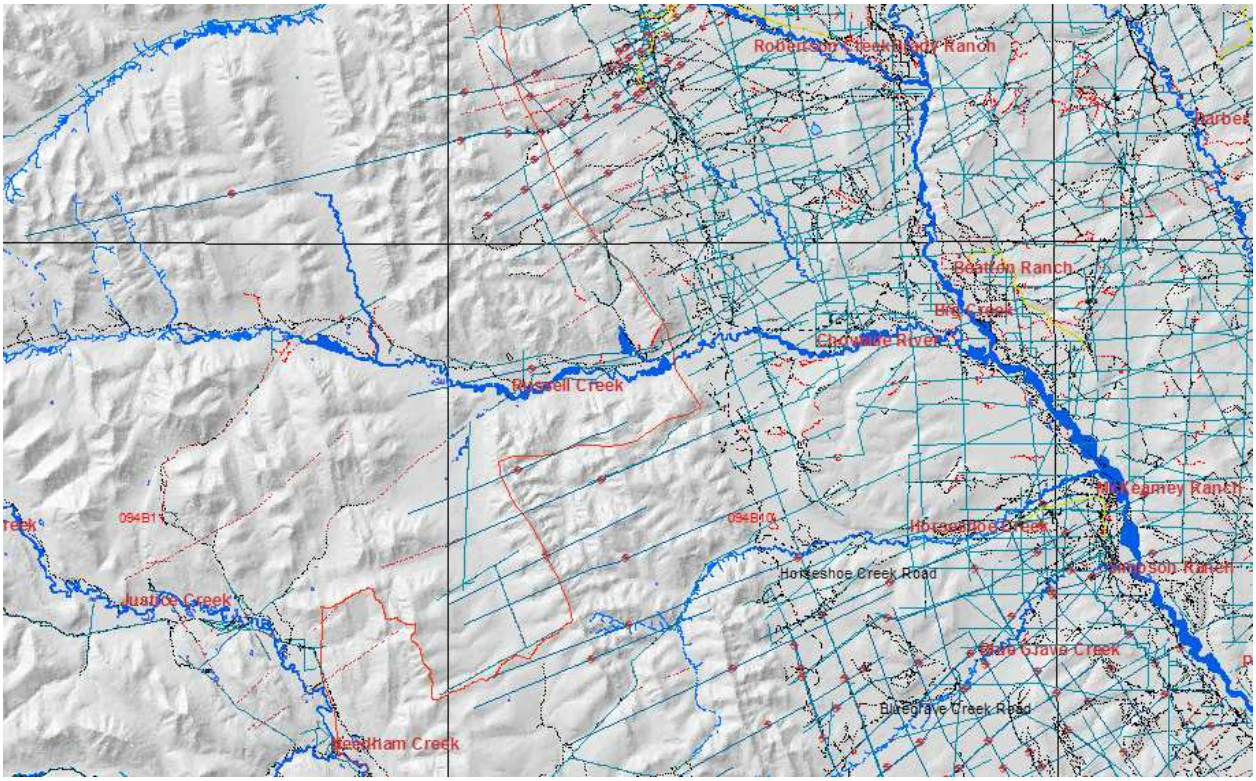

Figure 5: Four map examples were tested with HRFN participants to determine HRFN preferences for an interview base map. The final base map included a hillshade base, access corridors, major rivers, oil and gas wells and facilities, English place names, and local road names. After the 2003 field season, data collected from field visits to significant sites and archaeological data from the provincial database were added to the base map. As an example, the figure shows a portion of the base map, plotted without confidential data. The paper map was plotted at approximately 1:140,000 scale.

participants at the reserve in July 2003, in order to solicit feedback (Participants 2, 7, 9, 13, 14, 23, and 25). We laid the four maps out on tables and had a discussion about which

features were important to include. This feedback supported designing an appropriate paper base map (Figure 5).

Participants indicated a preference for using the hillshade as a base because of the four maps, it looked, “most like what we see,” (Participant 14) (also: Participants 2, 7, 23, 25). Discussion with participants identified additional elements that should be included, namely: roads annotated with local names, major rivers, wells, oil and gas facilities, additional access routes (seismic lines and cutlines), and annotations of English place names. The spatial extent of interest was covered by one paper map, plotted at a scale of approximately 1:140,000, to minimize issues encountered in 2003 when attempting to use multiple sheets plotted at larger scales. Supporting maps, using the same features as the base map, were plotted at larger scales and made available if interviews or conversations with Elders benefited from looking more closely at features not easily discerned at the smaller scale.

In September 2003, informed by our experiences with participants during the first field season, we revised the base map format to include GPS records from field activities conducted during the field season. A few HRFN place names, shared by participants during the 2003 field season, were added to the map at this time. Archaeological data, acquired from the provincial archaeological database, the Remote Access to Archaeological Data (RAAD), were also added to the map. HRFN interest in archaeological data became evident through my observations of HRFN interaction in resource management and planning (Chapter 4). Not only does archaeological evidence provide concrete historic links to the land use, but archaeological surveys conducted during assessments for potential resource developments are one of the foremost ways that

First Nations can have their interests recorded. This final base map was verified with community participants (Participants 7, 14, and 25) in January 2004 and used during the 2004 season.

3.4.1.5.2 Paper Map-Reading

One Elder was instrumental in providing me with guidance on how best to use the paper maps during interviews with HRFN participants (Participant 2). He advised turning the map so that rivers depicted on the map lined up in the same direction as the rivers in real life, relative to where we were sitting. He stated that, "then people could picture in their mind what you are talking about." Input was also received from a community member (Participant 27) who had experience through his employment with using paper maps with the Elders. This individual also stressed the need to emphasize the major river confluences to the Elders. It was notable that he also indicated that Elders, "remembered best," when out on the land, and not in a building looking at a paper map. This point was reinforced by the Elders themselves, who indicated a preference for being interviewed while out in field camps, as opposed to on the reserve.

Researchers began the interviews by tracing the major river systems for the interviewees and then made reference to the general direction of where the rivers physically were. Interviewers also pointed out other comparative features on the paper map, such as the Elders' camps and the roads used to access the camps, in an effort to increase familiarity with the paper map. When referencing a location that had been visited during the study, such as a sacred site or old village, the interviewer also tried to connect the mapped location and symbol used to depict that site or area with a memory of the visit. Appendix 4 contains three examples of paper map use during interviews with HRFN participants.

There were indications that HRFN participants referred to their mental maps when envisioning the landscape. During field trips, Elders frequently located themselves relative to other places by mentally counting the number of ridges or rivers we had crossed. In combination with the advice to align paper maps relative to river flow, I concluded that Elders who used the maps to communicate information were actively tying the map to their personal cognition of the landscape. This suggests that to bridge the use of maps on a computer screen, the computer should be positioned in the room so that the presentation of mapped features also line up with their real-world counterparts. This also suggests that the computer screen should be horizontal not vertical, similar to how one would read and use a paper map.

The comfort level and ability of participants to read maps is strongest amongst men who have worked as or for guides or outfitters. I suggest this is because they have interacted with non-Aboriginal clients, for example, by using paper maps to show the clients where they are. In addition to the formal interviews, I reviewed paper mapped data with a group of male Elders who had worked for guides and outfitters as a way of verifying existing recorded trail data and to record new information (Participants 2, 3, 4, 7, 16, and 20). The group format worked well in this instance because there was much discussion amongst participants, all of which provided relevant information.

3.4.1.6 Impediments to Research

Impediments to research included unfavorable weather conditions that disrupted the planned schedule of field activities, changes to the health of key Elder research participants, and unforeseen community events. Access to remote, backcountry areas proved difficult for Elders who could no longer walk or ride long distances. Field site

access was further complicated by spring washouts of bridges and roads. Many Elders felt that public hunting season openings made camping and traveling in the bush unsafe in the fall. Finally, cattle grazing proved disruptive: when cattle were released into range areas they interfered with camping activities, for example by polluting water sources.

It was not possible to follow a rigid list of research tasks to accomplish, since illness, death, trips to the doctor, work opportunities for Aboriginal participants, and other matters required modification of plans. Two Elder research participants passed away during the course of this research project. These events underscored the importance of collecting and recording Elder input. By staying in the community in the summer of 2004, I was able to maximize flexibility.

There were two HRFN elections during the life of this research project, the first in December 2003 and the second in December 2005. Research partner Roslyn Pokiak was elected in December 2003 to the Chief position. In December 2005 a new Chief and Council were elected.

3.4.1.7 Data Analysis

Interviews were transcribed by three transcribers in Prince George. I provided training, reviewed samples of transcribed work, and gave feedback to ensure consistency (Appendix 5). Confidentiality was discussed to ensure transcribers understood the importance of restricting knowledge of HRFN TEK. I also reviewed completed transcripts to ensure there were no errors by listening to each tape and comparing it to the written transcript. I reviewed photographs and videos, and took separate notes to supplement interview and journal records. In addition, I made notes during and after consultations with Erin Sherry, Roslyn Pokiak, and Alex Hawley.

I performed a content analysis on the amalgamated research notes and interview transcripts. NVIVO (version 2; QSR International 2002) analysis software was used to organize themes. Key words and categories were identified from knowledge about important sites, place names, culturally important plants and animals, plant collection and preparation methods, and other related activities. This list of themes was continually revised as additional material added to the analysis, and new perspectives became apparent. I coded the material primarily for the existence, as opposed to frequency, of key terms because some interviews had been conducted with key informants, who were recognized by other HRFN participants as the only community members knowledgeable about particular subjects. Next, I examined the data for thematic patterns and kept a list of values that became evident. Themes and sub-themes were formulated and modified as general patterns emerged.

3.4.1.8 Verification and Reliability

I confirmed or clarified assumptions with HRFN participants during informal conversation. For example, I mentioned in conversation what I thought a theme was, and by listening to what the reply was, received some level of confirmation. Responses in some cases also indicated how themes should be linked together. When these conversations took place in small groups, such as occurred around a fire, group consensus occurred as participants discussed the question I had asked and this process provided feedback. If disagreements remained, I recorded details of each view. In addition, a few individual participants were central to furthering my understanding because they were skilled and had experience in talking with people from another cultural background. In a sense, these individuals acted as translators from one culture to another.

Photographs and videos were reviewed with Elders for content and verification. Videos were edited into short movies (Appendix 6). Chief and Council identified two Elders (Participants 8 and 14) to view videos and photos from the field work. The viewing of videos was done in the HRFN community hall's Elders' room in January 2004 and the two Elders provided feedback on content and editing. As well, copies of the videos were made available to HRFN members by placing copies in the HRFN office and giving copies to participants. I was aware that many community members viewed the videos in their homes because I received input and verification about them when people commented on their content to me during my visits to the community. In addition to being examined by the two Elders mentioned above, photographs were used to make calendars for community members (Chapter 6). By using the photographs to illustrate the calendars, the photographs were distributed throughout the community, and in many cases posted in people's homes. When I came to visit, people generally connected me with the photographs and would discuss the work we had done in the summers. In 2004, the youth researchers made a scrapbook from the photographs taken in 2003 and in this way the 2003 photographs were circulated amongst Elders and other community members, who provided additional comments. Observations or remarks in these instances were made either to a group or to me directly. Interactions concerning video and photograph use were recorded in my field notes and contributed in an iterative fashion to data analysis.

3.4.1.9 Utilization of Secondary Sources

Secondary written sources provided information about HRFN ethnography. In particular, I was interested in recorded views and concerns of HRFN members as a

source of information on whether progress had been made in addressing resource management issues. Similar to primary research findings, I discussed any research musings from these sources with HRFN participants to verify their content.

Studies reviewed included the UBCIC (1979; 1980a; 1980b) LUOS conducted in the late 1970s, Brody's book *Maps and Dreams* (1988) which was a product from the UBCIC study and included his experiences with the HRFN, and the 1999-2000 T8TA TUS report. The transcripts from the 1979 Northern Pipeline Agency's (NPA) Alaska Pipeline Hearings (Northern Pipeline Agency 1979a; 1979b; 1979c) provided additional contextual information. Other studies also reviewed for appropriate information were those of Regional (1978), Sneed (1978), Mair (1980), Dixon et al. (1991), HRFN (1996), and Ruttan (1999). Anthropologist Dr. Robin Ridington's work was also examined for relevancy to the research questions.

3.5 Results and Discussion

Results are presented and discussed in two thematic sections. The first summarizes the values of participants concerning what they feel is essential to communicate to industry and government about resource management. Distinctions between HRFN and the dominant, non-Aboriginal way of managing the land are evident. In the second section, HRFN TAW characteristics from a geospatial perspective are identified and discussed, for the purpose of developing a geospatial approach to represent HRFN values and knowledge in a manner consistent with their way of knowing and communicating.

3.5.1 Beliefs and practices central to HRFN resource management values

The value of the traditional territory to HFRN members extends beyond hunting

and gathering plants for food and medicinal purposes. The health of the land is clearly linked to the health of animals and the people, and the links to their traditional territory and its values are strong. Once I brought a gift of bear meat and saskatoon berries to camp. Even though they were received politely I noted that no one ate them. It was explained to me that because the Elders did not know for sure where the meat and berries had come from, they were uncertain about eating them. What they wanted were meat and berries from their own territory. Hawley et al. (2004: 42) captured this quality when they wrote, “land is not a place where people live as much as it is something that is part of people and that people are part of.” By eating from the land, one becomes of the land.

HRFN participants did not always seem comfortable on the reserve, even though many non-Aboriginals think this is the homeland of HRFN. Participants viewed being out on the traditional lands as healthier, both in spirit and body, than being on the reserve. Some Elders only wanted to be interviewed when out on the land, away from the reserve, since they said they were able to remember more. Chief Pokiak summarized this view when she stated, “Reserve life is not culture.”

In the late 1970s, Brody (1988) also observed that HRFN members considered that life on the land surpassed their existence on the reserve. For example, he recounted how community members felt that youth in trouble with the law would be better served by going to the bush with an Elder than by entering the judicial system. By observing that, “The effects of colonial pressure, of the frontier, and of the very presence of the white man are escaped in the bush,” Brody (1988: 153) emphasized the importance of access to their traditional territory as central to HRFN well-being.

The heart of HRFN traditional territory is relatively undeveloped (as compared

with that of First Nations from the east side of the Alaska Highway, and closer to Fort St. John), but the areas around the reserve lands are heavily impacted. Because of the increase in privatization of land around the reserve, HRFN can no longer ride horses directly from the reserve to traditional areas (see: Union of British Columbia Indian Chiefs 1980b; Brody 1988). HRFN access has been gradually eroded, first during the 1960s and 1970s to the areas around the upper Halfway and Chowade Rivers, and then during the 1980s and 1990s to areas closer to the reserve, including along the North Road. Even if they are not physically capable of riding horses for long distances, Elders value the idea that their traditional territory is accessible by horse: "I want to look at the places where I, we used to ride horses…My horse ride [is] very important to me" (Participant 14). Yet, it is the heart of HRFN traditional territory which has the greatest potential for industrial activity in the next few years through oil and gas expansion.

HRFN participants believe that an increase in access to outsiders, from industrial roads, seismic lines, cutlines, and other linear corridors, negatively impacts their lives. Not only does an increase in access permit industry into HRFN traditional territory, it also enables outside users to penetrate long after industry has gone:

> There's… road[s] open all over that got … oil and gas and timber. … People all over the place now….They used to be, nothing, just horses that's all. Now you can drive all over the place and ruin the country. Even the river there's no fish. They used to be full of fish. Now them forestry open them road, and oil company opened the road, now everything gets damaged … (Participant 2).

Outsiders push beyond main access corridors through the use of all-terrain vehicles (ATVs). HRFN members observed that when they travelled on horses, ATVs frequently had ripped up the trails, making it hard on the horses. HRFN members also recognized that the experience of the large number of outside workers who drove or flew to work

sites gave them knowledge of land that the workers might not otherwise know about. Even if company employees are restricted from hunting during off-time at camp by company regulations, some people return on their own time to hunt, or tell friends about favourable game habitat (see: Brody 1988).

Elders were also apprehensive to use the land during the fall hunting seasons when sport hunters are present (Participants 4, 7, 10, and 14). One Elder wears a fluorescent vest when fall berry picking. There were similar views expressed by HRFN members in the late 1970s. In 1979, at the Northern Pipeline Hearings, an Elder made this comment, "It's pretty hard to go hunting around hunting season. Too many trucks, we've just got to stay here. Even right across the river on the seismic lines, they drive the Bombadiers and get moose in there in hunting season," (Northern Pipeline Agency 1979a: 122).

There was also a consensus amongst HRFN participants that roads open HRFN traditional territory to hunting and gathering by members from other Treaty 8 communities. Concerns were voiced that it was impolite for members from other Treaty 8 First Nations to hunt and gather in HRFN's 'backyard' without first asking permission, and these actions went against their traditional practices (Participants 15, 23, and 25). During the late 1970s, UBCIC (1980a VOL V: 8) also noted that the pressures of cumulative impact[17] had altered the spatial extents of traditional use areas and that there was pressure on territories less impacted from First Nations who had experienced a greater territory loss.

Roads and other linear disturbances were also described by participants to reduce

[17] Cumulative impact and HRFN views on it are discussed more extensively in Chapter 4.

ecological values of the land. For example, participants discussed areas where mineral licks had been damaged by seismic lines (Participants 1, 2, 9, 10, and 11). As well, much concern was expressed about the grazing of moose and deer around active and inactive sump and well areas. Elders stated that spraying by forestry companies eliminated the berries and any animals that relied on them, as well as the predators that required those animals. In addition, industrial activity in the mountains was linked to observed reduction in alpine animal and plant species.

Industrial access routes have also directly and indirectly impacted cultural values. For example, videos made by community members in several different areas demonstrated where gravesites were damaged during the construction of cutlines by caterpillar tractors. As well, in some areas erosion was observed that had amplified impact of the caterpillar action on and around the graves. In one area, Elders pointed out where graves had eroded into the river.

Travel to traditional villages and other significant sites is much longer by road from the reserve than by the horse trails that provided direct access before the surrounding land was privatized. Some access points are not drivable by truck because of road decommissioning or locked gates. In one prominent spot, the removal of a bridge divided road access to HRFN traditional territory into approximately southern and northern halves, and members are required to drive all the way out to the highway and back in before they can reach locations north or south of this point. There was much discussion while camping near this area about how this access point should be managed. Some people felt that since the road had already been built the bridge should be reconstructed with limited access, only open to HRFN members. One Elder stated that

because the roads and bridges had been built, without HRFN permission, HRFN could use them to access, “where we used to live,” but that access should be restricted to HRFN members and not open to the public (Participant 14). However, there was not a unified consensus on this matter, as some Elders felt the road should be inaccessible to all. Others wondered how to keep out non-HRFN people since ATVs can go practically anywhere. In the 1970s, Brody (1988) also recorded concern about the same issue, and noted that community opinion was divided.

Participants were dismayed by other land users whose activities ended up compromising their experiences on the land. For example, the ranging of cattle on Crown Land led to the spoiling of water being drunk at an Elder’s camp. Elders also did not wish to drink water where forestry spraying had occurred. Logging trucks rolling by the camp created dust and safety hazards.

During this study, camping areas were selected by participants according to their potential provision of dry wood, shelter, and water. Much discussion ensued in the community about whether an area was suitable before setting out, and trips out to prospective areas were made days before setting camp. For example, an area used the year before was avoided if it did not have enough dry wood. Elders and other HRFN participants observed that hunters sometimes came in and used their camping areas, thus using up the dry wood supply. In a few instances, it was evident that garbage had been left behind by the hunters, and in one case a cabin built by an HRFN member had been vandalized and destroyed by a chainsaw, an act attributed to a hunter from the outside.

I also noted that an oil and gas development plan proposed to use, in accordance with OGC regulations, ‘existing openings’ as locations for its personnel camp, drilling

sump, and other required facilities. These existing openings were exactly where we had camped in 2003, but Elders had chosen not to return to in 2004 to 'let the land rest'. Because we had camped there, I am aware there are TEK values associated with the surrounding land that would be compromised by industrial activity. Further, my understanding of the HRFN attitude towards camping sites leads me to think that the creation of a drilling sump, essentially a pit used to store and treat wastes, will mean that HRFN will never desire to camp in that area again.

Many HRFN members voiced opinions that industry and government benefit more financially from the use of HRFN traditional territory than do HRFN members. Many of the high-paying oil and gas jobs require training at technical schools and long apprenticeships, and even when members expressed interest in pursuing these activities, it would mean leaving the community for long periods of time, a difficult prospect for most HRFN members. Similar to the late 1970s, wage economy activities on the reserve are presently dominated by slashing, guiding, and employment by the HRFN council (Mair 1980; Union of British Columbia Indian Chiefs 1980a, 1980b; Brody 1988). Seasonal wage work allows HRFN members to remain active on the land. Some people recognized that benefits from industry, such as short-term jobs, may provide needed cash to community members but, after industry is finished, HRFN is left with the impact on their traditional territory (Participants 2 and 26). Elders noted that both of the main industries, forestry and oil and gas, left long-term impacts but created only short-term benefits:

> They damaging a lot of our area, our traplines, … these seismic lines. Roads. All … stuff like that. They making it. They making a lot of money. What do we get? We don't get nothing! (Participant 14)

One day while driving past some cutblocks, which had been harvested in the 1970s, an Elder noted that although HRFN members made money by planting trees, all those jobs are now gone and so are the forests. He expressed his belief that a similar thing will happen with the oil industry and its slash and burn jobs that some HRFN young men are employed in (Participant 2).

Many Elders commented that the monetary compensation received for use of the land was not enough (Participants 1, 2, 5, 6, 7, 8, 14, 15, 16, 17 and 18). One Elder expressed concern that even though they are told by industry and government that the HRFN is remunerated, they still do not have enough money to buy things in the Fort St. John stores (Participant 8). Another Elder recounted an exchange between family members, as trapline holders, and industry about compensating the family for its trapline losses. They recounted how the family was successful in deterring industry from developing by asking for a significant sum of money: “When industry sees [we are] asking too much they back off” (Participant 14).

Significant or sacred sites remain a central part of contemporary HRFN awareness, and thus compose an essential part of their values system. This point was underscored to me during a visit to one sacred area. All summer, discussion in the community had focused on participants’ desires to visit this area and to take me out there to show me what it meant to them. Finally, the day came when we made the trip. During the visit, it became apparent to me that at least one Elder had never been there before. From the way the area was discussed, I had assumed that all the Elders had visited the area many times. The fact that this was not the case emphasized to me that the importance of the area, and the Elders’ knowledge and experience with it, exceeded mere

physical attachment. Further, if knowledge of the sacred area's existence fuelled the Elders' appreciation of it, the reverse may also be true: knowledge of degradation to the area would make the Elders concerned about what was happening on the land. Moreover, information about that area and the land as a whole could and did reach HRFN members from those who had visited the area or were monitoring industrial activity in the area.

Community members also discussed the dream maps that Beaver prophets had made in the past, and considered whether there was a community member who could act in the role of spiritual leader. There seemed to be consensus that, "maybe when things get better someone will draw [more] dream maps." There were also some spiritual areas that we did not visit because community members decided that as a group we were not, "spiritual enough."

Throughout the study period, Elders consistently communicated their desire to maintain sacred and significant areas as undeveloped and their wish to teach their children about their importance. HRFN Elders talked repeatedly of their desire to take their children and grandchildren out to the general area where they grew up. In order to pass knowledge on to the younger generations, Elders expressed that they require access to their traditional lands.

It is noteworthy that the messages voiced by HRFN knowledge holders strongly overlapped with messages evident in the UBCIC LUOS (Union of British Columbia Indian Chiefs 1979, 1980a, 1980b; Brody 1988) as well as later work with consultants (e.g., Ruttan 1999). In particular, there is consistency between this study and those from the late 1970s, the period of the last oil and gas boom. This suggests that HRFN interests and concerns have not been adequately addressed in resource management by

government, industry, or First Nations using existing methods of engaging First Nations in resource management and planning.

It is also worth considering the differences in messages between this study and earlier ones. By comparing spatial information I concluded that this study collected details on HRFN use of their traditional territory that I did not see recorded elsewhere. Thus, despite the existence of earlier studies, this project resulted in newly recorded TEK. This underscores the importance of accommodating the dynamic nature of TEK. Differences in data could reflect the participation of different Elders in this study. As well, Elders recalled memories over time rather than all at once, and the recounting of their memories was stimulated by certain or specific cues, accessed by Elders when we were out on the land. Further, this fact may reflect that TEK is accumulating and changing on individual and community levels.

Brody (1988: 110) noted that the youth of the 1970s who were raised in the community would be, "reluctant to move back," to the land. Those youth are today's middle-aged population, and in my experiences with the HRFN, some members of this generation have a strong appreciation for participation in life on the land, demonstrating that traditional culture is an active component for some members of the HRFN community. Many of this generation, however, live in what Hawley et al. (2004: 40) term the 'cultural shadowland', "exist[ing] outside of traditional Aboriginal culture, but not fully within non-Aboriginal culture." One of the consequences of the cultural shadowland is that it, "impede[s] amalgamation," of traditional Aboriginal and WBS approaches to management, since assumptions made from communicating with First Nations living in the cultural shadowland increase the likelihood that resource management practices will

be founded on information that does not accurately represent a TAW (Hawley et al. 2004: 40). An approach and system to effectively communicate Aboriginal worldview must include a way that participates in teaching youth their culture and preserving knowledge for future generations.

3.5.2 Defining HRFN Spatiality

Central themes relevant to representing HRFN TEK spatially were made clear from the work with HRFN participants to map TEK. First, it is apparent that the values attached to individual sites extend beyond the physical confines of the site and may be variable according to an inestimable number of reasons for which the site is valued in the first place. Secondly, data collection methods under-represented TEK and HRFN values, most significantly the knowledge that is not site-based. This suggests that there is a need to develop a system that will enable the HFRN to collect their TEK over time and without the confines of the start and end date of a particular project, and that will enable them to focus not only on individual sites but also the linkages between sites.

The boundaries of TEK sites are not easily distinguished if one tries to determine them through knowledge of values attached to place. Although a point may represent the approximate location of a site when it is recorded on a map, values generally extend beyond its geographic coordinates. In addition, values typically link to other sites, and this is not easily recorded when points are used to record site-based activities, and lines are used to delineate knowledge of particular trails or travel ways. For example, discussions around a moose hunt site indicated that HRFN participants clearly saw not only the hunt site but also the moose habitat, including a nearby lick, and the roads used to reach the area as connected and integral. Distance from active wells was also important

to perceptions about whether or not the moose may be healthy.

Although the map biography method of this and other projects may record such values through the description of a generalized area, practice has been to de-emphasize polygons in favour of points, because resource managers prefer to use point data (Markey 2001; Millennia Research 2005). Areas cover large extents and are much harder to incorporate into a resource management plan under the WBS worldview. Markey (2001: 9) considered that within the B.C. government TUS program, "The aim of the site-specific TUS's is to establish boundaries that separate "Indian" reserves and traditional lands from other Crown-held or private lands where resource extraction is not burdened by Aboriginal interests." She indicated that the static borders around site-specific information, and the requirement of First Nations to assign "arbitrary" values reflecting significance to points, are steps designed to enable the government to, "minimally mitigate impacts, where necessary," (Markey 2001: 128). This approach fails to capture or reflect the cultural and social meanings that First Nations attach to the land and represents a major philosophical difference between traditional First Nations participants in TUS and government application of TUS (Thom and Washbrook 1997; Weinstein 1998; MacKinnon et al. 1999; Markey 2001; Carrier Sekani 2006).

There are also other factors to the HRFN besides extent and location to consider when expressing value, for example as to whether an area needs to be quiet. HRFN participants pointed out many areas where they considered it important to be quiet and there was much concern over existing or potential noise created by industry (Participants 1, 2, 7, 9, 12, and 14). Elders instructed youth how to behave in these places, and were dismayed when helicopters flew low over particular areas. In discussions with Elders and

other participants in an effort to define the proximity and shape of a ‘zone’ of quiet, it was apparent that opinion varied from person-to-person depending on their knowledge of a given area.

It was also apparent that certain viewscapes were valued. There were several ways that participants indicated that views were significant. For example, we were driving along a road and an Elder traveling in another truck stopped and came back to explain to me that the view we could see was the one that he used to see from an old village site. We spoke of the value of this view and took standard as well as overlapping panoramic photographs to visually record the view. At a later date, we visited the old village site and GPS recordings were made, which enabled linking of the photographs with the village site. It was also noteworthy that the view was important to the Elder from more than one physical location. I asked informal questions at various sites in an effort to gauge how the construction of seismic lines or other development would impact the view. The Elders indicated that impacts would be negative. In one instance, I did not personally visit a site but the importance of the view was apparent from the way Elders talked about the location and the view of the mountains.

HRFN participants typically discussed values amongst themselves before providing a consensus view of how industrial activity might affect that value. This suggests that the process of defining the spatial extents of HRFN community values would require an ongoing practice of community discussion to accommodate the way HRFN members assimilate knowledge, communicate amongst themselves, and come to decisions in the expression of spatiality.

Notably, trails are underrepresented using the map biography method. In HRFN

TAW, the trail may be the path that the HRFN travelled on, but there were many places along the trail, at varying distances from the trail, which were also central to the HRFN way of life. For example, HRFN participants travelled and camped along trails, but also hunted, prepared dry meat, and gathered plants and berries in various locations. Some sites were visited every year, while others were used as opportunity or need presented itself. One Elder described this process as, "going on tour," suggesting that although the main destination, a seasonal camp or winter village was the goal, the process of reaching a place may have involved roundabout travel (Participant 11). Further, I noted that making dry meat was linked inexorably to the concept of storing the meat and then traveling with it, as the female Elders told stories of how they would travel between spring, summer, or fall camping spots and their winter villages, leading horses packed with dry meat to be stored for winter consumption.[18] UBCIC (1980a) and Brody (1988) captured this phenomenon in the seasonal round model, where travel along trails was illustrated as occurring in general directions, towards seasonal camps, hunting grounds, or villages, but with much variance. It was also clear that trails play a central role in Beaver spirituality and understanding the significance of trails requires much cultural indoctrination. GPS records of trails provided more spatially accurate representations of trails than the map biography method, but linkages between points (sites) and lines (trails) had to be connected by understanding how the HRFN culture viewed the lands as a whole, rather than through individual features.

Because trails are difficult to record, they comprise a large portion of the 'blank

[18] Female Elders also discussed collecting, drying, storing, and transporting plants required for the winter. For example, reminiscences of using moss for diapers also brought a laugh. These discussions emphasized the role of the women as the domestic provider.

spaces' in WBS maps. The question of asking HRFN Elders to point out trails where they used to travel received answers that indicated that although travel occurred along general routes, it was also opportunistic:

> Interviewer: "Where do you travel to get the moose?"
>
> Answer: "You leave the horse trail where you see the moose tracks" (Participant 20);

and

> "People hunt all over this land" (Participant 4);

and

> Interviewer: "Where did you travel?"
>
> Answer: "Travel all over, where ever you want to go" (Participant 2);

and

> Interviewer: "Did you mainly follow one trail in here or are there a bunch of little different trails?"
>
> Answer: "Go different ways" (Participant 14).

The abundance and ubiquitousness of HRFN traditional trails was underlined through Brody's (1988) analogy that asking a hunter to draw out all his trails on a map is similar to asking an office worker to list all the places s/he walked within one day.

3.6 Summary and Conclusion

Community-based research methods were applied when working with the HRFN to identify individual and community values. Participation observation and site visits proved to be complementary tools to the interviews. Data were verified in informal conversations, and through reviews of photographs and videos. Content analysis supported a consideration of themes and sub-themes.

Collected HRFN spatial knowledge identified specific sites well, but under-represented TEK as a whole, in particular trails and communication of other values that are not represented well with points, lines, or polygons used by WBS mapping. It is clear that within the HRFN worldview, movement between areas on the landscape is as important as the areas themselves and trails are not merely pathways between designated points on the landscape. A geospatial approach must reapportion the emphasis from site-specific points and include lines and areas as representations of HRFN worldview within a decision-making framework.

Communication processes center on community discussion about TEK and values, and values informing decision-making are not always apparent to someone from outside the traditional culture. Further, HRFN decisions about resource management approaches cannot easily be compartmentalized from other aspects of their culture. An emic perspective must be reflected in a geospatial system by enabling people to have internal community discussions. The geospatial approach must reflect the dynamic aspect of HRFN TAW by enabling community spatial data to remain in the community and under community control. In addition, the geospatial approach must also meet the primary concerns of HRFN Elders in educating their youth. An approach that is successful in realizing these aims may achieve the breadth of community input required by enabling a large proportion of HRFN members to be empowered and effectively contribute to decision-making.

3.7 Principles identified from the community-based research that are central to the creation of a geospatial communication system:[19]

3.7.1 Principle 3: Use a mapping approach that is preferred by HRFN to support and increase their familiarity and comfort level with maps.

HRFN participants indicated a preference for using a mapped image that more closely matched how they saw the land. For example, the hillshade image enabled Elders to more easily count ridges or follow river valleys, similar to how they did when locating themselves through their mental mapping processes. Vector representations of key features, such as roads and seismic lines, proved important when HRFN participants referenced known locations on the paper map. A geospatial approach must consider applying supporting images or backgrounds (including orthophotos or satellite images, where available).

3.7.2 Principle 4: Identify and incorporate dominant modes of communication amongst HRFN (e.g., oral language).

A significant component of communication amongst HRFN members is done orally, through the spoken word. A geospatial approach must accommodate this dominant method of communication. In addition, some cultural conventions are conveyed non-verbally. Outside researchers, when interacting with First Nations in the creation and design of a geospatial approach, must become aware of these to improve success in cross-cultural communication.

3.7.3 Principle 5: Cultivate an environment where Elders and other members will recall events, experiences and values, particularly during times of the year when they may not experience the land the way they used to directly (e.g., in winter).

It was evident that many Elders required or preferred memory cues in order to be

[19] Principle 1: page 44; Principle 2: page 44.

in a mental space where they were able to recount stories of traditional use and practice. Most indicated a desire to be out on the land, and if possible, to visit places of significance. Since it will not always be possible to meet ideal conditions, the geospatial approach must incorporate other ways to engage and encourage HRFN members to participate.

3.7.4 Principle 6: Identify and record characteristics of TEK while recognizing that knowledge and values may change over time and vary between individuals and family groups.

TEK is dynamic, changing as people's experiences on the land are incorporated into their individual and group knowledge systems. Discussions and decision-making practices demonstrated that values vary among individuals, family groups, and individuals. At the same time, HRFN participants emphasized that some community members were considered more knowledgeable than others on certain topics or geographic areas. A geospatial approach that enables the community to record and update their TAW values, and incorporate changes in individual and group values, will have the most success of enabling the community to communicate these values to outsiders.

3.7.5 Principle 7: Accommodate goals for knowledge beyond resource management through flexibility in collection, storage, and presentation.

The approach is required to accommodate the priorities and vagaries of resource management because resource management is so integral to the HRFN values. However, the approach must go beyond resource management because HRFN values around the collection and use of their TEK extend beyond and outside resource management applications. Educating their youth about their history and traditional practices is of primary importance to HRFN Elders. Therefore, it is important that the geospatial method

empower HRFN to provide a means to engage the youth in learning about their TAW in order for it to be embraced by HRFN Elders.

CHAPTER 4: RESOURCE MANAGEMENT PRACTICES AND THEIR IMPACTS ON THE HALFWAY RIVER FIRST NATION

4.0 Introduction

This chapter provides an overview and analysis of resource management practices as they impact the HRFN. The chapter begins by describing the role of consultation in resource management and planning. To evaluate the suitability of existing geospatial communication methods used by First Nations, industry, and government in resource management, processes operating in northeast British Columbia which aim to include First Nation information in planning are identified and discussed. In particular, the role of paper maps and existing geospatial tools are described and evaluated. Significant challenges to First Nation participation in resource management consultation, as identified by the HRFN, are identified. The chapter concludes by considering ways in which a geospatial communication system can address these challenges and thereby enable HRFN to participate more fully in resource management and planning. These considerations are summarized as principles to the development of a geospatial approach.

4.1 Methods

In December 2004, a structured approach was taken to determine how well resource management processes in northeast B.C. included and represented Aboriginal values. A total of 80 questionnaires (Appendix 7) were emailed to government, industry, or First Nation mappers who were attendees at the fall 2003 conference on Aboriginal mapping at Duncan, B.C. or who I met personally during the course of this research.

Information gathered during informal conversations with HRFN Chief, Council, Halfway River (HR) Lands Staff, Elders, Environmental Monitors, and other community members provided an overview of the challenges HRFN was facing. Maps from the

HRFN Lands Office and community meetings were shared with me in order to provide examples where companies attempted to include elements of HRFN TEK and TUS in their consultation with the community. Documents, newspaper articles, industry magazines, and websites were also reviewed for relevant information.

Research notes were analyzed using structural analysis, which enabled identification of both common and anomalous themes (LeCompte and Schensul 1999) (as detailed in Chapter 3). The substance of this chapter was reviewed with Chief Pokiak on August 22 and 23, 2005, at which time she provided clarification and additional comments.

4.2 Results from Email Survey

I received between 12 and 20 responses to the email survey. Loss of data through computer failure precluded confirmation of the exact number of responses because the surveys were conducted over the Internet and hardcopies were not printed. The low response rate and uncertainty surrounding the data compromises the utility of these data. However, the information that was obtained was useful because it helped identify the origins of problems facing the HRFN in resource management as regards issues that arise from outside the community and issues that arise from inside the community. In addition, it was essential to communicate and vet with the community this information because it influenced my thinking and development of the GVS.

Two themes were evident in the email responses. If a respondent perceived that TEK is completely comprised of TUS data, then answers focused on the application of TUS data, which is stored and referenced by the provincial government, and their conclusions were that extant mapping systems and approaches are adequate in their

representation of First Nations' values. Conversely, if respondents believed that TEK is comprised of a broad range of cultural and ecological elements, then answers indicated that TEK was not adequately included in resource management processes and to these people the questionnaire appeared naive. This binary disparity in perspective led me to conclude that assessing the inclusion and representation of HRFN values in resource management would be better served by means of participant observation at meetings between HRFN members and industry and government, and during visits to proposed sites of industrial development with HRFN members. The remainder of this chapter presents findings from this approach.

4.3 The Role of Consultation in Resource Management

Governments are obligated under the Canadian Constitution Act, 1982, to consult with all First Nations on Aboriginal rights, Treaty rights, and Aboriginal title. Thus, the B.C. government must consult with HRFN to determine if proposed developments infringe on its Aboriginal and Treaty rights (Bankes 2003; Fogarassy and Litton 2003; Haida 2004; Taku River 2004; O'Callaghan and Willms 2006). The legal foundation for the B.C. government's obligation to consult derives from the Sparrow (*R*. vs. *Sparrow* 1990), Delgamuukw (*Delgamuukw* v. *British Columbia* 1997), Haida (*Haida Nation* v. *British Columbia Ministry of Forests* 2002a 2002b), and Taku (*Taku River Tlingit First Nation* v. *Tulsequah Chief Mine Project*, 2002) court cases, but the courts have not provided specifics on the actual process that defines consultation at the operational level (Lawrence and Macklem 2000; Marsden 2005).

The B.C. government outlines its operational approach to consultation in a systematic framework (British Columbia Ministry of Sustainable Resource Management

2002). Individual ministries may also publish guidelines for staff that reflect the fundamentals of the provincial policy. The process begins when industry proposes a natural resource development on a First Nation's traditional territory. The framework details that consultation takes place following a four-step process, where step 1 is to initiate consultation and obtain from the First Nation proof that Aboriginal interest exists. In step 2, government employees assess the soundness of the First Nation claim of Aboriginal interest. Step 3 involves an assessment of whether the proposed activity will likely infringe on Aboriginal rights or title, and step 4, pursued only if the government determines that an infringement exists, seeks to determine accommodation or negotiation with the First Nation (British Columbia Ministry of Sustainable Resource Management 2002: 22). At any point during this process, the government can approve an industry proposal for development if Aboriginal rights or interests are deemed not justifiable (Sharvit et al. 1999; British Columbia Ministry of Sustainable Resource Management 2002; Dacks 2002; Fogarassy and Litton 2003; Marsden 2005). Because consultation is a 'two-way street', First Nations are compelled to involve themselves in this process or decisions about resource management on their traditional territories will be made on their behalf, without their input (British Columbia Ministry of Sustainable Resource Management 2002; British Columbia Ministry of Forests 2003a; Carpenter and Feldberg 2005; Marsden 2005). Because industry representatives, as the project proponents, can more effectively discuss and address questions from First Nations concerning potential projects than government, the provincial government regularly delegates the task of meeting with First Nations to industry while maintaining fiduciary responsibility for consultation (Muckle 1998; Sharvit et al. 1999; Fogarassy and Litton 2003; Marsden

2005).

Marsden (2005:1) described the consultation process involving northern B.C. First Nations as a, "political, legal and cultural issue that is changing and developing." The process of consultation remains contentious because for many First Nations the process does not comprise co-management in spite of the court cases affirming Aboriginal title and rights. Marsden (2005: 1) further emphasized divergent interpretations of consultation between government and First Nations by referring to two definitions of consultation, whereby government perceives consultation as a process to, "seek information or advice from," whilst First Nations define consultation as a process that is closer to the concept of "seek[ing] permission or approval from." HRFN's ability to participate in resource management decision-making occurs within this challenging environment.

4.4 Including HRFN TEK in Resource Management: Characteristics and Description

The consideration of HRFN TEK in resource management planning varied with the two main resource management sectors with which HRFN interacts: forestry and oil and gas. HRFN was engaged with dozens of large and small oil and gas companies but only a few forestry businesses, primarily Canadian Forest Products Ltd. (Canfor), Slocan Forest Products Ltd. (Slocan) (a subsidiary of Canfor), and B.C. Timber Sales (BCTS). HRFN traditional territory is overlapped by Tree Farm License (TFL) 48 as well as the Fort St. John Timber Supply Area (TSA) 40. The characteristics of HRFN's relationship with the two main industries, as well as the process under which HRFN engaged in consultation, are described below.

4.4.1 HRFN Interactions with Industries Regarding Resource Management

Proposals for resource development or extraction were prepared by industry and approved by the OGC, the regulatory agency that makes decisions on applications. Oil and gas companies sent representatives to HRFN to consult over projects they intended to submit, or had submitted, for approval to the OGC. Companies were represented by their own employees or by Land Agents, hired by companies to interact with First Nations on their behalf. The OGC also assigned staff members who act as liaisons between the OGC and each First Nation community. The majority of oil and gas proposals emphasized individual projects, such as facilities, seismic lines, pipelines, roads and road use permits, wellsites, and testholes. Since 1998, the OGC negotiated and implemented Memorandums of Understanding (MOUs) with each Treaty 8 First Nation, which are intended to pay monies to support First Nation capabilities to respond to applications from the energy sector. HRFN was able to assign caveat stipulations to proposals, which typically addressed issues including access, worksite behaviours, or general habitat protection. Caveats submitted by First Nations required approval by the OGC. In the summer of 2001, engagement of HRFN in the resource management process broke down and HRFN blockaded a proposed Petro-Canada pipeline location, an act which resulted in some concessions from the company as well as a revised relationship between HRFN and Petro-Canada.

Forest companies sought input from HRFN on multi-year plans that covered numerous cutblocks over vast tracts of land. Chief Pokiak considered that HRFN's relationship with forestry was more established than with oil and gas, given their longer history of interaction. As a result, both forestry employees and HRFN members were more educated as to what each expected and wanted. HRFN was also involved in a court

case in the 1990s which resulted in a harvesting moratorium on a large tract of land across the river from the reserve (*Halfway River First Nation* v *British Columbia Ministry of Forests* 1999). This experience left HRFN members with positive memories of engaging in dispute with the forestry industry and government, and created a sense of empowerment amongst community members.

4.4.2 Characteristics of the Consultation Processes

The following generalized description illustrates key elements of the consultation process that is typical of resource management interaction with HRFN.

4.4.2.1 Collection of HRFN Input for Consideration in Resource Management and Planning

Collection of HRFN input was very much face-to-face and involved industry and government representatives visiting the HRFN reserve. Company or government representatives drove out to the HRFN reserve to meet with Chief, Council, HR Lands Staff, Elders, and other community members. Standard proposal submissions were delivered to the Chief and Council and the HR Lands Staff. Binders containing reports, paper maps, and other written materials were left at the community. Presentations were sometimes given by industry or government to community members. Generally no decisions were immediately forthcoming from Chief and Council since HRFN decision-making involved elected and traditional decision-makers, and Chief and Council needed time to seek input from community members. When attendance at a meeting was low, a community member was typically sent house-to-house to gather information and opinions. Industry and government employees recorded their interaction with HRFN in the form of consultation records, documents containing notations on the date of contact, who was contacted, method of contact, and a summary of outcomes. This may have

served as proof of consultation when the government made a decision about whether HRFN was provided with an adequate opportunity to participate.

During visits to areas of proposed development in the proposal stage, as well as during construction of oil and gas developments, HRFN members employed as Environmental Monitors by industry acted as on-site ears and eyes for the HRFN. Monitors were trained in habitat evaluation, archaeology, and field safety. A main responsibility of Environmental Monitors was to provide HRFN input into industry-funded Archaeological studies since these studies form a major component of HRFN's ability to record evidence of cultural activity. HRFN viewed the Environmental Monitor system as one that works well if the company was cooperating. For example, if a Monitor located a feature such as a moose lick or grave, then HRFN would recommend that the development skirt around the feature. To make this approach successful, industry must have been willing to accommodate validity of the Environmental Monitor's findings and community needs.

In addition to the Environmental Monitor program, Elders, HR Lands Staff, and others from HRFN may have flown over proposed development sites in industry or government-funded helicopters and reported their findings verbally to other HRFN members. Photos or video may have been taken by HRFN for use in communicating particular aspects of their flight to others in the community.

4.4.2.2 The Role of Paper Maps, Geospatial Tools, and Digital Data

Paper maps played a significant role in the consultation process, and paper maps were the primary method industry and government use to communicate the location of proposed developments. Paper maps were produced by industry and government from GIS programs, where data is stored, manipulated, and managed. Industry produced their

own maps and submitted them to HRFN as part of industry application packages, or these maps were brought to the community during instances when a company entered into discussion with HRFN ahead of filing the application. HRFN Chief, Council, and HR Lands Staff were the primary users of these maps since not all community members readily understood the conventions of WBS maps. HRFN Chief, Council, or HR Lands Staff would sometimes use industry-produced paper maps to educate themselves on the location of a proposed development and then communicate this knowledge orally to community members for use in decision-making.

Depending upon how features were represented and what was present on the map, some industry paper maps were more useful than others to HRFN. For example, Anadarko, a major oil and gas company, used maps with an orthophoto base to discuss plans for wellsites, represented as points, on the HRFN reserve. Petro-Canada supplied a paper map to the community showing Petro-Canada wellsites and pipelines as vector features layered on an orthophoto background. In both cases, HRFN indicated that photo images readily supported their questions about where proposed features were in relation to other features, for example existing wells, pipelines, and cutblocks. Otherwise, maps typically excluded development features from other companies or industries and were printed on white backgrounds.

Industry applications submitted to the OGC do not require TEK sites or values to be mapped (British Columbia Oil and Gas Commission 2005c). Participating forestry companies in the Fort St. John Pilot Project also use GIS to manage data, including archaeological data (British Columbia Timber Sales et al. 2004a). Some companies presented provincially recorded archaeological data to HRFN as part of their

understanding of TEK.

Paper maps may also display the results of manipulated and modelled digital data. Conventional geospatial manipulation, in particular the creation of buffer zones, is regularly proposed to HRFN by industry and government as a way to maintain site-specific TEK values. Industry and government use language that supports the creation of analysis using buffer zones, special management zones, and exclusion. For example, some archaeological reports use buffers of 250 m and 500 m around sites to identify areas that could be impacted potentially by a development such as a seismic line. Government Aboriginal specialists talk of defining 'go' and 'no-go' zones, under which development will be permitted (go) or excluded (no-go). At times, companies have also supplied HRFN with a map of buffers drawn around a proposed development such as a seismic route and asked the First Nation to indicate whether any sacred sites or areas of concern fall within buffers.

HRFN adopted this notion of buffer zones from WBS maps and map-making, and occasionally use it to assess the potential impact of developments by considering whether or not the development falls within a 10-mile radius of a significant spiritual site.[20] However, HRFN members have also communicated to me that standard round buffers on points that represent recorded TEK exclude essential components necessary for ecological protection, such as the headwaters of important rivers, or protection of cultural values such as significant views. Further, government officials have indicated that parcels greater then 10 hectares in size are too large to be considered for removal from the area

[20] The 10-mile radius measurement is one that is cited by Chief, Council, Elders, and HR Lands Staff. I was not able to discern why community members used the 10-mile figure; however, it may have origins with the T8TA TUS, which used a 10 km radius around highly sensitive cultural features (Candler 2000).

of potential development, and thus the application of buffers appears inadequate to HRFN.

The Archaeological Assessment component of resource applications uses resource predictive maps to identify an area's archaeological potential, a process that employs orthophotos, plan maps, and the RAAD (Millennia Research 2004; Millennia Research 2005; British Columbia Oil and Gas Commission 2005d). Although field visits may be used to verify a model's accuracy, the modelling process is adapted in part as a means to reduce the expense of intensive field-based surveying (Millennia Research 2005). Data from the predictive model are provided by the OGC in raster formats to oil and gas companies (British Columbia Oil and Gas Commission 2005e). Maps are generated from predictive modelling processes; however, the documentation stresses that "Appropriate interpretation of the model … is critical" and that one needs to be a specialist to be able to successfully interpret the findings (Millennia Research 2005: 79).

The OGC further encouraged Treaty 8 First Nations to adopt GIS technology by providing them with a one-time grant to spend on software, hardware, and training. The stated goal of this program was to equip First Nations in an effort to improve collaboration (British Columbia Oil and Gas Commission 2004). Forest industry representatives also indicated that if HRFN began to use digital mapping technologies, then any output should be compatible with standard vector mapping systems so that information from HRFN can be compared and/or integrated with industry decision-making systems (J. Beale, Canfor, Pers. Comm., 18 July 2002).

4.5 HRFN Concerns with the Process of Including Their TEK in Resource Management Consultation

The most critical challenges from the resource management consultation process

identified by HRFN are identified and discussed below.

4.5.1 The decision-making process at HRFN involved both elected and traditional decision-makers and was an internal process.

Chief, Council, and HR Lands Staff expressed that they felt they must educate and inform community members as to the possible impacts of resource management development, and in turn, Elders must speak to the values of specific areas. Some industry and government representatives may have assumed that all HRFN members have the same information and knowledge, but Chief and Council first needed to identify which individuals or family groups from their community had to be consulted to collect knowledge relevant to each resource management issue. When HRFN members met with highly placed industry managers, Chief and Council considered it necessary to go back and consult with Elders and others before making decisions. In contrast, the CEO of a company may be able to make a decision almost unilaterally, or come prepared to make a decision without further discussion within the company, and may assume that Chief and Council have the same powers. Further, HRFN indicated it can be problematic for Chief and Council to visit sites with industry representatives. This introduced the risk that industry representatives would claim in their consultation record that they had sufficient consultation because they had reviewed a site with an elected official. HRFN members expressed that in the past when the traditional decision-making practice was breached, they felt disenfranchised, and they felt that instability occurred in the community.

4.5.2 Cross-cultural complexities contributed to communication misunderstandings.

Industry and government employed specialists to communicate with First Nations, e.g., Land Agents and OGC Aboriginal Specialists. Specialists were both non-Aboriginal

and First Nation peoples. The First Nations employed as specialists were not from the HRFN community and therefore HRFN members considered them as external to HRFN worldview and to the community as a whole. Specialists were tasked with establishing and maintaining personal contact with HRFN community members. HRFN members expressed that this relationship structure is in contrast to how First Nations deal with each other, which is in person, one on one, on the reserve and out in the bush.

Furthermore, resource management culture is paper-oriented whereas HRFN culture is oral. Industry and government representatives provided Chief, Council, and HR Lands Staff with thick binders of information, maps, and technical diagrams which they were expected to digest and communicate, through précis and English-Beaver translation, to community members. In recognition of the HRFN emphasis on oral communication, industry and government employees jotted down communications with HRFN in their consultation records. HRFN members expressed that sometimes this felt excessive to them. In one case, HRFN participants reported that this even resulted in a note being made after an industry representative approached a HR Lands Staff member while she was shopping in a Fort St. John grocery store.

Cultural differences in communication also led to significant misunderstandings. HRFN Elders did not typically make eye contact when speaking with someone they did not know and feel uncomfortable when non-Aboriginal visitors try to use eye contact as a way to connect. Also, when company representatives asked Elders and other members if ‘everything look[ed] alright’, the typical reply was ‘sure’. Because Elders believed that it was impolite to overtly disagree with their visitors, the industry employees were misled and may have referenced an exchange such as this in their consultation record as proof

that meaningful consultation had occurred (Participant 15).

4.5.3 Government expectations of HRFN's contributions to consultation were WBSW-oriented while HRFN's ability to participate was impeded because their potential contributions were largely based in a TAW.

Government expectations regarding consultation timeframes and HRFN capacity to respond were WBSW-oriented and HRFN's ability to participate in resource management decision-making was impeded by the fact that much of their potential contribution was based in a TAW. Most notably, TEK was not always immediately available for use in the decision-making process. Before responding to a proposal, Chief and Council had to speak with Elders and other people knowledgeable about a particular area. This took time if a particular knowledge-holder was away, for example, in town at the doctor, out on the land, visiting relatives on another reserve, or attending an event. Chief Pokiak stated that if a site visit was required, elected leaders and other HRFN members may have needed to be educated by community Elders as to how to enter the area, particularly if it was sacred. Some Elders may have withheld information until they were sure that they could trust a new Chief and Council (R. Pokiak, Pers. Comm., 14 July 2005). Further, as a traditional community, TEK was a dynamic component of HRFN culture and new information and experiences may have altered its characteristics. Also, if an Elder did not readily know the answer to a specific question, time may have been needed for them to think about what they knew in relation to proposed activities before they could answer. Elders may also have wished to discuss elements of TEK amongst themselves before presenting a consensus-based view.

Elders stated that they like to spend some time on the land to help them remember their experiences, and if consultation occurred only in winter, then they might not

remember all that was important to communicate. HRFN traditional territory appeared different in the winter than in other seasons. Most community members were used to traveling extensively on the land during spring, summer, and fall. Both the consultation process and oil and gas field activity, however, were busiest during the late fall and winter months because of access problems across soft ground when temperatures averaged above zero.

Consultation was compromised further because resource managers may not have fully appreciated the characteristics of TEK communication and collection. In his presentation to the MKAB during the MKAB's June 2004 meeting, (former) OGC Commissioner Derek Doyle stated that the collection of community knowledge was economical, "because it is already there [with community members]," as compared with, for example, the time investment required to obtain data from animal-habitat studies. But HRFN expressed that time frames under resource management consultation were inadequate to allow HRFN to assess the large number of proposals they were given. HRFN members expressed that neither oil and gas nor forestry sectors provided time frames for HRFN input that reflected cultural processes involved in collecting TEK and consulting knowledge holders. Similar to officials from other First Nations (Wilson and Graham 2005), HRFN elected officials indicated that they did not feel they had the ability to hire and train a large staff, and staff that did exist acted in generalized, not specialized capacities. HRFN elected decision-makers were thus placed in the position whereby they made decisions on incomplete information, appealed to the government for extensions of existing time frames, or ignored deadlines, risking that the government would approve proposals before TEK could be assessed in the context of outstanding proposals.

A 10-day turn-around time allowed to assess individual oil and gas proposals was primary amongst HRFN concerns. The scenario HRFN faced was that a company would provide a paper map, which may not have been adequately detailed, and HRFN had 10 working days to approve the proposals or to voice concerns. During peak oil and gas season in the late fall, HRFN received approximately 18 to 40 new proposals a week. Generally, the time was too short for the community to assess each submission from a company, even though some companies elected to begin the consultation phase before making an official application to the OGC. In a 2005 evaluation of the oil and gas industry, WMFN also raised issues with the consultation process, asserting that time frames are too short (Sierra Legal 2005).

The government did not have to receive written or verbal verification or support from a First Nation for an oil and gas project occurring in their traditional territory before approving a proposal (Memorandum of Understanding 2002). HRFN and other First Nations expressed that they did not feel that they had an option to unilaterally turn down a proposal (Parfitt 2004; Sierra Legal 2005). Companies were only required to show that they had entered into discussion with the First Nation. If a First Nation failed to consult, or did not consult in a timely manner (within 10 days), HRFN reported that the project was routinely approved by the OGC. It is my observation that the remoteness of the HRFN reserve may have impeded HRFN's attempts to communicate with the OGC. Inclement weather prohibited phone, fax, or Internet communication. Also, driving during the winter months between the HRFN reserve and the OGC offices in Fort St. John could be treacherous.

HRFN indicated that they sometimes receive incomplete proposal packages. A

major point of concern for HRFN was that archaeological report data were frequently missing from OGC proposal packages presented to HRFN for review. Other communities, including the WMFN, also voiced their concerns about missing information (Sierra Legal 2005). Furthermore, although HRFN typically provided input to the archaeological report process when a community member acted as an Archaeological Assistant or Environmental Monitor, this input sometimes failed to appear in the final proposal (Participant 29; R. Pokiak, Pers. Comm., 3 August 2004).

HRFN was not typically consulted during oil and gas planning until after tenure to blocks had been sold. Companies may have invested millions of dollars in acquiring rights to tenure within HRFN traditional territory before approaching HRFN Chief and Council. HRFN recognized that it could be frustrating for companies when they were not allowed to proceed due to First Nation issues after investment, and Chief Pokiak suggested a more effective approach would be one which includes HRFN participation at an earlier stage (R. Pokiak, Pers. Comm., 13 June 2005).

Despite these objections, the OGC seemed intent on shortening the overall time it took to assess new applications. Under Goal 2 of the OGC Service Plan for 2005/06 – 2007/08 to, "make timely and informed decisions based upon the input [the OGC] receives," (British Columbia Oil and Gas Commission 2005f: 7), the OGC aimed to decrease its overall response time to industry from 23 days to 18 days. In this instance, days were no longer measured in working but calendar days, "at [their] clients' request," (British Columbia Oil and Gas Commission 2005f: 13). This initiative seemed to be counter to the primary concerns and main impediments faced by the HRFN in the consultation process and contributed to a sense of disempowerment amongst HRFN

members.

HRFN also felt disempowered in the oil and gas review process. An Advisory Committee to the OGC, consisting of representatives from the environmental, First Nation, service, and oil and gas sectors, existed to handle requests from landowners, First Nations, industry, and other parties for reconsideration of OGC decisions. The Advisory Committee recommended to the OGC issues to send to an Alternative Dispute Resolution, which suspended development activity until after the Alternative Dispute Resolution outcome; however, until an issue reached the Alternative Dispute Resolution stage, development on the land continued (West Coast Environmental Law 2004). The OGC Commissioner had the authority to unilaterally decline Advisory Committee recommendations when he reviewed them. By the end of the 2004/2005 fiscal, 53 applications to participate in the Alternative Dispute Resolution process had been reviewed by the Advisory Committee, of which 8 were recommended to the OGC for reconsideration. All 8 recommendations were overturned by the Commissioner (three of the eight were recommended for 'consensual' resolution, outside the formal process) (British Columbia Oil and Gas Commission 2005a). The resolution process may not be accountable to people outside the OGC (Sierra Legal 2005).

Caveats may have been placed on proposed activities by HRFN but HRFN reported that the OGC did not always recognize that First Nations differed from each other and thus had different concerns, even over the same proposal. For example, according to Chief Pokiak, the OGC may have read WMFN approval to a project that fell on an overlapping Traditional Use area with HRFN and assumed that HRFN could not have had any issues because WMFN did not raise any (R. Pokiak, Pers. Comm., 23

August 2005). Pokiak stated that HRFN had to make clear in its letters to the OGC that HRFN conditions that applied to one area did not automatically apply to other areas (R. Pokiak, Pers. Comm., 22 August 2005). In its 2004-2005 Annual Report, the OGC Advisory Committee recommended that a discussion paper on, "standard First Nations' conditions," be created (British Columbia Oil and Gas Commission 2005b: 29), a step that may prove detrimental to some First Nations since it may predispose industry and government to certain issues and outcomes before consultation takes place. It may also promote the idea of a homogenized whole on the part of individual First Nations.

The HRFN felt that the lack of HRFN's resources to assess proposals was not addressed by the MOU between HRFN and the OGC, although the MOU provided some monetary support for HRFN to assess proposals (Memorandum of Understanding 2002). The WMFN also found that, "capacity funding [through MOUs was] inadequate to deal with [the] volume of applications," (Sierra Legal 2005: 60). Even when HRFN had the resources to hire more help for its own office, they experienced challenges around building trust with employees hired from outside HRFN since decision-making incorporated discussion of confidential and private cultural information. It took time for HRFN to educate outsiders in the community's values and for new people to understand how the community wished those values to be expressed. Likewise, it took time for potential community members employed by the HRFN Council to gain the skills and knowledge to be able to work in capacities that allowed them to understand government and industry.

Marsden (2005: 56) suggested that the province is less willing to share the concern over capacity with First Nations then it has in the past. She compared the 1998

and 2002 versions of the provincial government's Lands Activities and Aboriginal Rights Policy Framework and noted that the 1998 policy contained concerns for Aboriginal capacity that were not repeated in the 2002 version. Specifically, the 1998 guidelines read, "First Nations often state that they are not able to keep up with the volume of referrals sent by the Province," and that, "the Province shares this concern," while the 2002 version omitted these and similar statements.

In some instances, First Nations hired outside contractors to do research on their behalf. Action by the OGC on contaminated sump pumps and flare pits was taken in 2005 after the Saulteau First Nations (SFN) and WMFN, through a contracted biologist, studied the impact of sump pumps and flare pits on animals. Their report demonstrated that animals that used water and mineral licks around the contaminated sites were unhealthy for human consumption (Sierra Legal 2005). But HRFN found that they did not usually have the funds, despite the MOUs, to hire people to do this work. Other support that was available to HRFN included utilizing T8TA staff. But whether using outside or T8TA experts, it was the opinion of Chief Pokiak that there must be trust and rapport between HRFN and the experts before HRFN members would disclose knowledge about their traditional territory.

HRFN also considered the planning requirements of the forest industry as exceeding their capacity to respond. Forestry's turn-around time was much longer, as the government guidelines recommended 60-days (British Columbia Ministry of Forests 2003a), but they required HRFN approval of multi-year plans. Thus, HRFN faced an intensive period of time when they were required to provide input over large geographic areas that would have had repercussions for years. For example, when asked to contribute

to the next multi-year plan, the community found it difficult to make a statement about 434 cutblocks at once. At the same time, HRFN was working with pre-approved forestry harvesting schedules, and they were limited in what they could influence in the present year's harvesting activities. Chief Pokiak expressed her reluctance to give permission for harvesting over multiple years because she recognized that a new Chief and Council may have different priorities than a former Chief and Council, and if permission had already been given for harvesting in successive years, it was difficult for the newly elected Chief and Council to have much impact on forestry activity.

Elders and community members expressed their concerns to Canfor representatives that aerial spraying impacts their traditional use of the land. Elders were visually reminded of the impact of aerial spraying simply by looking at the dead or dying shrubs when out in their traditional territory (Participants 2, 4, 14, 16 and 17). In 2004, HRFN was successful in postponing aerial spraying proposed by Canfor over an area used by community members for hunting and berry picking. In 2005, forestry representatives demonstrated hand spraying at the reserve to show community members how hand spraying targeted some plants and not others, and Pokiak stated that some herbicide spraying was conducted by hand rather than by air (R. Pokiak, Pers. Comm., 22 August 2005).

These examples underscore how differences in worldview hinder HRFN's ability to make contributions to resource management decision-making that involves outside organizations. TAW values may have different temporal and spatial scales than values in a WBSW. In resource management, things with short temporal, small spatial scales may be of high value compared with the things that are valuable in TAW. Hawley et al. (2004:

41) stressed that, “Issues of apparently less importance on a provincial scale to resource managers in distant locations can be hugely important to local First Nations (e.g., limits on hunting or fishing that affect both locals and visitors alike).” A geospatial approach must empower HRFN by allowing community members to think about their TAW, and then be able to come back to industry and government and present their views in a way that those non-Aboriginal managers can understand or appreciate. The current TUS approach, which takes data, information, and knowledge out of the hands of First Nations and places them into the hands of government for decision-making, impedes HRFN’s ability to meaningfully contribute to resource management planning.

4.5.4 Consultants, industry, and government collected HRFN knowledge and may have used it to make decisions without further HRFN input.

In the past, industry and government have collected HRFN’s data, information, and knowledge and used it to make decisions on behalf of HRFN without requesting their further input. HRFN participants reported that this happened even when HRFN were active participants in data collection (Participants 2, 11, 12, 20 and 25). While identifying and researching secondary sources of information for this project, I noted that there is a considerable amount of HRFN information and knowledge stored in consultants’ reports. Because this information is in written format, these reports were not used extensively by HRFN. Some of these reports provided detailed information on what HRFN identified to me as sensitive information, and some of this TEK appeared on paper maps used by industry even though its use may not have been sanctioned by HRFN. Furthermore, HRFN Elders and Environmental Monitors stated that companies regularly GPS TEK sites of interest such as villages and cabins and record it in their own databases for future use. HRFN members felt that outsiders may have used this information to visit these

sites, or companies may have used the information to assess potential impact of other developments without consulting with HRFN (Participants 2, 11, 14, 16 and 25). Furthermore, the government manages for features including gravesites by maintaining its archaeological geospatial database, the RAAD. Archaeological assessments, done prior to construction of developments, are designed to locate and record details of additional sites. During a presentation on this research project to government representatives, I observed that one government employee appeared troubled to notice that the HRFN had recorded knowledge of graves that was not also stored in the RAAD. For HRFN members, this reinforced their concern that the government desired to maintain its own separate and complete set of First Nations information as an aid in its decision-making process, perhaps without fully engaging HRFN.

Other First Nations have stated similar concerns. At the Implementing Degamuukw Conference, Russell Collier (1999:2) of the Gitxsan expressed that, "our biggest fear [with the B.C. Government-sponsored TUS studies] was that the information we provided would be used against us, or in place of acceptable consultation," (also in Marsden 2005: 82). By providing detailed information in their TUS on locations of fishing, hunting, gathering, and sacred sites, the Gitxsan were concerned that, "the province would somehow either subvert the consultation process and use it in place of actually talking to us, or that they would find a way to turn it around and use it against us," (Collier 1999: 2). Collier concluded by noting that is exactly what the government did (also in Marsden 2005: 82).

4.5.5 HRFN held differing views to government on participatory status in LRMP and other planning bodies.

LRMPs are plans established by consensus by representatives of government,

industry, and interest groups. Other resource management plans have to be consistent with the principles of the LRMP: resource management planning documents refer directly to the LRMPs for direction, and management outcomes from the LRMPs form the foundation for benchmarks to be met by industry. But Treaty 8 First Nations chose not to participate in the LRMP process because they considered that the process disregarded their Treaty and Aboriginal rights (Korber 2001). The government responded to the First Nations' refusal to participate by mailing them meeting agendas and minutes and providing them an opportunity to comment on the draft plans (British Columbia Ministry of Sustainable Resource Management 1997). Further, planners altered the plan on behalf of First Nations in instances where the planning body participants felt they were partial to knowledge about First Nations' values:

> Although the First Nations peoples were not formally represented at the LRMP Table, their archaeological, cultural and heritage values were recognized by all of the LRMP participants. The Table attempted to incorporate any First Nation interests that were known by Table members at the time (British Columbia Ministry of Sustainable Resource Management 1997 Sec 1.3).

HRFN regarded it as disrespectful that LRMP implementation continued without first addressing the concerns that kept them from contributing originally. Further, because they did not participate in the LRMP processes, any future decisions based on LRMPs will be made with inadequate HRFN representation and remain controversial.

Recognizing that the lack of First Nation participation in the LRMPs weakens any decisions based on their content, the OGC Advisory Committee made recommendations to the OGC Commissioner on April 22, 2004 that, "The Commission … refrain from referring to LRMP's in response to First Nations issues given the First Nations did not participate formally or fully in the LRMP process," (British Columbia Oil and Gas

Commission 2005a:27). The Commissioner responded that, “LRMPs are important in discharging our regulatory duty and thus [the OGC] cannot refrain from referring to them,” (British Columbia Oil and Gas Commission 2005a:27). Further, the Commissioner asserted that he perceived that First Nations would come to accept LRMPs: “While some First Nations choose not to formally participate, we see a growing interest by First Nations in the importance of Land and Resource Management Plans” (British Columbia Oil and Gas Commission 2005a:27).

HRFN’s reluctance to participate in the LRMP implementation process was reinforced by a change made to land management by government that was in contravention of the planning outcome of the Fort St. John LRMP (British Columbia Ministry of Sustainable Resource Management 1997). In 2003, the B.C. government passed Bill 84, which allowed for changes to the boundary of Graham-Laurier Park, so that a road for oil and gas development could be built (Canadian Parks and Wilderness Society 2003; Pynn 2003; West Coast Environmental Law 2004). The government took this action even though the consensus decision-making process amongst LRMP participants advocated protecting the area against, “logging, mining, oil and gas development and exploration, and hydro dams,” (British Columbia Ministry of Sustainable Resource Management 1997 section 4.2.2). Further, the MKAB publicly recorded their disagreement with the government over this action by asserting that such unilateral action contradicts planning by consensus (Muskwa Kechika Advisory Board 2004). HRFN members feared that other LRMP decisions might be legislated away in favour of industry and thus were disinclined to embrace the LRMP process.

4.5.6 HRFN were cautious in dealing with government and industry because of past experiences.

Impacts from existing development on their traditional territory also created a level of distrust among members of the HRFN community. HRFN looked to the Harold Ellis Road (known locally as the North Road) and the Cutting Permit (CP) 212 area (an area across the river from the reserve which was the focus of concern during the consultation court case between Halfway River and the Crown) as examples of past experiences that led to distrust because they felt that industrial development had threatened or destroyed their ability to use traditionally significant areas. For example, HRFN members felt they could no longer camp on the North Road, which runs along an old native pack trail, because of oil and gas activity. The pack trail formerly served as a central connector between the HRFN reserve lands and the centre of their traditional territory. Industry trucks using the road stirred up dust and made the area dangerous for young children. There was also evidence that sport hunters have used traditional camps for their own purposes. HRFN blockaded the North Road in 2001 over a dispute with Petro-Canada, and members talk of the fact that their lack of success in moose hunting during the blockade was evidence that the habitat is in poor shape (Participants 2, 12, 9, 14 and 15).

Video shot in 2004 by Chief, Council, and HR Lands Staff along the North Road showed hydrogen sulfide (H_2S) warning signs as well as newly constructed wells and pipelines. Because most HRFN Elders do not read English well, a warning sign in English acted only to make them feel further isolated within their own traditional territory. H_2S, also known as sour gas, is poisonous at certain concentrations and because it is heavier than air, will concentrate in valleys or other low-lying areas if emitted from

wells (Ridington 1990e; West Coast Environmental Law 2003a). The signs warn area users of the possibility of H_2S presence growing to unhealthy levels without warning. HRFN members expressed that they did not feel comfortable in using areas for family camps where poison gas could leak.

HRFN members stated that a lack of respect and trust was shown to them when OGC representatives asserted during a July 2005 meeting that they would hold off posting oil and gas tenures to certain areas until issues raised by the Chief, Council, and HR Lands Staff were addressed. However, HRFN indicated that tenure was posted and sold a few weeks after the meeting, before the promise of 'getting back to you' was fulfilled (R. Pokiak, Pers. Comm., 23 August 2005). Although the Halfway-Graham Pre-tenure Plan recognizes that not all First Nations sites have been identified, tenure sale began in 2003 and by May 2004, "All of the Halfway-Graham area [was] … available for tenure disposition," (British Columbia Ministry of Sustainable Resource Management 2004: 4-1). Significantly, once a tenure is sold in the MKMA, the government does not hold a company responsible for meeting any policy or enforcement changes that are developed after the sale, such as might occur through HRFN participation in the planning process based on information from this or other studies (British Columbia Ministry of Sustainable Resource Management 2004).

Past experiences in communicating with the forest industry over herbicide and pesticide spraying also led to mistrust. Elders stated that spraying kills all the plants except trees and they felt they were misled by forestry representatives as to the impact and extent of spraying:

> last year they said no spraying in the [certain] area. Few days ago they went up the [name] road, there's big cutblocks in that area over there, it wasn't like that

> last year when we went over there and … here after we came back they sprayed that area, it's just brown now. They lied to us, they do a lot of things behind us (Participant 14).

Elders recounted how Canfor responded to their desire to have trees left in cutblocks for martens and other wildlife. Elders observed that the snags left under Canfor's Wildlife Tree Program offer no protection for wildlife (Figures 6 and 7). Elders referred to the snags as marten 'apartments' and talked of the martens residing in their 'penthouses', where they would be picked off easily by hawks or eagles since there is no cover. Elders pointed to this example as one where industry did not understand the needs of the land, and even though industry consulted HRFN Elders on this particular project, communication was not effective.

Figure 6: Elders called wildlife tree snags 'Marten apartments' and said they envisioned martens getting 'picked off' by predators because the snags provide no cover. Elders pointed to this situation as an example where even though industry consulted with Elders, communication between HRFN members and industry proved not effective. Photo credit: E. Sherry.

Figure 7: Signs explaining the 'Wildlife Tree Stub Project' are posted only in English and made Elders feel further isolated within their traditional territory.

HRFN members expressed that they felt they had to be cautious about what they expressed to industry or government because they felt that anything they said could be used against them later as proof of consultation. Marsden (2005: 99) concluded that the majority of interactions between First Nations and the provincial government are, "with prejudice," and observed that this acts to, "[erode] relationships." She (2005: 103) noted that it is challenging for First Nations to build relationships when the legal framework is "in flux":

> As indicated in all of the provincial policies and procedures, virtually all interaction - from official meetings, to attempted phone calls, to chance encounters - between provincial officials and affected First Nations is considered with prejudice to any future court proceedings. It is difficult to see how trust can be built in such a litigious environment.

4.5.7 The site-specific focus of government and industry did not reflect a TAW.

The collection of HRFN information and knowledge showed that HRFN values are not site-specific (see: Chapter 3). Central to the government's approach to include First Nation values into the planning process is their inclusion of information at the site-specific level. For example, the 'Cultural and Heritage' category of the Fort St. John LRMP emphasizes protection of, "past and present uses by aboriginal and non aboriginal peoples," defined under three categories as, archaeological sites, defined traditional use sites, and historical sites of cultural significance (British Columbia Ministry of Sustainable Resource Management 1997 2.10). Although the Pre-tenure Plan for the MKMA recognizes that the government's recorded information on First Nation use of the Halfway-Graham Pre-tenure area is incomplete, it emphasizes that consultation, "possibly through site-specific assessments," may be required to identify First Nation values (British Columbia Ministry of Sustainable Resource Management 2004: 4-8, 9). The Pre-tenure Plan also acknowledges the significance of provincially designated historic and heritage features, including two trails in the Halfway-Graham pre-tenure area, but assesses impact of the trails on a site-level basis by measuring, "metres of trail disturbance," (British Columbia Ministry of Sustainable Resource Management 2004: 4-12). Further, the Heritage Conservation Act (sec. 12(2)(a)) (1996) allows for the potential alteration of any heritage feature, and under a protocol agreement between the OGC and the Ministry responsible for heritage protection, the OGC is authorized to issue applicable permits (British Columbia Ministry of Sustainable Resource Management and the Oil and Gas Commission 2004). Therefore, the decision-making power embedded in the OGC makes it possible that the Crown agency will determine that sections of a heritage trail or site, and the values ascribed to it, can be forfeited to accommodate

industry. As Marsden (2005) stressed, it can be a potential source of conflict when the agency that may benefit from the sale of tenure is also responsible for protecting heritage values.

Forestry follows a similar site-specific approach to inclusion of First Nations' values in management plans. The Ministry of Forests Consultation Guidelines (2003b:6) emphasize identification and protection of Culturally Modified Trees (CMTs), traditional use sites, and other site-specific areas. In the Fort St. John Sustainable Forest Management Plan (SFMP), the objective to, "Respect known traditional aboriginal forest values and uses," is measured by the percentage of, "known traditional site-specific aboriginal values and uses identified … [and] addressed in operational plans," (British Columbia Timber Sales et al. 2004a: 221).

Recognizing that treaty rights, specifically those regarding hunting, fishing and trapping, are not site-specific, the SFMP aims to protect these rights through conservation of biological diversity, soil, and water (British Columbia Timber Sales et al. 2004a). But there are no overt mechanisms to link First Nations input with habitat protection. In the MK Pre-tenure Plan, First Nations' values are also categorized separately from other values, including wilderness and wildlife. Although this management structure does not preclude First Nations from contributing to categories other than those designated specifically as First Nations interests, it makes it difficult for First Nation input to be heard and incorporated.

Once sites are identified, management practices incorporate buffers of specific distances around each site to measure potential impact based on intersections between proposed development and a cultural site. For example, the Archaeology Guidelines for

oil and gas development set a radius boundary of 500 m around the boundary of proposed developments as the limit of the area to consider potential impacts on known or potential archaeological sites (British Columbia Oil and Gas Commission 2005d; British Columbia Oil and Gas Commission 2005e). Sites falling within this radius are required to be reviewed by an archaeologist. HRFN felt compelled to provide information to the government on their knowledge of archaeological sites to ensure their consideration and thus the community was required to share information and knowledge with consultants, industry, and government that they might otherwise have desired to manage internally.

The use of buffers does not usually take into account values other than proximity to a proposed development. For example, precluded are areas where First Nations consider it important to remain quiet, culturally appropriate ways to enter a site, and certain significant views from a site. When site-specific features, such as CMTs, are flagged for operators to avoid, it can result in a tree being left standing, but devoid of the values that support that site when values extend beyond the tree itself. Further, flagged sites can act as beacons for others using the area who might disturb significant sites, similar to how parks have drawn people to the resource they are trying to protect, and is an issue noted by other First Nations (Chambers et al. 2004; Wilson and Graham 2005).

As well, Chief Pokiak reported that industry officials typically required visits to culturally significant sites as a means of proving that such a site actually exists (R. Pokiak, Pers. Comm., 11 May 2004). Therefore, a common practice for HRFN was to take industry or government representatives out to their sacred or significant sites (Cross Country 2003). HRFN was also required to provide concrete, measurable proof of use or occupation where possible, for example by producing an old leghold trap, pointing out

gravesites, or by identifying CMTs, a requirement which they found disrespectful and adverse to trust building (R. Pokiak, Pers. Comm., 22 August 2005).

Identification and protection of specific sites or their immediately surrounding areas fail to protect First Nations' values when they are connected to the landscape. For example, HRFN members did not just camp at one or more sites along a road, they camped at various locations along the road in family groups, and moved back and forth between these places. Development impeded this movement and the site-specific approach to identifying and protecting sites failed to recognize these values. Chief Pokiak stressed that the importance of individual sites to First Nations was underscored by their connections to other sites or the land in general, where:

> Campsites are connected to walk trails, walk trails are connected to moose licks, licks are connected to animal trails, animal trails are connected to habitat components, and … all of that … is also connected to the spiritual component. When industry proposes a particular [act] all of these other things have to [be considered] (R. Pokiak, Pers. Comm., 23 August 2005).

Landscape-level planning approaches do not adequately address these issues because data inputted into the models and plans are based on site-specific information (Lee 2004; Norwegian and Cizek 2004; Rumsey et al. 2004; see: Chapter 2). Once entered into a GIS, the site data may be applied at a smaller scale, but the source data remain site-specific. Similarly, any buffers drawn around sites at the landscape level do not protect their values because the problem has merely been spatially, and potentially scalarly, modified (see: Chapter 5).

4.5.8 Inadequate attention was paid to cumulative impact.

There was limited consideration of cumulative impact in the HRFN traditional territory in the resource management process. HRFN's MOU with the OGC did not

address cumulative impact (Memorandum of Understanding 2002; West Coast Environmental Law 2004). The emphasis on site-specific planning focused the efforts of HR Lands Staff on site-specific issues at the expense of discussing cumulative development, a concern shared by other Treaty 8 First Nations (Sierra Legal 2005). T8TA publicized their concerns about cumulative impact following the 2004 First Nations Oil and Gas conference: "the failure of the government to require cumulative impact assessments in advance of oil and gas development infringes our Treaty and Aboriginal Rights, and we are committed to rectifying this" (*B.C. First*, 2004). Critiques of B.C.'s oil and gas laws also point to the absence of cumulative effects planning as a reason for heightened concern (Korber 2001; West Coast Environmental Law 2003b; West Coast Environmental Law 2004; Sierra Legal 2005).

HRFN found that they were not typically made aware of existing or proposed activities in adjoining areas. The government may not consider that First Nations need to be involved in cumulative impact management. For example, an OGC response to HRFN's request for more information on potential impacts of a proposed Coal Bed Methane (CBM) project emphasized that because the CBM project was in its earliest stages, HRFN did not have to worry about related impacts. In a letter from an OGC Aboriginal Specialist, Chief, Council, and HR Lands Staff were provided with this analogy to explain the OGC's rationale for not discussing the "bigger picture" of CBM: "[it would be similar to the] OGC and HRFN having a discussion *on all Oil and Gas Activities when the proposed activity is a Seismic Line*" (Calvert 2004; emphasis in original).

There was little cumulative impact management amongst individual oil and gas

companies, as well as between oil and gas and forestry companies. Chief Pokiak observed that companies were reluctant to share pipelines because they desire to reserve capacity for their own potential future gas wells (R. Pokiak, Pers. Comm., 13 July 2005). Further, despite the fact that the OGC's Advisory Committee called for the OGC to address cumulative impact (British Columbia Oil and Gas Commission 2003), there was no definitive government plan or mechanism to examine the collective impacts of the two main industries. For example, there is no requirement for an oil and gas company to reforest a seismic line when it is built outside a regulated forestry operation (West Coast Environmental Law 2003a). Timber cut down when seismic lines are constructed is also not included in the annual allowable cut, so the removal of trees for seismic line construction is not calculated in the provincial harvest totals (British Columbia Ministry of Forests 2003b; West Coast Environmental Law 2004; Sierra Legal 2005).

Much of the discussion on cumulative impact that does exist focuses on concepts of shared access routes, since access provides a ready commonality between oil and gas and forestry. For example, the Halfway-Graham Pre-tenure Plan recognizes that because of mountainous terrain, access will be concentrated along valley bottoms (British Columbia Ministry of Sustainable Resource Management 2004: 1-14). The Plan also predicts overlap between, "historical and current uses and values," since it is known that First Nations established and used trails running through the valleys (British Columbia Ministry of Sustainable Resource Management 2004: 1-14). The Pre-tenure Plan, "strongly encourage[s]," companies to link their access use with others but does not require industry to do so (British Columbia Ministry of Sustainable Resource Management 2004: 3-9).

The Fort St. John Pilot SFMP Project states that it will address the concerns of First Nations about cumulative impacts from forestry through consolidation of multiple aspects of the development plans (British Columbia Timber Sales et al. 2004a:29) and that oil and gas impacts on forestry will be addressed (British Columbia Timber Sales et al. 2004a). During 2003-04, there were 8 successful attempts by forestry companies to co-ordinate access with the oil and gas companies (British Columbia Timber Sales et al. 2004b). This approach may achieve some additional success in the future if more access routes are addressed. HRFN members maintained that they wished to see all existing and potential future developments in an area, not just the ones industry determines that it can plan together.

A lack of effective enforcement tools has been cited as a reason to be further concerned about long-term impacts of the oil and gas industry (West Coast Environmental Law 2003b; West Coast Environmental Law 2004; Sierra Legal 2005). The OGC can require companies to post bonds up to $100,000 to ensure protection of the environment (West Coast Environmental Law 2003a) and fine a company between $500 and $5,000 for infractions to B.C.'s oil and gas laws under the Petroleum and Natural Gas Act (Petroleum and Natural Gas 1996; Sierra Legal 2005). HRFN felt that these were insignificant amounts considering that some companies had invested upwards of $7,000,000 at the pre-tenure stage, before they even entered into discussion with HRFN. Further, the OGC has the goal of reducing the amount of regulation required for companies to operate (British Columbia Oil and Gas Commission 2005b; British Columbia Oil and Gas Commission 2005f). At the same time, the capacity to enforce existing regulations declined when the number of government monitoring and

enforcement employees was significantly reduced in 2001 (West Coast Environmental Law 2004). Without effective enforcement tools, HRFN members were concerned that cumulative impacts may increase.

HRFN viewed existing and potential activities of other sectors as increasing cumulative impact. Plans to establish Site C on the Peace River and wind turbines on mountain tops were seen to threaten HRFN's ability to practice their culture on their traditional territory. Furthermore, the creation of roads, seismics, and cutlines provides increased access opportunities for recreationists and hunters, who create additional pressures on HRFN traditional territory. HRFN community members and Elders expressed that they needed only to look towards Blueberry and Doig River First Nations to see what cumulative impact can do to traditional lands and the ability of a First Nation to hunt successfully.

The HRFN concerns regarding cumulative impact are not unfounded. For example, the Albertan experience may stand as an example to B.C. resource managers (Sierra Legal 2005). Alberta is, "already experiencing species loss and ecosystem disruption from its decades of oil and gas addiction," and, "BC appears immune to those lessons, and intent on replicating the problems through laws that fail to look at the big picture," (Sierra Legal 2005: 7). Studies conducted in Alberta have shown that oil and gas development causes habitat-related stress to caribou and grizzly bears, and that the noise from industrial activities reduces ovenbird mating success (Bradshaw et al. 1997; West Coast Environmental Law 2004; Linke et al. 2005; Habib et al. 2006).

The problems of cumulative impact are not new for this area or to the HRFN people. HRFN issues with cumulative impact were recorded in the UBCIC (1980a;

1980b) studies of the late 1970s, and HRFN members voiced their concerns during the Northern Pipeline Agency (NPA) hearings from the same period. For example, one HRFN Elder stated during the 1979 NPA hearings: "If the pipeline goes through, the game will never be here and is there no way that we can stop this pipeline from going through and when the game goes away, how would the people make their survival for meat?" (Northern Pipeline Agency 1979a: 430). A HRFN Elder also wondered, "If the white man makes more roads, … if they get on my trapline and if they cut all the trees down, where would I go hunting and where would I get the fur?" (Northern Pipeline Agency 1979a: 431). Brody (1988: 246) summarized his observations of the effects of cumulative impact from working with Treaty 8 First Nations:

> To understand effects of new development…we must understand what has passed and been experienced before….From the Indians' perspective the long history of the region's development can be understood only as a progressive loss of lands by a people for whom mobility has always been at the heart of economy and culture….A simple analogy may convey the result of cumulative impact on such a people. To shove, be it gently or forcibly, a person who stands in the middle of the field is one thing; but to shove someone who stands at the edge of a cliff is quite another.

During this study, HRFN Elders and other community members encapsulated their perception of cumulative impact when they observed that, "Industry never lets the land rest." Furthermore, Chief Pokiak recognized that HRFN participation in resource management would be strengthened if the, "Elders talk [more] about cumulative impact," to outside resource managers and planners, but mechanisms first must be developed to encourage them to do so (R. Pokiak, Pers. Comm., 23 August 2005).

4.6 Summary and Conclusion

HRFN participants identified a number of concerns about the processes of

including their input in resource management. Concerns about cumulative impact are paramount. The site-specific focus of industry and government is largely antithetical to HRFN TAW. Consultation time frames are not consistent with the way in which TEK is collected. Cross-cultural communication leads to misunderstandings. Past experiences with industry and government have cultivated distrust. Objections about lack of capacity to reply to mass planning should not be mistaken as conflicting with HRFN's interest to increase their contribution to planning. The process of identifying what is important to HRFN members prior to communicating to outsiders is a central step of the decision-making process.

The challenges faced by the HRFN are not helped by the fact that the processes within which they must interact are beyond their control and exclude many of the tenets and facets of TAW (A. Hawley, Pers. Comm., 26 March 2006). Differences in worldview inhibit HRFN's ability to effectively integrate their concerns about protecting their cultural values within existing resource management practices. HRFN participants feared that non-Aboriginals may view reserve lands as adequate provision of space for a First Nation to practice their culture when the true aspects of spiritual and cultural ways are experienced on the expanse of their traditional territory. The lands that HRFN live out their culture on are owned by the province as Crown lands. Under the Canadian Constitution Act, HRFN has protection of its Aboriginal and Treaty rights. The government largely determines how those rights are protected in its four-step process to consultation with First Nations.

HRFN desires to participate in resource management planning but finds it difficult to match what is important to HRFN members with what is important to industry

and government. Existing mechanisms and approaches to incorporate their knowledge constrain the HRFN from participating more fully. HRFN requires an approach be developed that aids in decision-making in land and resource management by capturing and teaching HRFN history and culture.

4.7 Principles identified from the examination of resource management processes and practices that are central to the creation of a geospatial communication system:[21]

4.7.1 Principle 8: Situate decision-making power in the community and empower elected decision-makers to make decisions that complement traditional decision-making processes.

The geospatial approach must empower Chief and Council to use traditional decision-making processes. Ways of communicating TEK and traditional Aboriginal values amongst HRFN members are dependent on the central characteristics of TEK and traditional Aboriginal values. These include a culturally appropriate time frame for knowledge collection and decision-making, creation of an atmosphere that supports Elders recalling memories, and use of oral, in addition to written, communication methods.

4.7.2 Principle 9: Control access to TEK and awareness of the locations of significant locales through collection, storage, and application of recorded knowledge.

HRFN must be empowered to collect, update, and apply their recorded TEK in resource management decisions. HRFN expressed that the practice by industry, government, and consultants of maintaining records of their TEK is unacceptable. This practice erodes trust by allowing decision-making to occur external to HRFN.

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[21] Principle 1: page 44; Principle 2: page 44; Principle 3: page 96; Principle 4: page 96: Principle 5: page 96; Principle 6: page 97; Principle 7: page 97.

4.7.3 Principle 10: Maintain ability to incorporate relevant information from disparate sources (e.g., Environmental Monitors who make site visits with industry representatives).

The geospatial approach must be flexible enough to record information from other sources of information relevant to HRFN decision-making. New data and information regarding resource management are obtained by HRFN on a regular basis, and in order for these to be effectively incorporated into a decision-making framework, the approach must support their inclusion.

4.7.4 Principle 11: Enable HRFN to assess potential impacts of multiple resource management projects across space and time.

Cumulative impact of resource development is of the utmost interest to HRFN. Tracking and evaluating existing and potential cumulative impact is not possible for HRFN using existing approaches. Government may not support their consideration of cumulative impact, and industry is largely concerned with their individual projects. The geospatial approach must empower HRFN to track, view, and consider cumulative impact.

4.7.5 Principle 12: Provide for compatibility with extant geospatial systems and management approaches (e.g., support computer input and produce output compatible with commonly used GIS).

Although internal decision-making by HRFN would best incorporate HRFN worldview and values, the geospatial approach should be compatible with existing geospatial systems and management approaches in order that HRFN concerns can be considered by external resource managers and planners. The approach should support known input formats and produce output in a form functional for external users. A primary method of communication about potential developments occurs when industry

provides HRFN with a paper map showing locations. One of the strengths of the existing B.C. government TUS database for government decision-makers is that it is spatially compatible with WBS mapping tools, and enables TUS data to be viewed on-screen and as necessary printed out on a paper map using WBS mapping tools. The inclusion of a compatible approach to existing geospatial systems will provide industry and government with certainty that a process exists that enables HRFN to make informed decisions and thus generate support, through external validation, for the HRFN geospatial approach.

CHAPTER 5: EXISTING GEOSPATIAL APPROACHES OF COMMUNICATING ABORIGINAL VALUES: TESTING APPLICABILITY FOR THE HRFN

5.0 Introduction

This chapter comprises a review of five existing approaches to geospatially communicate traditional Aboriginal values, namely: hardcopy maps with supporting photographs and video; weighted buffer and polygon creation and analysis; ArcMap with hyperlink multimedia functions; visibility analysis (viewshed polygons); and three-dimensional (3-D) terrain models. The goal was to determine if one or more of these existing approaches would meet the criteria as revealed through principles for the creation of a geospatial approach for communicating traditional Aboriginal values, identified in Chapters 2 through 4. Each approach was assessed to identify its potential use by the HRFN.

These five approaches were selected for consideration for diverse reasons. Paper maps were frequently used within the HRFN community. Paper maps, supported by photographs and videos, formed part of the reporting process to the community of research done. Finally, paper maps were the dominant medium through which industry and government communicated proposed resource developments with HRFN. Weighted buffers and polygons are used regularly by industry and government as methods to incorporate Aboriginal data with non-Aboriginal spatial data in planning and management. We therefore felt the need to obtain community input on this approach. ArcMap is a dominant GIS software program outside the HRFN community. HRFN acquired ArcMap part way through this work. This afforded the opportunity to explore the potential use of this system within the community. Hyperlink became a natural extension, once we had feedback from photographs and videos. Visibility analysis – or

viewsheds – are polygons that are generated in a GIS that represent the potential view at a particular spot (e.g., what a viewer would potentially see across a landscape). It was evident when visiting culturally significant locations that views were important to community participants. We therefore modelled some views and evaluated the reactions of community participants to see if such views should be included in a geospatial approach. Computer 3-D visualizations in projects with other First Nations suggested that 3-D modelling allows communities to better envision what areas looked like in the past or the results of proposed future developments. Because the HRFN participants communicated best when out at significant cultural areas, we wanted to develop and test some 3-D models to see if these efforts should be included in a geospatial approach. Methods, results, and discussion for each approach are summarized below. The chapter summary and conclusion identify and discuss applicability of the five approaches within the context of each principle.

5.1 Methods

5.1.1 Community Participation and Feedback

Examination of the potential for making use of existing geospatial methods was a dynamic approach in which HRFN participation informed and modified development. Feedback received from HRFN Chief and Council, Elders, and other participating community members revealed the degree of acceptance and appropriateness of each method. Results were iterative and informed the direction of further evaluation (as in Chapter 3). Community contact was minimized in the fall of 2003 at the Elders' request for reasons related to spiritual upheaval around the upcoming Chief and Council elections.

Geospatial approaches were evaluated through consideration of HRFN perceptions. Interaction with Elders, community researchers, Chief Pokiak, Council members, and HR Lands Staff revealed that a subjective evaluation of these perceptions would be most effective. Community members grew accustomed to me being around and coming back to the community even after I had left for awhile. Key informants, identified by Chief and Council, were instrumental in providing feedback to each method appraised. The methods section for each mapping technique expands on details.

Elders would be quiet and avoid eye contact to signal their disagreement. Sometimes, when they were feeling more comfortable, they would laugh and tease me if they thought something was not applicable to their situation. I also received feedback from Elders and other community participants when industry and government representatives left after meetings, so I learned what community members liked and did not like about what was presented in those meetings and extended that knowledge to the creation of a geospatial approach. In addition, I recorded instances when community members of all ages showed evidence of acceptance of a product or method, for example when people discussed photographs. I also received support and feedback from Chief Pokiak, the Councillors, and the HR Lands Staff, who were used to dealing with non-Aboriginals and interpreted not only my questions but sometimes verified or clarified feedback from other community members. Personal observations, made during informal conversations with community participants, were also recorded.

A content analysis for themes was conducted to discern patterns. Both similar and dissimilar themes were examined and included in results. Findings were assessed for validity and reliability through crosschecking amongst participants. Hypotheses and

assumptions were also discussed with key project participants, Alex Hawley and Roslyn Pokiak. Findings are summarized at the end of this chapter as principles to direct the development of the geospatial approach.

5.2 Review and Use of Hardcopy Maps and Multimedia

5.2.1 Methods

5.2.1.1 Hardcopy maps

Hardcopy maps were provided in 2003 and 2004 to Chief and Council, HR Lands Staff, and participating community members as part of the reporting and feedback process. I produced paper maps at UNBC on behalf of the community until fall 2004, when HRFN acquired ArcMap software, a suitable computer, and a plotter, after which maps were produced in the community. HRFN data sources used in the creation of paper maps included: TUS point, line, and polygon data; TEK spatial information digitized from archival sources and existing maps from the HRFN Lands Office (e.g., police trail info); archaeological data obtained on behalf of the HRFN from the provincial archaeological database; and GPS locations and attribute data of significant site visits collected during the 2003 and 2004 field seasons. Provincially standard geospatial data incorporated to provide context for HRFN data included: base features (e.g., streams, lakes, roads, pipelines, airstrips, indexes, and elevation); Forest Cover; wells, seismic lines, and oil and gas facilities; guide/outfitter territories; traplines; English language place names; and the MKMA boundary. These maps used conventional symbology such as lines for trails and points for TUS sites, with appropriate legends, scale bars, and north arrows. For example, a map entitled '[An Elder's] Trip with Halfway River First Nation, July 2003' was created highlighting the GPS points collected by a community researcher

during a horseback trip led by an Elder. This map was plotted using a hillshade image that Elders had indicated they preferred for use as a base map during interviews (see: Chapter 3). HRFN TUS data, collected between 1999 and 2000, was plotted using symbolization to represent values in the TUS categories established by the provincial government such as a moose image for 'Moose' indicating that an interviewee had talked about something relevant to moose at that point. The TUS data maps were plotted out using the hillshade image as well as a white background because some data elements could be seen more clearly on the white paper.

A total of eight paper maps were produced and assessed by HRFN community members between August 2003 and June 2004. Maps varied in scale from approximately 1:50,000 to 1:220,000. The community evaluation of each map comprised different individuals depending on the application. Overall, a total of five different Elders, four office or management staff, and three other community members reviewed and evaluated maps on three different occasions. I reviewed maps with participants by inviting them to look at the map and asking them questions about what they liked or did not like, and by watching them for non-verbal clues as to their level of interest. For example, interest was judged by the amount of discussion amongst Elders or whether they made eye contact with me when discussing the map, generally an indication that they were comfortable and engaged.

5.2.1.2 Multimedia

Multimedia products, photographs and video, were provided during and after the 2003 and 2004 field seasons to Chief and Council, HR Lands Staff, Elders, and participating community members as part of the reporting and feedback process. Additionally, I received six individual requests from participants for copies of certain

photographs or video. Video was edited for clarity and content, vetted by HRFN members, and a number of short movies were circulated to community homes on VHS tapes (Appendix 6). Each movie was reviewed with Elders at the reserve in January 2004 (Participants 8 and 14) (see: Chapter 3). At HRFN's request, photographs were used to produce 'Halfway River First Nation' wall calendars for 2004 and 2005. Chief, Council, and HR Lands Staff shot additional video in September 2004 to illustrate H_2S warning areas, new wells and pipelines, traditional campsites, a moose that had died in a sump pit, and the proximity of industry sites to several mineral licks. Existing multimedia materials were acquired during the search through archives for existing HRFN records, including the "Treaty 8 Country" video (1982) and photographs of Halfway people from the 1960s and 1970s. Observations of Chief and Council, HR Lands Staff, Elders, and community members were made during resource management meetings and a consultant's presentation on Treaty Land Entitlement where photographs were used by community members to illustrate their views on the importance of accessing their traditional territory.

5.2.2 Results

5.2.2.1 Hardcopy maps

Paper maps from the 1999-2000 TUS and this project proved very difficult for Chief, Council, HR Lands Staff, and Elders to interpret since plots using only map symbols did not provide enough context on information associated with each point. Elected HRFN decision-makers were overwhelmed by the volume of mapped data, but under-whelmed by the lack of actual information and knowledge portrayed by these data. For example, users did not know with certainty if a moose symbol meant a moose had been hunted at a particular location, or was only seen there. It also revealed nothing about

who was hunting, who was with them, and when they were there. However, the maps were posted in Chief and Council's office and the amount of data thereby portrayed was referred to with pride by community members.

Most Elders did not act in interested ways towards the paper maps. This included the paper plot made of an Elder-led horseback trip even though community members discussed aspects of the trip enthusiastically. I noted that this was in spite of the map having been plotted on the hillshade image Elders preferred for use in the map biography interviews.

HR Lands Staff requested additional paper maps showing well sites, seismic lines, and main roads because Elders, and other knowledge holders, used these features, along with rivers and streams, to describe specific locations when providing HR Lands Staff with information relevant to HRFN's assessment of proposed developments. Additional maps were created that showed existing or proposed development to assist HRFN in addressing specific resource management issues when industry produced paper maps. When Chief and Council asked 'where is this in relation to [significant community feature]', a map was created to show developments and HRFN information.

A limitation to the paper maps was that some elements of the digital data used for production were incomplete or out-of-date. For example, omission and commission errors with secondary roads and seismic lines created confusion during discussion. Also, the maps were printed at small scales (~1:220,000) to reduce the number of maps managed by HR Lands Staff, but discussion frequently referenced areas that would have been better viewed in greater detail.

Chief and Council requested paper maps for use with Elders during the 2004 field

season when community members met with industry representatives to discuss proposed seismic projects. Neither Elders nor other participants readily consulted these maps. Elders preferred to visit the site in person, or to speak with community members who had visited the site. Some Elders were reluctant to look at paper maps because they felt they could not 'read' them, as described earlier. Elders most comfortable in using paper maps were those men who had experience navigating with paper maps while employed as hunting guides.

5.2.2.2 Multimedia

Photographs were valued by community members as demonstrated by their comments and the multiple requests by the participants for copies. Community youth made visual displays from the 2003 field pictures and presented them to Elders. One Elder subsequently brought out photographs from an early study and a number of Elders told stories about the time they went to particular locations. HRFN members also pointed out photographs displayed prominently in the HRFN office of Elders and other members who had passed away. As further support of the value placed on photographs, the Adult Basic Education class used the 1960s and 1970s archival photographs in their own project to interview Elders and collect information about the people, places, and events in the photos.

Industry regularly produced and presented calendars to HRFN which were titled '*Halfway River First Nation*' and used photographs of wells and oil and gas facilities. This made the HRFN members feel estranged from their own traditional territory. In contrast, calendars produced with HRFN with photographs from field research were used by Chief and Council to demonstrate to industry and government that research into cultural activities was ongoing. In addition, the display of the calendar in prominent

community locations appeared to elevate community self-esteem and encouraged discussion about project activities. Copies of the calendars were also located in private houses around the reserve and HRFN research participants as well as other community members commented favourably on them to researchers. During a HRFN presentation to government representatives in July 2005, an Elder used the calendar to demonstrate the significance of the land to her when she pointed at the calendar photographs and said, "This is my life," (Participant 15).

Videos reviewed with Elders, "brought out memories," (Participant 14). In addition, community members commented multiple times on how they enjoyed videos of research activities on HRFN traditional territory. In particular, there was much interest in video shot by a community researcher during a horseback trip along the Cypress Creek. During training in July 2004, youth researchers watched this video and afterwards told their own stories about traveling and camping on the land. In 2005, an Elder asked me, "Had I seen [this video]," forgetting that I had been involved in the project at that time, but at the same time conveying to me the importance of seeing the images and hearing the messages it contained (Participant 15). It was noteworthy that community members who were not officially participants in the study also commented to researchers that they had enjoyed the videos. In addition, community members were determined over the course of the study to ensure that I had seen the "Treaty 8 Country" (1982) movie that had been shot on the North Road in the late 1970s. The movie is divided into two main scenes: the first has extensive footage of camps and a hunt on the North Road, and the second covers a community meeting. In recounting this video, the HRFN people referred almost exclusively to the first section, the section which depicts their experiences on the

land.

Elders and other participants were always accommodating when I took a photograph or made a video of an event or place. Joking and laughter occurred when the cameras appeared indicating that participants were comfortable and candid during filming. Study participants would point out practices and events they judged essential to capture photographically. Community and youth researchers took pictures and created video of events important to them. In addition to recording details of significant places, they chose to document more everyday occasions, including swimming and hiking trips and a hoop dance performance.

Observations of HRFN members at industry and consultants' meetings indicated that HRFN members showed great interest in displayed photographs. They used these photographs to refer to locations on the land and provide comments. This was in contrast to paper maps introduced by industry and consultants, which generated comparatively little interest, as evidenced by the short amount of time people spent looking at the maps versus the long time they lingered over and discussed the photographs.

Chief Pokiak, HR Lands Staff, and Elders made use of stills from videos at the Treaty 8 Oil and Gas Conference, October 2004, to contrast the North Road in the late 1970s, when HRFN made regular use of the area, with the situation in 2004, when HRFN members were severely restricted in their ability to hunt or camp there. The photographs illustrated the degree of road development along former native trails, proximity of pipelines to camp areas, and disturbance to camps by outsiders who access the area along development roads. The images also promoted discussion amongst community members on related concerns, for example the decline of moose and other game animals.

5.2.3 Discussion

5.2.3.1 Hardcopy maps

The community found the paper maps useful to demonstrate proof of their knowledge about their traditional territory, even though they found that paper maps were not effective mechanisms to encourage communication of information and knowledge amongst community members and in relation to resource management projects. Interaction with Elders and HR Lands Staff revealed that the main features Elders and other knowledge holders used to locate themselves on the paper maps were rivers, ridges, and locations of wells and seismic lines This was valuable to the construction of a geospatial approach which works for HRFN because it provided an indication of which features would best support community discussion. Overall, reliance on paper maps as the main medium of communication fails to enable HRFN to meet its varied goals including collecting TEK for decision-making and educating youth, preserving Elder's knowledge, improving Elder-youth interaction, and planning for the future.

The reaction of Elders to different map scales revealed that it is difficult to predict the spatial extent that Elders reference during discussions. As a consequence, paper maps must be produced, stored, and updated at varying scales. This is an onerous task. Integral elements of an Elder's knowledge may be physically distant from a site-specific location, as in the relationship between an animal and key areas of its habitat, or metaphysically extend beyond mapped areas, such as a spiritual area. Therefore, representing TEK solely through static map symbols under-represents TEK and devalues its inclusion in WBS decision-making. As an extension, the application of standard buffers around vector points, lines, and polygons reinforces this gap between worldviews.

It was significant that the hillshade image did not generate discussion amongst

community members even though they had indicated a preference for using this image in map biographies over other map types. It is possible that participants could relate to the hillshade valleys and mountains when trying to locate themselves on the map, but did not relate to the circles and lines used to represent places and pathways of the horseback trip. Alternatively, given a choice between different base maps for the map biographies, participants may have selected the type they preferred, but did not relate strongly to any of the maps. The method for selecting the hillshade map over others may have also been flawed. For example, the hillshade image may have been selected previously for aesthetic reasons rather than for reasons relating to spatiality.

5.2.3.2 Multimedia

Multimedia were well-received and discussed frequently by HRFN members of different ages, by elected decision-makers and HR Lands Staff, and with outside researchers and resource managers and planners. Elders were inspired by project multimedia to share old photographs and videos, thus educating community youth as well as supplementing researcher knowledge. Furthermore, both genders were engaged in recording activities by video and photograph. For example, cameras captured not only the location and process of hunting and killing a moose, but also the making of dry meat at camp. HRFN members preferred multimedia to paper maps because they captured more of what the people thought was important, as opposed to paper map representations.

HRFN members readily saw that photographs and videos, as opposed to paper maps, could be used in a number of different end products, including the community calendars and videos. Multimedia prompted Elders and other community members to recall and communicate the identities of people, places, and events connected to their traditional territory. The use of multimedia in the calendars and in the community Treaty

8 conference presentation created a mechanism whereby Elders participated at resource management meetings by talking about how the land is important to them. In particular, multimedia from different time periods promoted discussion around the impact of cumulative development.

Participants were keen to collect information using a camera and video camera, and added originality to research materials by recording everyday happenings. This acted to reveal to outside researchers what was important to HRFN participants. Similarly, Ridington (1988a; 1990c) found that recording the ordinary, not just the extraordinary, not only contributed to a more extensive soundscape of the Beaver people, but improved his understanding of what was important to the Beaver people with whom he worked. Culturally, it is important to record the silences as well as conversation because in Beaver culture much is communicated through body language, and learning is achieved through quiet observation and experience.

Multimedia stimulate more than one sense at a time. In particular, audio associated with video or by itself can be much more meaningful than a written transcript of the same event or happening (Ridington 1988a; Ridington 1990c), although video is more effective at capturing body language communications than a tape recorder because movements can be observed. I personally experienced the effect of the recording of everyday sounds. When viewing video footage taken by a community researcher which featured only the sound and sight of a horseback rider, I suddenly ‘smelled’ horses, even though I was sitting in the GIS lab at UNBC.

This study did not measure the specific memories or senses affected by multimedia amongst HRFN members and the consideration of the psychological basis of

multimedia in stimulating memories goes beyond the scope of this thesis, but it is clear that the impact is significant. Multimedia can capture elements that are relevant to generating memories. Multi-sensory perceptions supported the emergence of memories as well as the discussion of people, places, and events. Research with other cultures indicates that this may be consistent with how Aboriginals envision their world. Faulstich (1998: 201) found during research on landscape imagery in Australia that landscape is defined within the Warlpiri culture as, "an assembly of sensory information … which generates seen and felt experiences of the world." Warlpiri knowledge is linked to the landscape through the use of different senses and thus the landscape is not external to Warlpiri individual knowledge holders. Similarly, Classen (1999) wrote that the Desana of the Amazon have a worldview that relies upon different senses to interpret individual elements, their interconnectedness, and to communicate cultural norms and behaviours.

To fully communicate and use traditional knowledge within HRFN culture, knowledge holders and other community members must be situated within the experience that provides that knowledge. Multimedia representations generated community responses that indicated memories of people, places, and events were supported. The approach to communicating Aboriginal worldview in a resource management context should include the application of multimedia as a tool to support decision-making with the HRFN community.

5.2.3.3 The Role of Gender in Evaluation

Most community members are not overly comfortable with map use, although as noted men are generally more so than women because men had more experience working as guides and outfitters. Other methods of collecting data thus became significant. Elders and other HRFN participants preferred to physically go to areas in their traditional

territory than discuss potential resource management impacts using paper maps. Paper maps, when used as the sole medium of communication, acted to isolate community members who do not make use of them, in particular women. Gender may have further influenced observations and thus conclusions. During field camps, physical camping locations were broken into men and women's areas, and many tasks were divided by gender. Much knowledge was imparted during talk around the campfire or demonstrated while participating in bush activities, and since I am a woman, I primarily participated with women. In his work with the HRFN in the late 1970s, Brody (1988) also noted that he learned much more from participant observation than from map biographies and concluded that his research findings were influenced by gender, for similar reasons. Brody (1988) also stated that women's work is characteristically different from men's in that it takes place continually, while men's work tends to be oriented around an event, such as a hunt. He felt that such distinction may be under-represented through the map biography method to data collection.

WBS maps may reinforce power and decision-making disparities in relationships between genders, where mapping is largely devoid of women's input and objectives (Kwan 2002; Schuurman 2004; Pavlovskaya and St. Martin 2007). Because experiences during this study suggest that there is a risk that knowledge from women may be underrepresented despite the effort to mitigate this risk by including both male and female HRFN participants and community researchers in the data collection, over reliance on WBS paper maps may inadvertently reinforce a power structure wherein men's knowledge is dominant over women's. Edmunds et al. (1995) noted that in certain cultures, men and women may use and look after spaces of varying scales, generating

different perspectives on resource management, but the difficulty in including female perspectives of land use in research projects dominated by WBS paper maps has led to a general disenfranchisement of women. Further, it has been argued that GIS, as a WBS-based technology, is also male-dominated (Kwan 2002; McLafferty 2002; Schuurman and Pratt 2002; Pavlovskaya and St. Martin 2007), and like the paper maps GIS produces, "What are most often mapped are worlds devoid of women's experiences produced from within professions that are dominated by men," (Pavlovskaya and St. Martin 2007: 1) At the same time, researchers recognize the potential for a GIS or similar digital technology to empower women, since GIS may increase the ability to record data, information, and knowledge in qualitative forms, include subject-centred research, and by emphasizing senses other than visual, better reflect the way women communicate (Kwan 2002; McLafferty 2002; Pavlovskaya and St. Martin 2007). Chambers et al. (2004) argued that the way GIS records, represents, and communicates men's and women's knowledge may require further research to adopt methods that equally include both genders. Future studies involving the geospatial approach to communicating Aboriginal values in resource management may focus on gender empowerment, and examine ways that different tools diminish or enhance equality.

5.3 Investigation of Buffer and Weighted Polygon Approaches

5.3.1 Methods

Two approaches for combining traditional land use and occupancy information with industry and government data using weighted polygons were investigated. Each approach explored the possibility of applying vector GIS tools to create a representation of cultural clusters on the landscape. The first approach used buffers to create polygons

of specific distances around TUS sites and trails. Cultural point and linear data from various sources, including 1999-2000 TUS, map biography data collected during this study, GPS locations of significant locations, and in one version of the model, provincial Archaeological data from the RAAD, were buffered using the Buffer function in ArcInfo (Appendix 8). Points were buffered to 1000 m and lines to 100 m. Although buffer distances were determined with input from Elders, they were not considered to be definitive and would have been subject to further consideration and possible revision if this method had been pursued.

The second approach used a weighted calculation to determine values for each TUS point, where values were based on distance of TUS sites to recorded trails, and those points in closer proximity to a trail received a higher value. A continuous polygon surface was created using the Thiessen polygon function, which produces polygon boundaries mathematically defined to be specific to each point relative to all other points. Thus, zones were delineated based on each TUS site and then ranked from low to high depending on site distance to trails (Appendix 9).

Results from both methods were printed as paper maps and evaluated with HRFN Chief and Council, HR Lands Staff, and Elders in March 2005 on the reserve, as described in section 1. Chief and Council recommended that I consult two Elders (Participants 14 and 15) and weigh their opinions. I had worked with both Elders before as they were active participants in the study. They were available and willing to consider the paper map output. I interpreted the mapped output for them (e.g., seven categories used to represent results under the Thiessen polygon approach).

5.3.2 Results

Chief, Council, HR Lands Staff, and Elders reviewed the mapped output from the buffer (Figure 8) and weighted polygon approaches (Figure 9). Chief Pokiak noted that although the resultant polygons could be readily combined with existing analyses such as provincial wildlife habitat ratings or CAD polygons, the output only served this one purpose and did not satisfy other community goals, such as educating youth or encouraging Elders to recollect additional information. Further, she commented that, "things get lost in translation when … subtracted from the dataset," (Pokiak, Pers. Comm., 4 March 2005). Although the maps themselves were not scrutinized, participants voiced concern over the possibility that these approaches increased the risk that HRFN information and knowledge, as represented by the polygon output, could be removed from the community, and thus, removed from HRFN control. Participants also found these maps difficult to interpret. There was a brief discussion around the subjectivity of applying equal or unequal weights to different points. Neither model could be readily updated. Because TEK is ongoing in its communication and collection, this would make the models out-of-date almost as soon as they were created.

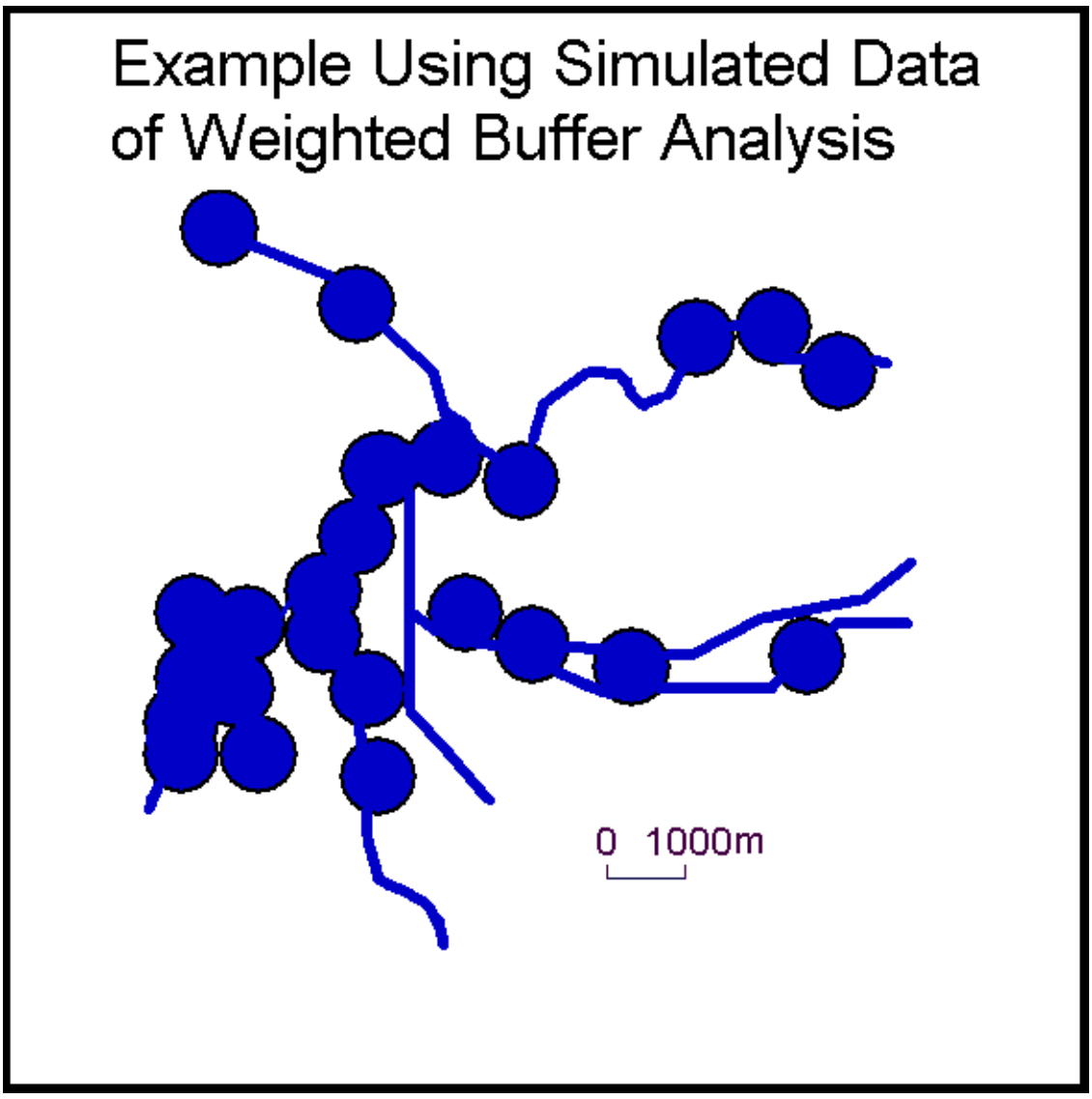

Figure 8: The buffer method to creating weighted polygons buffered points to 1000 m and lines to 100 m. Buffer distances were determined with Elders' input, but were not considered definitive and would have been subjected to further consideration and possible revision if this method had been pursued.

Figure 9: In a second approach to create weighted polygons, points were weighted according to their proximity to trails, with points closest to trails receiving higher values. A surface polygon feature was created from the results by generating Thiessen polygons. The above example uses simulated data to protect the confidentiality of HRFN TEK.

5.3.3 Discussion

GIS methods producing digital data representing weighted surfaces are used by industry, government, and other First Nations to identify areas where proposed development may impact recorded TUS, TEK, or traditional Aboriginal values (Candler et al. 2003; Ebert 2003; Honda-McNeil and Parsons 2003; Alberta Traditional Use Study Cross Ministry Committee 2004; Lee 2004; Norwegian and Cizek 2004; Rumsey et al. 2004; Close and Hall 2006; McCall 2006). Creating weighted polygon coverages is not a method that is extendable to HRFN communication of values and knowledge. The output proved hard to understand and was not easily updated by community members. Elders appreciate the opportunity to discuss amongst themselves knowledge and values, and because no individual Elder holds all the information of the community, the geospatial communication system must include an approach that stimulates rather than impedes discussion. Although the weighted surface approaches may support timely decision-making by government, they do not promote or support community-based values.

5.4 Development of ArcMap Capacity and Introduction of Hyperlink Tool

5.4.1 Methods

5.4.1.1 Development of ArcMap Capacity

Assistance in acquiring GIS software and appropriate computer hardware was provided to HRFN in 2004 in cooperation with Treaty 8 Tribal Council and OGC GIS specialists (Appendix 10). With input from HRFN Chief and HR Lands Staff, I developed and delivered a GIS training program specific to resource management demands of the HRFN Lands Office. HRFN Chief and Council identified one staff member, a Lands Officer, to receive the training. Three documents were prepared and used in introductory GIS training sessions: a manual describing basic GIS software

functions specific to the context of HRFN needs (Appendix 11), a guide to UTM zones (Appendix 11), and a metadata document describing HRFN TEK GIS data. Chief and Council and other HR Lands Staff requested and received additional copies of this material. Additional support was provided over the phone during times when I was not in the community.

Training was conducted in person between August and November 2005. Jeremy Burbee, Treaty 8 GIS Specialist, provided supplementary support until he left his position in the spring, 2005. In addition, Chief and Council supported two HR Lands Staff employees in attending a week long ArcMap training workshop in August 2005.

ArcMap map document files (.mxd) that save the way a user has chosen to display selected data were initially created at UNBC when producing paper maps for review by HRFN members (see above). These files were transferred to HRFN once ArcMap was available in the community, along with TEK GIS data and supporting TRIM, Forest Cover, and other relevant data layers. Map document files were modified by the HRFN GIS operator during training and use. When appropriate, new map document files were created by the HRFN operator (e.g., creation of .mxd to support data update). Mapping symbols initially created for paper maps were also reviewed and modified by HRFN.

5.4.1.2 Implementation of a Hyperlink tool

Hyperlink is an ArcMap tool that references and opens files stored externally to ArcMap through a shapefile database field. A point shapefile was created using existing TUS data and data collected in 2003 and 2004 for use with hyperlink. Hyperlinks are connected to points within ArcMap (Figure 10). The hyperlink tool displayed HRFN photographs, video, and written interview extracts. The database was updated twice during 2004 with additional photo and video research materials. In most cases, files were

connected directly to a recorded point, such as a GPS or map interview site. However, in a handful of instances, information from interviews that lacked point-specific spatial location was also linked; for example, an interview referencing traveling up and down a particular river. In this case, a point was created along the river and the database record attached to this point. These locations were reviewed with Elders (Participants 2 and 7) in October 2004 in the HRFN Lands Office to verify that selected locations were acceptable. The evaluation was conducted with two Elders who had previously demonstrated comfort reading WBS maps, an ability necessary for determining if points were placed in suitable places within ArcMap. The hyperlink tool and accessible multimedia files were presented to the community in October 2004 during a formal meeting for input and review.

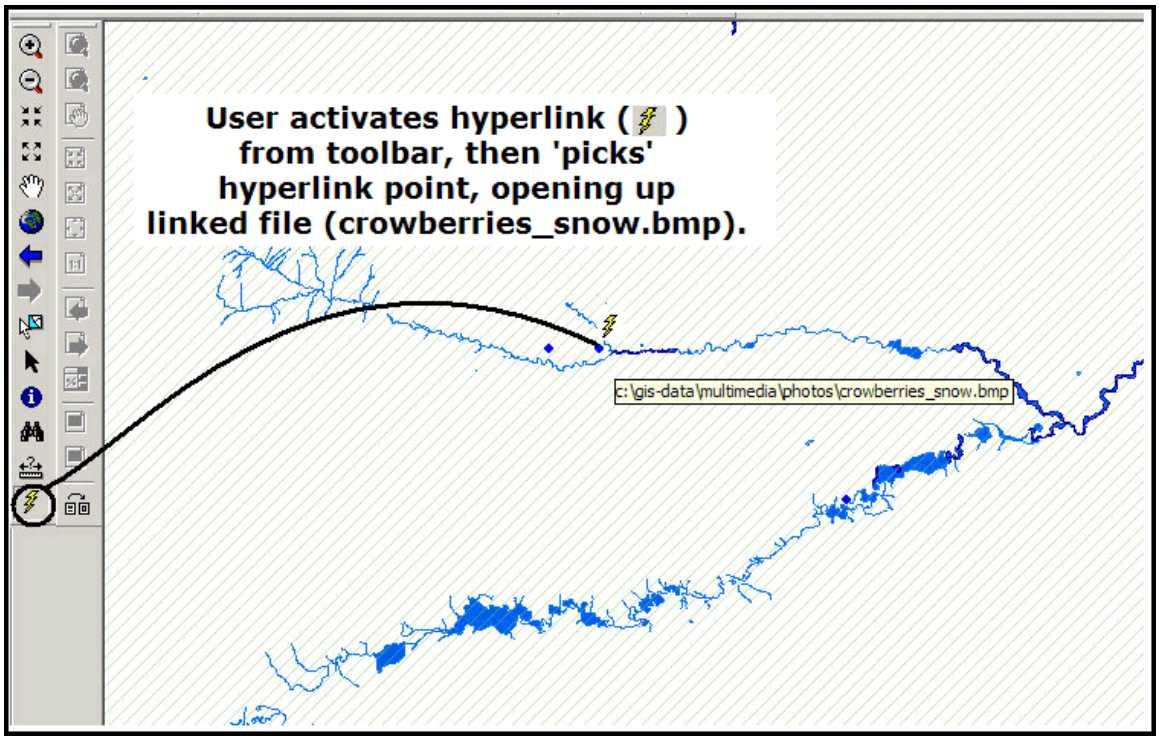

Figure 10: Through the ArcMap hyperlink tool, users access external files by connecting with a point that activates the link. Users found it problematic to locate the exact point on the screen which would activate a link. The above example uses simulated data to protect the confidentiality of HRFN TEK.

5.4.2 Results

5.4.2.1 Development of ArcMap Capacity

HR Lands Staff used ArcMap to digitize information related to proposed resource developments during training as well as independently. Sporadic use of ArcMap resulted in the need for staff to reacquaint themselves with more complex tasks. Issues raised by HRFN users were discussed and overcome during training sessions and over the phone, and by referring to the aforementioned documents produced to support HRFN use of ArcMap. It was noted that Chief and Council expressed concerns about the cost of the yearly license update for ArcMap (~$950).

Two ArcMap map documents were used by HRFN personnel. The first contained HRFN preferences. HRFN users reorganized their map documents and data to reflect preferences which allowed them to use information more effectively during decision-making. Data relevant to access to HRFN traditional territory, including roads, cutlines and seismic lines, were put in one group.[22] New database categories were developed to increase the usefulness of the 1999-2000 TUS information. Moose, originally grouped with other animals on the TUS paper maps, were highlighted because of their cultural dominance by symbolizing them separately. Trails were coded by activity according to TUS information and their use confirmed during informal discussions with HRFN participants. Trapping areas held by HRFN members were accented by member name. Local and Beaver names were added to sites and roads. Other types of spatially coded data, such as verbal descriptions from HRFN Environmental Monitors, were added within ArcMap.

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[22] Groups are used to organize related layers. In this instance, a group titled ‘Access’ contained layers for roads, cutlines, seismic lines, and other data layers relevant to entry into and movement across HRFN traditional territory.

The second type of ArcMap map document used by HR Lands Staff contained the same information as the first except that sensitive or sacred information and knowledge were made obscure through the use of generalized symbols for HRFN knowledge. This second map document was used when HRFN made presentations to industry or government representatives with whom they chose to share only selected information.

ArcMap was used by Chief and Council and HR Lands Staff during training to create different size buffers around cultural information. In particular, a 10-mile buffer was placed around one significant and sacred feature. The 10-mile radius had been chosen by Elders and this buffer was referred to during discussions about resource development. HRFN GIS operators and decision-makers also used the measure tool in ArcMap to measure the distance between the significant feature and a proposed development feature to determine if the feature was within the 10-mile buffer. Since a standard buffer created by ArcMap envelopes the buffered feature using a specified distance, the visualization of buffers promoted discussion about what a potential buffer would and would not protect. For instance, it was noted that buffers would not protect headwaters of streams or forest habitat lying outside the buffer distance even though an area valued by the HRFN was reliant on the health of these areas (Participants 26 and 29).

ArcMap was also used by Chief and Council and HR Lands Staff to visualize and discuss the effectiveness of potential ‘no-go’ zones. The concept of these zones was presented by government officials as provisions to HRFN in exchange for HRFN permission to go ahead with development in other areas. In the fall 2005, buffers sized between 5 and 10 hectares were created to demonstrate to HRFN examples of the extent

of land that government representatives indicated could potentially be covered by the projected ‘no-go’ zones. Community discussion occurred around the theoretical application of zones meeting these size restrictions (Participants 14, 15, 25, and 26). It was noted that these smaller zones would also be ineffective in protecting values that extended beyond a particular site.

ArcMap proved useful in visualizing and communicating cumulative impact. In particular, one image, displaying the study area, major rivers, the MKMA boundary, and HRFN reserve, was created in ArcMap. This image was then contrasted with a second to which seismic lines, cutlines, TRIM roads, wellsites and facilities had been added (Figure 11). These images, displayed at the October 2004 community meeting, demonstrated the magnitude to which development covers portions of HRFN traditional territory and promoted discussion amongst HRFN Elders, Chief and Council, HR Lands Staff, and other participants around the spatial and temporal extents of cumulative impact (Participants 2, 4, 6, 7, 14, 15, and 16). A second series of images, produced by HRFN and Jeremy Burbee for the October 2004, Treaty 8 Oil and Gas Conference, focused specifically on the North Road and promoted similar discussion at the conference.

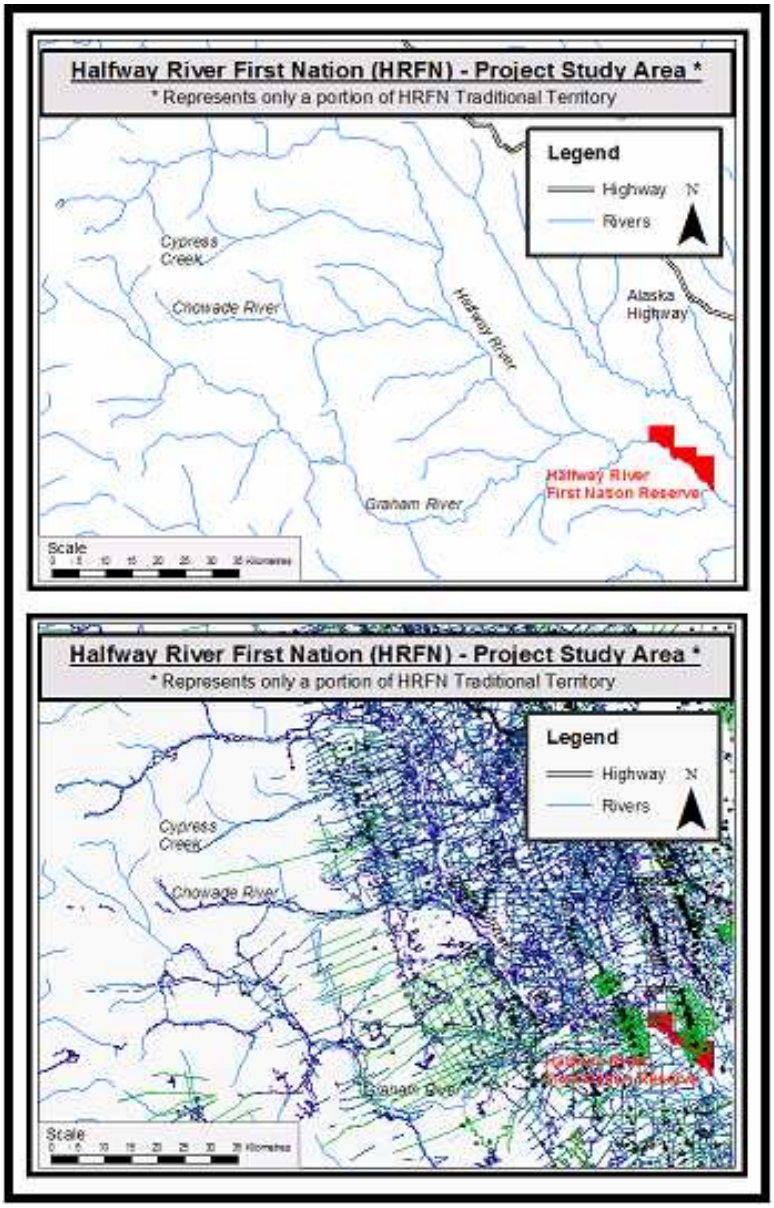

Figure 11: ArcMap proved valuable when communicating the effects of cumulative impact. The top image illustrates an approximation of the study boundary using base features, including major lakes and rivers, the HRFN reserve, and the MKMA boundary. The bottom image displays the same base features at the same scale with identical symbology, but the inclusion of resource developments such as seismic lines, cutlines, and wells, creates a dramatic contrast. The bottom image encouraged discussion amongst Chief, Council, HR Lands Staff, and Elders regarding the spatial and temporal impacts of development.

5.4.2.2 Implementation of a Hyperlink Tool

The main difference between multimedia (discussed above) and hyperlink material was that hard copies of multimedia material could be shared around the

community, in homes, and on the porch in front of the HRFN office, whereas hyperlinked material could only be seen if someone came into the Lands Office so that the material could be viewed on a computer screen. HRFN Chief, Council, and HR Lands Staff queried hyperlink points located on the ArcMap display to examine multimedia relative to that location. Photographs and video acted to provide an onus of proof of significant locations without HRFN members having to take industry out to visit these areas. Feedback indicated that HRFN users were enthusiastic about having the ability to prove that these areas were in fact part of their living culture without having to reveal their exact location or take people who were not spiritually prepared to the sites. During meetings with government and industry resource managers, the presence of photographs and video encouraged Elders to recall past experiences and important events, thus further demonstrating to industry that culture and communication of culture is active within HRFN society (Participants 14 and 15). It is notable that although written documents could be accessed through the hyperlink, HRFN users chose not to read them. When I pointed out the written documents, even to formally educated members to whom such written material might be useful, they were not interested and preferred to look at video and photographs.

Hyperlink viewed in combination with digital representations of proposed resource developments allowed Chief, Council, and HR Lands Staff to consider how the proposed development might impact the area based on HRFN values captured and evident in the photographs and video. Further, Elders and other knowledge holders were brought into the office to view multimedia files and contribute to decision-making (Participants 7, 8, 14, and 15). For example, discussions occurred around potential

temporal impacts on animal populations as well as spiritual areas where Elders indicated quiet is necessary. Photographs and video were the primary media accessed. Written text from the TUS interviews was viewed only to see what files were linked, but they were not referenced further by Elders or other community members.

Viewing the multimedia prompted Elders to produce photographs from their homes for the purpose of including them. Where possible, this material was scanned and included in the ArcMap presentation. In addition, photographs taken by consultants working on other projects were obtained by HRFN and added to the database if Elders showed interest. However, Elders did not want to use the computer themselves.

Questions from HRFN personnel using ArcMap on how to activate hyperlink suggest that the hyperlink tool is not intuitive for HRFN users. Also, users found it awkward to locate the exact point on the screen which would bring up each individual link. Further, hyperlinks are displayed within ArcMap as points. This reinforces the concept that hyperlinked material does not extend beyond the extents of the mapped point.

Researchers also noted that during a community presentation to demonstrate the hyperlink, community members showed great interest in the linked multimedia materials, but almost no interest in the map itself (Participants 2, 4, 5, 6, 7, 8, 14, 15, and 16). This presentation was made on the same day as a presentation by consultants using paper maps with photographs to illustrate their project progress on the HRFN Treaty Land Entitlement project. Researchers noted that HRFN Elders and other attendees did not look at the map closely but spent much time reviewing and talking about various photographs taken by the consultants.

5.4.3 Discussion

5.4.3.1 Development of ArcMap Capacity

ArcMap proved to be a valuable tool in promoting discussion of cumulative impact, particularly when spatial data were exported to images and used outside the software in illustration to Elders and others. Discussion ensued amongst community members around spatial and temporal impacts of seismic lines and other developments. Further, HRFN participants reported they felt empowered by being able to collect, maintain, and manage control over their own data and information. However, a significant level of abstraction is required to include TEK into standard vector files (e.g., a point representing a spot where a moose was harvested does not capture the cultural practices involved in tracking and harvesting the moose and the production of dry meat).

The images depicting cumulative impacts provoked some noteworthy comments from government representatives, who focused their questions on the representation of accuracy as a means to discredit the image use and presentation. Seismic lines in the cumulative impacts image (Figure 11) were represented as 60 m wide according to map scale. On the land, historic seismic lines were constructed between 8 to 10 m wide, and since the mid-1990s they have been created approximately 5 m wide (ForestEthics 2003; West Coast Environmental Law 2003a; Linke et al. 2005). Although the width was selected to illustrate the presence of seismic lines, the discussion revealed that HRFN members have a contrasting view of the spatial and temporal impacts of linear corridors. Chief Pokiak responded to an assertion by a member of the OGC that the effects of seismics are merely temporal and only last between 20 and 25 years by stating that community members had observed that seismic lines and oil and gas activity caused a decrease in animal populations. Research in Alberta has shown that secondary impacts on

the landscape from seismic lines, namely a reduction in patch size and an increase in variability of space between patches, caused grizzly bears to use areas less (Linke et al. 2005). Also, Chief Pokiak commented that access to the land continues long after seismic lines have been used for geophysical testing, as HRFN traditional territory is opened to other people who use 4x4s and/or quads along seismic lines or old logging roads. These impacts are not new, as they were also observed by Brody (1988: 232) in the late 1970s:

> hunters can follow new trails that are being cut or bulldozed into the bush as a result of the burgeoning frontier: seismic lines and pipeline rights-of-way that have slashed ever deeper into the foothills and forests. Four-wheel drive pickups can often follow the roughest of these cutlines, which therefore offer safe trails for Whites who might otherwise soon be lost in lands they would not normally dare to enter.

The employment of two separate map documents enabled the community to maintain strict confidentiality of their data, but meant that links to data had to be maintained twice, once in each map document file. A risk that others could access location information on HRFN sites existed because x and y coordinates were stored on the computer; theoretically someone could simply access, download, and remove relevant data files from the community. HRFN Chief and Council minimized this possibility by keeping the computer in a locked room and obtaining a lockable, fire-proof cabinet for digital and other study data. Plans were also made to store recorded TEK on an external hard-drive which could be more readily secured than a computer tower.

Concerns over barriers to sustainable software use and the necessity for continual training have been noted by other First Nations and are shared by HRFN (Johnson 1995; Canada-BC 2001; Candler et al. 2003; Wilson and Graham 2005). ArcMap may require intensive and continual training. Because of other duties that their job required, HR Lands Staff made use of ArcMap sporadically, and therefore forgot how to do some of

the tasks. There was a concern that once trained, HR Lands Staff might end their employment with HRFN. Additionally, new administrations may introduce different priorities and choose not to continue with ArcMap. Like other First Nations, the cost of license renewal was also an issue with HRFN, which may reveal that for its use, ArcMap is simply not valued that highly within the community.

Successful implementation of ArcMap and related geospatial software may hinge on the development of training tools that enable users to directly access information on how to do specific tasks and, through success, build confidence in users. Training is more effective when done in small units with manuals designed to address specific HRFN problems, which then link to general ArcMap concepts. All approaches need to be tailored to become as intuitive as possible and, given the visual and oral culture of the community, supported by visual and audio help materials.

There may be other factors that determine sustainability of the use of geospatial software in HRFN. Corbett (2003) worked with two separate communities in Indonesia and found that one community displayed long-term interest and maintenance in their PGIMS and the other did not. Corbett observed that success was dependent on elements external to skills and knowledge, including the maturity of community program operators and the commitment of community leadership.

How information is categorized and presented within ArcMap is important to HRFN since it eases their ability to access information and increases their familiarity and ability to read the digital map and thus increased its relevance for decision-making. Although there was limited buy-in by Elders to the use of ArcMap, for example through the ability to label places with local names, the map interface remained intimidating to

those who were not comfortable with maps. Further, the use of a computer may act to alienate HRFN members not comfortable with technology.

5.4.3.2 Implementation of a Hyperlink Tool

Hyperlinks to multimedia promoted discussion amongst Elders and other community members, similar to the way in which photos and videos by themselves proved of interest. However, multimedia by itself was shared with a greater number of community members simply because it is more portable. The presentation of HRFN multimedia through hyperlink did allow values associated with photos and video clips to be discussed specifically to spatially referenced existing and proposed resource developments. Corbett (2003) also found that users were less interested in the map and more interested in the multimedia itself. He considered that because users may choose to view the spatial information contained within multimedia outside of a Cartesian map context, any information stored in the computer could justifiably be termed community geographic information.

Hyperlinked files were accessed with interest by Elders but written text documents from interview transcripts were not. Photographs, video, and sound recordings of Elders helped Elders recall past experiences and important events. The hyperlinked multimedia reinforced the community's oral communication style. Further, using multimedia complemented preferred data collection techniques by community researchers and youth. There was minimal abstraction of data, information, and knowledge when photos and videos were used to invoke memories. The appeal to Elders resulted in traditional decision-makers becoming engaged with resource management.

Sowa-Babik (1999) noted that its structure of nodes and links make hyperlinks non-linear, and users determine the context, form, and sequence of accessed information.

Non-linear sequencing may provide opportunities for First Nations to record and communicate information and knowledge in more culturally relevant ways. If users are given the ability to easily add new multimedia, then the map becomes fluid or dynamic. She contrasted this process to that of accessing information from a paper map, where the map-user passively receives the message created by the map author.

Chief Pokiak indicated that hyperlink multimedia elements were valuable in proving to industry that special traditional sites existed without having to make site visits. It enabled HRFN to demonstrate that TEK is part of the living HRFN culture and is not just an abstract concept. It also emphasized that TEK continues to be practiced within HRFN traditional territory, and that continuation of culture requires the health of that traditional territory, not just the reserve.

The hyperlink tool itself proved to be not intuitive for HRFN ArcMap users. The setup and design of ArcMap tends to subsume any hyperlinked material to other geospatial data. This seems to act to present multimedia as an afterthought, whereas clearly for the HRFN the multimedia was an integral part of the system. The dominant way in which HRFN TEK was presented to users was through the point and line symbology. Even though HRFN users designed, modified, and edited symbols to represent information as they desired, the reliance on points and lines to represent their TEK maintained the same type of frustrations they found when using paper maps that used points and lines to represent TEK. There is more to a TEK record than what is contained visually by a point or line record.

5.5 Creation of Areas Derived from Visibility Analysis (Viewshed Polygons)

5.5.1 Methods

Visibility analysis is used in GIS to flag areas that can be seen from designated locations. Output is in the form of a polygon, which can then be used in analysis with other GIS layers. Field research with HRFN participants in 2003 and 2004 identified places where HRFN Elders indicated the view itself was significant, including from: villages, burial sites, campsites, and spiritual areas. Locations were recorded using a GPS and later verified by overlaying the points on orthophotos and comparing recorded and known locations. Verification was also established during conversations with HRFN knowledge holders, who viewed viewshed polygons at the reserve in September 2005 (Participants 8 and 14). In one instance, I did not have the opportunity to visit a site but it was apparent from one Elder's stories that the view is important (Participant 8). Approximate locational data were collected using the map biography method, and results were compared with those from the 1999-2000 TUS data. Viewshed polygons from five separate locations were generated using the VISIBILITY command in ArcInfo Workstation 8.0 (Figure 12) (Appendix 12). The five locations were chosen to provide a selection of examples to review with HRFN participants, and included: a spiritual site, two campsites, one traditional village, and one burial site.

5.5.2 Results

Viewshed polygons were incorporated into the community's ArcMap map document file. Queries enabled HRFN users to determine where proposed developments would intersect significant views. In theory, this presented a model where developments in the real world impacted values associated with view. Further, the views were

augmented by photographs taken in the field and stored as hyperlink objects in ArcMap.

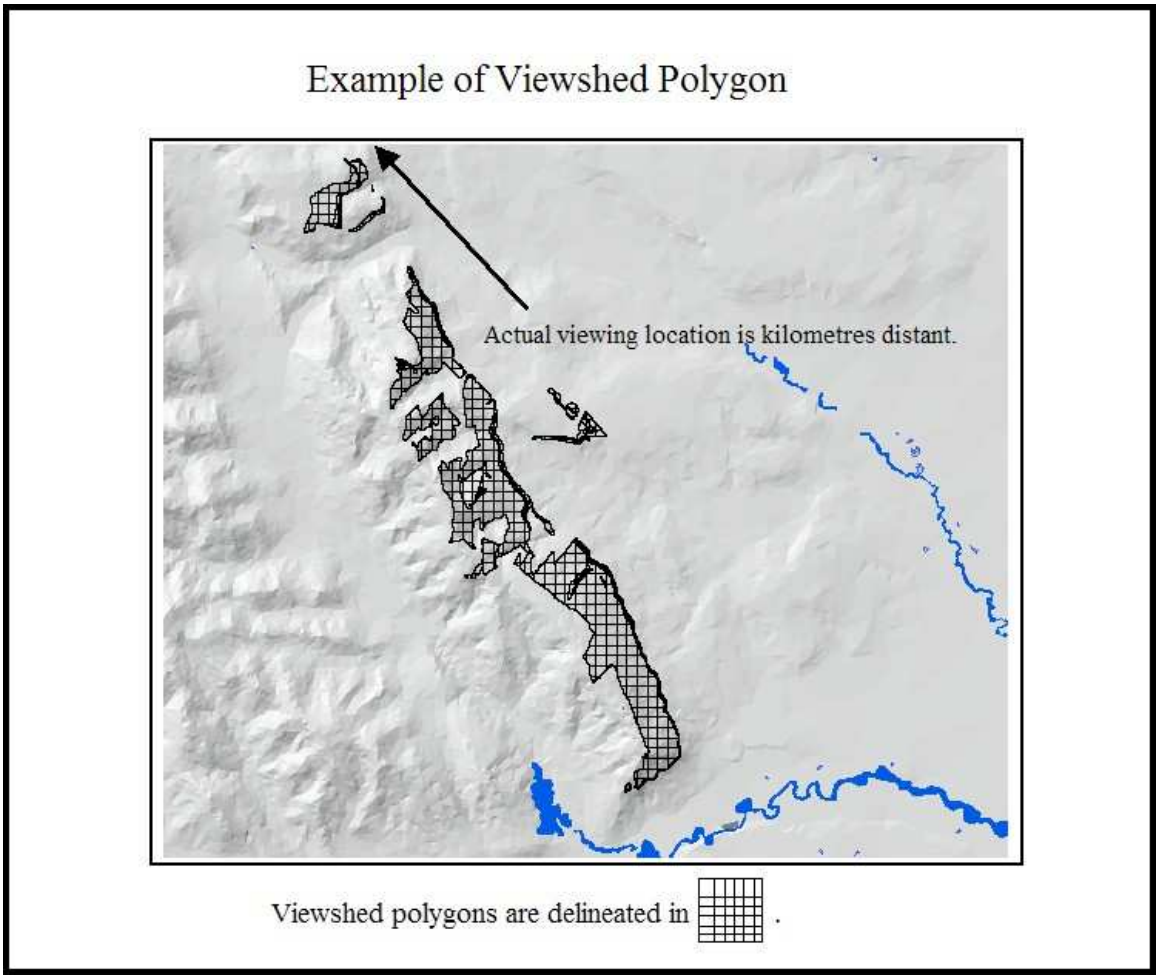

Figure 12: Viewshed polygons model areas representing views that can be potentially seen from significant locations, as specified by Elders. The actual significant location is not pictured above and may in fact be many kilometres away. The above example uses simulated data to protect the confidentiality of HRFN TEK.

In practice, the viewshed polygons were referenced only when I pointed them out during training sessions or when I assisted Chief and Council and HR Lands Staff with ArcMap application during resource management decision-making. The photographs associated with the views were consulted independently of the viewsheds through the hyperlink and outside of ArcMap software by HRFN members who asked about photographs taken at those locations.

5.5.3 Discussion

HRFN participants did not embrace the output of the viewshed models and this approach was not successful in encouraging communication amongst HRFN members. It may be that the viewshed process is not intuitive to HRFN users and that a broader education program aimed at all community users could illustrate what line-of-sight analysis entails and how the output could potentially be used.

5.6 Consideration of Three-Dimensional (3-D) Terrain Models

5.6.1 Methods

Computer visualizations of three-dimensional (3-D) terrain models create a more holistic depiction of the landscape than two-dimensional (2-D) GIS. Projects with other First Nations suggest that 3-D models may allow community members to view what areas looked like in the past, or to perceive proposed future developments. Further, 3-D visualizations may enable Elders whose health compromises their ability to travel on the land to participate more fully in discussions relating to land use (Lewis 2000; Sheppard et al. 2002). Preliminary observations suggested that communication with HRFN members about the land and its significance could be strengthened through enhanced 3-D modelling. I observed HRFN Elders mentally reconstructing images of the landscape during discussions in the field by using ridges and valleys as points of reference. Further, HRFN project participants indicated a preference for a hillshade image to be used as a base for the interview maps.

The potential of using 3-D representations was investigated in 2004 using three software platforms: ArcGIS software extension 3D Analyst, Ecomodeller visualization software, and in the fall of 2005, using the National Aeronautics and Space

Administration's (NASA) World Wind web-based Open Source software. The use of World Construction Set, although prominent in a few projects with other First Nations, was avoided based on reports of requirements for long-term and extensive training (Sheppard et al. 2002; C. Brooks, Pers. Comm. 20 Nov. 2003; Sheppard et al. 2004). Findings from this research had already shown that maintaining skills was a challenge, given the remote environment of the HRFN reserve and the fact that personnel used software at irregular intervals.

I produced several 3-D 'flies' in 3D Analyst, outputting movies which moved the viewer's perspective across a 3-D landscape. The flies centred on a location that was geographically prominent to the HRFN people and therefore should have been recognizable and perhaps meaningful to Elders and other HRFN participants. Different themes were used to evaluate HRFN users' reaction to varied landscape depictions: 1) contours draped over a plain green 3-D landscape with water features (Figure 13A); 2) a landscape shaded to emphasize elevation change (Figure 13B); 3) addition of vector elements representing real-world features, including roads, wells, and seismic lines; and 4) the addition of trees. Trees were added in an effort to make the landscape appear more realistic. The 3D Analyst results were reviewed separately with three Elders (Participants 8, 14, and 15) in January 2004. The three Elder reviewers watched the 3-D 'flies' I had produced at UNBC on my computer at the reserve in the HRFN Lands Office. Their independent responses were triangulated for analysis of their reactions and consideration of the degree of their appreciation for the flies.

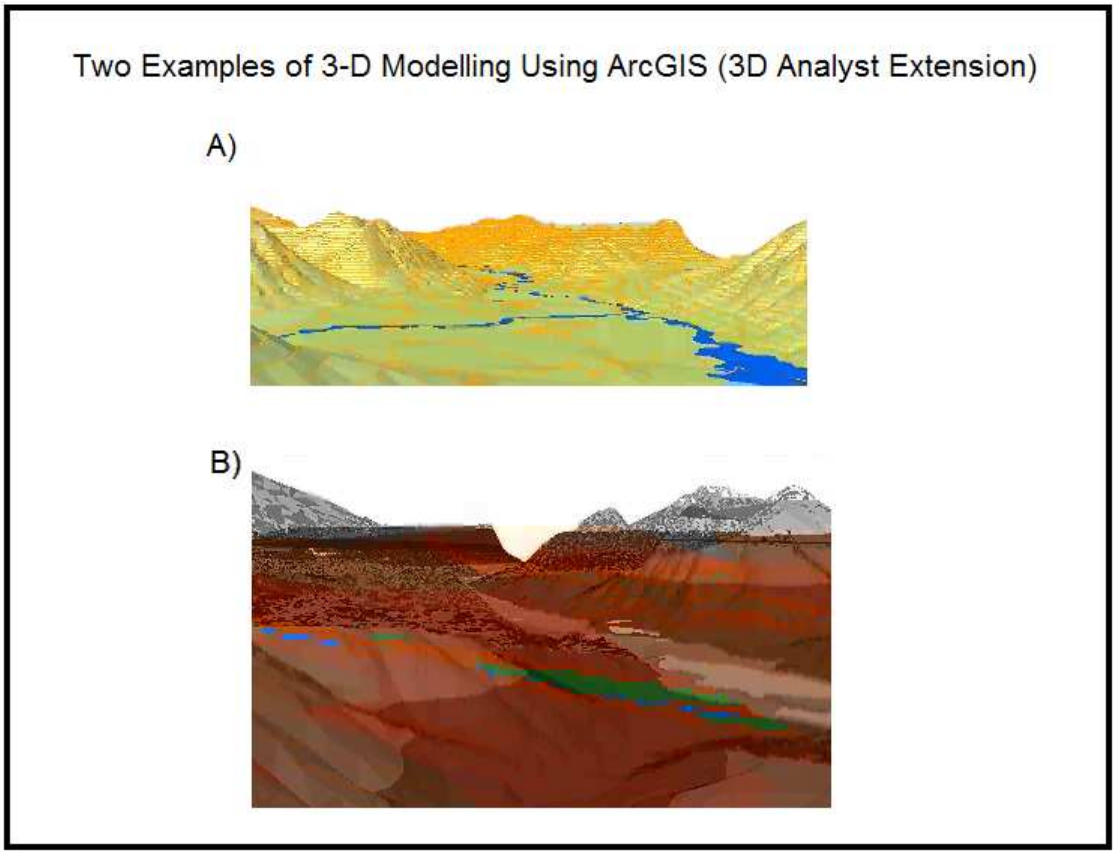

Figure 13: Two examples of 3-D models depicting landscapes in the HRFN traditional territory. The examples above were produced using 3D Analyst and shown to three HRFN Elders to record and evaluate the degree of their appreciation for the models. These captured frames are heavily pixelated and the images appear far clearer in the movie image viewed by the HRFN Elders. No scale was presented in the moving picture, but images A and B were at scales of approximately 1:30,000 and 1:20,000, respectively, on the computer screen, as determined by comparing the screen image to 1:50,000 paper maps.

Ecomodeller software was investigated since the advertising on Ecomodeller and user feedback indicated that it allowed for modelling on the landscape level, suggesting that it would be possible to model broader areas than computationally possible with 3D Analyst (Collens 2003). In addition, Ecomodeller is produced by a B.C. company, Viewscape3D Graphics Ltd., and therefore uses tree images that are native to B.C., providing the potential to create additional realism.

In the fall of 2005, we considered National Aeronautic Space Association's

(NASA) World Wind (see: worldwind.arc.nasa.gov) for use as the primary software for this project. World Wind creates a terrain model using available satellite images and elevation data over the Internet. World Wind can also be used independently of an Internet connection by downloading a 1-km^2 resolution base image, termed the 'Blue Marble'. The potential utilization of any application built around World Wind was increased by this function since Internet availability at HRFN was sporadic. Building on the positive responses of community members to hard copy multimedia and ArcMap hyperlink, we examined adapting World Wind's use of eXtensible Mark-up Language (XML) to display HRFN cultural information through hyperlinks to HyperText Markup Language (HTML) pages (Figure 14) (Appendix 13).

5.6.2 Results

Feedback indicated that the 3D Analyst models did not provide a high enough degree of realism to elicit meaningful responses from participants. Elders indicated that it was difficult to connect the models with their impression of what the land looked like. Chief, Council, and HR Lands Staff also stated that they did not find the models realistic enough. The addition of trees to the model slowed down processing and increased file size significantly and did not result in a model of sufficient realism to engage HRFN participants. Further, Elders commented that the view was from high up, and not from on horseback, which is what they remember.

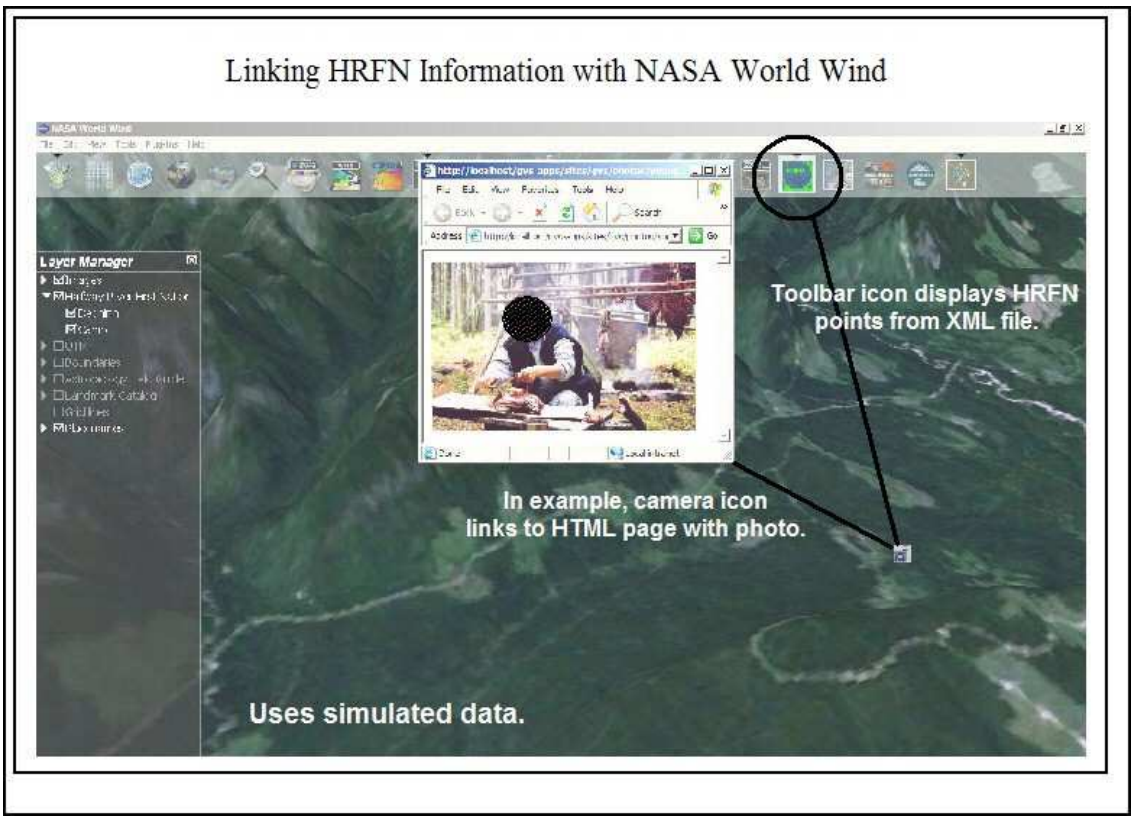

Figure 14: HRFN data was linked to NASA World Wind and evaluated for its potential ability to enable HRFN to communicate their values to resource managers. The background is satellite imagery accessed through World Wind; the photograph, linked to the imagery at the geographic coordinates where it was taken, was acquired during data collection in the field. The above example uses simulated data to protect the confidentiality of HRFN TEK. Identity of the participant is obscured in this representation but not in the original.

It takes considerable time to create a quality 3-D fly using 3D Analyst or Ecomodeller. The initial geographic extent was much too large for the computational power of the computer and had to be reduced several times. The size of area that was achievable computationally was too small to be relevant for discussions with HRFN members; it was impossible to predict what landscape extent Elders and other knowledge holders wanted to discuss because HRFN TEK is dynamic and was communicated sporadically. To accurately determine what extent was appropriate, one would have to be in the position of having an intimate awareness of TEK held by each HRFN individual.

Further, the time needed to produce an additional fly focusing on additional areas mentioned by Elders was too long to make practical contributions to on-going discussions. HRFN also is challenged with decision-making which centres around linear features, such as seismic lines and roads, and 3D Analyst works best on area regions. These technical problems cannot be solved simply, for example by acquiring a newer computer, since they are related to software limitations.

Ecomodeller proved quite onerous to use (Appendix 14). Ecomodeller was reviewed with Chief Pokiak in March 2004 and it was noted that the software did not provide adequate solutions to issues raised during HRFN feedback on ArcMap's 3D Analyst and therefore was not introduced to community members.

World Wind readily shows x and y coordinates using latitude and longitude, and users can add UTMs with a plug-in. The resolution was sometimes too coarse and the screen can appear quite crowded when zooming in on specific features. In addition, tools for creating output directly consistent with geospatial tools used by industry and government resource managers and planners were not available.

5.6.3 Discussion

The 3-D flies made from 3D Analyst did not look enough like the landscape to the Elders and others to entice them into discussion about the land or its importance to them. Potential exists for an increase in realism if and when higher resolution satellite images become available and are used as drapes over the models. Each of the three programs worked most efficiently when data focused on a small (~15 ha) area. However, many of the proposed developments being reviewed by the HRFN at this time are linear in nature (e.g., seismic lines), and the 3-D software tested was not able to provide much detail

along a linear corridor let alone beyond the corridor itself. The cost of obtaining higher resolution images for HRFN's traditional territory, as well as the computational power required, makes this option impractical. Additional costs would be associated with the licensing requirements for 3D Analyst and Ecomodeller. Further, the higher skill level required for each of these systems would likely require HRFN to rely more on outside contractors, and thus trust others with their TEK.

5.7 Summary and Conclusion

The results from the research provided definitive direction on the development of a geospatial approach. The use of weighted polygon models to represent HRFN values was not embraced by HRFN elected members or traditional decision-makers, primarily because their knowledge was placed in a form that was too abstract to support community discussion. Three-dimensional model approaches did not engage HRFN viewers and were time consuming to prepare and generate and, because of software and hardware limitations, did not always show areas or scales of the traditional territory that Elders deemed relevant to discuss. A mapping tool, ArcMap, enabled HRFN to view existing and potential resource development in relation to other spatial data and to categorize and symbolize HRFN data in preferred ways. Portrayal of multiple existing resource developments supported HRFN consideration of cumulative impact. It is clear that multimedia stimulated and supported HRFN discussion of locations and values associated with those areas. However, multimedia as accessed by the hyperlink tool placed TEK in a deferential order to spatial data that better fit storage, access, and analysis through WBS-based mapping software. Any approach that was not easily updated, and did not support the collection of TEK as a dynamic entity, was not supported by the HRFN.

5.8 Principles identified from testing applicability of geospatial approaches with HRFN that are central to the creation of a geospatial communication system:[23]

5.8.1 Principle 13: Provide supporting information to HRFN decision-makers, such as wildlife habitat polygons, in a way that does not subsume TEK to WBSK.

HRFN elected decision-makers, Elders, and HR Lands Staff demonstrated interest in viewing TEK with other spatial data. ArcMap provided the most direct method of doing this, since industry and government data formats are compatible with ArcMap. Further, query tools in ArcMap allowed ready consideration of attributes that coincided spatially as HRFN information was stored in a format compatible with ArcMap. HRFN layers were promoted to exist as the top-most layer in ArcMap, but this action did not free HRFN from using points, lines or polygons to represent their knowledge. The hyperlink tool provided one method for attaching multimedia and other files to spatial data, but HRFN users did not find hyperlink intuitive.

5.8.2 Principle 14: Use computer systems and software that serve the other principles and have the potential to grow with changing HRFN, industry, or government requirements.

The selection of software for the geospatial approach must serve the identified principles. Discounting one or more principles because it is expedient to do so at the moment may prove short-sighted, given that the geospatial approach is designed to grow as the needs of the community grow. Different individuals and groups will prioritize the principles differently. For example, one of the primary goals of this thesis was to develop a geospatial approach that communicates Aboriginal values for the purposes of inclusion in resource management. However, it is my opinion that most HRFN participants would

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[23] Principle 1: page 44; Principle 2: page 44; Principle 3: page 96; Principle 4: page 96: Principle 5: page 96; Principle 6: page 97; Principle 7: page 97; Principle 8: page 138; Principle 9: page 138; Principle 10: page 139; Principle 11: page 139; Principle 12: page 139.

prioritize creating an approach for the purpose of preserving and communicating TEK to their future generations above their participation in resource management, although because of the connection of HRFN TEK to the land, the goals are not mutually exclusive. A different prioritization of principles may best satisfy each goal, depending on one's worldview. Therefore, to maximize potential for success, software should be selected that meets all principles.

Secondly, to develop a geospatial approach that is responsive to the changing needs of a First Nation, it must be possible to make modifications and updates to the software and the geospatial approach as a whole. The work described in this chapter emphasized that multimedia elements need to be at the centre of the geospatial approach since they proved most effective at stimulating discussion amongst Elders and other HRFN members about events, experiences, and values, a point that directly supports Principle 5. Multimedia use also reinforced the need to create methods that enable the incorporation of relevant information from disparate sources, as stated in Principle 10. Because the mechanism to access multimedia within the computer was through hyperlinks, the software must use a hyperlink approach. Thus, either a hyperlink tool or the avenue to create one must exist. Additionally, the software must be responsive to different requirements from industry and government, for example by accommodating a shift in the way geospatial information is transferred. This ability would serve also to meet Principle 12. The principles derived from the work and used in preparation of the geospatial approach are listed for convenience and easy reference in Table 2.

Table 2: Principles derived from the work in this thesis are used to guide the development, design, and testing of the Geographic Valuation System (GVS) with the HRFN. Chapter 6 demonstrates how the principles contributed to informing the creation of the GVS by linking individual principle numbers with methodological steps.

Principle 1	Incorporate community-based research methods in working with the HRFN to identify characteristics of the geospatial approach.
Principle 2	Identify and address threats to sustainable use of geospatial tools, where feasible (e.g., identify and address training and capacity concerns and issues over costly software licensing).
Principle 3	Use a mapping approach that is preferred by HRFN in order to support and increase their familiarity and comfort level with maps.
Principle 4	Identify and incorporate dominant modes of communication amongst HRFN (e.g., oral language).
Principle 5	Cultivate an environment where Elders and other members will recall events, experiences and values, particularly during times of the year when they may not experience the land the way they used to directly (e.g., in winter).
Principle 6	Identify and record characteristics of TEK while recognizing that knowledge and values may change over time and vary between individuals and family groups.
Principle 7	Accommodate goals for knowledge beyond resource management through flexibility in collection, storage, and presentation.
Principle 8	Situate decision-making power in the community and empower elected decision-makers to make decisions that complement traditional decision-making processes.
Principle 9	Control access to TEK and awareness of the locations of significant locales through collection, storage, and application of recorded knowledge.
Principle 10	Maintain ability to incorporate relevant information from disparate sources (e.g., environmental monitors who make site visits with industry representatives).
Principle 11	Enable HRFN to assess potential impacts of multiple resource management projects across space and time.
Principle 12	Provide for compatibility with extant geospatial systems and resources management approaches (e.g. support computer input and produce output consistent with commonly used GIS).
Principle 13	Provide supporting information to HRFN decision-makers, such as wildlife habitat polygons, in a way that does not subsume TEK to WBSK.
Principle 14	Use computer systems and software that serve the other principles and have the potential to grow with changing HRFN, industry, or government needs.

CHAPTER 6: DEVELOPMENT AND APPLICATION OF THE GEOGRAPHIC VALUATION SYSTEM

6.0 Introduction

Development of a geospatial communication system to empower the HRFN in communicating their values within a WBS resource management context was directed by knowledge gained during earlier phases of this study. This chapter presents the development, implementation, testing, and modification of this approach, which we termed the Geographic Valuation System (GVS). In accordance with our research methods, development of the GVS occurred iteratively with HRFN participants, including modifications to existing software that were selected to support the GVS. Methods to implement the GVS in the community, including a training program undertaken with HR Lands Staff, are detailed and discussed below. The GVS was applied by HRFN in resource management decision-making, and examples of these real-world applications are summarized to illustrate characteristics of the GVS. External feedback was gathered formally and informally from other First Nations and industry and government representatives as a result of presentations made by the key research team, Roslyn Pokiak, Alex Hawley, and myself. Key points raised during these presentations by attendees in the form of questions or statements provided some indication of what aspects of the GVS were appealing to others, or ways in which others feel that the GVS could be altered to more closely fit their needs and values. These points were summarized to facilitate a discussion of how others perceived the GVS might contribute to decision-making, and to illustrate their concerns or suggestions. The chapter ends by presenting recommendations for future work.

The principles which were integral to the creation of a geospatial approach to

communicate Aboriginal Traditional values were summarized in Table 2 (of the preceding chapter). Throughout the present chapter, the relevant guiding principles are identified where appropriate to demonstrate how each principle was significant to the development and design of the GVS. Principle numbers match those listed in Table 2.

6.1 Methods

6.1.1 Iterative Feedback

Creation of the technical and end user components of the GVS were iterative as feedback was collected from two primary groups, HRFN participants and potential external beneficiaries of GVS output, industry, and government (as described in Chapter 3). Modifications were incorporated as appropriate.

The first group providing feedback was comprised of HRFN participants. The initial adaptation of software to support the GVS occurred at UNBC during the winter and spring 2004-2005 and was reviewed and modified with input from Chief Pokiak in March 2005. Community input was gathered, evaluated, and included in the GVS during practical applications of the GVS when I spent approximately a week on the reserve in each of June, July, August, October, and November 2005. Training sessions with HR Lands Staff and hands-on use of the GVS to address resource management challenges provided information that was used to modify the GVS. Chief, Council, and Elders (Participants 7, 14, and 15) referenced HRFN data, information, and knowledge contained in the GVS when discussing real-world resource management issues. Feedback from other community users such as members who attended resource management meetings where the GVS was used, also provided information to guide development and modification (Principle 1).

When working with Chief, Council, HR Lands Staff, Elders, and other community members, I was able to ask specific questions and receive direct feedback because of their familiarity with me. My experience enabled me to interpret their degree of appreciation for aspects of the GVS, particularly when communication was non-verbal. In addition, my interpretations were discussed with Chief Pokiak who provided verification and clarification as necessary.

Specific input was sought from Elders and other HRFN participants in June 2005 regarding the symbology of mapped elements developed for use in the GVS. The symbols were summarized on a survey which was used during interactions with community members (Appendices 15, 16, and 17). Participants were selected with guidance from Chief and Council and were approached for their interpretations of appropriate symbology (Participants 14, 15, 24, 25, 26, and 29). As well, the survey was posted on the community bulletin board to provide the community with a visual display during my absence from the reserve. One HRFN participant gathered additional feedback while I was away (Participant 24). I received and discussed this additional feedback with the participant in July 2005 (Appendix 16) (Principles 1 and 3).

A second broad group of people provided valuable counsel on the GVS. Several presentations were made by the core research team of Roslyn Pokiak, Alex Hawley, and myself to government employees, representatives from the T8TA, other First Nations, and the MKAB, consisting of industry, government, and other representative users of the MK (Appendix 18). Feedback was received both formally and informally. Formally, presentation attendees made comments or asked questions that identified for researchers which GVS elements were, from the attendees' perspectives, most important. Informally,

personal follow-up by people in attendance with one or more members of the core research team further informed this research by revealing issues from their various points of view. Observations made by the presenters, as well as by HRFN Elders and community members who attended meetings, were discussed by the core research team after each presentation. This approach allowed for identification of opportunities and potential concerns (Principle 12).

6.1.2 System Development Personnel

Three UNBC undergraduates were hired to support development of the GVS software platform and to support creation of additional materials for use in the GVS. From the fall of 2004 until late 2005, Aaron Koning, the creator of the primary software used by the GVS, was contracted to provide technical support in the development of existing software so that it became applicable to HRFN needs. In addition, Aaron mentored me in the creation of software modules, scripting in Pre-Hypertext Programming (PHP) and HTML, and miscellaneous tasks. During the winter of 2004-2005, Geoff Hughes performed the task of converting interview tapes from analogue to digital format, to create the audio files that were used in the HRFN TEK multimedia database. Equipment at UNBC's Educational Media Services (EMS) lab was used for this task. In addition, Amy Barnes was hired during August 2005 to assist with producing the GVS help file system, comprised of illustrated materials and videos. Several image software programs, including NeoPaint for Windows, and Screen Virtuoso, a program enabling video capture of screen movements, were used. The GVS Help system was initially created in the GIS lab at UNBC and was modified in the HRFN community once feedback was received during October and November 2005.

6.2 Description of GVS Software

The GVS uses Open Source software, addressing the concern expressed by HRFN and other First Nations regarding dependency on licensed software such as ArcMap. Financial barriers arising from costly annual license renewals prevent some First Nations from maintaining long-term commitment to software implementation. In addition, the restriction of limiting the potential number of users or applications to one or a few computers may impede the growth of community support for collecting and using local knowledge within a computer. Open Source software may be made available to users for free and encourages the emergence of a technical development community, which promotes sharing of knowledge and techniques amongst software developers and users, by requiring that the source code be distributed with software (Fogel 2005; Mitchell 2005; Koning et al. 2007). Therefore the potential exists for the GVS to grow as needs are identified by either First Nations using the GVS or by external resource managers using its output (Principles 2, 12, and 14).

6.2.1 Components of the GVS

Four primary[24] technical components comprise the GVS: a web server (Apache Web Server), a mapping server (MapServer), a database (PostGreSQL with the PostGIS module), and a web-mapping interface (Flexible Internet Spatial Template (FIST)) (Figure 15). Each is explained and discussed below. These four Open Source components plus supportive software, including GVS programming scripts, a projection library, ArcExplorer map viewer, two Open Source GIS (Quantum GIS (QGIS) and User-friendly

[24] There are other components to the software of the GVS, such as a projection library, but the four components described herein comprise the majority of the system in terms of key functionality.

Desktop Internet GIS (uDIG)) were packaged with a technical document, 'Geospatial Communication of Aboriginal Values in Resource Management: A Technical Guide to Installing and Utilizing the GVS' (Koning et al. 2007) and provided to the HRFN and MKAB (Appendix 11). The completed GVS was posted on the Internet as Open Source in January 2006,[25] and is available for use free of charge (Principle 2).

6.2.1.1 Web Server

A web server is a computer program that serves web pages to a web browser over the Internet or Intranet by communicating directives from the user to the underlying mapping and database software. The GVS uses the Apache Web Server (http://httpd.apache.org/), which interprets both HTML and PHP code (Koning et al. 2007) (Figure 15). A web browser is distributed with new computers or can be downloaded for free from the Internet (Principles 2 and 14).

6.2.1.2 Map Server

A map server is a computer program that generates and serves up digital maps from mapping data. The University of Minnesota MapServer (MapServer) (http://mapserver.gis.umn.edu/) is an Open Source system enabling users to interact with their on-screen data in a dynamic fashion, for example by adding layers, and also permits outputting a map view to hardcopy map by creating a Portable Document Format (pdf) file format. MapServer supports a broad range of data formats, for example PostGIS layers, shapefiles, and raster images, and uses data compatible with government and industry GIS programs, such as ArcMap. An external connection may be used by GVS users to access and display spatial data stored on other servers, including data owned by industry, government, or other First Nations, through a Web Map Service (WMS), a Web

[25] The GVS is available at www.gvs-mapping.com.

Feature Service (WFS), or a Web Coverage Service (WCS)[26] (Erle et al. 2005; Mitchell 2005; Koning et al. 2007) (Principles 12 and 14).

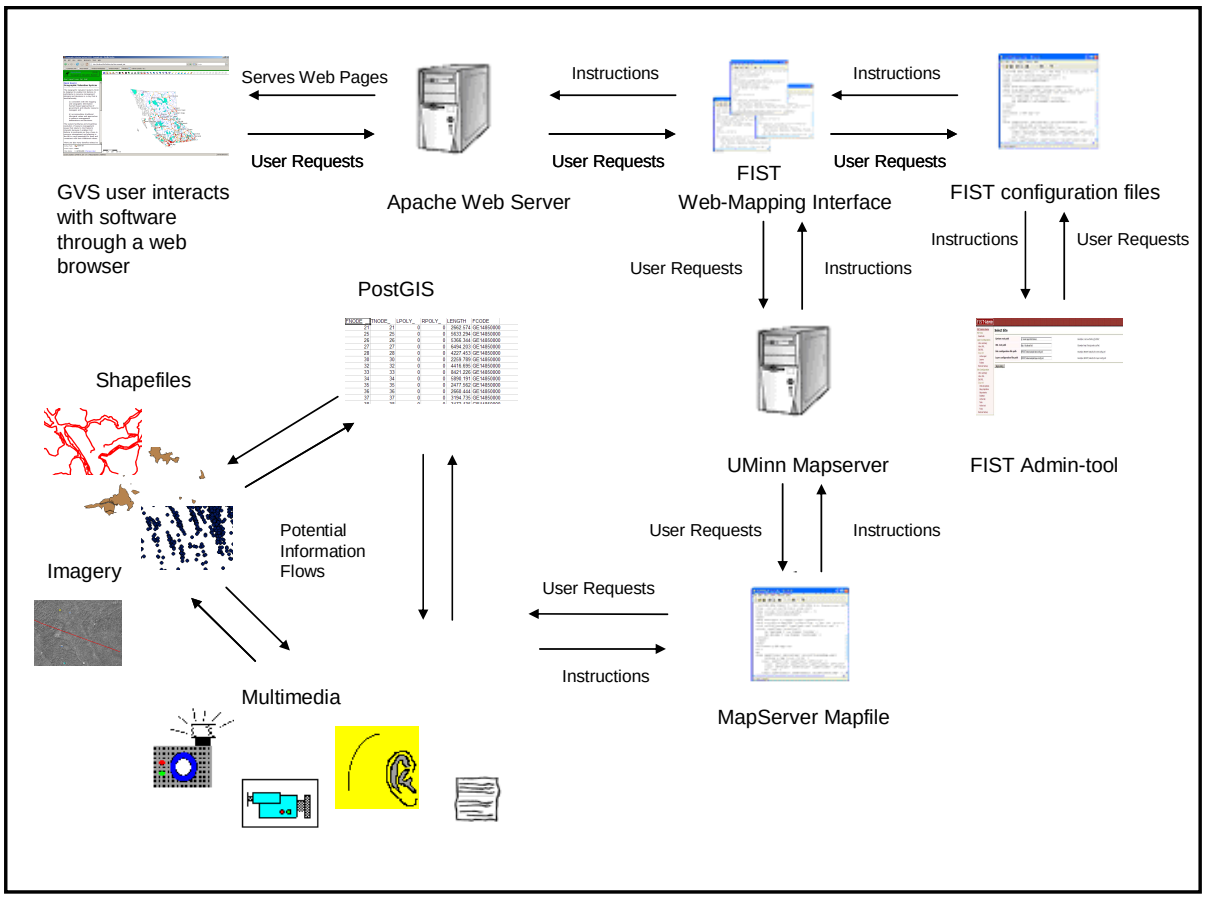

Figure 15: A diagram illustrating interactions of the main GVS software components (modified from: Koning et al. 2007). The four central components are a web server (Apache Web Server), a map server (MapServer), a database (PostGreSQL with the PostGIS module), and a web-mapping interface (Flexible Internet Spatial Template (FIST)).

6.2.1.3 Database

Existing geospatial software packages are built to use a database. Therefore, in order for the output from the GVS to be compatible, the GVS needed to implement a database structure (Principle 12). PostGIS (http://postgis.refractions.net/) is an add-on

[26] The UMinn Mapserver is an Open Geospatial Consortium compliant map server, meeting internationally recognized standards that promote sharing of Web Service GIS information, including vector and raster data.

module that interacts with the PostGreSQL relational database (http://www.postgresql.org/) to provide geographic support to tabular data by storing and relaying geographic coordinate information (Erle et al. 2005; Mitchell 2005; PostGIS 2005; Koning et al. 2007). PostGIS uses Structured Query Language (SQL) to support users' queries of information stored in the database, further making interaction with mapped data, information, and knowledge dynamic (Mitchell 2005; PostGIS 2005). Points, lines, polygons, and text attributes stored in the database can be also edited within a PostGIS layer (Mitchell 2005; PostGIS 2005; Koning et al. 2007) (Principles 12 and 14).

6.2.1.4 Web-Mapping Interface

A web-mapping interface serves a central role in combining the functions of a web server, a map server, and a database in order to generate digital maps and serve them to the interactive platform, an Internet web browser. Essentially, the interface connects the software components so the user can complete end-user tasks, such as selecting records from the database, adding additional layers, entering new data, and manipulating the map view (Koning 2004a; Koning 2004b; Erle et al. 2005; Mitchell 2005; Koning et al. 2007). The GVS uses the FIST[27] as its web-mapping interface.

The FIST includes a set of HTML and PHP code files that are interpreted by the Apache Web Server, which in turn requests digital maps from MapServer. The Apache Web Server then delivers digital maps and interactive web pages to a web browser, through which users interact with the FIST and its functions. The results, an interactive map, are displayed through web pages on an Internet browser (Koning et al. 2007).

[27] The GVS used FIST versions 0.1 through 0.4. Updates to version names reflected the progress of developments in the FIST interface, made primarily for the HRFN GVS project.

The FIST is an Open Source application that originated as a UNBC Geography Honours thesis project, undertaken by Aaron Koning. The initial version of the FIST was developed in 2004, under the supervision of Scott Emmons, Senior GIS Lab Instructor, and Dr. Roger Wheate, UNBC GIS Coordinator. Existing features and modules, such as the map legend, zooming tools, and the ability to generate new map images at variable scales, supported HRFN requirements (Principle 14). Also, the FIST's creator and primary programmer, Aaron Koning, was available for further development (Principle 14). With Aaron's support we figured that we could modify existing or develop new software features that would meet HRFN needs, as set out in the principles for development of a geospatial approach to communicate HRFN values. We thus had no concerns that we would reach a ceiling in technical development that would limit what the HRFN could accomplish (Principles 2 and 14).

The development of the FIST from its existence as Version 0.1 (the Honours project) to its use by the HRFN, was driven by the needs of the HRFN (Principle 14). Enhancements and modules created for the FIST during the time period of this research project were undertaken to support development of the GVS. While some are specific to the HRFN and reflect a First Nation worldview, others may have applications to broader, cross-cultural mapping projects.

HRFN decided to run the GVS internally, over an Intranet, as it provided the HRFN with the ability to secure its knowledge and reduce potential risks related to external Internet connections (Principle 9). Further, HRFN expressed interest in using the GVS in the local school as a teaching tool (Principle 7); an Intranet (or Internet) creates the possibility for using the GVS and its stored knowledge on an internal network. In

addition, an effective Internet connection presupposes the consistent availability of a reliable high-speed connection, which many First Nations may not have access to because of the remote location of their communities.

6.2.2 Preliminary Technical Work, HRFN Evaluation, and Modifications

Technical work was undertaken to prepare the GVS for preliminary evaluation and use by HRFN. New modules and enhancements were added to the FIST to support HRFN requirements. The GVS was reviewed with project team members Roslyn Pokiak and Alex Hawley and by HRFN participants. Modifications were incorporated, as appropriate. The technical work, feedback, and revisions are described below:

6.2.2.1 Porting of FIST from Linux OS to Windows XP OS

The FIST was originally developed on the Linux operating platform. It was ported to the Windows XP Operating System (OS) (Principle 14) as Windows XP is more universal than Linux on desktop computers and its Graphic User Interface (GUI) interface makes computer use familiar to many people, which would maximize the comfort level of HRFN users and thus increase the potential for sustainability (Principle 2). Further, the opportunity to incorporate the GVS on additional HRFN computers could be maximized if the software could be installed through a Windows platform because more off-the-shelf desktops use Windows (Principle 7). Although there were challenges to making the FIST work in the Windows environment, issues were addressed by setting up error files and searching the Internet for relevant solutions.

6.2.2.2 Enhancement of Existing Map Output Module

The pdf map output module of the FIST was enhanced, increasing options for the HRFN when they produced paper maps (Principle 12). Several iterations of the pdf map output were built (Principle 14). The original pdf map module limited output to portrait

letter-sized paper with the legend on the left-hand side and carried a fixed basic title ‘Map’. The first enhancements (version 2 of the tool) allowed HRFN users to choose an alternative landscape layout and different page sizes (letter size up to ARCH E, 32 x 44 inches or standard map plot size), customize the title, add ancillary information, and determine the location of the legend from a select number of choices. The third version of the map output tool placed the enhancements into a Wizard tool, which guided HRFN operators through the above options via graphic and text explanations, and was designed to be easier to use than the second version of the tool (Principle 2).

The pdf map and its options enabled HRFN users to produce different sizes and layouts of paper maps. Thus, they were able to provide industry and government with HRFN themed maps (Principle 12). In addition, by selecting which digital data layers were presented on a paper map, HRFN determined the content and amount of information that was released, thus reducing the risk that HRFN confidential information would be removed from the community and be used to make decisions that affected them without their further input (Principle 9).

6.2.2.3 Expansion of Data Selection Tools

New data selection modules were created to maximize HRFN’s ability to search spatial layers and isolate specific records (Principle 14). The ‘Select-by-attribute’ module was created to enable HRFN users to find TEK records relating to the values stored in a particular attribute. For example, HRFN users could query the database and locate spatially all database records, each a knowledge element, relating to a specific Elder or land activity (Principle 7).

6.2.2.4 Creation of Data Entry Modules

Digitizing modules for each of point, line, and area features were created

(Principle 14). This was done in recognition that TEK is dynamic and growing with community members and their experiences (Principle 6). To maximize the success of any data collection and storage approach, HRFN members needed to be able to update their TEK records (Principles 7 and 9). The ability to add new data recognized that the collection of TEK occurs over time and may vary amongst individuals and with new experiences (Principle 6). Digitizing modules allowed for interactive additions to be made to the collection of TEK stored in the GVS. A second source of information, for example from industry or government, could be entered into the GVS through on-screen digitizing, uploading a text file, or importing a shapefile (Principles 10 and 12). The ability to add information on resource development from more than one company, or multiple industries, enabled HRFN to view and consider the combined impacts of proposed developments (Principle 11).

A coordinate import module was also created that allowed for the entering of geographic coordinates in a text file, which was then uploaded directly to the GVS PostGIS database (Principles 10 and 12). The module was created in anticipation that GPS coordinates, collected in the field, would be downloaded and used to create new spatial features. Either TEK or information related to proposed and existing industry projects could be entered this way (Principles 10 and 12).

6.2.2.5 Addition of UTM Projection Scripts

The original FIST version supported Albers and Geographic (latitude and longitude) projections. UTM was identified as a necessary addition since UTM is frequently used by industry when presenting data (Principles 12 and 14). Its inclusion also provided HRFN with greater flexibility when recording coordinates with a GPS since many recreation class GPS do not collect locations in Albers coordinates but do use

UTM (Principle 10). UTM projection from the United States Geological Service (USGS) C++ UTM code was converted to Java language script and incorporated into the FIST projection scripts.

6.2.2.6 Creation of GUI Editor and Support Scripts

In the initial version of the FIST, file setup and changes required editing of configuration files in a text or web editor. Because it was known that HR Lands Staff would use the GVS on a part-time basis, as the need arose, a GUI interface was created to make these tasks a little less daunting (Principle 14). It was thought that GVS use would more likely be sustainable over the long-term if tasks could be completed using a format that was familiar and more easily recalled (Principle 2).

Thus, the FIST-Admin module (version 1) was created for the HRFN project to introduce a GUI method of entering data into two FIST configuration files, the site-config.xml and layer-config.xml. These two configuration files are the most frequently used, as the site-config.xml dictates site appearance and functionality, and the layer-config.xml is used when adding, deleting, or organizing data layers. In addition to creating software elements to access the FIST configuration, files were also scripted to support other tasks that would otherwise be done using command line. For example, the ability to create new PostGIS databases, designate database users, and import shapefiles into a PostGIS database was made more straightforward though interactive scripts (Principle 12). This also supported the flexibility required to potentially expand GVS use by setting up additional sites, for example for each HRFN family group (Principle 7). This also enables familial control of sensitive information while enabling sharing of information within the community (Principle 6).

6.2.2.7 Loading and theming supportive mapping data (e.g., TRIM data, Orthophotos)

A base set of provincial spatial data, including Forest Cover and TRIM, were loaded into the GVS to support HRFN resource management decision-making (Principle 12). Digital data requested by HRFN members to supplant existing information, such as slope and aspect, were created and included in the GVS as part of training with HRFN personnel (Principle 2). Data from proposed oil and gas and forestry developments were also added to the database during training.

Orthophotos were included and HRFN users reacted favourably to the black and white photo images, and thus these replaced the coarser resolution hillshade at appropriate scales (Principle 3). Further, HR Lands Staff discussed the possibility of obtaining Lidar imagery from an oil and gas company for inclusion within the GVS, further indicating the significance of having imagery to reference for the HRFN GVS users.

6.2.2.8 Creation and population of TEK multimedia database

A TEK multimedia database was created for the GVS because multimedia elements had proven to encourage and support communication amongst HRFN members (Principles 4, 5, and 14). The ArcMap hyperlink point shapefile developed and tested with the HRFN was used as a spatial base (Principle 7) (Chapter 5). The inclusion of additional TEK and supportive materials were discussed with project participants and where feasible, were prepared by or with HRFN staff (Principles 1 and 10). For example, new photographs from field trips made by HRFN members with industry were included in the GVS. This task was completed as part of HRFN training in GVS use (Principle 2).

Different photograph and video formats were created, tested, and compared for quality and file size, with the goals of achieving the highest quality and smallest file size

(Appendix 19). Information from a DVD video featuring HRFN Elders and produced by North East Native Advancing Society (NENAS) was prepared for inclusion in the GVS by editing the DVD into segments related to specific themes or locations on the landscape (Principle 10). In total, 631 photographs, 165 videos, 227 audio interview segments, and 65 text documents were included in the GVS.

Attributes that supported searching of the database by significant locations, people, and activities were populated based on input from HRFN users on how they preferred to classify database elements. In addition, a blank attribute field was created with the intent that HRFN users would populate records with their own descriptions of TEK elements, and thus have the potential to culturally enhance the classification system (Principle 14).

6.2.2.9 Creation of Logos and Content for Introductory GVS Web Page

Two potential logos were created for display on the GVS introductory page with direction and input from Chief Pokiak (Principle 14). The two options were reviewed by HRFN participants through the survey developed to elicit feedback on GVS symbolization (Principles 1 and 3). The majority of HRFN members chose as a symbol a drawing which represents a significant spiritual area. In the generic GVS version created for the MKAB and public, a moose silhouette was substituted for this logo. This change enabled the community to maintain control of the symbol representing the significant area while reflecting to the outside world the importance of the moose in the lives of the HRFN people (Principle 9). In the GVS acknowledgements section, it was recommended by Chief and Council that the community members be thanked in general and collective terms rather than as individuals (Principle 1). This is consistent with Elders' desires that their participation remain confidential, as expressed in the Research Agreement between

UNBC researchers and HRFN participants.

6.2.2.10 Creation of Help Documents and Videos

Extensive help documents and videos were prepared to support HRFN use of the GVS (Principle 14) (Appendix 20). The written documents followed the example created with HRFN users' input used during earlier ArcMap training sessions (see: Chapter 5), which utilized illustrations and focused on tasks relevant to HRFN decision-making (Principle 2). In addition, training sessions with HR Lands Staff further informed the communication style and content of the written documents. Feedback on tasks that were not instinctive or clear to the trainee guided which topics were expanded on (e.g., adding data from geographic coordinates) (Principle 1). These help files were given high priority since it was known from research with the HRFN that the use of the GVS was likely to be intermittent. Similarly, videos demonstrating tasks focused on those that were evident from training as central to HRFN use (Principle 2).

6.2.2.11 Creation of Values Discovery Tool

The GVS was built to access TEK in a way that emphasized oral and visual qualities of the HRFN community and did not subsume TEK to other sources and forms of spatial information (Principles 4 and 13). A hyperlink tool to query and display TEK information, the Values Discovery Tool (VDT), was developed, reviewed, and modified with team members Roslyn Pokiak and Alex Hawley. Using HTML and PHP coding, links were built connecting audio descriptions of each record, recorded in Beaver and English, to visual symbols representing each language (Principles 7 and 14). Because the research had shown that it was important that Chief, Council, and HR Lands Staff be able to identify which community members held knowledge relevant to particular areas, photographs of the knowledge holder linked to each specific element were included

(Principle 8). Graphic symbols indicated links to audio recordings, photographs, videos, or interview transcripts (Principles 3 and 4) (Appendix 15). Other symbols indicated that TEK was related to a particular category, for example, moose, elk, dry meat, or culturally significant plants. A survey of Chief, Council, HR Lands Staff, and community participants revealed preferences in how data should be displayed for their optimal use (Principle 1) (Appendices 16 and 17). A second, generic version of the VDT was created in March 2006 and included in the deliverable to the MKAB, as it was recognized that the HRFN VDT was specific to their nation and thus the creation of a more general tool was appropriate (Principle 9).

6.3 HRFN Application of the GVS

The HRFN community used the GVS in support of a number of applications including community analysis of proposed developments, discussion of cumulative impact, inclusion of TEK in resource management decisions in a manner that reflected the spatial and temporal scales of a TAW, engagement of community members in discussion about the land and their values, and support of the collection of TEK. These applications are discussed below to illustrate how the GVS functioned, what it did, and how it was used by the HRFN community.

6.3.1 Analysis of Proposed Developments

The GVS was used by the HRFN in support of community evaluation of proposed resource developments. The GVS assisted dialogue amongst Chief, Council, HR Lands Staff, Elders, and other community members. It aided HRFN-elected representatives in decision-making by providing them with knowledge of recorded TEK, additional input from knowledge holders, and community members' views on how development would

affect individual and community values, including economic, cultural, and spiritual components (Principles 4 and 8).

HRFN participants used the GVS by viewing on-screen links to data containing information on their TEK, which was displayed with provincial data features, including rivers, roads, and orthophotos, for reference purposes. The FIST Map Layers module enabled HRFN to turn on different layers, including TEK, and view TEK elements as they preferred, for example, with mineral licks and a significant spiritual area separate from collective TEK knowledge (Figure 16) (Principles 3 and 14). The ability to turn confidential layers off through the Map Layers module allowed HRFN to protect its TEK when desired, such as when printing a paper map (Principle 9). The FIST Map Legend module facilitated identifying how features were symbolized (Figure 17) (Principle 14). The VDT opened georeferenced links to video, photographs, audio files, and documents of Elders and other HRFN members discussing and practicing TEK (Principle 10).

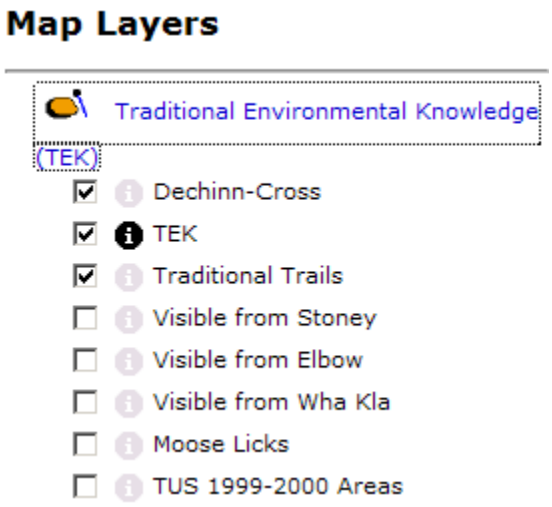

Figure 16: Illustration of the FIST Map Layer module, through which GVS users are able to organize and view TEK information as they prefer. In the example, the categories of TEK that are displayed on the map are Dechinn-Cross, (multimedia) TEK, and Traditional Trails.

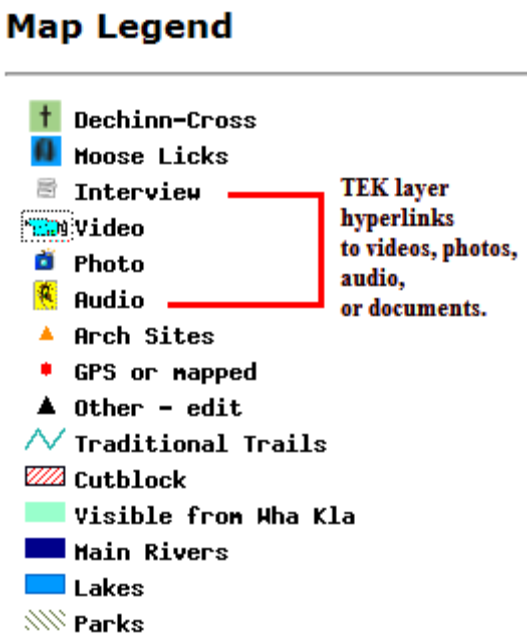

Figure 17: The Map Legend component summarizes and presents symbolization of spatial information, including links to TEK. The four symbols for the hyperlinked multimedia TEK are the interview, video, photo, and audio graphics.

The GVS was used by the HRFN when addressing resource management proposals, such as a proposed seismic line.[28] The proposed development was first entered into the GVS when the HR Lands Staff operator created a spatial layer from coordinates printed on the paper map delivered with the OGC proposal (Figure 18). Once the proposed seismic line was entered and displayed in the GVS, it was then viewed with other geospatial information, including HRFN TEK, which was accessed through the VDT (Figures 18 and 19) (Principles 12 and 13).

[28] Examples reflect characteristics of HRFN GVS use observed and recorded from real-world applications, but use simulated HRFN TEK (and industry data) to protect the confidentiality of HRFN TEK.

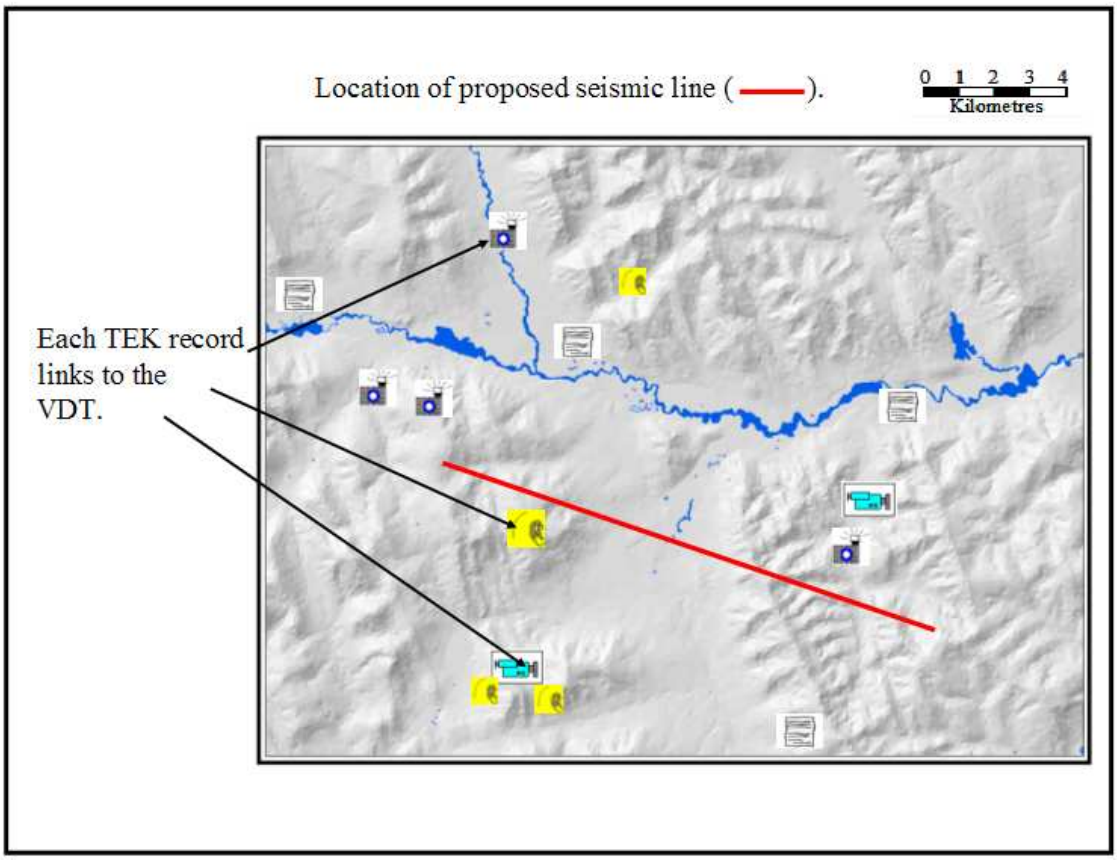

Figure 18: Illustration of proposed and existing resource developments can be added to the GVS as new layers and considered alongside HRFN TEK. The symbols displayed on the maps identify the type of medium associated with that point and information (e.g., video, photograph, audio, and document). The VDT is illustrated in Figure 19. This example uses simulated data to protect confidentiality of HRFN TEK. The size of TEK symbols is unrelated to figure scale.

Community users interacted with the GVS to identify information about recorded TEK near the proposed seismic line. For example, the 'measure distance' tool was used to measure distances, both straight-line and along access corridors such as traditional trails and roads, between the proposed seismic and features of interest, including: a traditional village, two spiritual areas, an old trading post location, and the Alaska Highway (Principle 14). This approach readily provided specific answers to questions regarding proximity that were not clear on the simplified map sent by industry, enabling HRFN participants to consider a range of temporal and spatial impacts (Principle 11).

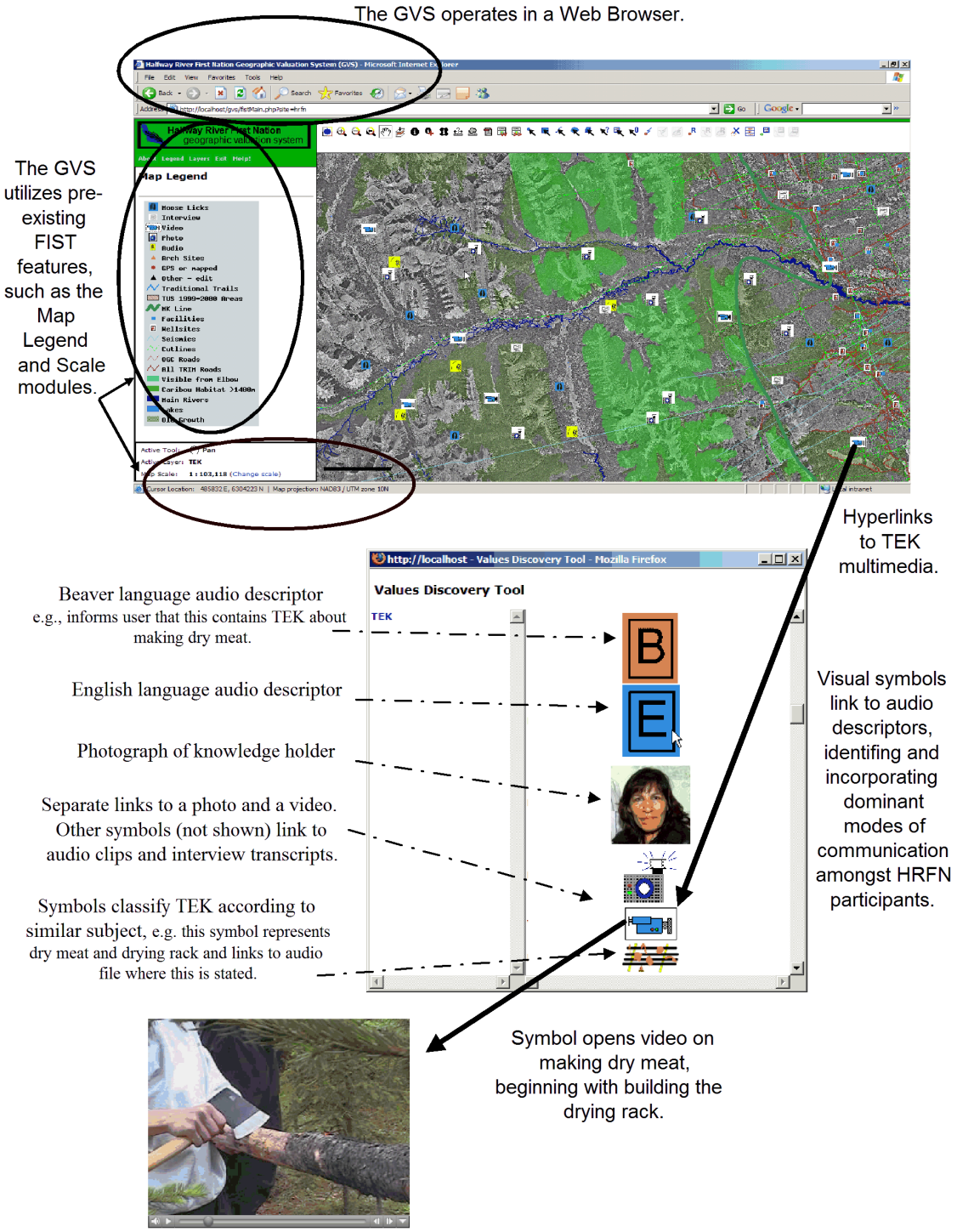

Figure 19: The VDT uses a legend developed with HRFN participants to highlight information from Elders who are knowledgeable about certain areas. The VDT links this information to multimedia files and other sources of TEK information. Special permission was given by Roslyn Pokiak to use her image in this illustration. The above example uses simulated locations of HRFN TEK to protect confidentiality.

Imagery, including orthophotos, was used when available to support HRFN recognition of land features and thus enhance community discussion (Principle 3).

The VDT was used by HRFN members to view multimedia files that included TEK (Figure 19). The first two symbols, a large B and a large E, linked to audio files in Beaver and English, respectively. Users heard information describing that TEK record, for example detailing the circumstances of a photograph including the subject and when and where the photograph was taken (Figure 19). The application of both visual and oral attributes was designed to make information accessible to all HRFN members (Principles 3 and 4). A photograph of the HRFN knowledge holder relevant to the TEK record appeared next in the display window to enable elected decision-makers to identify which community member(s) they needed to consult about that area (Figure 19) (Principles 6 and 8). Next, users clicked with their mouse and were linked directly to the multimedia record, such as a video demonstrating TEK practice or knowledge (Figure 19). A series of symbols, designed and reviewed with HRFN members (Appendices 16 and 17), linked to audio files that identified the database category in which the feature was categorized (e.g., ‘making dry meat’) (Figure 19) (Principles 3 and 4).

Queries using the VDT stimulated discussion amongst community members about sites and areas important to the HRFN (Principles 4, 5, and 8). The discussions ensured that new or varying knowledge entered into the decision-making process (Principle 8). The values discussed typically extended beyond the spatial confines of the x-y coordinate of the record, and were identified spatially to include, for example, the way sound travels, knowledge and location of wildlife habitat, and pathways between TEK elements (Principles 4, 5, and 8). For example, a video recording of a logging truck recorded

during Elders' camps on HRFN traditional territory, prompted Elders and other participants to discuss appropriate cultural ethics relating to the area. In another case, video and photos taken at a moose hunt were discussed in relation to the making of dry meat at a separate camp location. In this instance, communication amongst HRFN members centred on landscape characteristics central to the protection of moose habitat, including the identification of two licks and the linkages between them. Further discussion identified and detailed use of old trails that existed in the area (Principles 4 and 5). These values were noted by the elected leaders and presented to industry and government representatives at subsequent meetings (Principle 8).

In another example, multimedia files revealed to Chief, Council, and HR Lands Staff the context and content of an Elder's knowledge of a traditional village site (Principle 8). The VDT displayed the picture of this Elder and thus identified him as a knowledge holder whom they could consult further (Principle 8). Sadly, however, he had recently passed away. Community members expressed that recording his knowledge was "a good thing," because it could be shared with youth (Principle 7).

6.3.2 Discussion of Cumulative Impact

Additional existing and proposed developments, such as an existing road and well and a proposed cutblock, were also included in the GVS display by HR Lands Staff, enabling HRFN consideration of cumulative impact (Figure 20). The GVS was used by HRFN to produce a paper map of an area specific to where Chief, Council, and HR Lands Staff were discussing a proposed seismic line (Principle 12). The company proposing the development had provided a paper map but it proved inadequate to answer all the questions of Chief, Council and HR Lands Staff. The GVS was employed to produce a

map of the same area but added elements of interest, specifically the existing road and well, and the proposed cutblock. The GVS thus supported community decision-making by incorporating cumulative development concerns (Principle 11). In addition, participants were better able to locate the area of the proposed development by referencing themselves to known features displayed on the GVS output (e.g., the existing road and well) that were not pictured on the company map (Principle 3).

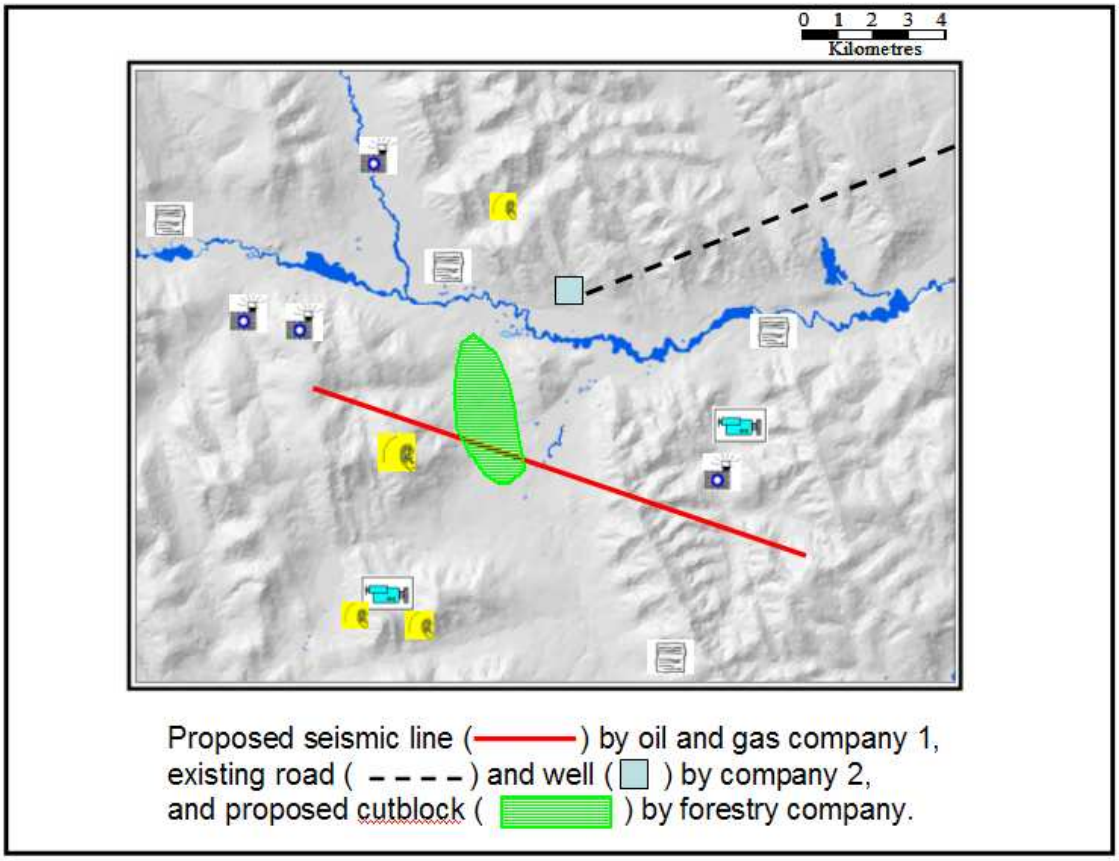

Figure 20: The GVS enables HRFN to view and discuss any potential or existing developments in relation to their TEK values. In the example, TEK related to the proposed seismic line and cutblock as well as the existing road and well can be considered by community members. Additionally, the viewing of resource developments from multiple projects enables HRFN to consider cumulative impact. This example uses simulated data to protect confidentiality of HRFN TEK. The size of TEK symbols is unrelated to figure scale.

6.3.3 Inclusion of TEK Within Resource Management Discussions in a Manner that Reflected the Spatial and Temporal Scales of a TAW

Discussion of TEK values and identification of their spatial extents by participants reflected TAW interpretations of accuracy (Principles 4 and 5). For example, discussions around one particular spiritual area revealed that Elders were not able, through their TAW, to delineate the geographic boundaries of the area with exact precision, as would be understood and perhaps expected under a WBSW. However, the use of the VDT to access relevant multimedia files encouraged Elders to communicate cultural practices pertaining to the area, including how people should act when entering the area, as well as their desires for appropriate behaviour, which included having helicopters avoid the area. Determination of boundaries to communicate to outsiders, including helicopter pilots, was achieved by using topographic features, such as small ridges, to define an 'Area of Concern' where HRFN would ask for consideration from industry and government resource managers (Figure 21). This was sketched out on the GVS using a new spatial layer. The GVS made it possible for the ideas expressed amongst HRFN community members to be communicated verbally to resource managers (Principles 8, 12, and 14). During training sessions, it was theorized that the 'Area of Concern' polygon would be submitted to industry and government as an indication of the community's concerns. In practice, however, these concerns were discussed in person with industry representatives during subsequent meetings. This difference was not fully explored but may relate to HRFN's belief that once hard copy information left the community government would make further decisions without approaching HRFN for additional community input.

The TEK database in the GVS used points to link HRFN data, information, and

knowledge to the map display. These coordinates were collected by using the map biography method or with a GPS. If this point data were presented to government and industry as part of a TUS deliverable, the data would likely be evaluated for their usefulness based in part on WBSW interpretations of accuracy and precision. The values attached to each coordinate may also be mistaken for being site-specific once removed from the community. However, as illustrated above, the use of the VDT promoted the

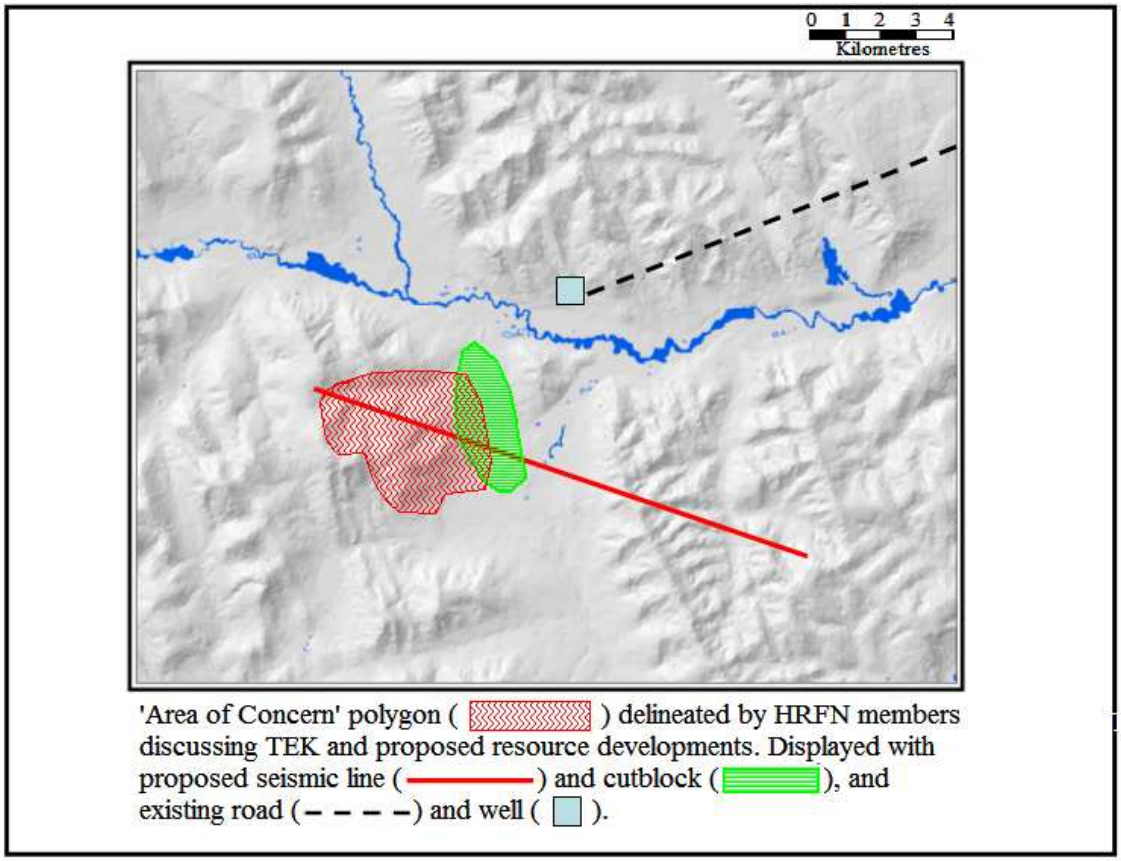

Figure 21: Illustration of a new shape representing an 'Area of Concern' using the on-screen digitizing tools. Discussions with Elders enable elected decision-makers to sketch out a geographic area that they will bring to government managers for consideration. The area can be communicated by Chief and Council verbally, on-screen, or by outputting a paper map. HRFN TEK can be removed from the GVS prior to communication with outsiders to protect its confidentiality. The size of TEK symbols is unrelated to figure scale.

identification of values that surpass the confines of a specific x-y coordinate. Furthermore, because the GVS uses a digital map display and may output a paper map, individuals operating under a WBSW may think that the GVS is subject to the limitations of WBS mapping, such as the imperfect abilities of a paper map or static digital data to reflect temporal variation. For example, the point coordinate data for each TEK point, could be considered to be merely a snapshot in time. However, the contributions made by Elders who recalled events, experiences, and values while viewing TEK multimedia records transcended the moment of data collection. This example underscores the importance of HRFN controlling its own TEK (Principle 9).

6.3.4 Engagement of Community Members in Discussion About The Land and Their Values

When Elders and other community members used the GVS to watch videos, view photographs, and listen to audio of knowledge holders speaking, they would add comments, new information, and provide Chief, Council, and HR Lands Staff with their thoughts on what was important in an area and their perceptions of impact from proposed developments (Principles 4 and 8). Elders also became engaged while viewing the GVS presentation during meetings with government and industry, and spoke about how the land was important to them (Principle 4). Consistent with the experience with the ArcMap hyperlink, videos, photographs, and audio were accessed by community members, but written transcripts of interviews were not.

6.3.5 Support of the Collection of TEK

Because the GVS was used in the community by community members, opportunities existed for recording new and updating existing TEK (Principle 6). For

example, a community trapline owner asked about seismic locations within her/his trapline area. In turn, the trapline owner provided information on observations made while out on the land (Principles 7 and 12). This was entered into the GVS as new knowledge which may be used to inform decision-making at later stages. Data and information collected by community members while out in their traditional territory was also used to document TEK not previously recorded in the GVS. Photographs and GPS coordinates collected by HRFN staff during a visit to a proposed development site were included in the GVS and contributed to community review and assessment of the development. It proved efficient to enter data into the GVS after making written notes from members who had visited the site, since people spoke too quickly to enter information in real-time. The orthophotos effectively supported discussion because much description was relative to identification of features that could be recognized and seen on the images (e.g., 'we went along this ridge..', 'the camp was right here in this meadow …') (Principle 3). This created an opportunity to collect georeferenced information relative to the field visit in locations where GPS coordinates were not recorded. Coordinates were read from the screen and then used to spatially link the photographs taken by the HRFN members. Later, field trip participants were invited to verify their contributions by viewing their knowledge contributions with the GVS. Google Earth and NASA World Wind 3D models were also used during this process, since the ability to readily change vertical exaggeration in these programs meant that elevation was modified until recognized by field trip participants. This supported discussion related to orientation, as described above (Principle 14).

6.4 Evaluating the Utility of the GVS - Discussion of Strengths, Limitations, and Concerns

6.4.1 Strengths

The research team identified strengths of the GVS based on our observations of, and engagement in, its development and application. The strengths of the GVS are presented below.

Consistent with the Fourteen Principles

The design, development, and community use of the GVS were consistent with the principles developed during this research. Development of the GVS incorporated community-based research methods (Principle 1) and accommodated the dominant forms of communication in the community (Principle 4). The design of the GVS used a mapping approach preferred by the HRFN (Principle 3) in a way that encouraged sustained use of geospatial tools (Principle 2). The GVS placed control of TEK in the community's hands and ensured that any data or information leaving the community protected the confidentiality of TEK, as determined by HRFN members (Principle 9). The GVS supported flexible data collection and update, responding to the dynamic nature of TEK (Principles 7, 9, and 10) and is able to grow with changing requirements (Principle 14). The GVS enabled HRFN to assess cumulative impact (Principle 11) and integrated with existing geospatial systems to be responsive to industry needs and did so while providing a method whereby TEK is not subsumed to other spatial data (Principles 12 and 13). The GVS presented TEK in a format understood and supported by HRFN worldviews and enabled community members to engage in conversation about issues regarding the land in a way that is consistent with what they want to do (Principles 5 and 6). In particular, HRFN Elders, a group identified by HRFN elected decision-makers at

the outset of this study as one being constrained in their ability to participate fully in resource management decisions, were supported and encouraged by the GVS to communicate their views and knowledge. The GVS situated decision-making in the community in a way that complimented traditional decision-making processes (Principle 8).

Developed with HRFN Community

These principles resulted from collaborative community research that identified challenges that the HRFN experienced in participating in resource management. The GVS was developed with HRFN to address these issues. Thus, the GVS was developed as a community-based response, rather than being an existing approach that was adopted by the community.

Potential for Educating Youth

Community members reported that the GVS is a valuable tool for educating the youth about their cultural practices. Participants stated that the GVS made their traditional territory 'literally come alive', particularly when an Elder who was captured in photos or videos had passed away. Chief Pokiak expressed that the true value of the GVS may be as a teaching tool. The GVS could play a central role in maintaining Beaver language use and promoting TEK use and practice, an opinion expressed by Chief Pokiak:

> The GVS incorporates our culture and beliefs. Youth know who they are and this is confirmed by the TEK shown in the GVS. Relive it, revive it…the youth will always know who they are even if they spend time in the non-native world.

Promotion of an Emic Perspective

The GVS promotes an emic perspective (e.g., facilitates participation of Elders) using an etic tool (e.g., is compatible with GIS software by application of standard data

formats). By supporting local, inside, community perspectives through data collection, storage, presentation, and analysis, the GVS supports the use of HRFN TEK in a manner that is consistent with how TEK is utilized on a day-to-day basis by HRFN knowledge holders. Etic perspectives are instructive about how others think about the GVS. In identifying limitations and concerns (below), etic perspectives are considered.

6.4.2 Limitations and Concerns

The research team also identified limitations and concerns during the project. In addition, concerns were identified by representatives from government, industry, geospatial practitioners, the T8TA, and the MKAB during various presentations of our research results (Appendix 18). These limitations and concerns are considered below along with discussion of possible remediation where appropriate.

Complexity of the GVS Mapping Interface

The GVS mapping interface may be too complex to meet the needs of all potential users. In particular, concern was voiced by one First Nation person that perceived or actual complexity would alienate some First Nations, and thus their knowledge may not be included in the GVS. This was felt to be true even if a person did not operate the computer themselves.

Reducing the number of tools present in the GVS mapping interface may increase the comfort level of users not accustomed to using computers. For example, Elders who are using the GVS to view information may need only some basic movement buttons, like zoom-in, and the VDT. Conversely, others, such as the youth, may want to search or add new information and will require a more complete toolset. Removal or addition of available tools from a default GVS set-up is currently possible by editing the site-

config.xml file, in either a text editor or through the FIST-Admin GUI tool, and is detailed in the GVS Technical Guide (Appendix 11). A productive next step may be to develop and test interfaces with users to identify preferred set-ups for groups or individuals.

Long-Term Applicability

First Nations, industry, and government representatives raised concerns regarding the issue of long-term applicability, since GIS has not proven sustainable in many First Nations communities. Identified concerns specified were: 1) access to software and software updates, and 2) potential capacity issues relating to day-to-day operations. The GVS was released as Open Source software at no cost thus removing the burden of costly software licenses. Under Open Source software licensing, the programming code for each of the main software components is available to users, enabling First Nations the potential to make changes to any or all of the software components as needs arise (e.g., addition of a module to directly add GPS coordinates). A limitation may be that a First Nation will have to contract a programmer to make changes to the software unless a community member knows or learns PHP or another required programming language. In addition, a programmer may have to learn the layout and interaction of the software components underlying the GVS before significant changes can be made to the GVS software.

Development and Maintenance of Community Capacity

The concerns around maintaining community capacity, specifically training and sustained use, may be expanded to consider whether the GVS increases the day-to-day capacity demands on First Nation communities. It is true that to use the GVS the community must develop a method of TEK data collection, and identify and train

community researchers and GVS operators. If community research projects are on-going or have occurred in the past, then the GVS can be developed using what is already in place. To input existing TEK information, computer-confident First Nations may follow and adapt the example in the GVS Technical Guide (Appendix 11) while other First Nations may require assistance from outside their community. Further, iterative feedback to the design of a Help system and the development of GUI-based tools may promote sustainable use of the GVS within an atmosphere where most First Nations staff are generalists, not specialists.

Demands on capacity may be offset by perceived advantages of maintaining the GVS. Other First Nations may share the assertions of HRFN participants that the GVS can create long-term cultural benefits. Thus, First Nations may successfully address training and use issues that would otherwise tax their capacity in order to maximize cultural benefits received from using the GVS.

Accommodation of GPS Data

Data from a GPS could not be loaded directly into the GVS. At present, data must be downloaded onto the computer and the x,y coordinates and accompanying attributes entered using a comma-delimited text file (.csv format) with the .csv upload tool. It is also possible to create a shapefile through another software program and load this directly into the GVS. Future software modifications may include developing mechanisms to load GPS data into the GVS directly.

Collectivity of TEK

A concern was raised by a government employee that within the GVS all TEK would be held collectively and could not be recognized or managed by individual contributions. Although the prototype GVS displays a collective (e.g., community) set of

HRFN TEK, individual contributors are identified by name in an attribute and may be separated from other contributors through selection based on name. Because each TEK record is labeled according to the knowledge holder associated with it, it is possible to identify individual contributions. If a First Nation desired, TEK layers may be created for each individual or family group, as opposed to using just one centralized TEK layer.

Protection of TEK

First Nations expressed interest in password protecting the GVS so that they could use the GVS on an Internet-linked computer; however, concerns were raised by First Nations that the GVS did not provide an adequate level of protection from hackers looking to access data on remote computers. In future applications, password protection on the PostGIS database may be used to provide security by releasing graduated levels of information and knowledge to designated users. This approach may work particularly well for individual First Nations who elect to make GVS-based contributions to a centralized Internet server (e.g., one maintained by a Tribal Council).

Connection to the B.C. Government's Land and Resource Data Warehouse (LRDW)

Government representatives expressed concern that the GVS will not be able to access data from the government's Land and Resource Data Warehouse (LRDW), a repository of current government data. As discussed above, GVS users have potential access to the most up-to-date government data for use in their decision-making processes through WMS/WFS/WCS, if the services exist from the data provider and as long as the GVS is programmed to readily accept the data. This would have to be detailed step-by-step in further technical guides or taught to users, although some First Nations will have trained geospatial specialists on staff to program required additions. The GVS Technical Guide (Appendix 11) references these services and readers can follow the links to learn

how to use them. Additional obstacles to LRDW access may include the on-line reliability of the LRDW. First Nations may also experience intermittent high-speed Internet access because of their remote locations. For example, HRFN did not acquire high-speed Internet access until the fall of 2004, and I have observed service interrupted by wind and winter storms.

Addition of Other Information

Concerns were raised by First Nations that users would not be able to add information from different sources. Because the GVS uses HTML coding, information that can be included in the GVS and accessed through the VDT is as extensive as the list of data types accessible from HTML hyperlinks.[29] Thus, quantitative, qualitative, spatial, and non-spatial data can be stored and accessed through the VDT. Challenges may also exist in relation to accessing individual multimedia objects because of large file size, but these issues may be overcome through increased computing power, larger hard drives, and improvements in compression of multimedia file formats.

Permanence of Data Storage

Several government employees brought up concerns that changing technology will make current data storage methods obsolete in 20 years. This is a significant question, given the importance First Nations place on collecting TEK to educate their future generations. The current trend appears to be moving towards digital storage, replacing optical storage formats (e.g., CDs and DVDs). First Nations may choose to maintain a good digital copy of the GVS TEK files that is updated on a regular basis as new material is collected. An external hard drive, kept in a secure location, may provide

[29] HTML hyperlinks connect to objects (or 'targets') and these objects can be a wide variety of file types. The target can be an independent file (e.g., .jpg or jpeg image) or another web page that has a file (document, image, etc.) embedded within it.

reliable storage options. First Nations may then have a digital copy to convert to a new format as alternative options are developed.

Compatibility with Conservation Area Design (CAD)

The MKAB, in particular Kaska Dene participants, have invested heavily in the MK CAD, a weighted polygon decision-making system covering large areas of the landscape (see: Chapter 2). Their concerns were that the GVS output will not be compatible with CAD. Unlike the CAD, the VDT acts to place TEK in the most prominent position of the decision-making process with other data types subsumed or comparable to TEK. Furthermore, the GVS supports dynamic collection of TEK, more closely reflecting the process of gathering knowledge in a community-based setting. Therefore, the GVS may provide CAD information in a way that allows HRFN users to more effectively consider its content. One could incorporate the CAD into the GVS and enable First Nations to be able to evaluate the CAD polygons in relation to recorded TEK and TEK values. Communication of First Nations' values through existing systems, like the CAD, could potentially be accomplished as First Nations produce polygons representing 'Areas of Concern'. In addition, First Nations could contribute directly to the collection of habitat knowledge, or the verification of scientific knowledge, through the GVS process.

Inclusion of Dates as Data

A concern was raised by a wildlife biologist regarding whether the GVS includes either dates of TEK activity, for example, when a moose hunt occurred, or dates the TEK was collected. In response to this concern, the HRFN operator added a date attribute to the HRFN TEK database. The database can be modified by users as necessary to include additional attributes.

Focus on Output

One concern is that people will focus on the software component and output of the GVS, since it is visible and attractive, and ignore the over-all approach behind the GVS, as summarized by the fourteen principles. For example, we noted that two government observers immediately examined the pattern of recorded TEK and stated that it was clear to them where land use had occurred. They asserted that the land base amount was too much to remove from potential oil and gas activity, under the government's go/no-go zone initiative. Further, they assumed that the blank spots were void of value to the HRFN, simply because no one had recorded TEK in those areas. These assumptions were made despite HRFN Chief and Council and HR Lands Staff explaining the broader GVS approach, including how it enabled them to engage traditional decision-makers and to control their own information. After this meeting, HRFN members expressed that more work needs to be done to counter entrenched views of spatial representation of TEK before HRFN can become more empowered in the consultation process.

Requirement for Continued Community Commitment

Chief Pokiak stated that she considers the GVS to be a significant under-taking for a community. She emphasized that the real costs of the GVS to a community are: 1) in funding studies to collect knowledge, and 2) the need for commitment from Elders, community members, and elected representatives to maintain the GVS. Even though the GVS software is available free of charge, Pokiak identified the true cost from her perspective as the community's willingness to participate. Long-term commitment by Chief and Council, First Nations' GVS users, and Elders is needed to ensure sustainability. She noted that a successful GVS project requires commitment and

acceptance of responsibility. Once it has been started, there has to exist long-term obligation to keeping it going.

Creation of an Environment of Trust and Respect

The success of this project has hinged on the high degree of collaboration within HRFN, as well as between HRFN and external researchers. To create another GVS, participants would need to create the trust and respect that has been essential to success; this would be challenging given required personal time, energy, and financial resources. From my experience working in the HRFN community, I would add that the success and sustainability of the GVS is dependent upon the participation of a community member who understands the traditional world as well as the non-Native world. That individual's role is to bridge communication between resource managers and their own people by clarifying referrals and other requests for information to community members in a manner consistent with the community's worldview. Conversely, they must also bridge communication between managers and planners by educating them to understand community values in a way that is non-threatening. In this way, community values may be included in resource plans and activities on the land. For example, the departure in December 2005 of Roslyn Pokiak from the position of Chief was followed by declining support and application of, and interest in, the GVS in the HRFN community.

7.0 Summary and Conclusion

During this project, I worked as part of a collaborative team of UNBC researchers and HRFN participants, to: 1) evaluate if HRFN had problems in participating in resource management that related to geospatial communication; 2) determine if existing geospatial approaches addressed those problems; and, 3) characterize and develop a geospatial

approach that enhanced communication. The central aspects of this work demonstrated that building trust and respect were central to ensuring that HRFN participants felt confident and comfortable in communicating their views to me (Chapter 3). This relationship proved essential to collecting information on how HRFN participants perceived their role in the resource management process (Chapter 4), as well as vetting the research team's efforts to create a geospatial approach to communicate HRFN values (Chapters 5 and 6). The main findings were presented as fourteen principles to guide the development of a communication system, the GVS. In its development and application in the HRFN community, the GVS was consistent with these principles.

The GVS is an approach to including traditional Aboriginal values and knowledge in resource management and planning, but it does not exclude other values and knowledge. Potentially, the GVS can be used by any First Nation person or community with any values; it does not presuppose that TEK is what needs to be protected. Although the HRFN experience demonstrated that Elders were empowered by the approach, it is possible that First Nations could use the GVS to exclude participation, for example by negating the contributions of certain knowledge holders. The GVS could also be used to give a voice to others who are disempowered in First Nations communities, including those who live in the 'cultural shadowland' (Hawley et al. 2004:40).

7.1 Recommendations for Further Research

Future research should be undertaken to develop and test a user-interface with First Nation participants that specifically identifies user interface needs from a cultural perspective. Such a study could begin with an in-depth survey of First Nations mapping projects and identification of issues with standard web map interfaces. For example, the

Red Roads HIV/AIDs Network GIS project found that web interfaces that offered too many options may have overwhelmed casual users (S. DeRoy, Pers. Comm., 25 November 2005; Lindenbaum 2006).

Developing an effective user-based interface may involve moving away from conventional approaches to software design. Corbett (2003) suggested that an entirely pictorial map may be effective in engaging participants with reduced written language skills. Future trends in computer development, which may include flexibility and customization of interfaces, as well as the incorporation of natural language and speech recognition tools or surface computing systems as replacement or support to the 'point and click' environment, may greatly benefit the design of First Nation mapping interfaces. A First Nation may desire to culturally enhance the system, since there are ways that a First Nation could use the system that come from emic perspectives of which we have little or no understanding.

In addition, future work should involve training a significant number of community members in an introductory GVS session. It has been my experience as a GIS analyst and technician that individuals who develop into the most capable and interested GIS users cannot be predetermined by education level. More important qualities may include the ability to be a self-starter and to be a critical thinker, since much learning about the GVS can occur through exploration. A user does have to develop confidence and recognize that 'breaking' and 'fixing' the GVS can also be part of the learning experience. By training many members, dedicated operator(s) may be identified.

Thirdly, future work should examine developing a 3-D module because there was some evidence that individual HRFN users related more strongly to paper and digital

maps that included backgrounds of a hillshade or images of the land than to maps that presented only vector elements. Alternatively, output from the GVS could be linked to an existing 3-D software program or Digital Earth. The 3-D method should be designed, tested, and modified with a First Nation. Three-dimensional images may support community decision-making if images can be generated in a timely fashion to complement on-going community discussions. Enabling First Nations to view and select their preference from a selection of 3-D approaches may ensure that tool development empowers rather than isolates First Nation participants of different ages and backgrounds.

Lastly, future work should develop and test with First Nations alternative ways of categorizing TEK. The GVS has potential to function as a tool that enables First Nations to communicate ways of categorizing data, information, and knowledge that is consistent with their worldview. For example, a suite of photographs consisting of plants, animals, and places may be used by knowledge holders to select elements that go together in their worldview. The GVS and its ability to communicate within and outside of the community will be strengthened by reflecting the connected ways that First Nations ‘see’ the land.

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Appendix 1: List of Acronyms Used in Thesis

2-D - Two-dimensional
3-D - Three-dimensional
AAC - Annual Allowable Cut
ABE – Adult Basic Education
AIA – Archaeological Impact Assessment
AML - ARC Macro Language
ArcIMS – Arc Internet Mapping Server
ATV – All-terrain Vehicle
B.C. – British Columbia
BRFN – Blueberry River First Nation
CAD - Conservation Area Design
CANFOR - Canadian Forest Products Ltd.
CBM - Coal Bed Methane
CIS - Community Information System
CiGIS - Community-Integrated GIS
CIT – Coast Information Team
CMT(s) – Culturally Modified Tree(s)
CP – Cutting Permit
D.I.A. - Department of Indian Affairs
DVD - Digital Versatile Disc
ESRI - Environmental Systems Research Institute
FIST - Flexible Internet Spatial Template
FNESC - First Nations Education Steering Committee
FOS - Forest Operating Schedule
GDP - General Development Permit
GIS - Geographic Information System
GNU – GNU Not Unix
GPL - General Public License
GPS - Global Positioning System(s)
GUI - Graphic User Interface
GVS - Geographic Valuation System
HRFN - Halfway River First Nation
HTML - HyperText Markup Language
H_2S – Hydrogen Sulfide
LRMP - Land Use Resource Management Plan
LUOS - Land Use and Occupancy Study
MK - Muskwa-Kechika
MKAB - Muskwa-Kechika Advisory Board
MKMA - Muskwa-Kechika Management Area
MoF – Ministry of Forests
MOU – Memorandum of Understanding
NASA - National Aeronautic Space Association
NENAS – North East Native Advancing Society
NTS – National Topographic System
OGC - Oil and Gas Commission

OS - Operating System
PAR - Participatory Action Research
PDF - Portable Document Format
PGIMS - Participatory Geographic Information and Multimedia Systems
PGIS - Participatory GIS
PPGIS – Public Participatory GIS
PHP – Pre-Hypertext Programming
PNG – Petroleum and Natural Gas
PPGIS - Public Participatory GIS
QGIS - Quantum GIS
RAAD - Remote Access to Archaeological Data
SFMP - Sustainable Forest Management Plan
SFN - Saulteau First Nation
SLOCAN - Slocan Forest Products Ltd.
SQL – Structured query language
T8TA – Treaty 8 Tribal Association
TAW - Traditional Aboriginal Worldview
TAV – Traditional Aboriginal Value(s)
TEK - Traditional Environmental Knowledge
TEKMS - Traditional Environmental Knowledge Management Systems
TFL - Tree Farm License
TLUOS - Traditional Land Use and Occupancy Study
TRIM - Terrain Resource Information Mapping
TSA - Timber Supply Area
TUS - Traditional Use Study
UBC – University of British Columbia
UBCIC – Union of British Columbia Indian Chiefs
uDIG - User-friendly Desktop Internet GIS
UMinn – University of Minnesota
UNBC – University of Northern British Columbia
UTM – Universal Transverse Mercator
USGS - United States Geological Service
VDT - Values Discovery Tool
VHS – Video Home System
WBS - Western-based Science (or as an adjective, Scientific)
WBSM - Western-based Scientific Management
WBSK – Western-based Scientific Knowledge
WBSW - Western-based Scientific Worldview
WCS - Web Coverage Service
WFS – Web Feature Service
WMFN - West Moberly First Nations
WMS – Web Map Service
WV - Worldview
WWW - World Wide Web
XML - eXtensible Mark-up Language

Appendix 2: Research Agreement between UNBC Researchers and HRFN

Research Agreement between

The Halfway River First Nation

And

Dr. Alex Hawley, Dr. Erin Sherry and Nancy Elliot,
University of Northern British Columbia

August 1, 2004.

Background

This document outlines the research agreement between the Halfway River First Nation (HRFN) (represented by Chief and Council) and a research team from the University of Northern British Columbia (UNBC) comprising Dr. Alex Hawley, Dr. Erin Sherry, and Nancy Elliot.

The research addresses the overlapping goals of the HRFN's Traditional Knowledge and Land Use Study (TKLUS) and Nancy Elliot's PhD thesis regarding the inclusion of Aboriginal values in resource management through enhanced geospatial communication. The agreement enables joint use and benefit from shared effort, information and knowledge.

The goals are:

1. To demonstrate to policy-makers, other First Nations and resource planners that the HRFN possess traditional knowledge which is a legitimate source of knowledge and should be consulted through the HRFN in resource decisions;

2. To demonstrate to government, industry, and others, particularly oil and gas corporations and forestry companies, that the HRFN is making progress in communicating this knowledge by documenting and implementing a project to collect, analyze, and apply traditional knowledge. As part of this communication process, Nancy Elliot's PhD. Thesis undertakes to evaluate: whether a) the geospatial methods used in resource management impede the embodiment of a traditional Aboriginal worldview into the process of resource management and planning; and b) alternative methods of geospatial communication can be developed that will more accurately articulate traditional Aboriginal worldviews to non-Aboriginal planners and managers.

Researchers from UNBC understand that respect for the traditional knowledge, heritage, culture, language, local news and community standards of the HRFN is essential. The HRFN community and Chief and Council retain intellectual property associated with their traditional knowledge and contributions to the project. Similarly, UNBC researchers retain individual property rights to their contribution to the project (eg. views on spatial software and hardware, views on integration of worldview in resource management not developed concurrently with HRFN, training programs). Intellectual property rights "should guarantee both an individual's and a group's right to protect and benefit from its own cultural discoveries, creations, and products" (Hansen and VanFleet, 2003: 4). The process of retaining intellectual property rights means that:

1. researchers will preserve integrity of original ideas and information when presenting information credited to research partners;
2. research partners will consult with appropriate partners when presenting information and/or results (see below);
3. consultation concerning any activity generating direct revenue (eg book, video) will involve discussion about revenue sharing amongst participants.

Following the principles outlined in this document, the UNBC research with HRFN was approved by UNBC's Research Ethics Board in June 2003.

What are potential benefits and risks to participants? How have risks been mitigated?

The benefits of this research include providing HRFN Chief and Council with the legitimacy and capacity to input into resource management plans based on traditional knowledge of the area. Additionally, this information may be used to produce educational materials for local schools to facilitate inclusion of traditional knowledge in the teaching curriculum with the objectives of cultural reclamation/revitalization, promoting identity and self-esteem in youth, and strengthening relationships among the Elders and youth of HRFN.

The major risk for participants would involve misuse of collected information. This risk has been minimized by adopting a community-based approach in which research and development are done collaboratively to ensure that objectives are developed cooperatively and with input from all groups of participants. The main purpose of this agreement is to outline intellectual property rights of collected information, and to outline possible uses of such information (see below). Risks have been minimized through the use of Informed Consent, safe storage of research materials, restrictions on future access, the application of verification procedures, a process to receive the review of a designed community member before submission of publications, and adherence to UNBC research protocols.

What will participants be asked to do?

Respondents will be interviewed using an interview guide developed by HRFN participants and UNBC researchers. In addition, researchers may be asked to answer interview questions regarding the use of traditional knowledge in resource management and planning as part of Nancy Elliot's thesis research. Participants may be asked to record their knowledge spatially, look at a series of maps or visualization tools presented to them on a computer or print out, and comment on the effectiveness of each tool in conveying traditional knowledge. Participants will be asked to provide Informed Consent, either in writing or verbally, at the beginning of each interview. In addition, participants may appear in photographs or video taken during research activities, including visits to significant sites, interviews, and community and/or Elder camps.

Who will have access to participant responses (interviews)?

The community representatives and/or Chief and Council will control access to information relating to traditional knowledge of the HRFN. As previously agreed upon with HRFN Elders, confidentiality will be addressed by assigning each participant a 'code' number. The identification of each 'code' number (look up table cross-referencing names and numbers) will be stored in a separate location from actual names of participants.

Recordings, transcripts, and other research materials (e.g., maps, reports) will be provided to HRFN and tapes and transcripts will be provided to individual participants. HRFN will store recordings, transcripts, and research materials for safekeeping and will control outside access to information. The lead investigator will also retain copies of recordings, transcripts, and research materials in a secure storage space for the length of the research project. After this time, these materials will be returned to HRFN.

Report of Research Results

The HRFN and UNBC researchers encourage and support the collaborative dissemination of research results. All documents, research materials, and data produced through research activities will be made available to HRFN and UNBC researchers. HRFN and UNBC researchers recognize and endorse the principles of transparency and accountability.

All research results, analyses and interpretations must be reported to Chief and Council and HRFN community to avoid any misunderstanding. Chief and Council (and/or a designate) will be provided with an opportunity to review individual chapters. Individuals will be asked to review transcripts of their interviews. A finalized copy of Nancy Elliot's thesis will be provided to the HRFN Band Office.

Authorship Guidelines

The results of this project may be of interest to many other audiences and communities. Part of the research process includes the communication of research results to other people and organizations engaged in similar areas of research. This section defines potential audiences, outlines ethical standards, and describes the process of communication.

<u>Audience</u>

Communications may be directed at five general audiences:

1. The HRFN Community at large
2. Other First Nations communities and organizations
3. Researchers, including scientists
4. Industry
5. Government

<u>Principles</u>

1. All data collected belong to the community.
2. Researchers must give credit in their research reports to all participants. The form of that credit may vary upon the content and form of the report.

Process

Results from research projects may be presented through:

1. Oral presentation to a community at large (see above) (eg. presentation to Industry on research goals and aims)
2. Oral presentation of "a paper" at a scientific conference or meeting
3. Poster presentation of "a paper" at a scientific conference or meeting
4. Articles in scientific journals ("a paper")
5. Teaching examples (eg. illustration of training methods to students learning about research in communities may use HRFN photographs)
6. Nancy Elliot's PhD thesis
7. community-based learning materials (eg. educational curriculum)
8. websites (HRFN, UNBC, Muskwa-Kechika)
9. community publications – newsletter, flyer, brochure, poster, press release, calendars
10. displays
11. progress reports to funders, HRFN, PhD. Committee
12. final reports to funders

The first author of a paper (ie the person whose name appears first on the article) will assume the major responsibility for preparing the article. The first author will assume most of the writing responsibility. Other authors contributing to the communication will appear in descending order. The order will depend on the contribution made to the subject of the communication and the preparation and writing of the communication. The first author has responsibility for identifying contributing authors and the order of their listing.

Photographs and video may be used in oral and written presentations. Photo credits will be attributed where possible.

Images of sacred objects and/or places will be restricted for use internally by the HRFN community. These images include photo and videos of the cross, caves, and any other site determined as sacred by the HRFN Chief and Council and Elders Advisory committee.

Nancy Elliot's PhD thesis

Nancy Elliot's PhD thesis focuses on developing a better process to include Aboriginal values in resource management through the use of geospatial tools. As such, it incorporates the traditional knowledge of the HRFN, but this knowledge is not the main focus. Nancy Elliot will acknowledge contributions of the HRFN community and individuals who played important and vital roles in the acknowledgements section of her thesis. Individual quotations and references will be referenced to protect anonymonity of participants; for example, by being referenced as 'Participant 1'. A separate look-up table containing code names and participant identities will be kept and provided to HRFN for

their future use, if so desired.

Nancy Elliot, UNBC PhD. Candidate	Date
Roslyn Pokiak, Chief of HRFN	Date
Sandra Field, Councilor of HRFN	Date
Georgina Hunter, Councilor of HRFN	Date
Dr. Erin Sherry, UNBC Researcher	Date
Dr. Alex Hawley, UNBC Researcher	Date

Appendix 3: Interview Questions Developed with HRFN for Community-Based Research

The following text replicates the interview question page formulated with HRFN elected leaders. The questions were developed by UNBC researchers and HRFN Chief and Council through an iterative process to maximize responses that would best meet community goals (e.g., identifying which families had travelled together and where). A typed page with these questions was used by external researchers and HRFN community researchers during interviews to ensure that interviews covered key topics and were conducted systematically.

Interview Questions with HRFN Elders

(Brackets contain potential follow-up questions to encourage interviewers to seek details from Elders.)

[Note to interviewer - You may want to start off the interview by asking ….]

When and where were you born?

Do you have a Dunne-za name?

Who are your parents? Where are your parents from?

Who are your brothers/sisters, and/or children?

Have you camped in this area before?
(Can you tell me when/how many years you have camped here?)

When you camped here, how long did you stay before moving on?

Where did you come from before camping here?

Where did you move to, or where did you camp next?

Who would have camped here with you?
(family names, brothers, sisters, white people)

Where else in this area did you camp?

Who uses and used this area? Which families? Are there other people who know these areas well?

How did you travel? (by foot, horse, snowshoe, etc.)

Who would ride? Who would walk?

Did certain members of your family remain in this area, while others travelled?

Where are the trails that you can remember?

Who set the trails out?

Did they send someone ahead to cut out the trails?

Do roads follow some of the old trails?

What do you think should happen to the road access? Do you want to see roads open so you can access areas or would you like to see all roads closed?

Where did you gather plants? Which plants? What were they used for?

Where did you hunt? What animals were you hunting for? (moose, marten, deer, porcupine, whistler?)

Are there licks in this area?

Did you trap for animals? Where did you trap? What animals did you trap for?

Can you tell me where there were other village sites like [name of site] ?

Do you know of any spiritual sites?

What did this area used to look like?
(were there … as many trees, was it quieter/noisier, were the same roads here?)

[Now you as the interviewer may start to change gears by saying … Perhaps use a phrase such as "we have just a few more questions about the study and the information"…]

Do you feel that you have been given an opportunity to tell us about this area?

Is there any information that we have not talked about that is important to you?

Can you suggest a way to discuss this area that may bring up some more memories for you?

In your opinion, what HRFN values are important to communication to resource managers and planners?

Appendix 4: Examples of Paper Map Use During Community Interviews

An introduction would be given, with the map aligned to match the direction of the main rivers in the real world. Known features would be pointed out as part of the introduction. Elders' comfort level with using paper maps varied from person to person.

Example 1 provides an example of the interviewer speaking with a participant and deciphering the map symbols. Example 2 provides an example of the interviewer and participant discussing and recording trails. Example 3 provides an example of an Elder indicating that he/she was unfamiliar with map-reading.

<u>Example 1:</u>

Participant: what's the green line?

Interviewer: the green line is where … there are trails. Some one pointed out that those are trails that you rode horses on….

Participant: this one [points to different line]?

Interviewer: that's a … that's the boundary of the Muskwa-Kechika Management Area …so it doesn't exist on the ground it's just a map line to show what you cross over

Participant: yeah, okay

<u>Example 2:</u>

Participant: that's ah, …. one trail cross here [pointing]

Interviewer: uh huh

Participant: that's where we catch the [river name] and all the way right through, that's the one we follow coming through [pointing]

Interviewer: [the trail] comes through across the river?

Interviewer: ya, and we follow, most of the time and [continues on]

<u>Example 3:</u>

Interviewer: Ok…. [says interviewee name] one of the first things we can do is look at the map.

Participant: I cannot read it.

Interviewer: that's ok. Can I just point a few things out and then if you, if we can reference them to the map later on, then we can come back to it?

Participant: uh-huh

Interviewer: [Pointing at map] So umm this…this is the [river name] going up here and this is the [river name] coming in here. So this is about where the [sacred area] is. And the [village name] is over here, umm this is the one that [second village name] and the [river name] runs along here, see how these look like mountains, and this is the [river name] that runs down here, and that's [sacred area] right there….so just, we will just keep it here and if we can use it, we will use it, OK?

Participant: uh-huh

Interviewer: if not we will just talk ..OK?

Participant: OK

Appendix 5: Guidelines for Interview Transcribers

The following topics were covered in an expanded format in the document for interview transcribers. Content is summarized here to protect confidentiality of HRFN knowledge:

1. Interviewers were shown an example of how to record information on the interview, including interviewer and interviewee name, place of interview, and place and time of interview;

2. An example of how to record the interviewee's consent from the tape recording was illustrated;

3. Transcribers were instructed to italicize names or words they were uncertain of;

4. A list of people and place names was created to assist transcribers with spelling;

5. An example was provided to guide transcribers in recording the naturalness of conversation, for example by including words like 'ummmm', or allowing for pauses through the use of '……' . Longer pauses were recorded using (pause). Physical breaks were recorded using (break);

6. Transcribers were guided in how to record that the interviewer and interviewee were looking at maps.

7. If there were two sides of a tape used, or more then one tape for a single interview, transcribers were instructed on how to record the termination of one side or tape and the beginning of another.

Appendix 6: List of Short Movies Produced from Videos Shot During Field Seasons, 2003 and 2004

Movies were produced from videos shot during field seasons 2003 and 2004. Movies were reviewed with Elders for their input and feedback. VHS copies of the movies also circulated amongst HRFN homes. Quotation marks indicate specific titles.

- Trip into Cypress Creek and Laurier Pass, led by [Elder Name]
- Bannock making, with [List of Elders]
- Kids' Hike along Horseshoe Road
- Swimming at Horseshoe
- "The Moose"
- "Jimmy and the Whistler"
- "Camp Life 2003: Little Town Chowade"
- "Trip to Crying Girl Prairie 2003"
- "Making Dry Meat at Chowade Camp"
- "Elbow Creek"
- "The LONG Walk"
- "Trip to Stoney and Dechinn 2003"

Appendix 7: Questionnaire Designed and Used with First Nations, Industry, and Government Mappers

Initially, research proposed to interview various First Nations, industry, and government personnel involved in resource management planning, use of maps, and GIS. Informed by the literature review on First Nations' mapping (Chapter 2), a questionnaire was written, pre-tested with knowledgeable individuals (a government forester, a government GIS specialist, and a First Nations mapping practitioner), and modified from feedback (see Chapter 4 for further information):

1. Is Aboriginal traditional knowledge included in resource management and planning?

2. What parts of the planning process use First Nations' knowledge?

3. a) Can you describe the methods used to obtain First Nations' input?

   b) How, if at all, are maps and mapping tools used in this process?

   c) Are other tools used (besides maps and mapping tools)? How are they used?

4. How are data input, output, and stored?

5. Are data updated? If yes, how are data updated?

6. Are distinctions made between data, information, and knowledge, and if so, how?

7. Can you identify First Nations values and elements of traditional knowledge as they relate to planning?

8. In your opinion, is the present level of First Nations' involvement in resource management adequate?

9. In your opinion, am I missing any questions or is there anything you would like to add?

10. Can you recommend someone I should talk to about this research?

Appendix 8: Summary of Method to Model HRFN Data Using Buffers

The ArcInfo buffer function was used to create polygons of specific distances around sites and trails. The aim was to view clusters of activity on the landscape.

Method summary:

1. Traditional trails identified from TUS lines (from 1999-2000 study), this study's map biographies, and GPS of trails made in 2003 and 2004 were combined to create one ArcInfo coverage with line features representing trails. Any overlap of trails from these three sources was left in the data because of inability to clarify whether data referred to differing or similar locations. Resultant coverage was checked for accuracy against original sources.

2. A point coverage was created from 1) TUS points (from 1999-2000 study), 2) this study's map biographies, and 3) GPS of sites taken in 2003, 2004, and 2005. Provincial archaeological data was added in one version. Resultant coverage was checked for accuracy against originals.

3. Trails were buffered to 100 m and cultural sites to 1000 m. Although distances were determined with input from Elders, they were not considered to be definitive and would have been subject to further consideration and possible revision if this method had been pursued more.

4. Resultant polygons were joined to create landscape clusters of recorded information and data.

Notes:

A challenge to this method is in determining what in fact constitutes a trail and how a trail is viewed and valued by HRFN. Many roads travel along old trails but Elders and other knowledge holders indicated that the value of areas accessed directly by roads has diminished given the impact of other users. Further more, HRFN may use some seismic lines and cutlines to access licks, thus incorporating these linear features into their trail system. Also, missing data have the potential to skew the model and lead to erroneous assumptions. For example, one cannot conclude that the lack of data in an area means that HRFN have no information about that area. These areas may appear blank simply because Elders have not been asked about their experiences at these locations.

Appendix 9: Summary of Method to Create Surface Representation of Traditional Values, Weighted by Distance to Identified Trails

Method summary:

1. A trails coverage ('trails_1') was created using the data mentioned above. In addition, it became clear from field work that occasionally other linear features were used for Aboriginal activities. These include cutlines, seismics and other trail information. 'Trails_2', a coverage of secondary trails added to 'trails_1', was created from existing Forest Cover, TRIM, and OGC linear data (e.g.,cutlines, seismic lines, trails). Roads were not included because they were too numerous.

2. A point cover ('points') of traditional site activities was created by combining points from various data sources (see above).

3. The NEAR command was used in ArcInfo workstation (version 8.0) to flag 'points' within varying distances (250, 500, 1000, 1500, 2000 and 2500 m) for each of 'trails_1' and 'trails_2'. Point attributes in resultant point coverages were flagged positive (Y) or negative (N) each time a given point was located within the specified distances to a trail. All resultants were combined in one point coverage with separate attributes for each distance value.

4. Points were then weighted for 'trails_1' and 'trails_2' based on proximity to trails. I choose to use categories numbered from 1 to 6 based on the six distances used as weights. For example, points within 250 m of 'trails_1' received a score of 6; points within 2500 m (but outside 2000 m) of 'trails_1' received a 1. Weights of 5,4,3, or 2 were assigned when the distance was 500, 1000, 1500 or 2000 m. Distance values were also calculated for 'trails_2'. A combined total from the scores was totaled in a third column. Thus, potentially the single highest score for a point was '6', from distance to 'trails_1' and 'trails_2', and the combined highest score was 12. The potentially lowest score for a point was 0, representing point distances greater than 2500 m from both 'trail_1' and 'trail_2' features. Zero scores were represented in the legend using -999.

5. Polygons were created to translate these weighted values into a surface model. Rather than use watersheds as coarse filter boundaries or arbitrary cell size, the data itself was used to determine the boundaries necessary for polygon creation. Thiessen polygons were created in ArcInfo from the points to create a surface reflecting weights.

6. Adjacent polygons of the same value were joined using DISSOLVE and a colour ramp was applied to display values ranging from low to high.

ARC Macro Language (AML) programs were created to automate this process.

Appendix 10: Specifications of GIS Software and Computer Hardware Obtained by HRFN in September 2004

HRFN acquired a Hewlett-Packard plotter, desktop computer, and ArcMap 9.0 software under a funding agreement with the Oil and Gas Commission (OGC). The computer desktop runs the operating system Windows XP Professional, and has a Pentium IV processor and 2GB (2048 MB) of RAM, more than sufficient for running ArcMap. It was designated by HRFN exclusively for GIS use. I assisted in setting up the GIS computer equipment and installed GIS software in September 2004.

Appendix 11: DVD Thesis Supplement: Guides and Manuals

1. ArcMap Training Manual.

An ArcMap training manual was developed for use in GIS training with HRFN Lands Staff (arcmap-training.pdf). The manual emphasized common tasks relevant to HRFN, for example adding a seismic line. The manual emphasized HRFN content and context through its emphasis on and use of HRFN data. Confidential information has been protected by blanking sensitive data with grey boxes:

2. UTM Manual.

A training manual was also prepared for and delivered to HRFN participants explaining Universal Transverse Mercator (UTMs) projection (utm-projection.pdf). As in the above file, grey boxes are used to protect confidential HRFN information.

3. GVS Technical Guide.

A GVS Technical Guide entitled: 'Geospatial Communication of Aboriginal Values in Resource Management: A Technical Guide to Installing and Utilizing the GVS', was developed for HRFN and other users (GVS-technical-guide.pdf).

Appendix 12: Detailed Summary of Viewshed Polygon Creation

This method answers the question 'what areas can you see from a given location?' Typically analysis is done from a high point, such as a hill or mountain, and will produce other high points that can be seen from the starting location. It does not account for interferences to a view, which could include vegetative cover or man-made structures. The resultant polygon coverage contains an attribute indicating visible and non-visible areas.

Viewsheds were created in ArcInfo workstation version 8.0. The command VISIBILITY was run using GPS and map biography points, collected with HRFN participants, as view locations. VISIBILITY uses a lattice as a surface model, which was created from a triangulated irregular network (TIN) surface model previously generated from Terrain Resource Information Mapping (TRIM) Digital Elevation Model (DEM) data. In some instances more than one input point for a general location was used, reflecting that multiple GPS points had been collected at that locale. This was done to better imitate a real-world model where the view would be slightly different from one spot versus another. Since the output polygon contained attributes identifying the polygons that could be seen from each input point, output was generalized to flag all polygons that could be seen from the general area. The parameter OFFSETA was set to 1.5 m to stipulate that the viewshed was run as if someone was standing and looking from a 1.5 m vantage point above ground elevation (e.g approximate height of observer).

Outlier anomalies in the TIN were removed from the resultant coverages by editing the viewshed polygons in ArcMap. This editing was done using a transparent view over TRIM contour coverages in an effort to remove only those polygons that were anomalies and not those that could be potentially viewed from the input points.

Appendix 13: Adding HRFN Hyperlinks to NASA World Wind Using eXtensible Mark-up Language (XML)

Provided below is an example of xml coding used to add HRFN links to NASA World Wind. Method follows the example by Lewis and Clark Trail, downloadable from worldwind.arc.nasa.gov .

XML Coding to Add One Feature to HRFN Layer in NASA World Wind

```
<?xml version="1.0" encoding="Windows-1252"?>
<LayerSet Name="Halfway River First Nation" ShowOnlyOneLayer="false"
ShowAtStartup="true" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="LayerSet.xsd">
  <!-- start first -->
   <Icon ShowAtStartup="true">
    <Name>Camp</Name><!--name you see when hovering mouse over point-->
    <Latitude>
          <Value>yyyyyy</Value> <!-- x and y removed to protect actual site locations -->
    </Latitude>
    <Longitude>
          <Value>xxxxxxx</Value>
    </Longitude>
         <DistanceAboveSurface>100</DistanceAboveSurface>
         <TextureFilePath>Add-ons\Earth\hrfn\camera.png</TextureFilePath>
         <TextureWidthPixels>100</TextureWidthPixels>
         <TextureHeightPixels>100</TextureHeightPixels>
         <IconWidthPixels>22</IconWidthPixels>
         <IconHeightPixels>22</IconHeightPixels>
    <ClickableUrl>http://localhost/gvsapps/sites/gvs/photos/young.jpg</ClickableUrl>
<Description> This has been removed to protect HRFN confidentiality but would be a
textual description of the attached material present on the viewer. </Description>
  </Icon>

<!-- this references the HRFN button on the toolbar -->
          <ExtendedInformation>
                  <ToolBarImage>Add-ons\Earth\hrfn\hrfn.png</ToolBarImage>
           </ExtendedInformation>
</LayerSet>
```

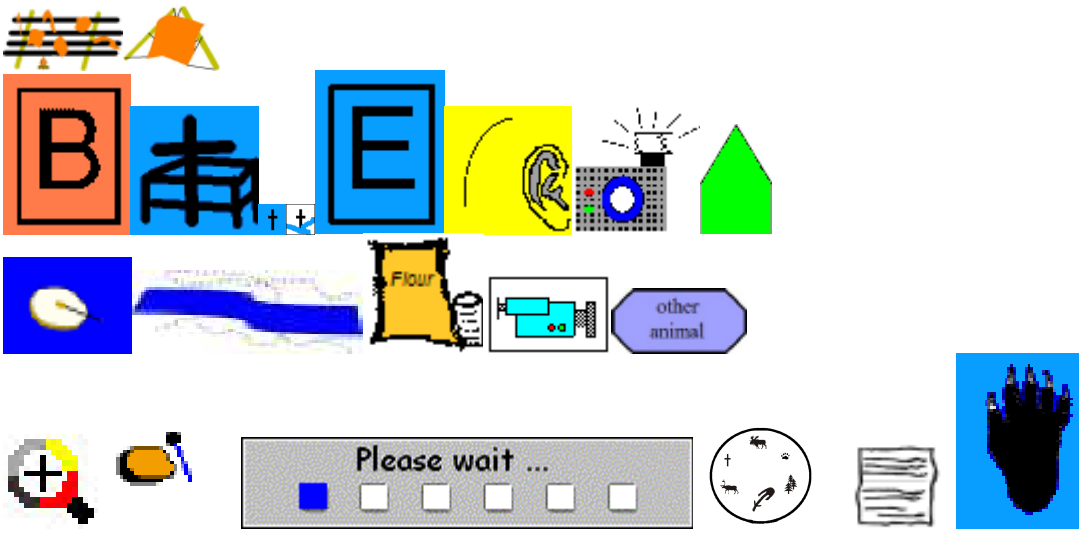
Appendix 14: Summary of Experience Using Ecomodeller

A brief summary of the experience with Ecomodeller:

- The software crashed frequently (approximately every 5th use);
- Input files needed to be formatted significantly to fit the required software parameters. Since this required an advanced GIS skill set, this increased the potential that HRFN would have to rely on external consultants, given that GIS software was used sporadically by HR Lands Staff;
- Each section of an over-all project (e.g., elevation and forest cover plus any additional files, such as roads) had to be processed every time the model was built or rebuilt. This meant that users had to wait for the model each and every time a small change was made. Since it is not possible to predict ahead of conversations with Elders what areas they may find relevant to discuss, the processing time would work counter to the spontaneous nature of Elders' contributions;
- Plug-ins from Viewscape3D were applied but did not function properly. For example, I tried using the annotation plug-in for points and it did not read user annotation. Also, the roads plug-in did not clear tree images from a newly created roadway;
- To compute the models, I had to create models at smaller than anticipated size (scale) and thus I do not consider this tool as providing effective landscape-level coverage;
- Cost of software and potential future updates were viewed as prohibitive for HRFN and would create a further barrier to sustainability (prices listed dated May 2003: Ecomodeler 1.0 and 2.0 - $3,000 each (Canadian). Ecomodeler 2.5 costs $1,900).

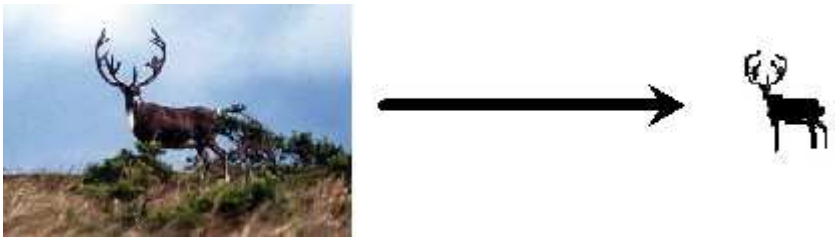
Appendix 15: Overview of Symbols and Symbol Sources Generated for and Used in HRFN GVS

Images I drew and/or produced using drawing software:

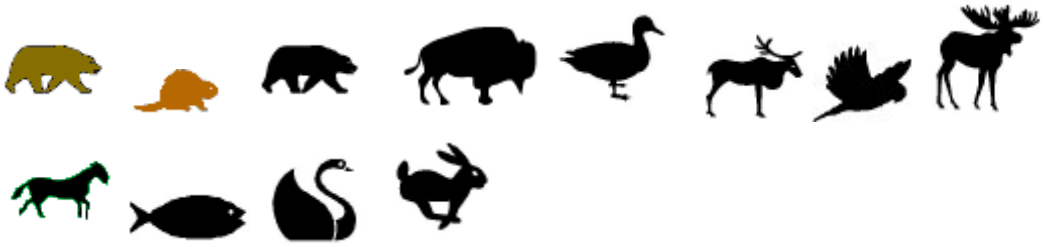


Images created from photographs I took with my camera and then modified in NeoPaint:

Example of modification of caribou photograph, using NeoPaint, showing beginning photograph and end image:



Images from SmartDraw program, Animals-1 and Animals-2 stencils (colours may have been modified):



Smartdraw, stencil Silhouettes 2, colours modified:

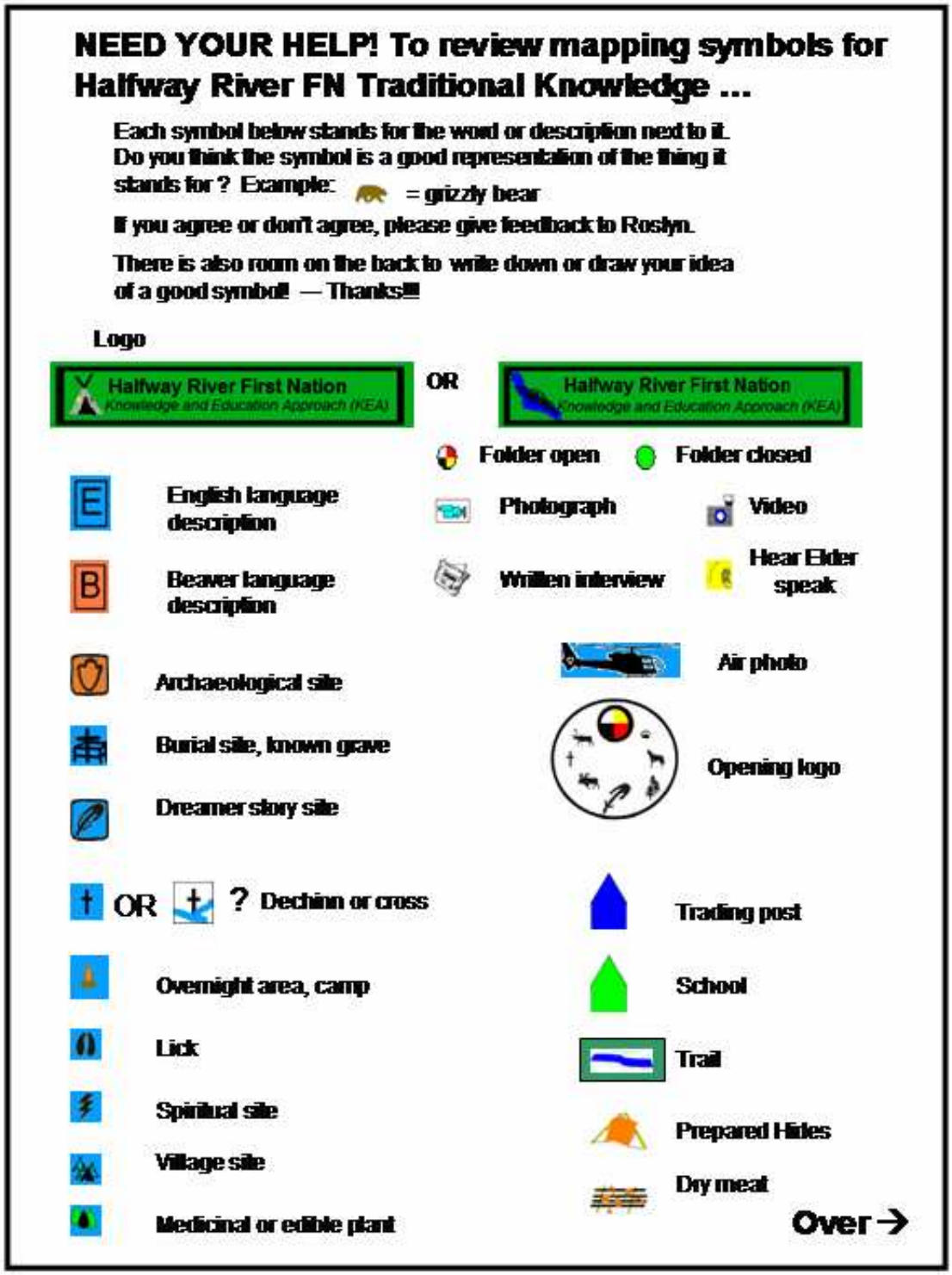
Image captured from Microsoft Word, ESRI Conservation font, colours and image modified:

Image captured from Microsoft Word, Animals font, colours modified:

Images captured from Microsoft Word, Animal Tracks font, colours modified:

Images captured from Microsoft Word, ESRI Caves 1 font, colours and image modified:

Appendix 16: Handouts Developed to Support GVS Symbology Review with HRFN Participants



NEED YOUR HELP! To review mapping symbols for Halfway River FN Traditional Knowledge …

Each symbol below stands for the word or description next to it.
Do you think the symbol is a good representation of the thing it stands for? Example: = grizzly bear

If you agree or don't agree, please give feedback to Roslyn.

There is also room on the back to write down or draw your idea of a good symbol! — Thanks!!!

Logo

Halfway River First Nation
Knowledge and Education Approach (KEA)

OR

Halfway River First Nation
Knowledge and Education Approach (KEA)

Folder open

Folder closed

English language description

Photograph

Video

Beaver language description

Written interview

Hear Elder speak

Air photo

Archaeological site

Burial site, known grave

Opening logo

Dreamer story site

OR ? Dechinn or cross

Trading post

Overnight area, camp

School

Lick

Trail

Spiritual site

Prepared Hides

Village site

Dry meat

Medicinal or edible plant

Over →

Grizzly Bear

Beaver

Fish

Deer

Moose

Black bear

Captured wild horses

Buffalo

Elk

Ducks or geese

Rabbit

Swan

Porcupine

Other animal (big horn sheep, caribou, chicken, Ptmarigan, ground hog, mtn goat, 'other bird')

Space for your comments, or drawing of a new symbol:

Appendix 17: Summary of Feedback to Community Review of GVS Symbology

Community Review and Input on GVS Symbols

• Direction was received from HRFN participants on the GVS logo. An image representing a community spiritual area was designed with HRFN participants and reviewed and approved by participants;

• A thunder-bolt symbol was initially used to symbolize special or spiritual areas. Several community members indicated preference for the use of another symbol and specifically mentioned the idea of using a drum symbol. Community members found images they liked in publications in the HRFN Office and shared them with Nancy Elliot. Based on these examples, a new symbol was developed and reviewed with HRFN participants;

• Use of a medicine wheel image for folders was described as “more of Cree thing”. An alternative to this image, a drum, was designed and reviewed with community members;

• The ‘other animal’ symbol, originally used for small animals, for example rabbits, was updated and replaced with symbols representing each animal group or species.

Appendix 18: GVS Presentations, July 2005 – January 2007

GVS Presentations, July 2005 – January 2007

July 14, 2005 – Roslyn Pokiak, Alex Hawley, and Nancy Elliot. Presentation to representatives from Ministry of Energy and Mines, HRFN Lands Office.

November 25, 2005 – Roslyn Pokiak, Alex Hawley, and Nancy Elliot. Presentation to representatives from Integrated and Land Management Bureau (ILMB) and Treaty 8 Tribal Association (T8TA), HRFN Lands Office.

February 8, 2006 – Roslyn Pokiak, Alex Hawley, and Nancy Elliot. Presentation to Muskwa-Kechika Advisory Board, Mackenzie, British Columbia.

May 31, 2006 – Roslyn Pokiak, Alex Hawley, and Nancy Elliot. Presentation at Northern B.C. GIS Conference, Prince George, British Columbia.

June 26, 2006 – Invited Presentation, Stakeholder Engagement Workshop, Geomatics Industry Association of Canada (GIAC), Victoria, British Columbia. Nancy Elliot representing Roslyn Pokiak, Alex Hawley, and Nancy Elliot.

January 10, 2007 – Invited Presentation to representatives from Inter-Agency Management Committee (IAMC), Integrated and Land Management Bureau (ILMB), Prince George, British Columbia. Nancy Elliot representing Roslyn Pokiak, Alex Hawley, and Nancy Elliot.

Appendix 19: Notes on Multimedia Formats Used in the GVS

Summary of multimedia formats used in the GVS. Technical specifications are referenced from the National (U.S.) Institute of Standards and Technology, Survey of Digital Media File Types (www.itl.nist.gov).

Video format

avi (Audio Video Interleave)
- supported by all computers running Windows OS
- may not play on Linux
- plays on Windows Media Player (distributed with PCs)
- large file size in comparison with mpeg

mpeg (Moving Pictures Expert Group)
- plays on Windows Media Player (distributed with PCs) and supported by most other major video players (file names suffixed with .mp4, .mp2, .mpg, among others)
- smaller file size in comparison with .avi, therefore downloads faster

Image format

bmp (Bitmap)
- supported by a broad number of viewers and editors
- large file format (very little compression)

jpeg (JPEG)
- supported by a broad number of viewers and editors
- compressed images are smaller size then Bitmaps, but compression artifacts are sometimes evident

png (Portable Network Graphics)
- probability of finding viewer and editor support in image programs increases in newer programs

Audio format

wav (Waveform)
- supported by Windows and Mac OS
- uncompressed; large file size

Text Format

doc (Microsoft Word Document)
- also supported by other word processors, including WordPad which is typically distributed with new PCs

Appendix 20: List of HRFN GVS Help Files and Videos

List of HTML Documents and Videos Created for HRFN GVS HELP

For the HRFN GVS, 52 documents, ranging in length from three pages to over fifty pages, and 39 videos, where created and linked to the Help tab. The Help documents are not reproduced here since they contain confidential information pertinent to HRFN TEK. The topics covered by the Help included:

Basics
GVS and web browser introduction
Starting the GVS
Shutting Down the GVS
Deleting temporary files
Resetting the GVS
Troubleshooting

Decision-making Using the GVS
Using the GVS to assist in decision-making
Querying TEK videos, photos, sounds, stories, interviews

Creating and adding new data
1. Adding data through a shapefile
• Creating a shapefile in ArcCatalog
• Adding new data to a shapefile (digitize line)
• Adding shapefile to postgres database and to GVS

2. Adding data by on-screen digitizing or GPS
• Adding data from estimated or known coordinates
• Editing data once entered in GVS

Extracting GVS Data
Going the other way - GVS to shapefile

GVS Basics
1. Introducing Tabs
• Introducing the toolbar
• Informing – About
• Investigating the legend
• Learning about layers
• Making a layer active
• Exiting the GVS

2. Introducing the toolbar functions
• Using the toolbar
• Moving around the map display (zoom-in, zoom-out, panning, zoom-initial, zoom

extents, zooming in on a fixed scale)
• Querying data with identifying tools
• Measuring distance and areas
• Creating a paper map
• Drawing tools
• Selecting data
• Using the editing tools
• Understanding and changing map scale