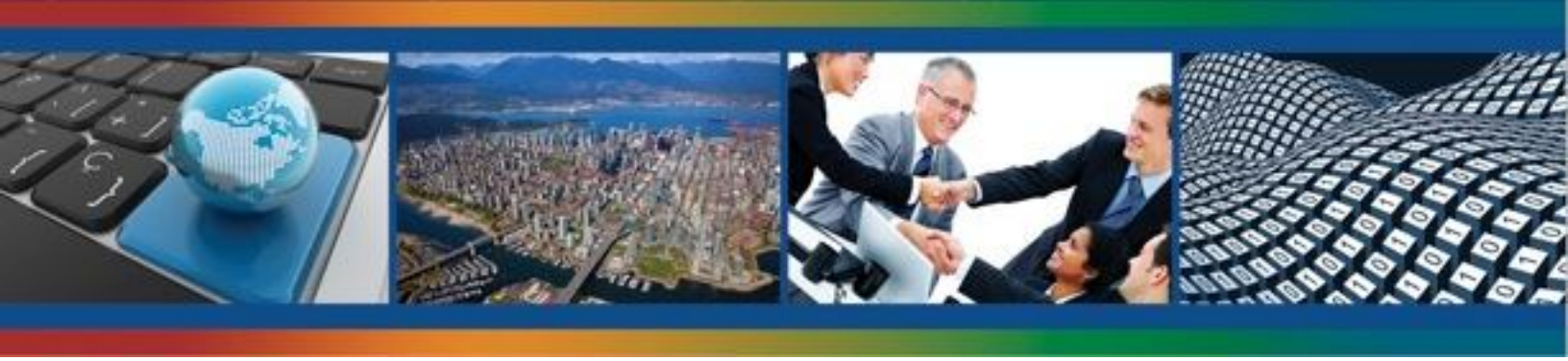

CANADIAN GEOSPATIAL DATA INFRASTRUCTURE
INFORMATION PRODUCT 11

Good Practices Guide : Success in Building and Keeping an Aboriginal Mapping Program

Centre for Indigenous Environmental Resources

2010

Natural Resources Canada
Ressources naturelles Canada

Canada

GOOD PRACTICES GUIDE

SUCCESS IN BUILDING AND KEEPING AN ABORIGINAL MAPPING PROGRAM

Prepared for:

GeoConnections
Natural Resources Canada

Prepared by:

Version 1.0
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Acknowledgements

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Executive Summary

The "*Good Practices Guide – success in building and keeping an Aboriginal mapping program*" profiles practices that lead to success when implementing geomatics programs in Canada.

The project team undertook a literature review including professional and scholarly research on factors for success when putting geomatics programs into operation, both in Canada and internationally. Findings were combined with the pooled knowledge of the report authors, who have over sixty years combined experience in this sector in many communities and organizations. A list of potential success factors was developed and a survey questionnaire based upon these was written. Representatives of Aboriginal organizations across Canada that were running or had operated local mapping programs were invited to fill out the questionnaire and participate in follow up interviews so they could share lessons they had learned while setting up and managing their programs. Their input was used to refine the list and complete a final list of good practices.

Practices and advice are grouped under six headings: getting started; gaining leadership and community support; funding and finances; human resources and training approaches; technology, data, and data networks; and support networks. Under these, specific concrete points of advice on principles for success are provided. Additionally, examples from first hand experiences are shared in a case study format to highlight specific principles in action.

The guide is not intended to provide a single-track road to success. Aboriginal mapping programs are as diverse as the communities themselves, and some principles presented will apply to some communities more than others. Taken as a whole, the guide should be useful to leaders responsible for setting up and managing programs, and for information technicians with responsibilities for mapping.

Introduction

WHY MAPPING?

Everyone maps. Even if we don't draw maps on paper, we all create mental maps of where we are and what is important to us. Thinking spatially is a part of being human. For thousands of years, Aboriginal cultures in Canada have expressed this type of thinking orally. It was embedded in language, in culture. After European contact, however, these expressions were put at a profound disadvantage, challenged by the new authority of the printed map.

The one who is in control of making maps controls the story of place. Governments put lines on maps to articulate boundaries of control and jurisdiction; companies put lines on maps to claim resources and tenure. Those who are not making maps are at risk of becoming invisible on paper. For over thirty years, Aboriginal communities across Canada have recognized the need to remain visible within this context and have been actively making maps of their own so information will be seen and understood from their viewpoints. The Labrador Inuit Association's *Our Footprints are Everywhere* from the late 1970s, the Kaska Dene's comprehensive planning in the 1980s, the Algonquins of Barriere Lake cultural mapping in the 1990s, and the Tsleil-Waututh Nation's bioregional mapping in the 2000s all are examples of what Aboriginal communities can accomplish when they pick up the tools of mapping to push back, to reassert control, and to retell their own stories of what is important on their land.

It seems like everyone is mapping today and we are now swimming in spatial information. We have maps that describe our natural and cultural resources, trap lines, territories, occupancy, and use areas. We have maps that compartmentalize our world from sub-surface geology and ground water up to the trees and the climatic conditions of the air and sky. A good librarian knows that the potential for using information can only be fully realized when the information is made readily accessible. Accessibility here is synonymous with organization – having information that is well catalogued and archived that can be put into action easily. As we make maps and as we receive maps made by others, Aboriginal communities need to think about how to create, store, catalogue and archive spatial information. For many, this means launching a mapping department or starting a mapping program.

> *In the age of computers, mapping is only part of using spatial information. A broad field, called geomatics, includes everything from surveying and remote sensing through GIS spatial analysis and reporting. Maps are still critical, though. The "mapping programs" we refer to in this guide more than likely will include activities that don't directly result in making maps. GIS are key for manipulating spatial information and making maps, so some good practices refer specifically to this technology, but don't forget that GIS are* ***part*** *of a mapping program, not the whole program.*

For this guidebook, we surveyed and interviewed twenty-three Aboriginal organizations across Canada to document lessons learned from setting up and managing local mapping programs. These groups have had extensive experience in using geographic information systems (GIS) – the main computer-based tool used in map making.

We wanted to capture some of the main principles of success: what has worked in the field as told first-hand by local mapping managers. This is a dialogue that has been noticeably absent from the sector where local successes (and failures) are rarely shared with others. There is also a noticeable gap in the literature regarding principles of good

practice for running an Aboriginal mapping program. There is information on how to conduct mapping research (such as the recent book by Terry Tobias, *Living Proof: The Essential Data-Collection Guide for Indigenous Use-and-Occupancy Map Surveys*), but almost nothing regarding how to set up and manage a mapping program where the information from this research would be stored and managed. The goal of this guide is to fill this gap and help communities to build on the successes of others.

BACKGROUND

GeoConnections, a national partnership program led by Natural Resources Canada, was created in 1999 with the goal of improving the capacity for Canadian users to share and apply geospatial information through the Internet. From 1999 to 2005 the focus of the GeoConnections program was to develop a Canadian Geospatial Data Infrastructure (CGDI). The 2005 Federal Budget provided a renewed mandate for GeoConnections until 2010. This second phase of the program works to expand the CGDI with a focus on applications in four priority areas, one of which is Matters of Importance to Aboriginal People.

To administer their resources and lands effectively, and economically empower their communities, Aboriginal organizations and communities must have location-based information. In just about every Aboriginal community in Canada, maps and the process of map making are being integrated into the local planning and decision-making process. These maps are being used for a variety of applications, ranging from land use planning and consultations with third parties, through to economic development and the assertion of Aboriginal title and treaty rights.

Strong GIS capacity can greatly improve the efficiency and effectiveness of Aboriginal administrations, while maps and other information products can help to foster community engagement. However, GIS technology and the human resources and management frameworks it needs to be effective are challenging to implement in small organizations.

Today the benefits of mapping are rapidly expanding through the opportunities for incorporating digitally based information now available from global positioning systems (GPS), GIS, and remote sensing using satellite and aerial photo imagery. While the rapid growth in user-friendly technology is making the task of mapping land use and occupancy easier, the large range of technology available can be confusing. What is needed is a clear and concise guide for Aboriginal organizations on how to consider, create, and set up a technology based mapping system that is not overwhelming or costly and that considers capacity and long-term sustainability.

The intended audience for this guidebook is Aboriginal leaders with the responsibility either to set up or to manage their organizations' mapping programs and spatial data libraries. The guide should also be useful for information technicians with responsibilities for mapping, who may gain some insights from the guide's documentation of experiences. The guide is not intended to be a single-track road to success. We recognize that Aboriginal mapping programs are as diverse as the communities themselves, and some of the principles presented in this guide might resonate more than others according to organizational needs.

The guide was developed by the Centre for Indigenous Environmental Resources (CIER) and project partners. The project team reviewed relevant professional and scholarly publications on success factors when operating geomatics programs. Findings were combined with the pooled knowledge of the report authors to develop a list of potential success factors and an extensive survey questionnaire was written, with more than sixty questions based on these findings. This was entered into an online Internet survey tool to allow participants the greatest flexibility to answer questions at their convenience. Once surveys were completed, follow up interviews were conducted by telephone and using email to clarify answers. Results were validated through consultations with sector practitioners and a peer review process.

The guide is more about how to govern a mapping program than it is specifically about mapping. We have consolidated lessons learned from our survey and experience in the field to highlight six broad categories for success: (1) getting started; (2) gaining leadership and community support; (3) funding and budgeting programs; (4) managing human resources and training; (5) technology considerations and data networks; and, (6) tapping into support networks. Specific principles for success are organized under these main categories. Where appropriate, first-hand experiences are shared in a case study format to highlight specific principles in action.

2.0 Getting Started

BEGIN WITH A NEEDS ASSESSMENT

When thinking about starting down the long road to establishing a mapping program, the first question you need to answer is: Do you even need GIS? Not all organizations are in the position to put in place the people and resources necessary to make GIS successful. There is a broad spectrum of ways to engage in mapping, from relying on outside consultants to building a state-of-the-art in-house system. Many organizations find themselves somewhere in the middle. Regardless of what your needs are, a good starting point is to have an experienced individual or third party organization conduct a comprehensive user requirements and geospatial data needs assessment for your organization.

"*Do a needs assessment and business plan first,*" is the conclusion Jennifer Carpenter, Director of the Heiltsuk Traditional Use Study (BC), has reached after over a decade of sometimes-frustrating work seeking resources to sustain a mapping program at the community level. "*An organization needs to determine if it can afford a geomatics program in the first place. There are a number of options—a fully functional sustainable in-house program, all an organization's geomatics work done by an external geomatics house, or a combination of some in-house capacity and work that is contracted out. Don't jump into thinking that the organization just needs to invest in hardware, software, and a trained staff member. Failing to plan is planning to fail.*"

Needs assessments take a comprehensive look at an organization's infrastructure, personnel, hardware, software, data, applications, and training requirements. A needs assessment will help you to identify a strategy for moving forward into mapping. The cost of a needs assessment will vary depending on the number of stakeholder groups that need to be consulted and travel required to consult them. Expect to budget around $5,000 for a thorough needs assessment in a mapping project for a single community. The budget might be several times higher or more for a project like the Cree GeoPortal, which needed workshops to be conducted in nine Cree communities, as well as consultations with a number of Cree organizations.

For organizations that have established a GIS program but have not done a user needs assessment, having one can still be very helpful. It will allow you to perform course corrections, overcome barriers and re-allocate resources to meet changing needs.

> *PRINCIPLE: Successful mapping programs use needs assessments to help chart a course for their activities. Needs assessments are also an important tool to help course-correct an existing mapping program to meet changing needs.*

Even if your organization thinks that it might be able to find the resources and put an in-house system in place, it is worth talking about the potential for sharing a mapping program with other like-minded organizations such as Tribal Councils or regional entities. By pooling resources, you may be able to achieve greater efficiencies and returns on investment for everyone involved.

LEARN FROM THE EXPERIENCES OF OTHERS

Networking with other organizations is always useful. At the scoping stages, it can be critical. If you can, talk to and visit other like-minded organizations that have put mapping programs in place. Of course you will want to talk to others who have made a success of their mapping programs, but it can be equally helpful to learn from those who have struggled with them. You are likely to find that even thriving programs have stories of difficulties encountered and things that would have been better if done differently. Through networking, you can increase the chances that the successes will be replicated and the failures avoided within your own organization.

> *PRINCIPLE: Successful mapping programs recognize that networking with like-minded organizations from the beginning can help to get on the right track and avoid obstacles to success.*

Online resources provide an important starting point for many organizations. Resources can range from general sites that allow users to discuss and share experiences to technical forums relating to software. A list of suggested starting points is included in Appendix B.

In our survey, of the respondents who said that they communicated with other like-minded individuals to discuss problems, over 90 percent said that outside support was very or somewhat important to the success of their programs. This highlights the need to plan for and to make a continued effort to connect with and build the Aboriginal mapping community. We discuss this principle in more detail in Section 7, where we look at the importance of connecting with peer and support networks.

3.0 Gaining Leadership and Community Support

LINK YOUR MAPPING PROGRAM TO DECISION-MAKING

Where should your mapping efforts be located in your organization? There are many different ways to structure and govern an Aboriginal mapping program. Where the program is incubated usually is reflective to who needs maps the most, where administrative support is available (e.g. book-keeping, fundraising), where office space is available, and where the work can be supervised and held accountable to its users (i.e. the decision makers).

> *PRINCIPLE: Successful GIS departments are incubated within organizations close to the decision makers. Mapping should be understood as a decision support tool.*

Organizations across Canada have taken different approaches to where their programs are incubated. Some have set up programs under the administration of the Band Council, others within a stand-alone economic development agency, still others within a tribal council, and some within a separate non-profit organization. Wolf Lake First Nation (QC) has set up its mapping program as an integrated component of its forestry program, under the direction of Chief and Council. Timiskaming First Nation (QC) has its mapping program under its stand-alone economic development corporation. The Sliammon First Nation (BC) houses its mapping program within their Treaty and Lands department. Treaty 8 Tribal Association (BC) fills a lot of the high-level mapping needs for its six member communities. In our survey, almost 70 percent of respondents had set up their mapping program as a department under the authority of their Band Councils. A third were accountable to a board of directors. Figure 1 and Figure 2 show survey results on where and how geomatics programs are governed among the participants.

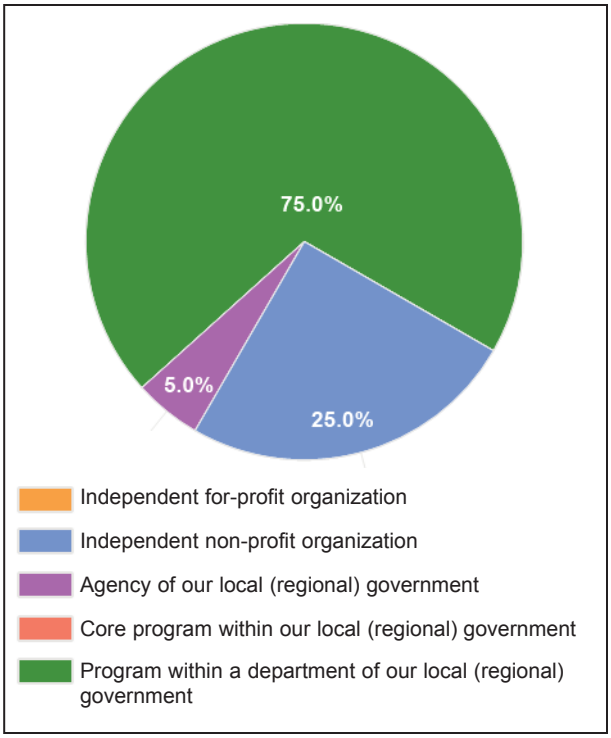

Figure 1:Survey Question: How is/was your program set up?

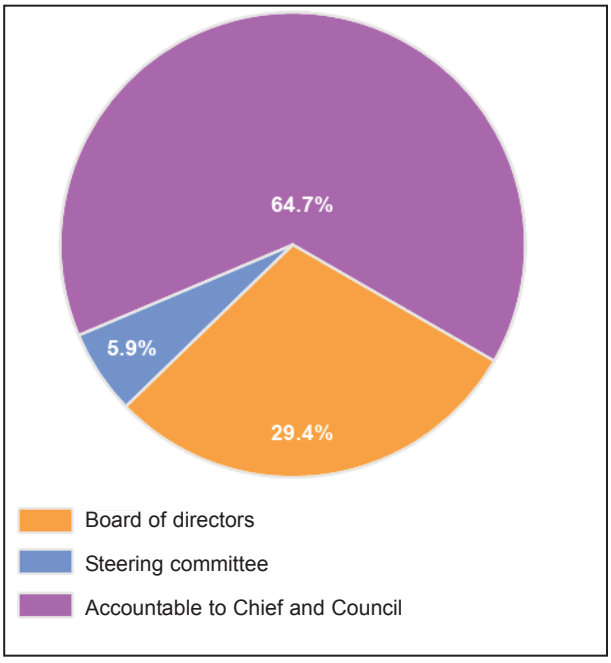

Figure 2: Survey Question: How is/was your program governed?

Success is dependent on not where, but how a program is governed. A key is never to lose sight of the purpose of your mapping program. Mike Townsend of the Nunavut Planning Commission makes this point well: "*If the program is not actively enabling the organization to fulfill its mandate, then it is misdirected and needs to refocus.*" A program's end goal should always be to support decision-making.

Case Study: The Treaty 8 Tribal Association

In 2003, the Council of Western Treaty 8 Chiefs hosted a meeting between leadership and Elders from each of their seven First Nations. The Elders directed their leadership to "*work together and protect the land and its resources.*" As a result, the Treaty 8 Tribal Association (T8TA) and the province of British Columbia began negotiating on impacts of development.

GIS are a key tool supporting negotiations and T8TA helps its communities apply them to facilitate and coordinate consultations. In 2008, the T8TA established the Coordinating Lands Office (CLO), a centre of GIS technical expertise for its communities. What has made the organization effective is that it maintains the GIS office in close proximity to decision makers, in this case, their leaders and negotiators.

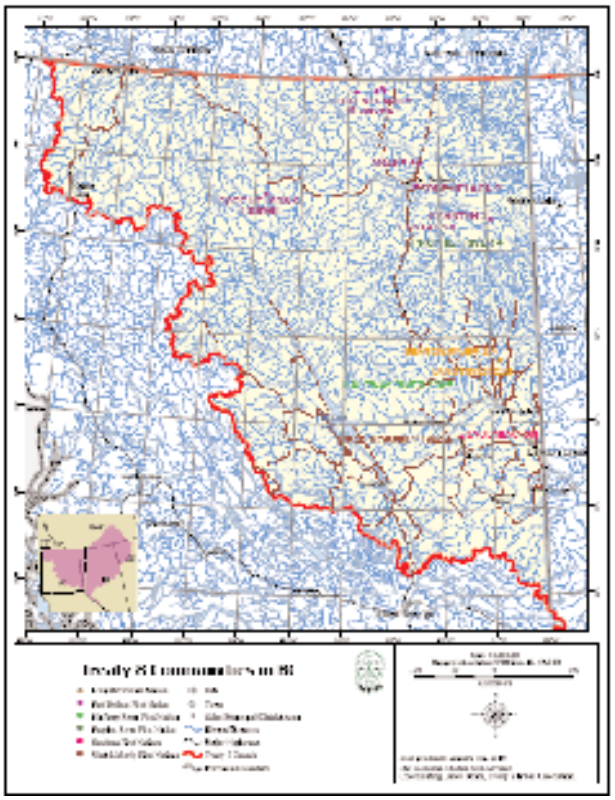

Figure 3: Map: Treaty 8 Communities in BC (Source: Leeanna Rhodes, Treaty 8 Tribal Association)

Leeanna Rhodes, the GIS Advisor for T8TA, has learned through her long career in the field that GIS technical skills are only one part of what she needs to know: "It *is a long learning process to be involved in land use issues. As the GIS technician, you need to be a good researcher, understand the principles of GIS data access and management, and be able to work in a multi-disciplinary team environment.*"

Source: Leeanna Rhodes, Treaty 8 Tribal Association

Leeanna recognizes the importance of having access to reliable and relevant data. To make certain information supporting negotiations is current and complete, T8TA has put data warehouse access and sharing agreements in place with government and industry data sources. Just some data sources she mentions include B.C. Integrated Land Management Bureau, Ministry of the Environment, Ministry of Energy, Mines and Resources, B.C. Oil and Gas Commission, Ministry of Forests, Canadian Forest Products, Louisiana Pacific, and the GeoGratis portal (Natural Resources Canada; see Appendix B).

The speed at which the GIS office is able to support decision-making enables the T8TA to lead negotiations. This has been one of the strongest tools in consultations. "*T8TA has had the foresight and strong governance to recognize the important contributions that GIS provides," says Leeanna. "By incubating the GIS office close to the decision-makers, we have been able to proactively meet the mandate to implement the true spirit and intent of the treaty.*"

USE AN INTEGRATED APPROACH

Successful mapping departments are often closely integrated into other departments within their organization. Because of the high costs to administer a mapping program, it is a good-practice to distribute overhead costs by meeting the mapping needs of other departments.

> *PRINCIPLE: Successful mapping departments support the needs of other departments to share costs and build capacity.*

For example, a BC community's Treaty negotiations team might pay their community's forestry department for mapping support, where the forestry department can earn additional revenue to cover its overhead for maintaining the GIS. All departments should be encouraged to build funds for mapping services into their annual budgets. Where another department is using outside consultants for their mapping, consider investigating what additional skills and capacity are needed to have this work contracted to you.

In our survey, respondents said the top five needs for mapping, in order of importance, were: (1) cultural inventories such as use and occupancy mapping (traditional use mapping); (2) consultations with industry and government; (3) land use planning; (4) treaty or land selection; and (5) forestry or resource management planning (see Figure 4). We have seen significant growth in mapping to support consultations with industry and government (see Figure 5). Since mapping should be a tool to support decision making, and the tool is best administered as close to the decision

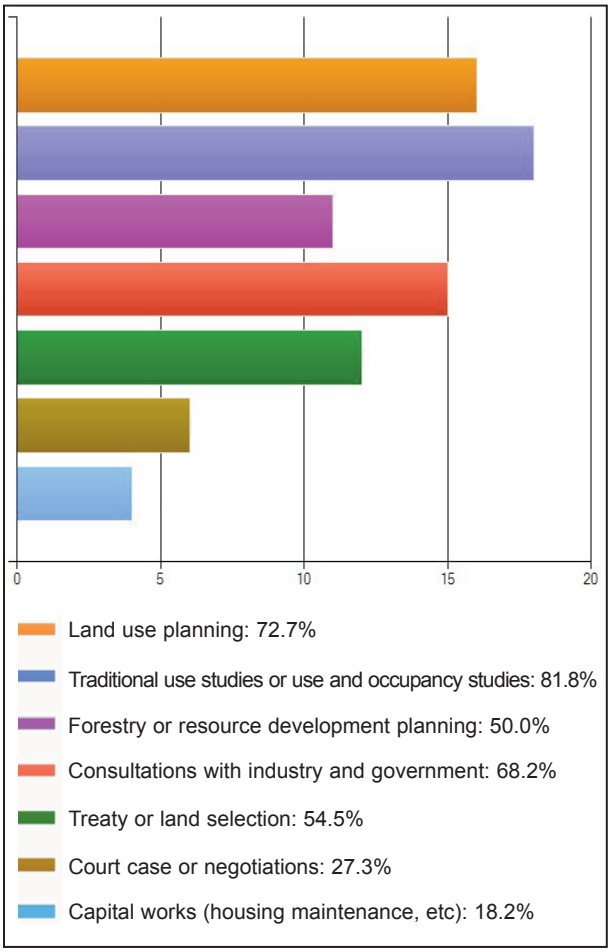

FIGURE 4: Survey Question: What were the original motivations for setting up your geomatics program?

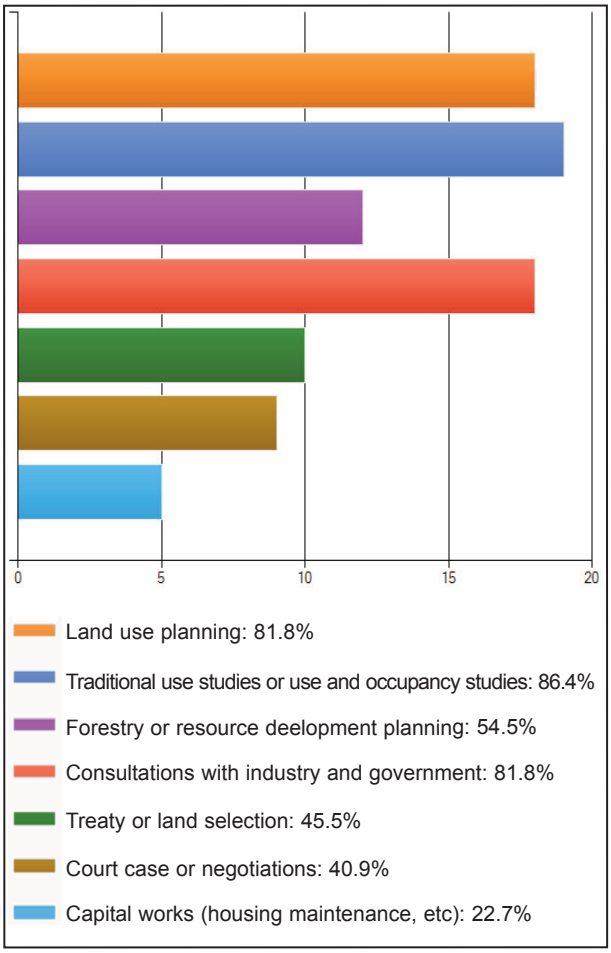

FIGURE 5: Survey Question: What are the current main applications for your program (if operational) or what were the main applications when it was fully operational?

makers as possible, the department that feels the most pressing need for mapping often effectively governs the program. Because mapping is useful in a lot of realms of community activity, the needs of other departments shouldn't be forgotten.

CULTIVATE COMMUNITY AND LEADERSHIP SUPPORT

Your mapping program can be shrouded in the mysteries of technology and data if you don't find time to communicate what you are doing. You don't want community members asking each other, "*What are they doing over there with all those computers and printers?*" Generating and maintaining support from the community, your administration, and politicians is a key element for long-term success. Programs often suffer when they drift away from the gaze of leaders. It is important to maintain tight connections with decision makers.

> *PRINCIPLE: Successful mapping programs generate and maintain community and leadership support as a condition for success. Tight connections should be maintained between those doing the mapping, and those using the maps.*

A variety of means can be used to achieve this, including: weekly team meetings; communication plans to report frequently to the community and its leaders (newsletters, open houses, etc.); establishing an advisory committee comprised of departmental managers; and physically locating the office in close proximity to those who use the tools the most. To let community members know what you are doing, ***posting beautiful maps in public areas and changing them often*** can really help to generate support. While this may sound obvious, it is too easy to post a couple maps somewhere but then get busy and leave them until they are ragged, stained, out of date pieces of wallpaper that suggest to people that nothing is happening.

Although our survey respondents noted that community support was never a barrier in launching or in running their mapping program, almost everyone noted the importance of maintaining support from the wider community. Respondents also noted the importance of maintaining a high level of support from the leadership as a road map to success.

The best way to do this is by producing results and keeping them in the eye of the community. Doug Aberley, Director of the Treaty and Natural Resources Department for the 'Namgis First Nation (BC), ranked community support as a significant challenge while the department mapping program was being set up, but now ranks it last. How did this come to be? "*If a tool does not prove its utility, it will not be either widely adopted or properly maintained. For 'Namgis, the challenge now is that every government department routinely asks for maps that assist their various operations. 'Namgis maps are now present at virtually all rights and title negotiation sessions, economic develop planning meetings, and community gatherings. What a pleasure it is to be struggling with this type of success.*"

IDENTIFY AND GROOM GIS CHAMPIONS

Successful community mapping programs are often hinged on the leadership of a local "GIS Champion." GIS Champions are people who understand the potential power of the technology and when and how it can be used to help in decision-making. They are also teachers and mentors who contribute to the general awareness, literacy and understanding of mapping tools. Success stories are usually found where someone at the top of an organization understands the power of the tool and brings this vision into organizational planning.

> *PRINCIPLE: Successful mapping programs encourage staff to become GIS Champions, sharing what the technology can do with leaders and the broader community.*

Sometimes the champion is found within the mapping program itself. "G*IS users are often the GIS champions*," Brenda St-Denis of Wolf Lake First Nation (QC) notes, "*and it's their responsibility to share their visions with the leadership and community at large.*" This speaks to the importance

of having your mapping staff take a pro-active role in helping your leaders understand the potentials of the tool, and excite community members with how it can be used to stand up for community rights and interests. Champions also can reach out to youth, nurturing some next-generation mappers and giving them an idea of a career they could pursue while staying rooted in the community.

In our survey, about three quarters (73.9%) of respondents said that their organizations have had a GIS Champion, and in most cases (68.4%) the Champion has been part of the program since the beginning.

USE AN INCREMENTAL APPROACH

We have heard from communities that problems arise when they grow their programs out of step with their demonstrated need. Buying only what you need now helps to keep your budgets in sync with your program needs. And yet, even for people who know this, it's easy to get near year end with unspent money on the books and find yourself saying, "*Let's buy some more computers and software for our mapping program.*"

> *PRINCIPLE: Successful programs grow incrementally, based on real and demonstrated needs.*

The problem is not only that unused hardware and software are a poor use of funds. Software and hardware cost money to maintain. Buying additional gear this year will require a larger budget next year to cover maintenance costs. In our survey, funding was identified as one of the most important challenges to running a stable mapping program. You shouldn't take on extra costs unless you can demonstrate that the payback makes them worthwhile.

Sophie Sliwa from the Mississaugas of Scugog Island First Nation (ON) knows the challenge, but also knows how to face it: "*March 31st: We all know that GIS activities, and especially the set-up of one, should not be dictated to by this deadline. At the same time, we know that the March 31st deadline is a reality and oftentimes this is when funds are available. To mitigate this, the key is to plan, and plan well. If a community is thinking about implementing a GIS, plan for the possibility of being able to take advantage of available funding opportunities. If a community already has a system in place, have a planned 'wish list' ready. In either case, only proceed if there is a plan that takes community sustainability and capacity into account.*"

After conducting a needs assessment, you will have a good idea what the right tools are to accomplish what you are doing and plan to do. When the opportunity arises to acquire more advanced software, data, or mapping tools, you should do a cost-benefit assessment. It is a good idea not only to look at the internal benefits and costs, but also to evaluate the benefits of adding to your local capacity versus the costs of contracting work out to a third-party. If, for example, you only need advanced GIS capacity for one specific task (e.g. to build a 3D hill shade model showing the topography of your territory), it might be best to contract this work out to someone who has the necessary software rather than taking on the additional annual software cost yourself.

4.0 Funding and Finances

The heading of this section probably makes you want to flip to the next page. It looks dry and overly administrative. But because secure and long-term funding is one of the main challenges in running a mapping program, you might want to read-on. This section looks at some of the principles for dealing with funding and financial challenges, to help keep your program afloat for the long-term.

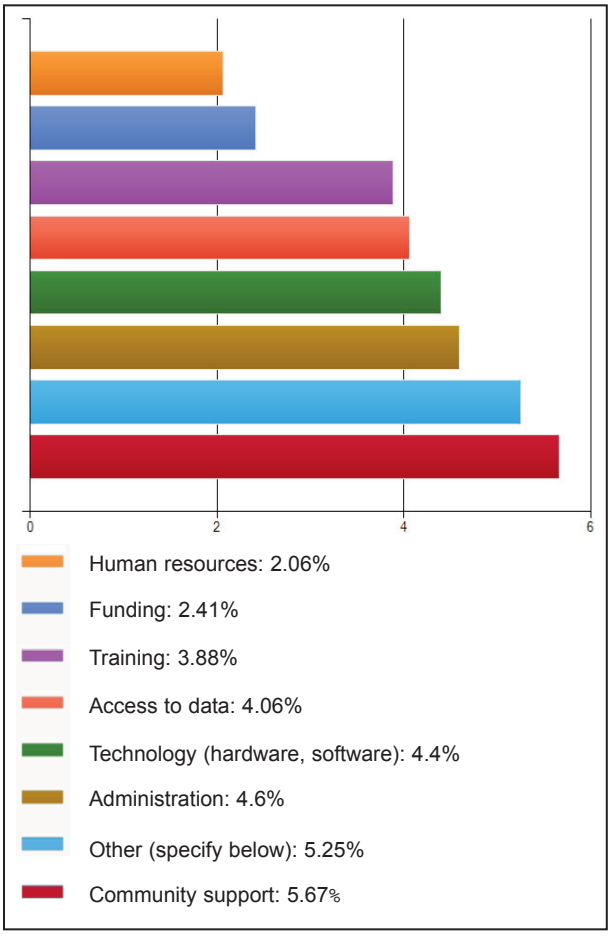

Figure 6: Survey Question: By rank, what were the major challenges in the start-up/set up of your geomatics program?

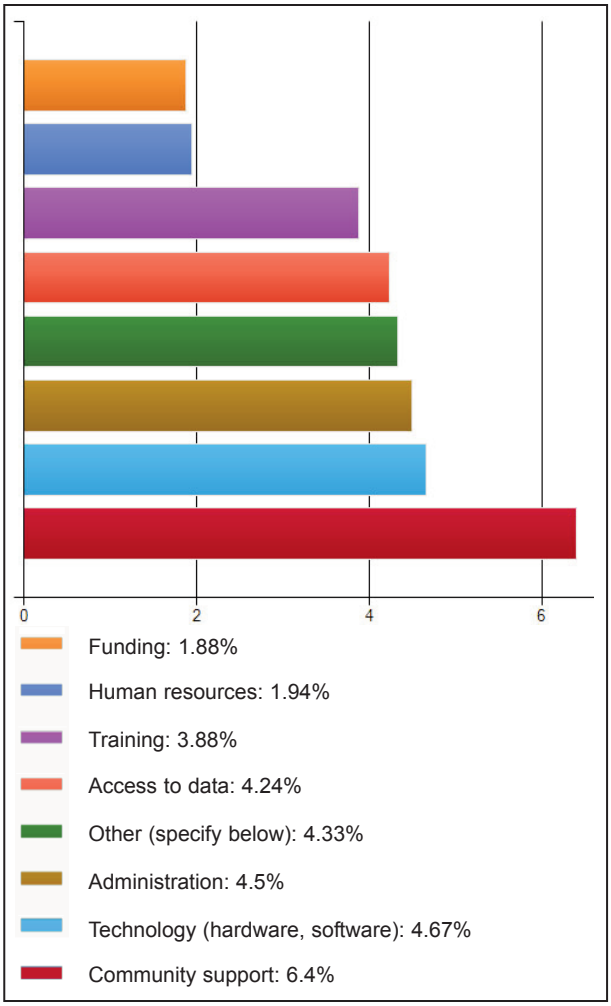

Figure 7: Survey Question: If it is still operational, by rank, what are currently the major challenges limiting the success of your program?

SECURE LONG-TERM, COMMITTED FUNDING

More than two thirds of respondents in our survey identified access to stable and secure funding is an issue in running a GIS program. The following (Figure 6 and Figure 7) show the average rank our survey respondents gave to challenges setting up and operating their mapping programs (where a

number closer to 1.0 denotes the higher average rank). Along with human resources, funding was ranked as the top issue.

Let's start off with a look at how much it actually costs to run a basic, bare-bones mapping program. Consider the cost of a staff of two people (one intern, one senior), with up-to-date hardware and software, including a plotter and paper supplies. According to survey respondents, the ideal average annual cost to run a mapping program ranged from $60,000 to $350,000. From the outside, it may look like mapping is easy, and that all you need to do is buy a box of software (or download a free open-sourced version), install it, and presto! - maps. Those with mapping experience know that this simply isn't the case. A successful mapping program is one that is adequately resourced.

PRINCIPLE: Successful mapping programs find ways to secure stable funding allowing capacity to build and benefits to be realized.

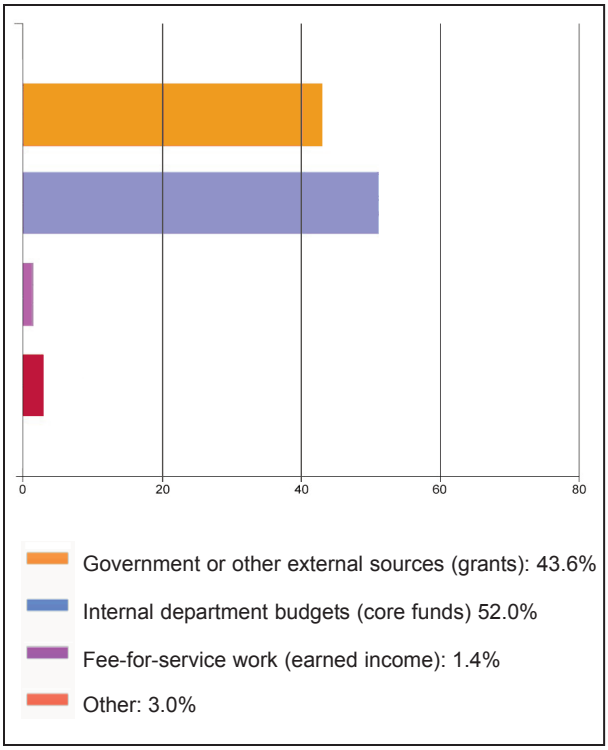

Figure 8: Survey Question: What are/were your main sources of revenue for running your program, and what (approximate) percentage does/did each contribute to your annual budget

Figure 8 summarizes the main sources of Aboriginal mapping program funding for our survey respondents. Internal departmental budgets (52.0%) and government and other external sources (43.6%) were the main funding sources, while fee-for service accounted for only 1.4 percent of funding sources. Other sources (such as foundation grants) were responsible for 3.0 percent of the share.

Many communities receive capacity grants to start up a mapping program. These are typically one to three year grants that help to pay for hardware and training. Staff members are hired, hardware is purchased, and staff members are trained. Unless another grant is secured, the program needs to be dismantled and the investment made in building capacity is lost. At best, a few people in the community will have gained new skills and training. To avoid this, organizations need to build into their budgets operational funding to sustain their programs over the long-term. Mapping programs are at risk where over half of their budget is derived from short-term, external sources.

David J. Buckley, author of the GIS Primer, put forward the need for long-term funding from a point of productivity. Using a productivity graph (see Figure 9), he compared the mapping productivity of two communities, one with GIS, one without. Without GIS, an organization might have to rely on outside consultants for their mapping needs, but over time it is assumed that their productivity will generally increase through knowing what to ask for, literacy with maps, etc. Communities that invest in GIS actually can experience an initial decrease in productivity while the organization allocates resources to training, organizing of data and capacity building.

In our experience, it might take two to three years to become proficient in GIS to a point where you begin to truly benefit from your investments. In Buckley's graph, this is called the *threshold point*, the point where your investments in GIS start to pay off. But if your funding ends in the third year, just when you're getting going, you'll never reap the benefits of

your investments. Long-term funding is needed to push your program, and keep your program, beyond the threshold point of productivity.

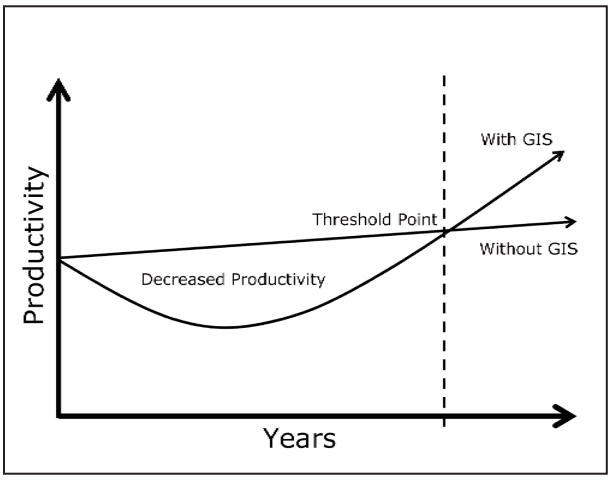

Figure 9: GIS Productivity/Threshold Point Graph
(Source: David Carruthers, adapted from David J. Buckley)

TRACK THE TRUE COSTS

Knowing the true costs of mapping, being able to track these costs and create budget plans is a fundamental good-practices principle for running a mapping program. Many offices rely heavily on outside grants and government funding to keep staff in place and the lights on in the office. These grants require a high level of financial record keeping to demonstrate that money has been properly allocated, spent and reported. One year of fuzzy bookkeeping can jeopardize an organization's ability to secure repeat funding. In short, a successful GIS office is often tied to successful financial reporting and fundraising capacity.

PRINCIPLE: Successful mapping programs are able to track and report their budgets through competent financial accounting; they are also often closely tied to competent fundraisers and proposal writers.

This doesn't mean that GIS technicians should be trained in bookkeeping, or that GIS technicians should be responsible for proposal writing. What it does mean, though, is that a GIS program should be governed with competent administrative infrastructure and administrative support, whether it is within the GIS program itself or within the larger organization where the GIS program resides.

ENSURE EXTERNAL BENEFICIARIES COVER COSTS

Consultations with industry and government are becoming an important application for Aboriginal mapping programs. Within consultation frameworks, communities are swimming in maps: maps arriving under the arms of the developer or planner; mining claims posted on provincial government servers; new protected areas boundaries mapped by environment groups; five year development plans delivered by forest companies in an atlas of maps; dispositions; alienations; claims; and surveys.

But who pays for the time for communities to review, analyze and output maps regarding development applications in an Aboriginal Territory or claim area? A principle our research has revealed is that, if possible, successful mapping programs make the full-costs of mapping known to those requesting the maps. These communities work out agreements where these costs can be covered or compensated for by users.

PRINCIPLE: Successful mapping programs are up-front about the real costs of mapping, and hold users accountable to pay these costs.

This approach can also be used internally. Consider making other departments within a community aware of the costs of performing spatial analyses and making maps, so they can budget for these costs when requests are made.

LOOK FOR OPPORTUNITIES TO COLLECT FEE-FOR-SERVICE INCOME

For the Aboriginal organizations that responded to our survey, government funding and grants usually made up a significant portion of a mapping program's annual budget. With such a large reliance on outside funding, most programs remain quite vulnerable to changes in political will, changes in funding priorities, and changes in

funding allocations. We believe that this is the number one reason there is so much instability in the Aboriginal mapping sector. Our survey findings corroborate this: 43 percent of the organizations surveyed have had to shut down their office at some point, most at least partially because of lack of funding.

PRINCIPLE: Successful mapping programs use fee-for-service income to help to grow, but don't let this work distract staff from the core responsibilities of the program.

Fee-for-service income (i.e. income generated from charging clients for mapping services) accounts for a very small portion of the overall budgets of most programs. For the organizations responding to our survey, 1.4 percent of funds were generated this way on average, with a maximum of 15.0 percent. Only three groups out of twenty-three collected any fee-for-service income. This isn't entirely surprising: Aboriginal mapping offices are set up to provide mapping services to decision makers, not to become consultancies bidding on work with third-parties. While you should never lose sight of this key goal, there is an important role for fee-for-service work to help offset overhead costs provided this work doesn't detract from the core responsibilities. Fee-for-service work can not only help to pay for existing overhead, but it can help an organization grow, and by extension, help train new community mapping staff. A diversified client-base helps to broaden the experience of existing and new staff members while ensuring that the mapping program wagon isn't being pulled by just one horse.

Case Study: Nunavik Geomatics

The Nunavik Research Centre (NRC) carries out scientific research on wildlife and the environment. The Makivik Corporation created NRC with the recognition that maps played a key role for land claims agreements and resource management for the Inuit of Nunavik. Makivik built a geographical database representing the personal land use histories and knowledge of over 400 Inuit hunters and traditional knowledge holders. As newer GIS technology appeared, the Research Centre incorporated them. Over the years, NRC has seen system platforms and software packages change numerous times.

NRC's primary focus is providing services for 14 Inuit communities spread throughout Hudson Bay, Hudson Strait and Ungava Bay in Nunavik. Internal budgets and supplementary Federal and Provincial government budgets pay for much of the research focused around Nunavik. However, says Adam Lewis, Geomatics Manager for NRC, "*We soon realized that our services, especially in the arctic, were in demand by individual community members and local and regional businesses and organizations.*"

NRC began to recuperate some costs of running the mapping facility through fee-for-service work for these external projects. As Makivik Corporation is a non-profit organization, from 2002 to 2009 funds were recovered at cost. While these have been exciting times for NRC, Adam tells us that they have not come without some challenges.

Costs associated with geomatics products and services were not initially tracked at the Makivik Corporation and Nunavik Research Centre. Successive annual budgets were based on the previous years, with little adjustments. However, complexities are added when staff are contracted externally. Staff had to adjust to better book-keeping and cost recording methods when conducting fee-for-service work. Receiving outside government funding requires rock solid financial record keeping. Even without doing fee-for-service work, Adam says, "*if you don't have a handle on true costs and returns, you can't be sure you aren't operating at a loss. This is true for any mapping program.*"

In 2002, the division purchased satellite remote sensing software with the idea that it would migrate to offering satellite imagery services. "*We learned the hard way how important doing proper needs assessments is*." High maintenance costs were carried for years until NRC realized that maintaining in-house tools cost more than was returned, and the best approach was sub-contracting all imagery related projects to external companies.

NRC has built on its experience and become a front runner in the Aboriginal geomatics field, and looks forward to an even brighter future. In 2009 Nunavik Geomatics, a wholly owned for-profit subsidiary, was opened with a focus on expanding services based on the current needs around Nunavik and abroad and to provide an expertise in Aboriginal geomatics. "*Unlike the recent past*," says Adam, "*we now have the opportunity and expertise*, as an Inuit organization, to charge standard professional fees for the products and services we provide."

5.0 Human Resources and Training Approaches

Next to funding, finding and managing human resources are commonly identified as the greatest challenges in running a successful Aboriginal mapping program (see Figure 6 and Figure 7 in section 4). Of course funding and staffing are linked, but there are many other reasons why the hiring, training, and maintaining of mapping staff can be challenging. This section lays out principles that will help to shed some light into this important dimension of Aboriginal mapping.

DEVELOP AND MAINTAIN A TRAINING PLAN

There is only one thing worse than training your staff and having them leave: NOT training them and having them stay.

To meet their mapping needs, many organizations focus on getting a concert hall, instruments, and sheet music—hardware, software and data—but forget that you need a well-trained musician (the GIS technician) to make the maps. Even with the most detailed strategic plan in place, a mapping office will not achieve its full potential unless its staff members are fully trained, and re-trained, on a routine basis. Training, however, is often relegated to year-end spending and grants, which require a demonstrated investment in skills development.

> *PRINCIPLE: Successful mapping programs make training plans. These are living documents that help staff meet changing technical demands. They can also contribute to job-satisfaction, which can improve staff retention and recruitment.*

A training plan is one way to link your organization's stated goals with a road map for how to get there. It should be a living-document that is routinely updated to reflect changes in staff skill-sets, along with changes in the technical demands that are being made of them. If updated annually, the training plan can itemize the budget required to meet the training objectives. These costs for training and potential salary increases can be included in an organization's annual budget and funding formulas. Active training plans are also a great way to build confidence and satisfaction in a position, which may help address recruitment and retention issues.

Training can include a mix of off-site course work and on-site customized training. For remote communities, self-study online course modules such as those offered on the ESRI Virtual Campus are often most convenient and cost-effective. Our survey shows that most organizations recognize the importance of having a combination of on- and off-site training for their employees. Training plans should include not only technical staff, but decision makers as well. Over 70 percent of our survey participants conducted training of non-technical staff, and 93 percent of them found that this investment significantly increased support for their mapping program. For training of non-technical staff, consider conducting an internal presentation by technical staff and on-site internal workshops and presentations by outside experts.

BUILD A TALENT POOL, INSIDE AND OUTSIDE THE ORGANIZATION

Aboriginal GIS managers are often faced with the challenging decision to hire locally or to bring someone in from the outside. Sometimes, it is simply more effective to contract outside expertise to handle particular problems rather than ask an overstretched staff member to learn new techniques while juggling other work demands. The problem is the staff member won't have the opportunity to learn through working on new problems, leaving your organization dependent on the outside expertise the next time a similar problem crops up.

Where outside consultants are needed, consider having a portion of the work conducted in the community, where mentoring, training and skills-transfer to local staff can add capacity while the work is being completed. On-site, real-world problem solving is an ideal way to learn GIS. This isn't suited for every situation, but when possible it can add to the long-term self-sufficiency of a local mapping department.

PRINCIPLE: Successful mapping programs support skills transfer from outside consultants to their staff. Engage with youth to build pool of next-generation mappers.

We have mentioned in this guide the importance of incubating champions who can encourage next-generation mappers. To further this idea, connect with your local skills development coordinator, school counsellors, or teachers to target specific youth who might be interested in taking on an internship with your mapping program. More formal grooming can take place with targeted learning programs, where students are given incentives to study geography or mapping in exchange for them coming home to work in their local mapping office. At minimum, making presentations in the local schools on the annual World GIS Day (November 17) can help to ignite the imaginations of youth to pursue a career in mapping.

TRAIN OR HIRE A MINIMUM OF TWO GIS STAFF

As Aimee Mann sings, "*One Is the Loneliest Number.*" Mapping departments with only one staff member are lonely places. They are also potentially unstable. Staff turnover in these departments can be catastrophic to the organization. The loss of the one staff member brings with it a crippling loss of institutional memory. Knowledge of previous successes and failures and how they came about, the source and contents of the local geospatial data library, file management practices and the like disappear with that person. Such an event can put an organization back at square one, having to rebuild their mapping program. Recognizing this, we say that ideally, the magic (and minimum) number of staff should be two. The idea is to build redundancy to accommodate the realities of staff turnover, which is very common in the Aboriginal mapping sector. A senior-junior relationship also helps in skills transfer, training and mentoring.

PRINCIPLE: If possible, mapping programs should have a minimum of two staff members, one senior and one junior, to build redundancy and mitigate impacts from staff turnover.

LEARN TO MAKE BEAUTIFUL MAPS

Most Aboriginal organizations use paper maps as the main medium for decision making (For an example see Figure 10). Of the communities surveyed for this study, 95 percent use paper maps as the primary format for use by their decision makers. We all know that good looking maps hold more power than lacklustre boring ones. A map is a communication tool. A good map engages people looking at it and tells its story in a captivating way, like an Elder spinning out a tale of the old days. Given the state of heightened negotiations and litigation in the Aboriginal rights and title sector, Aboriginal mapping technicians can't afford to over-represent the truth when creating maps. But they can be creative in using cartographic tools to make their maps more convincing.

Maps should reflect the local culture, local language and should be easy to understand by community members and decision makers. This often involves being creative about the use of symbols, colour palettes, and other design elements.

GIS technicians should be trained in not only how to make accurate maps, but how to make beautiful maps. Training programs for technicians often revolve around spatial data management, data formatting and standardization, and usually end with a quick module on how to lay out and symbolize a map. Map making originated as a craft dominated by artists and explorers; only in the last fifteen years has the field been replaced with computer technicians and resource

managers. The cartographer's imagination, pencils and drafting tools have been largely replaced with software-derived templates and standardized computer-generated symbol sets. But mapping still is a communication devise. Maps tell stories. As such, cartographic design should be a fundamental complement of an Aboriginal mapping program's training plan for its technicians.

Successful Aboriginal mapping programs are able to make accurate maps beautiful. Maps that carry the voice of the community into negotiations with creativity as well as accuracy will be given more attention. Doug Aberley summarizes this well: "*Produce maps that tell stories in a way that makes description of complex issues accessible to decision makers and community members. Maps should be 'on the wall' at every important meeting. Great maps will show external partners and adversaries that your community has the capacity to be a substantial partner ... or foe.*"

UNDERSTAND HOW MAPS ARE BEING USED, NOT JUST HOW TO MAKE THEM

Even if you are an expert public speaker, when giving a speech to a large group of people the first thing you need is a good understanding of the subject matter. If you haven't learned that well, you won't pull the wool over anyone's eyes. Similarly, when making a map, you have to understand the subject matter being presented. For example, it is not effective to have a technician model and map species distribution without a basic understanding of the ecology and biology of the species. Similarly, for a use and occupancy study, the technician needs to have a good understanding of how the data were collected and how they will be used before she designs a database, digitizes the information and outputs composite maps.

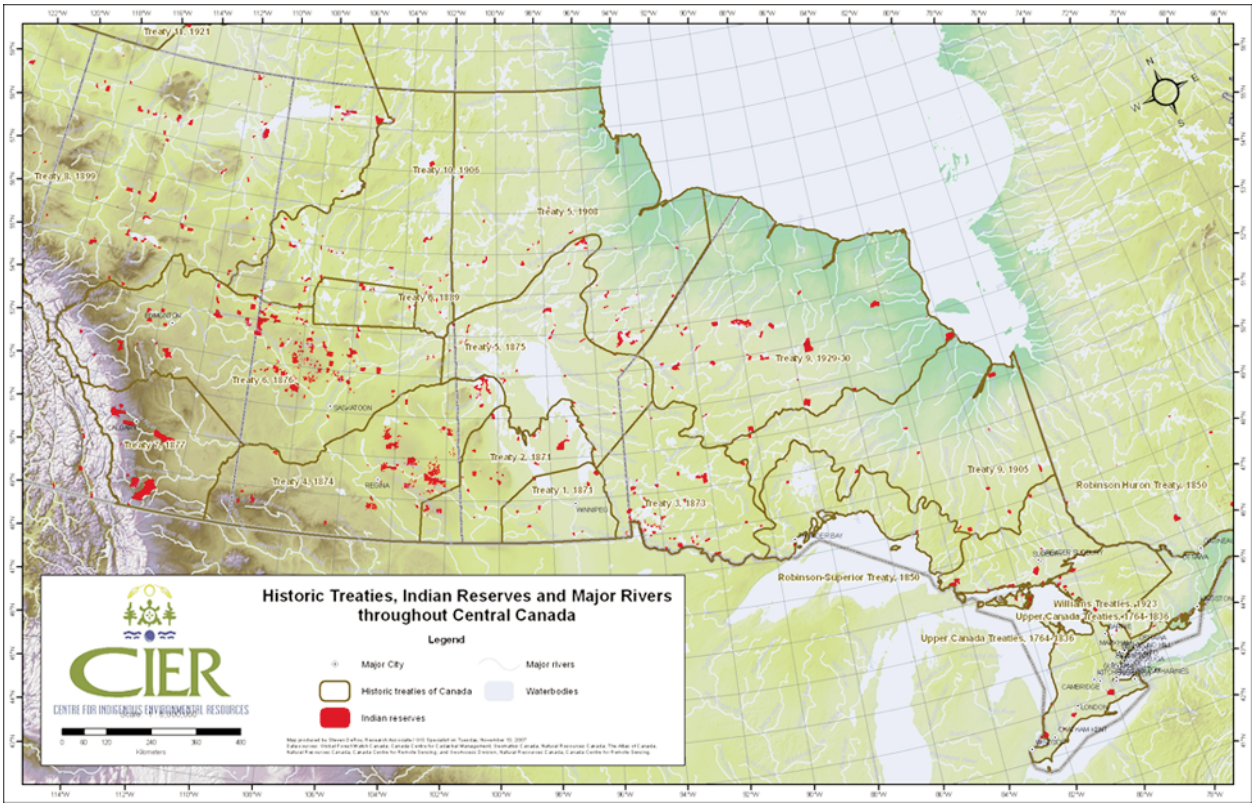

Figure 10: Map: Historic treaties, Indian reserves and major rivers throughout central Canada (Source: Steven DeRoy, CIER)

What's more, knowing the subject matter on its own isn't a guarantee of success. If you don't know something about the audience and its knowledge and interests, your speech may fall flat. The same principle applies to making a map: you have to know the audience and the context for how the map is being applied. A map prepared for a group of biologists with advanced knowledge of species habitat and ecology who want to understand impacts of industrial activity on a species should contain different information than one made for a Band Council considering a response to proposed activity that may impact important community hunting grounds for the same species.

PRINCIPLE: Successful mapping departments hire or train technicians who not only can make good maps, but also understand the subject matter being communicated through their maps and can predict, anticipate and know their audiences.

To be effective, technicians need to be not only technically literate in making maps, but also familiar with how their maps are being used. In this regard, they cannot work in isolation from those collecting data, or from those using the maps. For example, when making training plans, GIS courses are obvious priorities for technicians, but a course in forestry planning can help a technician sharpen his maps for use in forestry consultations or forest development planning. Successful mapping departments have technicians who not only can make good maps, but also can anticipate their audience's needs and understand the subject matter being communicated through their maps.

6.0 Technology, Data and Data Networks

SELECT SOFTWARE THAT SUPPORTS DATA STANDARDS

There are many mapping software options, some available at no cost, others requiring significant financial investment. Your needs assessment will help you narrow your list of software to packages that have the functions you need. It is critical to ensure that whichever software is chosen, data and maps are interchangeable with external stakeholders. Often, when datasets are available, they are distributed in a common data format. The software you select should be able to load data from numerous sources. Taking the time to learn which software options are available will assist when it comes to purchasing. This may involve talking to other like-minded organizations to determine what software they operate. Finally, initiate a dialogue with GIS software vendors in order to learn more about their products and to help evaluate what software is right for your needs.

> *PRINCIPLE: Successful mapping programs select software that supports the data standards used by government data providers, industry and other communities. As well, using the same software as peers in other communities makes it easier to get advice from networks if problems are encountered.*

In general, GIS software may be classed as open source or proprietary commercial. Additionally, closed source viewer software has begun to become more popular as a means of distributing spatial information to web users.

Open source GIS software has the advantage of being generally free, with support being provided by a community of other users and programmers. At its best, open source can be very capable and robust. With a large enough community, if a problem is discovered and reported, a repair to the program code may be available in hours. Alternately, if you have sufficient programming skills, you may be able to solve it yourself by modifying the source code. However, in some cases, if you run into problems, there is no guarantee that you can find someone who will help you solve them. As well, you may find that support for the "free" software is available only at a cost. As well, you may find that some commonly used data formats are proprietary and not supported. Some examples of open source GIS software include:

GRASS GIS (http://grass.itc.it)

QGIS (http://www.qgis.org)

uDig (http://udig.refractions.net)

Most proprietary commercial GIS software is only available at a cost. An initial licence fee must be paid. As well, often an additional annual maintenance fee, which purchases software upgrades and technical support services, also is required. At its best, proprietary commercial software offers you the safety net of knowing full time paid technical support staff are available if you run into problems. Usually, the vendor will provide online forums that allow a community of users to form and company technical staff to monitor questions and answer them. However, paid technical support does not guarantee that an unusual problem you encounter will be solved. As well, like open source software, you may find that not all data formats you encounter will be supported. Examples of proprietary commercial software include:

ArcGIS from ESRI (http://www.esri.com)

Manifold from Manifold Net Ltd. (http://www.manifold.net).

Many government agencies and resource development companies have adopted ESRI based software and its data formats as standards in their sectors. In our survey, 100 percent of respondents said that their organizations are using ESRI's ArcGIS as their main platform for mapping. This is consistent with other studies conducted in Canada, where ESRI has dominated the market as the default software for Aboriginal mapping. Because of this standardization, it is easy for Aboriginal organizations to network solutions, share data and gain access to training and support.Closed source viewer software includes

Bing Maps (http://www.bing.com/maps)

Google Earth (http://earth.google.com)

Google Maps (http://maps.google.com)

NASA World Wind (http://worldwind.arc.nasa.gov)

These are spatial data viewers that link to online repositories of satellite imagery and framework data, but allow other data to be added, and sometimes, custom applications to be programmed. We are aware of some Aboriginal organizations experimenting with porting their data to the Internet using Google Earth and the Keyhole Markup Language (KML), which is now an approved Canadian Geospatial Data Infrastructure (CGDI) data format, and with custom Google Map applications. While these are in their infancy, they allow organizations to liberate their data from the confines of GIS workstations, making information accessible to a wider, less technical audience.

PLAN FOR DATA MANAGEMENT FROM THE BEGINNING

Knowing where and how files are stored is an important part of any office. It is even more important in a GIS office, where hundreds of gigabytes of data may reside on multiple computers.

Successful GIS offices draft file management standards for how to catalogue, store and archive their data. These include organizing data by either source, scale, theme or format, incorporating metadata standards,[1] and addressing issues of confidentiality and security. A challenge when drafting standards is anticipating what will be needed in the long term. At the outset of a mapping program you may well not be able to anticipate how your data holdings will grow over several years. If you outgrow your standards, revising them and fitting your old data into the new standards is likely to be an arduous task.

It is one thing to draft these standards, it is a more challenging task to implement, and to uphold them. We have found that the duties to maintain data standards are best articulated within the job descriptions of staff. Here, the role of data custodian / librarian / gate-keeper is clearly defined.

Gord Haines of the Doig River First Nation (BC) offers good advice: "*Get someone with lots of experience to gather and structure your data at first. It takes a lot of experience to know what information is available, where to get it, and how to use it. Setting up a data structure from scratch is a daunting, tedious job.*"

Case Study: Algonquin Nation Secretariat - Data Management Standards

"*It's not glamorous—it seems mundane—but if you don't know where and how your information is being stored, then why bother collecting it in the first place?*" This blunt statement comes from someone whose career is built on data. Peter Di Gangi has been engaged in land claims research for over thirty years in Canada. At a basic level, information is his business.

Now the Director of Policy and Research with the Algonquin Nation Secretariat (ANS), Peter has been in charge of overseeing in-house mapping capacity building with the Secretariat and with its three member communities.

Before building a geospatial data library Peter started by commissioning the development of a blueprint and standards for how the library would be managed. This

[1] Federal Geographic Data Committee (FGDC) metadata standards (http://www.fgdc.gov/metadata/)

included where and how to organize the datasets, how they would be catalogued, how the data would be updated, and how they would be backed up.

Having well defined data management standards has surfaced as one of the fundamental principles of running a successful GIS department. But Peter recognizes that standards alone aren't going to keep their data in order. "*We recognized early on that the standards need to be tied to people and tied to budgets. They can't be an after-thought. They need to be included in job descriptions, with routine performance evaluations as to how well they are being upheld.*"

In the past three years, the ANS geospatial data library has grown to over 100GB in size. Peter notes that "*access to digital data is growing exponentially involving multiple people.*" Communities need to organize their information to account for staff turn-over or changes in leadership. "*There is a huge volume of data for land claims, for negotiations, for the courts. These are long-term processes involving dozens of people. When we're done here, we want to be able to pass the keys to the next person and know that the house is in order to pick up where we've left off.*" Keeping the long term view of data management in mind helps to highlight the importance of following day-to-day data management operations. With the importance of these data for the community's negotiations and claims, keeping data well organized is not an option, but a requirement, for success.

PRINCIPLE: Successful GIS programs maintain file management standards and practices to organize and maintain their geospatial data libraries. "Practices" mean having a plan to implement and maintain the standards. One way to implement them is to incorporate these duties within staff job descriptions.

USE AND ENFORCE CONFIDENTIALITY AND USAGE PROTOCOLS FOR CULTURAL DATA

A cultural data inventory is often a keystone dataset for Aboriginal mapping. Cultural data inventories cover subjects such as locations of harvest sites for fish, birds and game, structures and occupancy locations like cabins, tent-frames, tents or igloos, places where wood can be cut or minerals can be found, and locations of community significance like old village locations, gathering places or spiritual sites. Taken together, cultural features represent the ways the land is important to the community.

Many cultural studies that are funded through industry or government make the requirement that the data results be shared with the funder. This is the case with the Native Values Mapping programs in Ontario (funded by the Ministry of Natural Resources), and it has occurred in British Columbia and other provinces as well.

Cultural inventories are sensitive. For one thing, members of the community may have marked spots on maps they wouldn't want shared with outsiders. For another, a point in a database on its own doesn't relay the full story of that feature's importance, which can lead to a misinterpretation of the site's value. To make sure that the community has its say in interpreting cultural datasets, care needs to be taken to control who has access to information and how they are permitted to use it. A good rule of thumb is that raw cultural data will never leave the community without a signed confidentiality and data sharing agreement in place.

Use of cultural data in Aboriginal communities can suffer from what David Carruthers, President of PlanLab Ltd., has termed the *confidentiality quandary*: On one hand, communities want to protect sensitive cultural sites from the public by keeping their locations secret, but on the other, if cultural data are not shared in public planning processes, sites important to the community won't be recognized and protected. GIS departments must tread the line between these competing, important concerns. Technical means exist to do this. Petr Cizek, who spent a decade working for the Deh Cho First Nations (NWT) using GIS to aid responding to the Mackenzie Valley Pipeline Project and other pressures, describes the Deh Cho First Nations straightforward policy: "*Raw traditional land use and occupancy data were never distributed. Only forms of density analysis of the data were publicly distributed.*" Other technical approaches to allow use of information while keeping specific data from outside eyes include not displaying sensitive data at larger scales and aggregating point data

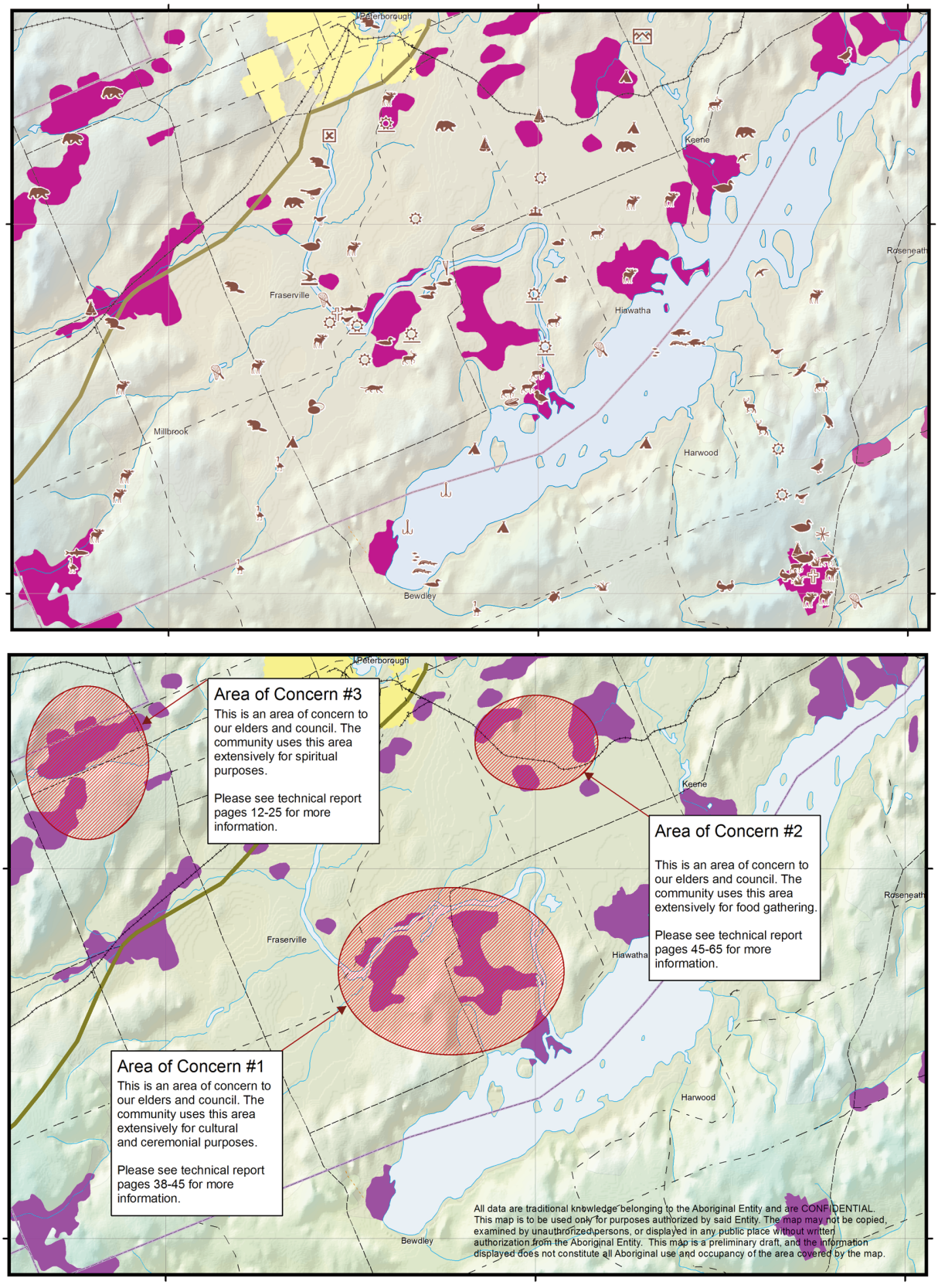

Figure 11: Maps: examples of raw use and occupancy point data and generalized polygons.
(Source: David Carruthers, PlanLab Ltd.)

into larger polygons with generalized annotations tied to sensitive areas (for an example, see Figure 11). If questions arise regarding site-specific details of an area, then confidentiality agreements can be signed and interested parties can come to the community to review raw data. A successful GIS department will be diligent in using, and enforcing, confidentiality agreements, and will be creative in how to share cultural data with the public in a way that doesn't risk the values of the sites.One other consideration for asserting control of cultural inventories and other community data arises if digital data creation or analysis is contracted to an outside firm. You should always include an explicit signed data use and ownership agreement, with provisions for delivery of the data and documentation to your organization and destruction of all copies held by the contracted firm upon your request, as part of contracts for work. While everyone expects people to act ethically, and most of the time they do, we have heard the occasional story of consulting firms that treated community datasets like they were property of the firm instead of the community.

BACK UP YOUR DATA REGULARLY AND SECURE THE BACKUPS!

We have all heard of Aboriginal mapping offices that have run into problems. The Band Office caught fire, and the data and original map biographies from Elders who had passed away were lost. A power surge caused a system to lose data. A computer virus got loose on the network, and getting rid of it required wiping the GIS computer's hard drive. Such occurrences are unfortunate but real threats to any office.

> *PRINCIPLE: Successful mapping programs assert control of community data. They keep community data confidential but use creative means to have the information used in public planning processes.*

A robust backup strategy is a key technological consideration for any successful GIS program. We insure our cars and our houses. The net value of all the GIS data and maps in an Aboriginal mapping office can end up being hundreds of thousands of dollars, or priceless if the system contains irreplaceable cultural research. It is a manager's duty to make sure data are adequately and routinely backed up.

There are several options that may work. The choice will depend on your particular situation. In all cases, there are five characteristics that a good backup system should have:

1. Backups should be simple to run, and preferably automatic.
2. The backup system should back up every file, and allow recovery of file versions at least a year old.
3. At least one current complete backup should be stored in a different building, preferably in a fire-safe vault.
4. Data should be secured so that confidential datasets can't fall into the wrong hands.
5. The backup system should be tested regularly to make certain that files can be recovered.

Many offices use external drives and automated software to perform backups. With multiple drives being exchanged nightly, a GIS manager can take a drive home weekly or even every night to maintain an off-site copy of the office's files. While buying several external hard drives might seem a bit costly, they will be very cheap compared to the value of the data that will be stored onto them. If you choose this approach, we recommend that drives be encrypted so files are protected should the drive go missing.

Other offices use remote data storage services, including Internet Service Providers, which charge a nominal amount to store mirror copies of data off-site. Remote backups can be scheduled using off-the-shelf software, some even some available for free. One critical consideration is the availability and cost of network bandwidth for your organization. (Even if bandwidth is cheap, you should consider how long it would take to restore a complete system if its entire drive fails.) Another area for caution is that many offsite data providers don't guarantee the protection of their data; routine testing should be done to ensure that files are being updated properly.

LEARN TO USE THE PUBLIC DATA LIBRARIES AND REMOTE CONNECTIONS

Our survey revealed that the sources of data used in Aboriginal mapping programs were derived, in order of importance, from: (1) the communities; (2) provincial / territorial governments; (3) the federal government; and (4) industry.

> *PRINCIPLE: A successful mapping program ensures that staff learn how to use available tools to discover and access the contents of public data infrastructures like the Canadian Geospatial Data Infrastructure to obtain valuable information.*

Framework data is the term used to describe geographic elements that are used to build base maps, such as roads, rivers, lakes, wetlands, and contours. Most Aboriginal mapping programs compile local data libraries for their territories or area of governance using provincial and federal framework data. These data include NRCan's National Topographic Database (NTDB) and CanMatrix data at 1:50,000 and 1:250,000 scales. Provincial and territorial data is relied on for larger-scale data, such as site-specific 1:10,000 and 1:20,000 scale framework data.

As mentioned previously, successful mapping programs maintain file management standards and practices to help keep their data libraries organized and well catalogued. Catalogues should include completed metadata when available, catalogued using the Canadian Geospatial Data Infrastructure (CGDI) and the Open GeoSpatial Consortium (OGC) metadata standards. Within these libraries, it is also common to find symbol sets and templates for outputting quick and consistent looking maps. Templates are usually made for three spatial scales: site specific, watershed and the territory-wide or regional scale.

One of the roles of the CGDI is to facilitate the sharing of Canada's geospatial data, tools, services and applications through the Internet. The primary benefit in using these web-based mapping tools and data is in the ability to connect the user directly to the data provider. This allows users to access data from its source, thereby maintaining currency, avoiding versioning issues and minimizing duplication. This is especially important when accessing data that is routinely updated such as real-time observation data.

CGDI supports the distributed sharing of geospatial data through the GeoConnections Discovery Portal (http://geodiscover.cgdi.ca).

Many common national framework datasets are now being hosted on federally maintained servers, such as Natural Resources Canada's GeoBase (http://www.geobase.ca), and the Centre for Topographic Information web site (http://maps.nrcan.gc.ca).

The GeoConnections Framework Data Guide provides an introduction to framework data concepts, sources, and uses (http://geoconnections.org).

Provincial governments are also providing public access to portions of their data holdings, for instance Land Information Ontario (LIO) (http://www.lio.ontario.ca).

A few private companies are also sharing their geospatial data through their own servers, such as ESRI Canada's Geography Network (http://www.geographynetwork.ca).

Over 70 percent of our survey participants told us that they are taking advantage of these data portals to access framework and value-added datasets. Most often, users are going to these web sites and downloading static copies to be catalogued into local libraries. We have heard from many communities that because their decision makers want to use paper maps, direct-connections to these datasets don't work for them, but that static copies of the data give them more flexibility to customize the information for plotting out large format paper maps. This trend emphasizes the importance of maintaining well-organized local data libraries.

Case Study: Cree Geoportal - Geospatial Decision Support Tool

The Cree Outfitting and Tourism Association (COTA) and the Cree Trappers Association (CTA), located in Quebec, are both working on promoting development of Eeyou Istchee in a sustainable way in harmony with Cree culture and values. A wide section of community members are involved, including individual hunters and trappers, institutions and businesses. To serve such a broad, important purpose with so many people distributed over a wide area, choosing the right information sharing approach was critical.

The region's data were collected using traditional means – pencil and paper – and then transferred to various databases managed by several Cree and non-Cree organizations. "*Although there was a significant amount of research that was done, it was very difficult for the actual users to access the information,*" recalls Ms. McGinley, COTA Executive Director. "*A community member would have to approach each individual organization to try and piece together the complete land use picture for their community or trap line.*"

To deal with this, COTA initiated a strategic planning process that resulted in an Eeyou Istchee Tourism Information Management System. A second initiative was a community-based project to collect mapped information for a preliminary database on tourism resources. Finally, in 2006, a COTA and CTA partnership was formed to consolidate information and make it available to decision makers. This initiated the Cree GeoPortal project.

The project began with a detailed user needs assessment and consultation, including community workshops and interviews with staff and managers. The main objective of the GeoPortal is to provide Cree with a wide range of geographic information on the lands and resources of Eeyou Istchee, and Cree and non-Cree infrastructures for purposes of land and resources management and tourism development. The GeoPortal incorporates Cree traditional knowledge datasets in combination with other information and reference maps from distributed sources. A user has selective access to datasets and geographic regions through interactive maps. COTA and CTA regional and community offices are the main users of the application, and public components benefit other Cree organizations and communities.

The GeoPortal handles web-based geographic information sharing using web mapping services (WMS) (see Figure 12 and Figure 13). Framework data WMS from the Centre for Topographic Information in Sherbrooke and GeoBase are combined with other data from various sources and local COTA and CTA databases. Confidentiality of sensitive information is maintained by restricting data access by user level and location. Thematic layers are displayed on top of the appropriate reference maps at pre-selected scales. Layers are fully documented with metadata and published through the GeoConnections Discovery Portal, which can be searched using standard tools.

Following the success of the first phase, other Cree organizations have expressed interest in data sharing and joined the project. The second phase includes two more Cree organizations and also provides public access to an educational application in Cree language, which limits the access to sensitive information to Cree language speakers.

The Cree GeoPortal approach to sharing information has benefited the community significantly. By using WMS services, custodians maintain their own datasets; information is kept current and close to the authoritative source. At the same time, data can be accessed in real-time by other Cree organizations, allowing easy information sharing without duplication.

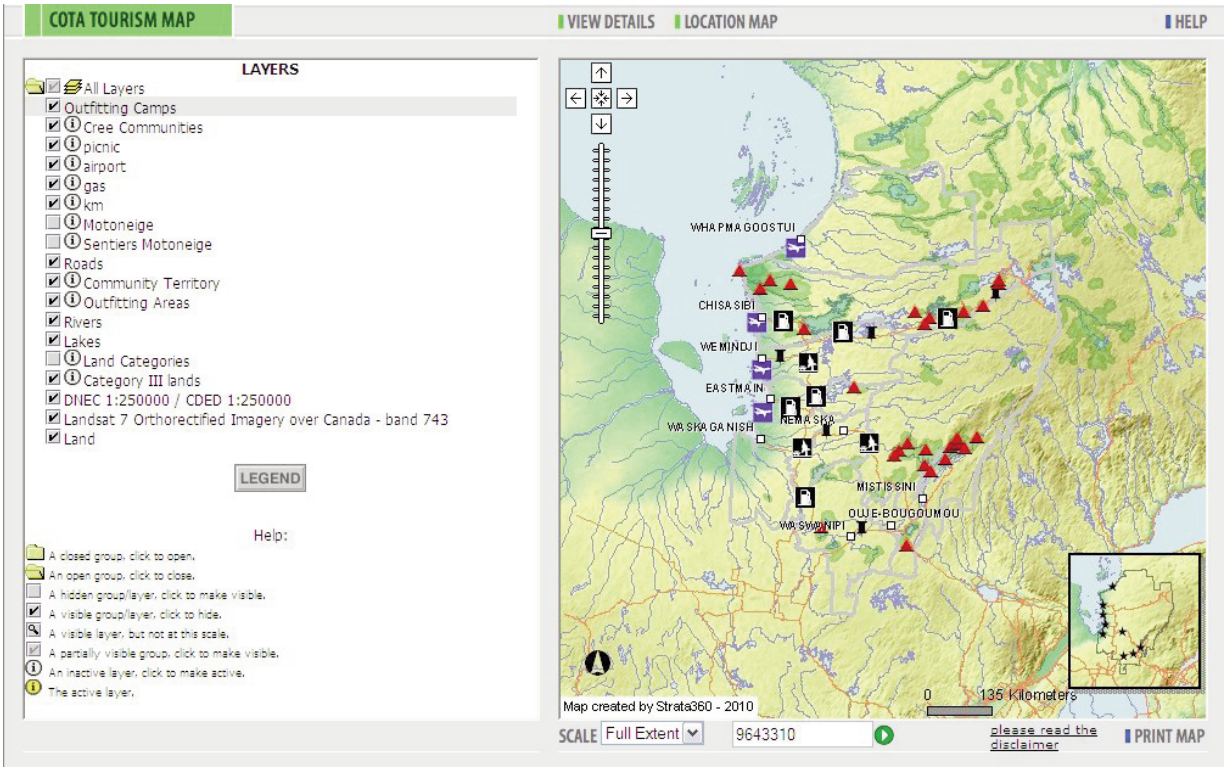

Figure 12: COTA tourism infrastructure map (public) using WMS 1:250,000 CDED as background
(Source: www.creegeoportal.ca)

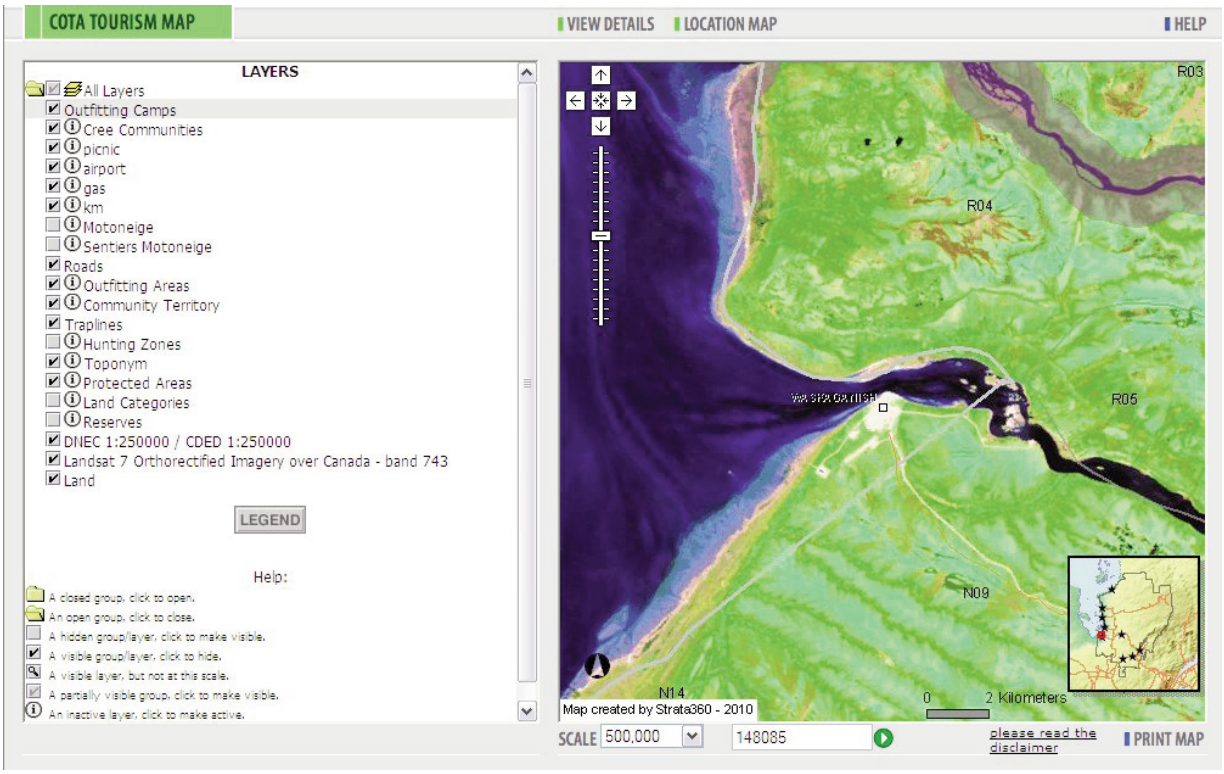

Figure 13: Close up view of COTA tourism infrastructure map shown with WMS Landsat 7 GeoBase background
(Source: www.creegeoportal.ca)

7.0 Support Networks

FIND AND CONNECT WITH PEER NETWORKS

Mapping is a complicated field. There are many shortcuts and tricks of the trade that can make a program more successful and productive, and an equal number of pitfalls and dead ends that may be experienced after significant investments of time and effort. Learning from the experiences of others can go a long way to help a mapping program overcome common barriers. Within the Aboriginal mapping sector, we suggest that it is critical to build partnerships and to network both within and outside of your organization. This can help to break a sense of isolation often experienced by Aboriginal mapping technicians: the feeling that they are the only ones in the world struggling with specific issues.

PRINCIPLE: Networking with like-minded organizations can help to break the sense of isolation, create support networks and help to build on the successes of others.

In our survey, nearly 60 percent of respondents said that they have communicated with other like-minded individuals to discuss problems, and another third indicated that they would like to share experiences with similar organizations (see Figure 14). Of the 60 percent, only 6.7 percent said that such communication was not important to their program success (see Figure 15).

Consider the many disciplines that maps are produced for. In the case of the Mississaugas of Scugog Island First Nation (ON), external consultants and proponents are leading numerous projects. As the sole technical support within their First Nation, Sophie Sliwa depends on external supports to provide guidance on issues related to environmental assessments, biological studies,

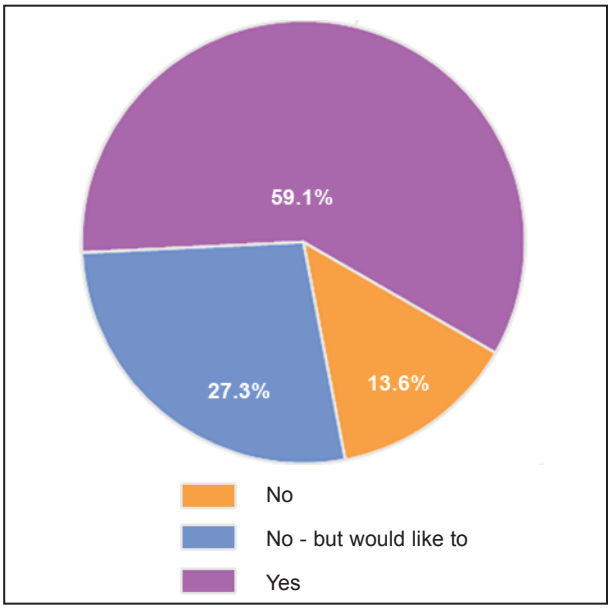

Figure 14: Survey Question: Do/did you routinely meet or communicate with other like-minded individuals or organizations to discuss solutions to your common problems

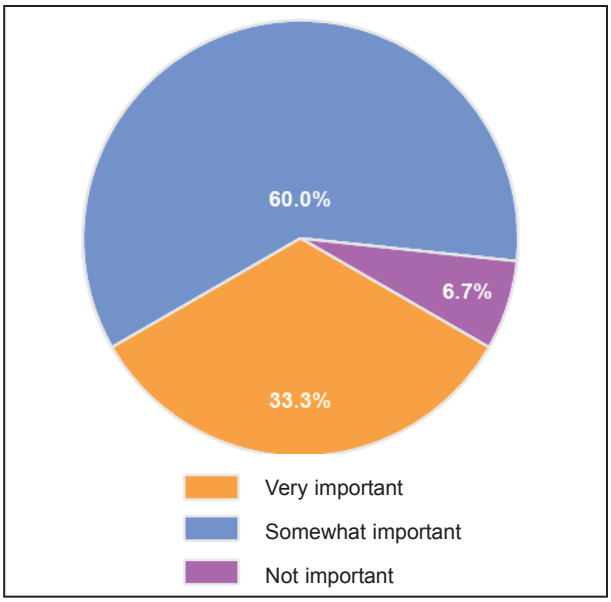

Figure 15: Survey Question: If you answered "Yes" to the question above in regards to routinely meeting with other like-minded individuals, how important has outside support been to the success of your program

archaeology, and other specialties. She depends on her support networks where expertise and experience could be drawn from.

If there are no regional networks in place, think about starting one. A regional GIS network might be as simple as a group of GIS technicians in a region who come together every few months to share ideas, or even just share a list of phone numbers, email addresses or through a social networking group so they can consult each other. If people are meeting, rotating hosting responsibilities between organizations can create a competitive and refreshing look into how other organizations have setup their programs. Blogs, web pages and other social networking tools can be used to keep the group updated on current events, or to post technical questions when problems arise.

Networks can be extended to include not only other Aboriginal entities in the region, but private sector companies, universities, non-profit organizations and others who are mapping in the area. ESRI Canada has setup formal regional GIS gatherings. The Aboriginal Mapping Network often hosts national mapping events to bring practitioners together from across the country. Both are worth checking out. (A list of suggested starting points is included in Appendix B.)

These social networks often turn into support networks, data sharing networks and professional exchange networks. These are all important components of a successful Aboriginal GIS office.

8.0 Conclusion

Do it! The ability to tell your own story through the visual language of maps is incredibly important. If you do not develop this capacity, the story of your community or First Nation is left to others to tell. They will never do this job very well. The task of truly protecting a culture and a territory requires the ability to visually represent the physical, biological and cultural identity your home place in a very detailed manner. As you grow the ability to meet this requirement there will be a blossoming of active stewardship and political and economic power." — Doug Aberley

In this guidebook, we have documented some good practice principles that successful Aboriginal mapping programs follow. As our survey respondents have noted, while mapping can be easy, keeping a mapping program going for the long-term is very difficult. This isn't an Aboriginal issue. Small non-native organizations like municipal governments, environmental organizations, and even private sector companies all face similar challenges. This is a story that is rarely told – that the governing of a mapping program for long-term sustainability is very challenging.

A GIS manager can reduce common challenges by being aware of what has worked well elsewhere. This guidebook is certainly a start. But what is really needed is greater dialogue within the sector and the continued sharing of experiences between practitioners. The responsibility to dialogue and network partly rests with you and we encourage you to take up this challenge. We wish you all the best in both the journey to build your mapping capacity, and the destination of establishing a successful mapping program.

Appendix A: Annotated Bibliography

Bond, Crystal. 2002. "The Cherokee Nation and tribal uses of GIS." Chapter 21 in W. Craig, T. Harris and D. Weiner (eds), *Community Participation and Geographic Information Systems*, London: Taylor and Francis, pp.283-293.

GIS introduction to American Indian Tribes was originally supported by U.S. Bureau of Indian Affairs through a Geographic Data Service Center (GDSC), established in 1990, which provided support, training, technical assistance. This was very important for implementing tribal GIS programs. After a number of years this was downsized, resulting in two distinct groups of American tribes with regard to geospatial technology, "those who have it and those who don't." (p.283). The paper states that the former group has a responsibility to assist the latter through the Intertribal GIS Council (IGC), which disseminates information about useful applications etc. The paper summarizes a number of such applications, including managing tribal land boundary information, transportation planning support, water rights litigation support, and natural resources management.

Buckley, David J. *The GIS Primer*. Available online from http://www.innovativegis.com/basis/primer/primer.html or http://bgis.sanbi.org/GIS-primer.

The GIS Primer contains a practical overview on issues and requirements for implementing GIS. This introductory text is directed towards resource specialists and managers. It presents GIS technology and terminology in a straightforward way, supplemented with illustrations from forestry and resource management. Originally written in 1988, the book has been updated regularly over the years.

Carruthers, David (2001) *Making it Work: GIS in community-based organizations*. Unpublished, Ecotrust Canada, Vancouver BC.

Building on the author's experience in setting up local mapping departments, Carruthers summarizes nine different themes that should be considered when building, and maintaining a community-based GIS program. The main themes include: (1) demonstrated and evaluated need; (2) organizational commitment (including budgeting); (3) staffing and skills; (4) training and technical support; (5) integration; (6) networks and partnerships; (7) configuration (hardware and software); (8) data and methodologies; and (9) expectations.

Craig, W.J. and S. Elwood. 1998. "How and why community groups use maps and geographic information." *Cartography and Geographic Information Systems* 25(2): 95-104.

Four types of community goals for GIS use were identified in this article: (1) administrative (e.g. evaluate programmes); (2) strategic (e.g. assess community needs); (3) tactical (e.g. produce counter maps); (4) organizing (e.g. recruit members). The article emphasises the importance of considering overarching goals for implementing a GIS.

Federal Treaty Negotiation Office & BC Treaty Negotiations Office. 2001. *A Survey of First Nations Geographic Information Systems Hardware and Software*. Canada-BC Information Sharing Protocol.

The survey, conducted by the Canada-BC Information Sharing Protocol, looked at the level of use and interest in GIS among First Nation organizations. A total of 109 First Nation organisations participated in the survey representing individual First Nations, Bands, Tribal Councils or other Affiliations. Nine of the twenty-two offices without GIS software had GIS software in the past. Lack of funding, problems maintaining personnel, insufficient work, and consolidating GIS operations lead to the demise of GIS in these offices. Organizations which had GIS capacity noted the following major obstacles in the order of severity: (1) financial; (2) training; (3) obtaining data; (4) community support; and (5) personnel. Organizations who wanted to build GIS capacity noted the following obstacles in the order of severity: (1) financial; (2) personnel; (3) infrastructure; (4) insufficient need; (5) training; and (6) community support. The report concludes with an appendix of quotes from community mapping practitioners, sharing their first-hand experiences to those who might be just starting out. Quotes capture a lot of themes not directly addressed in the study:

- *"Start small and make sure that you have the resources to maintain operations."*
- *"The biggest obstacle for First Nations in GIS is not a lack of work or not knowing where to go, but being able to obtain the continued support and funding needed to keep GIS running."*
- *"Start with a long term, well documented plan for GIS implementation. This will help overcome the problems of staff turnover."*
- *"Do a proper user needs analysis prior to purchase to make sure that it will really meet the needs of the community."*
- *"Get someone with 5-10 years experience to do a user needs assessment. Do your homework first!"*

First Nations Technology Council. 2009. *Community Needs Assessment: Creating Direction Towards Implementing a First Nations Shared Information Service*. Vancouver: First Nations Technology Council.

Results of a community user needs assessment aimed at creating a First Nations common services organization. The assessment summarizes 126 completed surveys from 99 different First Nations governments and organizations. Key findings summarize current First Nations information management capacity, data, software and systems, and key needs in the same areas.

GeoConnections. 2010. *Best Practices for Sharing Sensitive Environmental Geospatial Data*.

This guide highlights issues and concepts associated with the protecting, sharing and utilization of sensitive geospatial data related to the environment and sustainable development; provides frameworks for assessing data sensitivity; and describes potential mechanisms for facilitating the sharing of data, including online transactions.
http://www.geoconnections.org/en/resourcelibrary/keyStudiesReports

GeoConnections. 2008. *Aboriginal Land and Resource Management Planning Data Needs Assessment Study*

Volume 1 - Aboriginal Mapping and Information Needs: Experiences from Ten Land Use Planning Processes Across Canada. Volume 2 - Data Identification and Analysis.
http://www.geoconnections.org/en/resourcelibrary/keyStudiesReport

GeoConnections. 2007. *A Developers' Guide to the CGDI: Developing and publishing geographic information, data and associated services*.

The Guide to the CGDI describes the Canadian Geospatial Data Infrastructure, and explains how you can use it. If you would like to increase the accessibility and visibility of your organization's data and services within the CGDI, or build an application with CGDI-endorsed standards and specifications, the Guide to the CGDI will show you how.
http://www.geoconnections.org/en/resourcelibrary/keyStudiesReport

GeoConnections. 2007. *Understanding Users' Needs and User-centered Design*. Available at http://www.geoconnections.org/en/resourcelibrary/keyStudiesReport. Accessed 1 March 2010.

This guide assists organizations in understanding approaches for user-needs assessments and user-centered design, which are required for some projects that GeoConnections funds.

Gilfoyle, Ian and Peer Thorpe. 2004. *Geographic Information Management in Local Government*. Boca Ratan [FL]: CRC Press.

Six dimensions critical to success of a GIS: (1) vision: clarity of organization's aims for using GIS in support of its key business objectives and the extent of its plans to translate strategy into action; (2) commitment: strength of organization's backing for introduction of GIS, especially from members and senior managers; (3) organization: how well organization has established working structures and allocated clear responsibilities for steering, implementing and monitoring introduction of GIS; (4) staff: extent of support from staff and level of skills, training and awareness programs; (5) systems: degree to which key requirements have been defined to provide clear focus for systems selection; (6) data: extent of data management (standards, quality, ownership), data capture and conversion. (Can be used as basis for audit of risk factors and presented graphically as a six axis wheel.) Problems likely to be faced by organizations implementing GIS were listed, including: lack of a corporate approach; inadequate resources; lack of staff commitment; underestimating time to create database; attempting to stick too closely to a standard methodology; technology advances proving harder than expected to realize.

Knapp, Connie L. and the Orton Family Foundation Community Mapping Program. 2003. *Making community connections*. Redlands [CA]: ESRI Press.

The book is logically organized. The community mapping program (CMP) is explained in detail, with advice on how to start a project in a local community, and explains who is involved, and why. The book offers practical advice on how to carry out a community-mapping project from conceptualization to delivery, so that it is sustainable and replicable. The thoroughness of the book is astounding, including practical advice on how to handle administration, technology, and. The book even includes advice on how to start internships for aspiring students to work in their communities, and how to adapt these ideas in a large urban setting. The book's format helps all who are interested to quickly assimilate its ideas.

Monmonier, Mark. 1996. *How to Lie With Maps*. Second edition. Chicago: University of Chicago Press.

This classic explains how cartographers must, by necessity, distort reality when representing the world with maps. Maps are tools for communicating information, but any map maker must choose what to include and exclude, and how to draw attention to what is important, not to mention make the basic choice of how to represent a three-dimensional world on a two-dimensional page or screen. Maps can communicate information erroneously through carelessness, or can be maliciously manipulated to mislead readers. This very readable and well-illustrated book belongs on the shelf of anyone who makes or uses maps.

Norwegian, Herb and Petr Cizek. 2004. "Using land use and occupancy mapping and GIS to establish a protected area network in the Deh Cho territory." Available from http://www.dehchofirstnations.com/documents/press/04_03_22_land_use_paper_norwegian_and_cizek.pdf.

This paper describes a technical approach used by the Deh Cho First Nations to consolidate data from eight land use and occupancy studies conducted using dissimilar methodologies. The goal was to develop a rigorous and legally defensible database to support lands and resource negotiations, land use planning/protected area design, environmental impact assessment, and natural resource management. The methodology described provides a useful illustration of how GIS technical analysis can be used to generalize use and occupancy data in ways that allow them to be used in public forums without disclosing confidential information.

Pratt, Monica. 2009. *The Most Important Part of a GIS*. In ArcUser Magazine. Spring, 2009. Redlands, California.

This somewhat biased article highlights the importance of maintaining a training plan for GIS employees. The article notes that no matter how well you plan for your software and hardware integration, you will never achieve its full potential without investing in staff training. And the best way to achieve this, according to the article, is to put into place a formal training plan. The plan is a living document that should be revisited on a regular basis. Its effectiveness should be evaluated by job performance indicators.

Sieber, R. E. 2000. "GIS implementation in the grassroots." *URISA Journal,* 12:1 (winter): 15-29.

The paper presents results of a five-year case study of GIS implementation patterns by grassroots conservation organizations in northern California. Two frameworks for analysis are provided that are useful for understanding GIS implementation in Aboriginal communities and organizations. Four case studies are presented providing examples for these analysis frameworks. Four implementation models are identified: wants GIS (presentation/analytical capacity in-house); wants map (wants output, limited analysis); wants consortium (share system costs or operate as service bureau); wants independence (individual wants complete capacity). A list of implementation factors is used for analysis: upper management commitment; allocation of resources; sufficient training, understanding; GIS Champion; system [ease of] use; organizational communication/coordination; lack of resistance; voluntarism; scarcity of resources; external sources of funding; tension between passion and progress.

Tomlinson, Roger. 2007. *Thinking about GIS: Geographic Information System Planning for Managers*. Third Edition. Redlands[CA]: ESRI Press.

This recent book from a geographer who has been referred to as the "father of GIS," is targeted to managers who administer GIS but also to technicians and other specialists who must implement the technology. Tomlinson's planning model places the onus for system planning on those who need the technology for decision making, and provides a framework for an alliance between information users and GIS specialists. While it takes discipline to follow, it results in clarity on desired outputs ("information products") to support decision making, what data inputs and technologies will be required to product them, and what human resources will need to be committed.

Tobias, Terry N. 2009. *Living Proof: the essential data-collection guide for Indigenous use-and-occupancy surveys*. Vancouver: Ecotrust Canada and the Union of BC Indian Chiefs.

This is a long awaited sequel to a highly regarded guidebook on designing and implementing cultural land use studies, Chief Kerry's Moose. The author draws on many years of experience in a great number of communities, both in Canada and elsewhere. He summarizes common pitfalls that can be encountered when collecting Aboriginal use and occupancy information, and offers clear guidance and practical suggestions on conducting rigorous research that will withstand scrutiny if challenged. It is a must-have book for anyone involved in doing or using cultural research.

Walker, Daniel H., Anne M. Leitch, Raymond de Lai, Alison Cottrell, Andrew L. K. Johnson, and David Pullar. 2002. "A community-based and collaborative GIS joint venture in rural Australia." Chapter 11 in W. Craig, T. Harris and D. Weiner (eds), *Community Participation and Geographic Information Systems*, London: Taylor and Francis, pp.137-152.

This paper describes a collaborative community GIS ("Collaborative Resource Information Centre," or CRIC), the Herbert Resource Information Centre (HRIC) in Queensland, Australia established by eleven industry, community and government agencies. A best practices guide was developed for the CRIC. This can be found at http://hric.tag.csiro.au. It defines twelve principles for establishing a successful CRIC: (1) Should be a joint venture, including a broad range of stakeholders; (2) Team approach: staff from each organization are involved; (3) Independence: centre is independent of joint venture partners; (4) Community ownership: community access to and acceptance of data and data products increases trust; (5) Private and community benefits: both of these are provided by a CRIC; (6) Dual roles: centre both manages and shares data (data management) and builds capacity of partners to use data (contrast with data warehousing); (7) Linkages and roles: CRIC fosters linkages between stakeholders and may facilitate new roles and relationships between them; (8) Data exchange: CRIC ensures data are exchanged between stakeholders; (9) Best practices data management: CRIC maintains industry standard spatial data and metadata directories; (10) Project brokering: CRIC has limited role in project work but key role brokering projects between partners; (11) Funding: CRIC is self-funded by venture partners proportionally to benefits. External seed funding is acceptable, but subsidization and ongoing external funding should be avoided; and (12) Lifespan: medium to long term commitment, ideally 10 years, no less than 5.

Appendix B: List of Online Resources

- Aboriginal Canada Portal - Aboriginal Communities and Friendship Centres in Google Earth (http://www.aboriginalcanada.gc.ca/acp/site.nsf/eng/ao36276.html)
- Aboriginal Mapping Network (http://www.nativemaps.org)
- Canadian Institute of Geomatics (CIG) (http://cig-acsg.ca)
- Centre for the Support of Native Lands (http://www.nativelands.org)
- ESRI email list (http://support.esri.com/listserve)
- ESRI forums (http://support.esri.com/forums)
- First Nation Technology Council of BC (FNTC) (http://www.fntc.info)
- GeoConnections, Aboriginal User Community (http://www.geoconnections.org/en/communities/aboriginal/index.html)
- GeoConnections Discovery Portal (http://geodiscover.cgdi.ca/)
- Geogratis portal (http://www.geogratis.ca)
- Indigenous Mapping Network (http://www.indigenousmapping.net)
- IT World Canada (http://www.itworldcanada.com)
- Manitoba GIS User's Group (http://www.mgug.ca)
- Open Forum on Participatory Geographic Information Systems and Technologies (http://www.ppgis.net)

Appendix C: List of Surveyed Organizations

Organization	Province
Algonquin Nation Secretariat	Quebec
Beardys and Okemasis	Saskatchewan
Cizek Environmental Services	British Columbia
Cree Outfitting and Tourism Association (COTA)	Quebec
Cree Regional Authority	Quebec
Doig River First Nation	British Columbia
Fox Lake Negotiations Office	Manitoba
Heiltsuk Cultural Education Centre	British Columbia
Kativik Regional Government (KRG)	Quebec
Labrador Metis Nation	Newfoundland/Labrador
Makivik Corporation	Quebec
Nunatsiavut Government	Newfoundland/Labrador
Nunavut Planning Commission	Nunavut
Nunavut Tunngavik Inc	Nunavut
Six Nations Council	Ontario
Sliammon First Nation	British Columbia
Timiskaming First Nation	Quebec
Treaty 8 Tribal Association	British Columbia
Tsawwassen First Nation	British Columbia
Westbank First Nation	British Columbia
Wolf Lake First Nation	Quebec