GIS USER NEEDS ANALYSIS AND IMPLEMENTATION STRATEGY FOR JASPER NATIONAL PARK

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EXECUTIVE SUMMARY

There is no doubt that geographic information system (GIS) technology has an important role in the effective management of Jasper National Park. Information is a key ingredient to quality performance management in government and industry. **The value of geographic information systems lies in their ability to convert geographical data into useful and timely information for people to do their jobs.** Their principal benefit to an agency lies in the use of substantially improved information to increase the cost-effectiveness of its day-to-day operations, to reduce the risk of poor investment, to lower liability, and to develop better policy options.

Objectives

A well-managed and fully implemented GIS in Jasper National Park will become the major repository of reliable data concerning the state of the Park. It will allow the continuing quantitative evaluation of the ecological integrity of the Park. It will be a long-term provider of consistent, up-to-date information to underpin Park analysis, conflict resolution and management decisions. In short, it will be a vital component of the business of the Park.

This happy state of affairs does not come about easily or quickly. Careful planning to identify the information that GIS can produce that will have a significant impact on Park operations and decisions has been carried out in the past year. It now requires an investment in hardware, software and people that will get the job done. Furthermore, as the growth of staff skills and the building of databases takes time, it takes a long-term commitment to the process if benefits are to be achieved in a timely manner.

Planning Process

Long experience has found that the key to implementing the technology and achieving maximum benefit from it is first to **identify the information** that the users need. This leads to a carefully planned sequence of steps to put in place the digital databases and the system capabilities necessary to produce the needed information.

Persons from a wide range of activities in the Park and the Townsite participated in the process of information identification and description. This provided a broad base of advice for the study.

Seventy-six potential information products were initially identified across the Park and Townsite. These potential information products were reviewed by Park staff and Townsite staff and **prioritized.** Note that the prioritization was undertaken by the staff and not by the consultant. This approach ensured that staff vision and values were the determining factors in prioritization. The working groups involved scored the information products on their contribution to public safety and reducing the risk of liability, on their contribution to the Park mission as defined by the District, on their contribution to the Park Management Plan and their tie-in to other projects, and on whether the information related to internal

Park activities or was also tied in with external activities. The results were presented and approved by the Park Executive.

It is important to mention this staff participation to illustrate that the GIS planning project was far from being a restricted technological assessment, but was focused on the information needs of persons directly involved in Park and Townsite operations and management.

Subsequently, the **fifteen highest priority information products were described in detail** to spell out just what really needs to be produced by the GIS and how to do it. This work resulted in excellent descriptions of the information needed from the GIS (as a basis for the rest of the planning study and as a specific guide for the future system manager) and also introduced a common terminology across the Park for GIS data handling functions, dataset names, data linkages, error tolerance and concepts of benefit. The **benefit** of each information product to the day-to-day operations of the Park or to the research programs of the Park was identified and spelled out. Further analysis of these descriptions clearly identified the **datasets** that need to be in place if the information is to be created and the **system capabilities** that need to be in place to handle the data to produce the information.

Implementation Strategy

A GIS implementation strategy was developed that laid out a working sequence for the building of information products, considering the likely availability of datasets and estimates of the time needed to put them in place. This sequence takes advantage of datasets available now or in the near term to build information products that can be immediately useful and plans a series of information products which takes into account the priority of need and foreseeable database building schedules.

The report contains an information product sequence flowchart (pages 9 to 13) which gives the recommended order of the work and shows the linkage between dataset creation and information product production. An implementation timing Gantt chart (pages 35 to 49) gives estimates of the time requirements for each part of the work on a week-by-week basis until the year 2001.

The highest priority (most important) information products in Jasper National Park are the Montane Ecosystem Diversity product and the Environment Assessment Scoping product. Both of these information products are complex and require access to a wide variety of data types. They do, in fact, require that other information products are generated as stepping stones to their creation. It is anticipated that these crucial information products will be created in the third and fourth year of system operation.

It is thus recommended that the Park undertake a **four-year pilot project** which will include the output of these information products and the building of the databases and interim products that lead to them.

Action Items

To achieve these objectives, several actions which have funding implications will be necessary.

1. **The Park GIS Unit requires a powerful workstation computing environment** with storage array disk technology that will allow for the handling of the data volumes involved, provide a high

level of data security and minimize staff time for manual disk management interventions. The Sun SPARCstation 20 workstation is recommended. It has been widely adopted as a GIS host and is the primary development platform for the proposed software. This hardware should be acquired in the near term so that the staff have a consistent platform on which to develop their skills.

2.   There is a need to migrate from the existing SPANS software to full capability GIS software from a major manufacturer. **It is recommended that the ESRI ARC/INFO system be adopted** for reasons of functionality, long-term stability and inter-agency compatability. The reasons are:

a) *Functionality.* The primary requirement is for large dataset handling and multiple spatial data manipulation rather than small dataset manipulation/statistical analysis. It is also clear from the functional requirements analysis (Section 8.1) that a very high level of multiple function use will be required for the complex information products. These must be fully automated and that is greatly facilitated by a high-level programming language of the type found in ARC/INFO.

b) *Long-term stability.* The objective for GIS in Jasper National Park is for the GIS to become an important provider of operational and management data on which the Park will depend on a continuing basis in the long term. It makes sense to procure software from a major vendor whose long-term prospects are good and where the capability for continuing software development and customer support is strong.

c) *Inter-agency compatibility.* The other Parks in the Mountain District currently have the SPANS system in place and exchange of data would be facilitated by the use of that system. To that end, it is recommended that the current SPANS system be maintained in Jasper National Park during the pilot project.

There are, however, other relationships to consider. The Foothills Model Forest and Yellowhead Region Working Group bring together a number of land management agencies in Alberta and British Columbia with a common interest in implementing ecosystem-based management. Jasper National Park participates in these two initiatives and exemplifies the Park Mission Statement with reference to Jasper's role in the larger regional ecosystem.

Most of the land managers neighbouring Jasper National Park operate geographic information systems. ARC/INFO is the standard for British Columbia and Alberta government agencies, as well as for some major companies including Weldwood and Weyerhaeuser. A number of other companies such as Cardinal River Coals Ltd. purchase GIS capability and use ARC/INFO as their standard. Few, if any, of the agencies and companies involved with either the Foothills Model Forest or Yellowhead Region Working Group utilize SPANS. Information and data exchange is becoming increasingly common as land managers are required to look at the cumulative efforts of their particular management actions on neighbouring lands. This is both a cost-effective procedure and the means to involve neighbouring land managers in land use planning. Jasper National Park has recently entered into formal agreements with the Model Forest to pursue these objectives.

Given the data volumes involved and the desirability of productive technological partnerships of benefit to the Park, a strong case can be made for the adoption of the ARC/INFO system on the basis of functionality, long-term stability and inter-agency compatibility.

It should also be noted that the systems currently used in the Townsite (ArcCAD and ArcView) are products of the ESRI company and are already fully integrated with ARC/INFO.

3. Staffing considerations. **The key element in a successful GIS implementation is the continuing availability of trained staff.** This point cannot be overemphasized. The best choices of hardware and software will yield little if the staff is inadequate or untrained. Investments in staff are as crucial as those in any other part of the system.

    The requirements of the work anticipated in the pilot project exceed current staff levels and capabilities. There is a need for a GIS manager who is trained in UNIX workstation system administration and is knowledgeable about ARC/INFO software and programming. In the Park GIS Unit, the GIS Manager will be a full-time, work intensive position, which should not be shared with other responsibilities. The position needs the support of a summer student to assist in database building and, in the early stages, the part-time services of an ARC/INFO expert to assist in the transition to the ARC/INFO system and database design.

    The current GIS Specialist, Helen Purves, is an excellent candidate for GIS Manager and should take full advantage of the training offered by Sun and ESRI in the next year to acquire familiarity with the new systems. A series of courses has been recommended to provide this knowledge.

    It is also strongly recommended that the GIS Manager attend the major ESRI user conference held in the U.S.A. each year. More than 4,500 people participated in this meeting in 1995. In world terms, this is the best source of relevant GIS knowledge and experience available.

    The cost of the above training and staff time and travel expenses has been included in the cost model.

Concerns

Commitment. The planned implementation is tightly structured and requires the recommended level of support throughout the pilot project if worthwhile results are to be achieved. The effort cannot be sustained without the commitment of the Park to the objectives of the work. There is a need for clear Park GIS policy that will survive changes in administration. Establishing such policy should be a priority matter for the Park Executive.

Retention of Staff. Perhaps the most crucial factor in successful GIS implementation is the continuing availability of trained staff. This is widely appreciated in the GIS industry. However, there is an annual shortfall of 3,000 trained persons versus jobs available in North America. The conditions that retain staff are an interesting and challenging task (which certainly applies in Jasper National Park), a supportive management environment, and continuing opportunities for knowledge development (training and contact with other GIS professionals). The recommendations for commitment and training made in this report will have a vital impact on the success of the implementation.

Timing. If there is uncertainty in the implementation timing, it will be in the development of the applications for the complex Montane Ecosystem Diversity product and the Environmental Assessment

Scoping product in the third and fourth years. It is impossible to estimate the degree of difficulty that will be encountered by the system manager due to inconsistent or incompatible datasets. The step-by-step building of the databases and their use in previous information products will minimize this, but some degree of uncertainty remains. The estimates of 30 weeks and 26 weeks respectively were made in conjunction with the current GIS specialist and are the best available at this time.

Cost Model

A full cost model for the GIS implementation by fiscal year until the year 2001 is provided in the report (pages 59 and 60). It includes all system acquisition and hardware costs, all data purchase and contract conversion costs, and the costs of data conversion and maintenance in-house and GIS application development in-house and for training. It should be noted that the costs for staff time were calculated using $240 per day. This conservative figure includes salaries, benefits and overheads. All of the in-house costs are for staff now in place in the Park and Townsite. It should be noted that, as is usual in most GIS systems, a comparison of total data costs versus system hardware and software costs illustrates that in the first five years over 70% of the total expenditures are for **data.** This is the real cost of GIS implementation, and highlights the need for data security. The total cost given is a summation of all costs, capital and operational, that can be foreseen in the operation of the GIS in Park and Townsite by year until the year 2001.

Benefits

There have been several changes in the past decade in the way in which value is associated with data and information. Historically the only value of data was the cost incurred in its acquisition. This view has changed in recent years as it was realized in industry and government that the value of data was that it could be changed into information that could have a beneficial impact on the operations of the institutions, on the way that they conducted their business, on the effectiveness of their expenditures, to minimize the risk of their investments, to increase revenues, to reduce their liability, and to develop better policy options. There is now a general agreement that the value of information can be expressed in these terms, and this approach was followed in the work in Jasper National Park.

Park staff were closely involved in benefit identification. In order to relate the work more closely to Park mission objectives, benefit was considered in the categories of **Ecological Integrity, Service to Clients, and Wise and Efficient Use of Public Funds.** In addition to identifying the benefits accruing from each information product, the Park staff identified generic benefits that apply to the combination of all information products. This approach worked extremely well and it allowed the benefits to be identified with much greater clarity and confidence. There is a summary of the benefits included in the report (pages 61 to 64), and detailed benefit calculations are found on the last pages of each information product description (Appendix 6).

The reader is referred to the detailed benefits calculations. As might be expected, these are conservative. **They were developed by senior Park staff, and each has been reviewed and confirmed (signed) by the Park Superintendent.**

The allocation of benefits to year is also conservative. Benefits are only assumed to begin in the year following the completion of the related information products. The generic benefits are not assigned until

1999 on the completion of the complex Montane Ecosystem Diversity and Environmental Assessment Scoping products. Even then, they have been calculated as 25% in the first year, 50% in the year 2000, and 100% in the year 2001.

Benefit Cost Analysis

The final table is a summary of the benefits versus costs of GIS implementation in the Park, in the Townsite, and in the Park and Townsite combined. This table is illustrated in graphs and bar charts following the table in the report (pages 65-67).

BENEFIT–COST ANALYSIS—JASPER NATIONAL PARK
(Thousands of Dollars)

	1995	1996	1997	1998	1999	2000	2001
PARK COSTS	25.25	257.89	187.33	136.83	136.63	186.73	86.83
PARK BENEFITS	0.00	0.00	76.50	99.00	491.00	1048.50	1585.40
CUMULATIVE B:C RATIO	0:1	0:1	0.16:1	0.29:1	0.90:1	1.84:1	3.24:1
TOWNSITE COSTS	0.00	77.8	30.25	30.25	30.25	30.25	30.25
TOWNSITE BENEFITS	0.00	0.00	115.70	115.70	115.7	115.7	115.7
CUMULATIVE B:C RATIO	0:1	0:1	1.07:1	1.67:1	2.06:1	2.33:1	2.53:1
TOTAL COSTS	25.25	335.69	217.58	167.08	166.88	216.98	117.08
TOTAL BENEFITS	0.00	0.00	192.20	214.70	606.70	1164.20	1701.10
CUMULATIVE B:C RATIO	0:1	0:1	0.33:1	0.55:1	1.11:1	1.93:1	3.11:1

The costs given in the above table are the total costs of implementation in each year including all capital and operational expenditures. The benefits given are the total benefits that will accrue from the information products generated in the previous year. The benefit:cost ratios given are cumulative, reflecting all benefits and all costs over time.

The pattern of expenditures and benefits follows the pattern of well-planned and well-managed GIS implementations elsewhere. Nondiscounted annual benefits versus costs go positive between the third and fourth year. Nondiscounted cumulative benefits versus costs go positive in 1999. The nondiscounted cumulative benefit-to-cost ratio over seven years is better than 3:1, which is a strong investment indicator. This leads to the recommendation that Jasper National Park implement GIS as planned.