REPORT OF THE
WATER AND WATERSHED TASK FORCE
FOR THE
RESOURCE INVENTORY COMMITTEE

by
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May 14, 1992

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ACKNOWLEDGEMENTS

I wish to acknowledge the members of the Water and Watershed Task Force for their valuable input, editing skills and encouragement. I appreciate Wally Kreuder's perseverance in ensuring full Federal participation.

Special acknowledgements to Tom Bradfield and Neil Chizeck of the Capstan Group for being willing to work evenings and weekends to create a better product.

Special thanks to each person who took the time to complete and return a questionnaire. I trust that their efforts will be rewarded through improved inventories which better meet their future needs.

Kevin Ronneseth
Victoria, British Columbia

May 14, 1992

1. INTRODUCTION

1.1 EXECUTIVE SUMMARY

The British Columbia Government and the Federal Government, together, have identified the need for improved and integrated data sets on forests and related resources. An inter-disciplinary committee - The Resources Inventory Committee (RIC) - was established to address the issues of what information to collect, for what purposes and to what standards. More specifically, the objectives of RIC are to identify and establish linkages between the different resource types, establish what information is vital for effective land management and to define how this inventory information can be acquired in a manner that minimizes duplication, promotes cooperative data collection, and encourages broad application and long term relevance.

As part of this process, the Committee established nine Task Forces to address different kinds of resource inventories. The Water and Watershed Task Force (WWTF) was established on the basis of "increasing public concern about water quality, quantity and watershed management issues."

The WWTF was to focus on the status of current inventories; needs of present and future users; standards and procedures required; linkages and interfaces with other inventories; and recommendations for future inventories, including data storage, interpretation and dissemination.

To fulfill the WWTF terms of reference, questionnaires were prepared and sent to 67 inventory holders and 155 users of water and watershed information. The return rate was 100% from the holders and 75% from the users. The 155 users included the 67 inventory holders, who are also major users of water and watershed information.

The questionnaires were designed to determine the status of the existing water and watershed inventories and to evaluate the needs of data users. Based on the information returned, the following observations can be made:

- There is growing support among collectors and users for the development of a common structure through which data can be identified, organized and shared.
- There is a large amount of valuable water and watershed information which has been, or is being collected in British Columbia. However, no one agency knows all of the data which are being collected or the areas those data represent.
- The information available meets the needs of some of the inventory holders and data users. In the majority of cases, the inventory holders and the data users "make do" with the information available. In some cases the amount of information required is considered insufficient or even non-existent.
- Common problems experienced by inventory holders are:
    - lack of resources to meet their mandate

  - an inability to meet expanding needs which require more of the same information or new types of information
  - lack of new methods and technologies to meet the changing needs and increased demand for their information

- Common problems experienced by data users include difficulty in:

  - knowing what information is available
  - accessing information
  - acquiring the type of information they need
  - acquiring the information needed in a consistent and useful format

- The major data linkages with water and watershed information are other water and watershed data. Equally important, but less frequently used, are non-water types of data, such as forestry, geology and fisheries.

- The objectives of RIC could equally be applied to the BC "water community". The water community needs to coordinate its activities if it is to meaningfully contribute to the RIC initiative.

- It is not known what additional water and watershed data exist or what areas are represented by this data. If all existing data were made known and available, more needs would probably be met.

- Cooperative data-sharing is hindered because:

  - different terms are being used for the same variables and processes
  - formats and scales employed are not standardized, and
  - different standards are being employed to collect, analyze, interpret and report the data.

There is a wealth of information in water resource reports, private consultant files and other smaller inventories which, if captured, would minimize duplication of work and effort. Resources potentially saved by eliminating duplication could be utilized in filling data gaps or collecting the types of information not currently being collected.

A water resource information management plan is needed to guide implementation of the recommendations of this report, and to provide for additions or amendments to the inventories as necessary. An integral part of this management plan would include a process which improves cooperation between the major data collection agencies.

If the organizations which capture water and watershed data are to meaningfully contribute to the process of improving the general status of resource inventories in this province, the following steps are recommended:

A. Develop a detailed data architecture, which is compatible with any RIC initiative, for all water and watershed subject areas.

B. Perform a more comprehensive inventory of the Province's water and watershed resources at the data element level.

C. Identify water studies completed, in progress, or pending, and make information about these studies generally available through a central library.

D. Conduct a feasibility study to identify and implement an infrastructure for sharing water data, both public and private.

E. Establish an environment in which new methodologies and technology can be adopted to support the sharing and integration of data.

F. Assess and identify capabilities needed for storing, analyzing and displaying all water and watershed data, through a GIS or some other capability.

1.2 PURPOSE OF THIS REPORT

This report has been prepared in partial fulfillment of the terms of reference of the Water and Watershed Task Force. In general, the report is to summarize current conditions and to make recommendations for improving water and watershed inventories, both in the short and long-term.
In particular, the report includes the status of current inventories; needs of present and future users; current status of standards and procedures employed, linkages and interfaces with other inventories; and recommendations for future inventories, including data storage, interpretation and dissemination.

1.3 BACKGROUND INFORMATION AND OBJECTIVES OF THE RESOURCE INVENTORY COMMITTEE

The Forest Resources Commission (FRC) report, "The Future of Our Forests", released in April

1991, was critical of the general status of resource inventories in British Columbia and suggested that they were not adequate to meet the changing needs of an expanding client base. The Commission emphasized that "good inventory information is vital to the land use planning process" and recommended that the provincial government "undertake a commitment to complete inventories for all renewable forest values using standardized compatible systems."

In response to this criticism, the British Columbia Government and the Federal Government have jointly funded development of improved and integrated data sets on forests and related resources. An inter-disciplinary committee - the Forest Resource Inventory Committee (FRIC) - was established to review the status of current inventories and develop mechanisms for rectifying the problems.

The objectives of the committee are:

1. Determine what information is vital for effective land management, at what level of detail, and for what purposes;

2. Define how this inventory information can most efficiently be acquired in a manner that minimizes duplication, promotes cooperative data collection and long-term relevance.

and the activities of the committee include:

1. Determining the resource inventory information that is being, or has been, collected in British Columbia, by whom, to what standards and at what costs;

2. Identifying what information (inventory) is vital for effective land management, at what levels of detail, and by whom.

FRIC commissioned G. G. Runka Land Sense Ltd. to investigate the need for "an integrated multi-resource inventory task force(s) effort to parallel and integrate with the work of the Timber Inventory Task Force". As part of this process and as recommended by Runka (November 12, 1991), FRIC established several task forces to address different kinds of resource inventories. The Water and Watershed Task Force is one of these.

Early in 1992, the scope of FRIC was broadened to include all provincial lands, and the emerging importance of the other inventories resulted in FRIC being renamed the Resource Inventory Committee (RIC). The existing B.C. Land Information Strategic Committee (LISC) is responsible for ensuring that data sets are consistent, exchangeable and can be used in land use planning in British Columbia. The resource inventory task forces include:

• Biodiversity	• Climate
• Coastal Resources	• Culture, Recreation and Tourism
• Fisheries	• Soils, Geology and Archaeology

• Timber Inventory	• Water and Watersheds
• Wildlife Habitat, Range	

1.4 BACKGROUND INFORMATION OF THE WATER AND WATERSHED TASK FORCE AND ITS MEMBERS.

The rationale for G. G. Runka Land Sense Ltd. recommending that the Water and Watershed Task Force be established was:

> "With increasing public concern about water quality and quantity and watershed management issues, it is my view that a task force to pursue associated inventory issues is warranted". (Forest Resource Inventory Committee Multi-resource Inventory Task Force Study, G. G. Runka Land Sense Limited, November 12, 1991)

By the end of November 1991, Jim Mattison, Director, Hydrology Branch, MELP was approved as the Chairperson of the WWTF and Brian Turner, Senior Environmental Planner, Integrated Management Branch, MELP was approached to Co-chair in early January 1992.
The first meeting of the WWTF was held February 14, 1992. Members of the Water and Watershed Task Force include:

Jim Mattison, Hydrology Branch, MELP , Co-chair
Brian Turner, Integrated Management Branch, MELP, Co-chair
Kevin Ronneseth, The Capstan Group, Consultant
Steve Chatwin, Research Branch, MOF
Hal Coulson, Hydrology Section, MELP
Mike Dunn, Canadian Wildlife Service, DOE
Elaine Geddes, BC Aboriginal People's Fisheries Commission
Wally Kreuder, Inland Waters Directorate, DOE
Ron Ptolemy, Fisheries Branch, MELP
Rolf Schmitt, Mineral Policy Branch, MEMPR
Erich Schulz, Soils and Engineering, MAFF
Joe Truscott, Aquaculture and Commercial Fisheries Branch, MAFF
Barry Willoughby, Public Health Protection, MOH
Rod Zimmerman, Groundwater Section, MELP

Mr. Kevin Ronneseth of The Capstan Group was retained on February 28th to investigate the status of the present water and watershed information inventories and make recommendations based on the WWTF terms of reference.

1.5 PURPOSE OF THE WATER AND WATERSHED TASK FORCE

The WWTF is charged with carrying out the terms of reference and will report its findings to RIC. More specifically, the terms of reference are:

1. To review and document the current status of water and watershed inventories, including:

   - water quantity (atmospheric, surface and ground)
   - water quality (physical, chemical and biological parameters)
   - water use
   - watershed characteristics

2. Identify data user needs, and products generated from water and watershed inventories.

3. Recommend where appropriate the adequacy of standards and procedures for data, to suggest inventory methodological modifications to improve utility of data, suggest linkages with other inventories and to recommend improvements to methods of data storage, analysis and dissemination.

4. Provide additional recommendations which could lead to the more efficient, economical and effective use of inventory resources.

1.6 SCOPE OF REPORT

The Task Force will not restrict itself to forested land only, but will address the province as a whole. More specifically, the terms of reference address fresh water inventories, including atmospheric, surface and groundwater, for both quantity and quality issues. The fresh-marine water interface was not included.

Early April, 1992 saw the inclusion of a seventh task force on Coastal Resources and an eighth task force on Atmospheric Inventories. The WWTF decided that future effort to capture additional atmospheric inventories would cease, but that inventories already logged would be analyzed and reported.

1.7 METHODOLOGY

The approach taken in reaching the objectives of RIC was as follows:

1. The first of two questionnaires, entitled the "Inventory

Survey Questionnaire", was prepared and distributed to inventory agencies as suggested by members of the task force and to others as considered appropriate by the Consultant. Included were sections which queried both the status of water and watershed inventories, and user needs.

2. The second questionnaire, "Users of Water and Watershed Information Questionnaire", was sent to users of water and watershed information. The users were suggested by task force members and respondents of the Inventory Survey Questionnaire.

3. Follow-up was done by phone or in person to ensure needed information was gathered.

4. The information gathered was then normalized, analyzed and summarized.

5. The report is primarily based on the responses received from the questionnaires and personal communications held with inventory holders and users of water and watershed information. Additional comments or recommendations based on the experience of the Task Force members were also included.

2. CURRENT STATUS OF WATER AND WATERSHED INVENTORIES

2.1. HOLDERS OF WATER AND WATERSHED INVENTORIES

This survey identified 67 holders of water and watershed inventories. The general jurisdictional breakdown is seen in Figure 1.

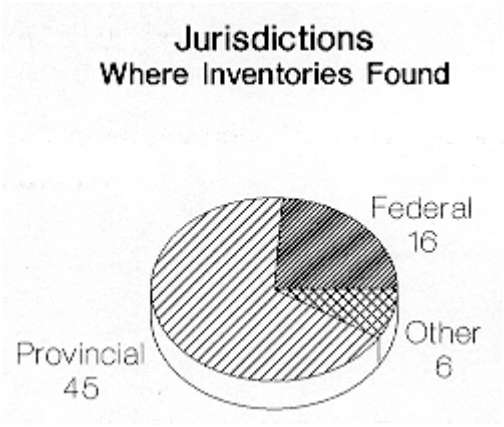

Figure 1: Jurisdictions where water and watershed inventories are

found. These include: provincial and federal governments, BC Hydro, Victoria and Vancouver Water Districts.

The majority of primary water data sources are represented by this survey and this survey probably represents most of the water data collected in British Columbia. However, there are a number of inventories with water data not represented (eg. consultants, forestry companies, water utilities).

2.2 DATA TYPES COLLECTED

Inventories which hold atmospheric, surface or groundwater data were surveyed. A number of these inventories were established to hold a primary water data type (see Figure 2).

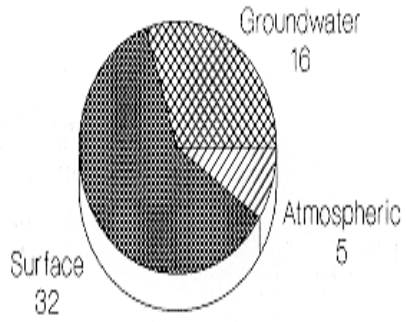

Figure 2: Number of inventories established to hold a primary water data type.

Many of the 67 inventories contain secondary water data (see Figure 3). These data are used to support the computation of primary water data or the generation of some other product. Since some of the 67 inventories hold more than one type of information (e.g. atmospheric and surface water data), the total number in Figure 3 is greater than 67. A more detailed breakdown of information held, by inventory, can be found in Appendix A.

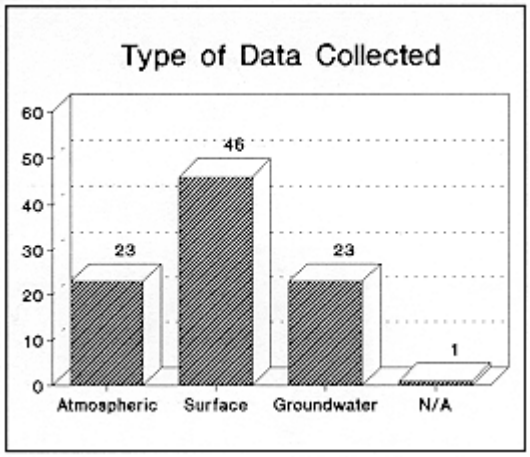

Figure 3: Number of inventories which hold each water information type.

2.3 SPECIFIC INVENTORY VARIABLES

This survey focused primarily on the quantity and quality aspects of water data. Figure 4 identifies the number of inventories which held quantity or quality water information. Often, inventories held both water quantity and quality data. One reason is that water quantity parameters are often collected to compute water quality data.

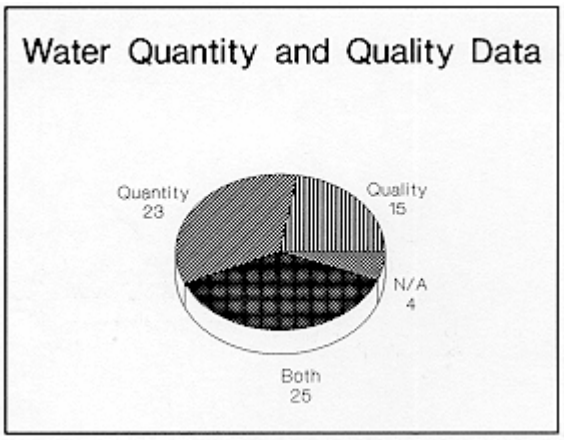

Figure 4: The number of inventories which hold quantity information, quality information or both.

Each of these broad categories was broken down into more specific variables collected. These include:

Quantity	Quality
• volume	• physical
• availability	• chemical
• movement	• biological
• ownership	
• location	
• time	
• other	

For a breakdown of which variables were collected, by inventory, see Appendix A.

2.4 SUITABILITY OF INFORMATION

Information collected was identified as being suitable for either operational planning, management planning or both. Some respondents did not answer this question or noted that it was not applicable (See Figure 5).

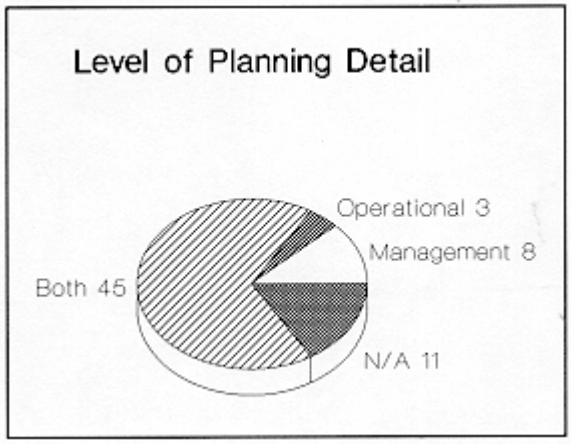

Figure 5: The number of inventories where the level of detail is sufficient for operational planning, management planning or both.

The mapping scale employed often varied within and between agencies. Adapting the scalar reference supplied by RIC, a breakdown of inventories and the mapping scale they employ was undertaken and can be seen in Figure 6.

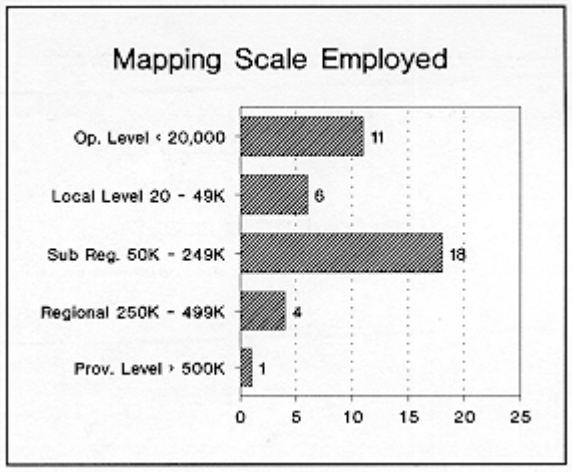

Figure 6: Number of inventories which employ a specific mapping scale.

2.5 SPATIAL ATTRIBUTES OF DATA

Migration towards more sophisticated information systems (e.g. GIS) will require knowledge of the spatial attributes of data found in an inventory. The survey queried if data collected were: discrete, that is, defined only at a certain point, line or area; or continuous, that is, varying over the whole line or area. (See Figure 7)

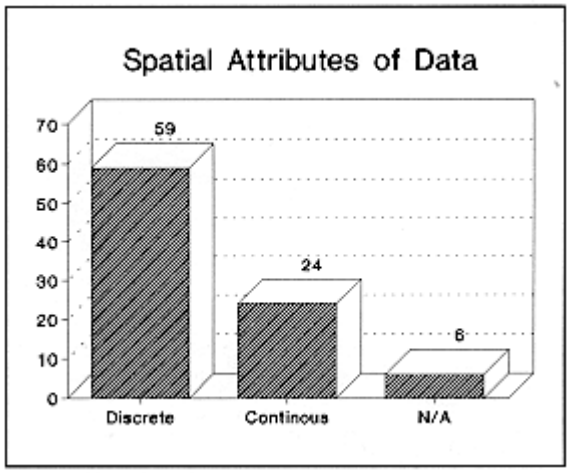

Figure 7: **Number of inventories with information defined as spatially discrete or continuous.**

Approximately half of the respondents identified their data as being discrete and tagged to a specific point. A breakdown of spatial attributes can be seen in Figure 8.

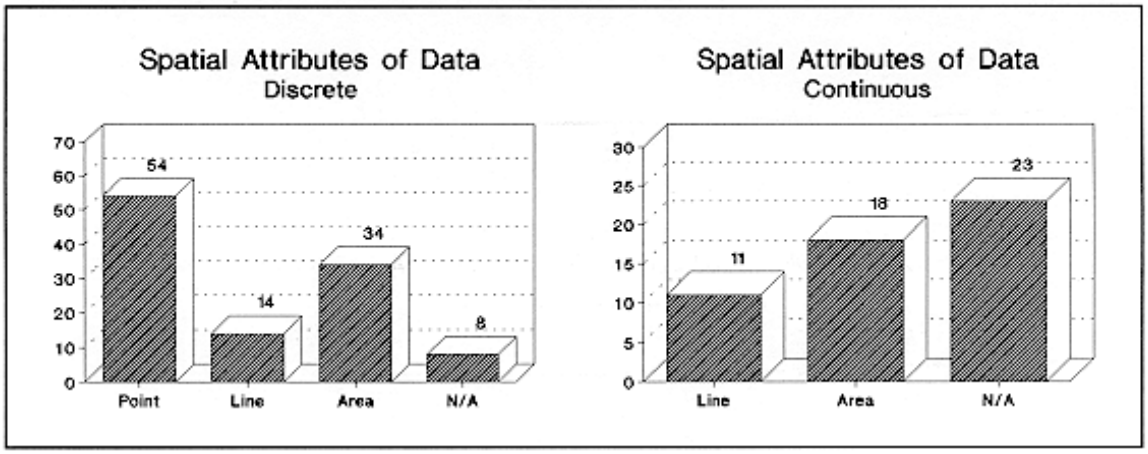

Figure 8: Number of inventories with specific spatial attributes for data.

2.6 STANDARDS EMPLOYED

Respondents were asked to comment on the standards employed to collect, analyze, interpret and report their data. Figure 9 reveals the number of inventories which adhere to some standard, by category.

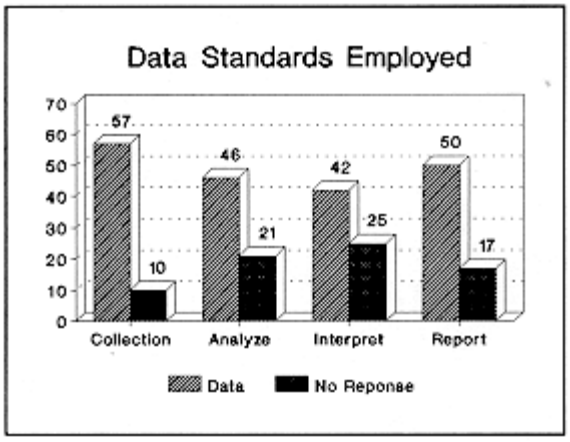

Figure 9: Number of inventory holders who employ standards to collect, analyze, interpret and report data.

Standards employed varied between agencies. They were usually sufficient to meet the different inventory holder's objectives. Standards reported included:

- provincial or federal standards
- international organization standards
- guidelines, objectives or classification systems
- standards dictated by a specific project
- standards based on the knowledge and experience of the individual
- conducting the task

In some cases inventory holders reported using multiple standards to maintain an inventory (See Figure 10). Reasons for multiple standards included:

- different methods or equipment to measure the same variable
- different people with different expertise conducting the same task
- data being processed by different labs

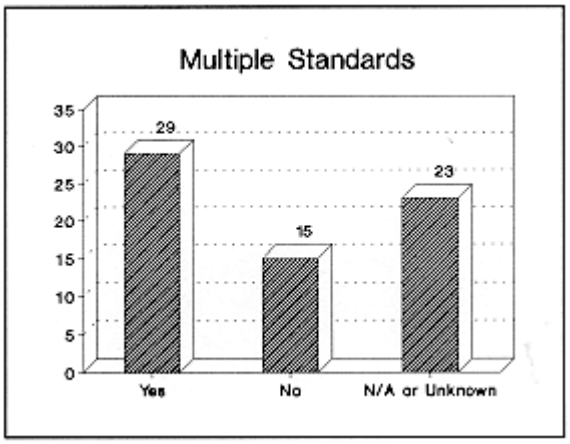

Figure 10: Number of inventory holders who reported using multiple standards.

Respondents were also asked if standards were documented. Figure 11 shows the number of inventory holders reporting documentation of standards. Documentation types reported include:

- contract documents
- manuals
- reports
- guidelines, objectives
- engineering specifications
- standard documents

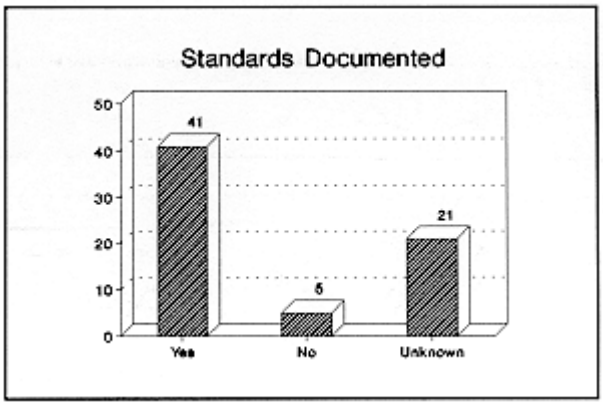

Figure 11: Number of inventory holders who reported their standards were documented.

2.7 COORDINATE SYSTEM EMPLOYED

A variety of location systems were used by the different inventories to locate their sample points. Location systems included:

- street addresses
- legal descriptions
- geographical coordinates
- point on a 1:50,000 map
- a sketch map

Some inventories used more than one system (See Figure 12). Note: N / A in Figure 12 means no response was given or not applicable.

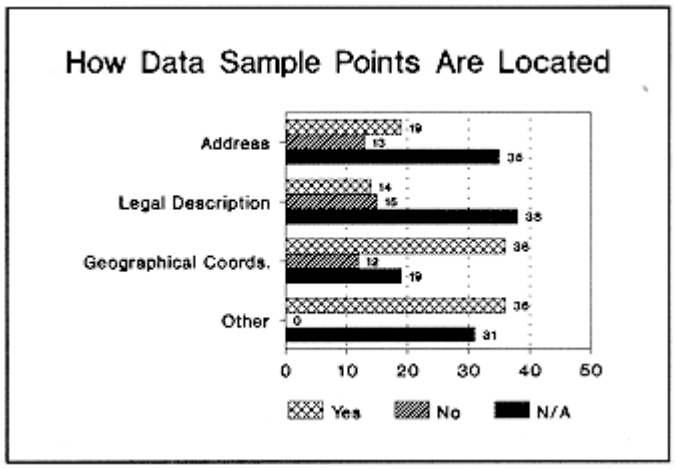

Figure 12: Number of inventory holders who use different location systems for locating their sample points.

A number of respondents commented about the move toward geographical coordinate systems and the use of global positioning devices.

2.8 SAMPLE POINTS

Data are sampled from a variety of points. These include:

• rivers	• soils	• atmosphere
• lakes	• boreholes	• other

Other sample points included: snowpack, springs, beaches, effluent. Figure 13 shows the major

sample points referred to by survey respondents. Boreholes include water wells, test holes and piezometers.

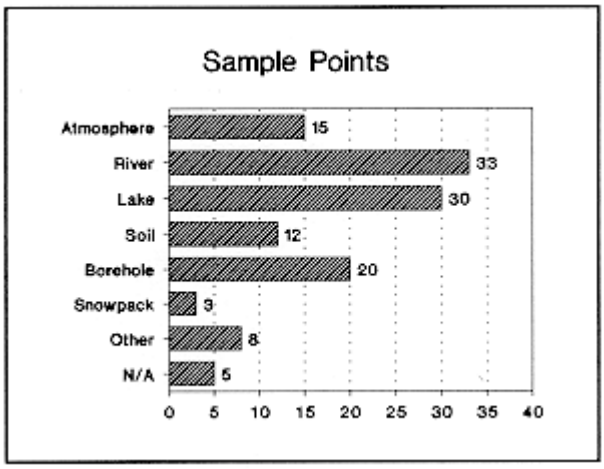

Figure 13: Number of inventories which employ data sample points by category.

2.9 MEDIA: HOW DATA ARE STORED

Data are stored in both hard copy and electronic form. The number of inventories which use the different media can be seen in Figures 14 and 15. Reported volume of hard copy data ranged from: a single report to 65,000 files. Electronic storage ranged from 2 megabits to more than one giga-terabits of memory.

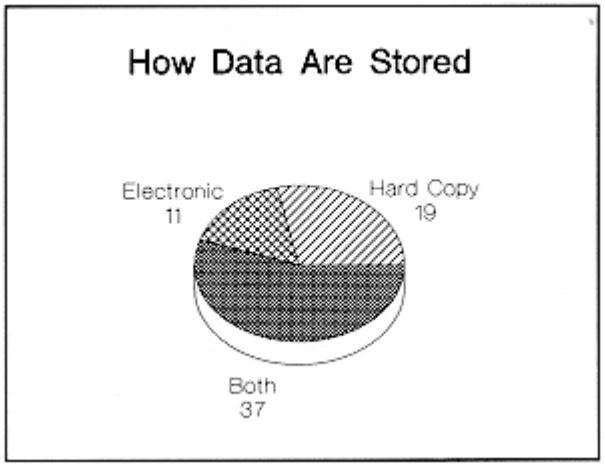

Figure 14: Number of inventory holders who reported hardcopy storage, electronic storage, or both.

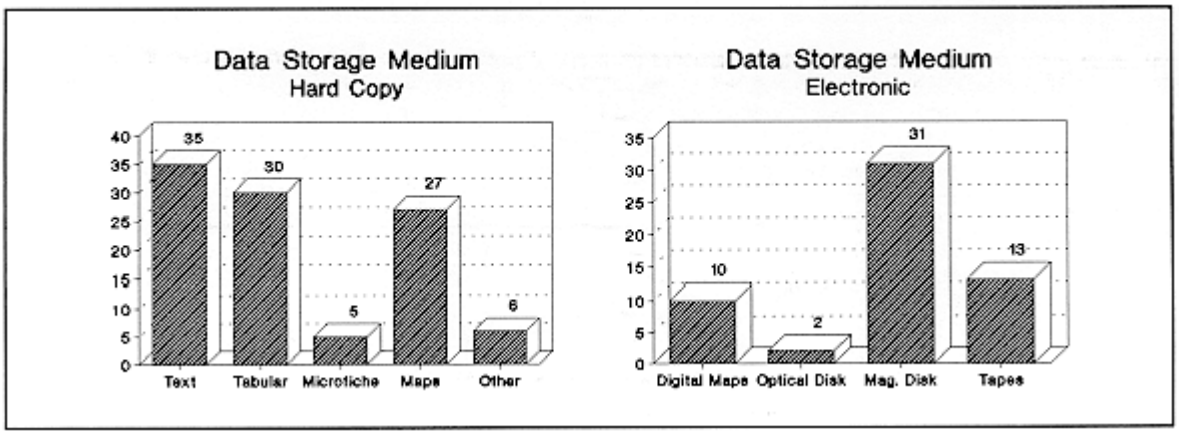

Figure 15: Number of inventory holders who use different types of hardcopy and electronic storage.

2.10 ACCESS CONTROL

Access is usually controlled by the organizational group which maintains the inventory. Sometimes a computing services group has access to electronic data bases. Electronic data bases are usually controlled by logon command and password. There is restricted access for some databases because of confidentiality. Where applicable, the Section Head is usually authorized to allow data access. The extent of this access varies for each inventory (See Figure 16). Backup of inventories varied considerably. Backup mechanisms included:

- microfiche and micro film
- paper copies
- magnetic disk and tape

A number of inventories were either not backed up or the backup media were stored on the same premises as the original.

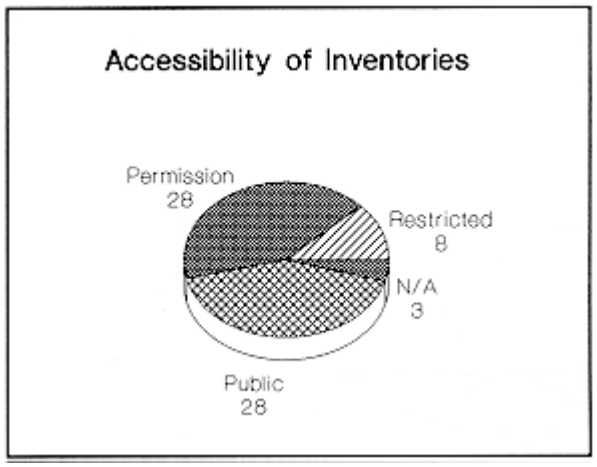

Figure 16: Inventory accessibility: Number of inventories open to public, requiring special access permission or open only to selected personnel.

2.11 INITIAL REASONS FOR INVENTORIES

Initial reasons for collecting water and watershed information were in response to planning and management issues.

These included:

- remedial action to flooding
- forecast river flows
- environmental impact assessments
- avalanche hazard forecasting
- monitoring groundwater levels
- inventory wetlands
- water quality - determining compliance with Health Act
- aquaculture siting feasibility studies

The current driving force behind the inventories surveyed was divided into four categories. These can be seen in Figure 17.

Other reasons reported to collect water resource information included:

- scientific research
- problem solving
- resource conservation

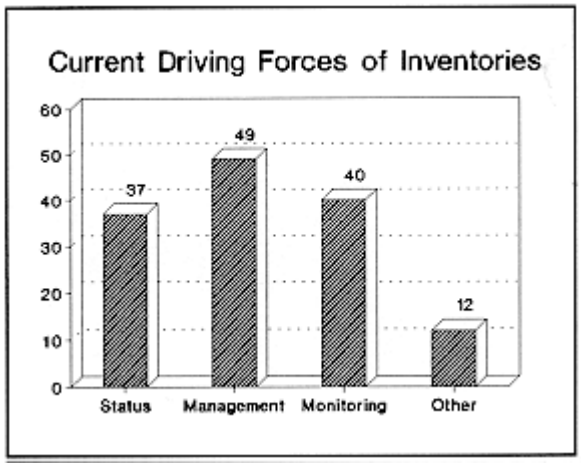

Figure 17: Number of Inventories governed by a specific purpose.

2.12 GOVERNING FACTORS FOR INVENTORY PROGRAMS

The different inventory programs are governed by legislative mandate, policy or operational requirements. Responses included one or more governing factors (See Figure 18).

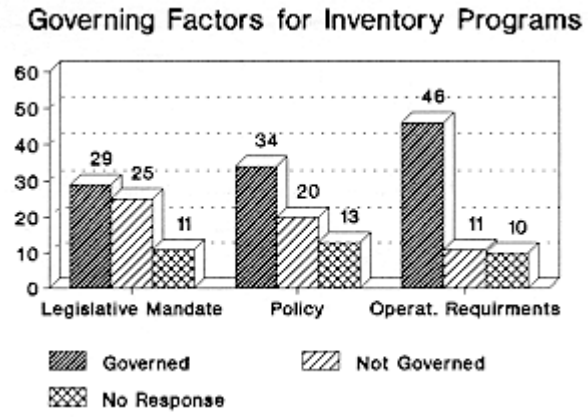

Figure 18: Number of inventories governed by legislative mandate, policy or operational requirements.

2.13 STATUS OF INVENTORIES

The majority of inventory holders responded that they were not meeting their objectives. Reasons objectives were not being met included:

- lack of personnel and other resources
- not all data collected or accepted has been entered into database
- unable to access information and inaccessibility of collection site
- technical problems

Figure 19 reveals the number of inventory holders meeting their objectives. The only reason supplied that an inventory was current was because it was required by legislation.

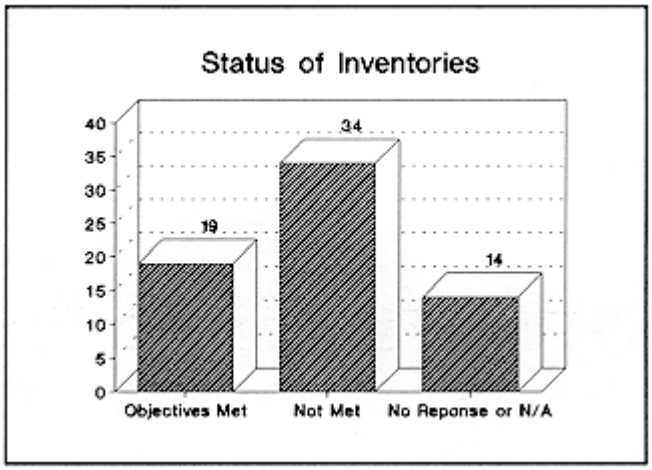

Figure 19: Number of inventory holders meeting objectives.

2.14 WHEN DATA ARE COLLECTED

Survey responses reported sampling programs were either discrete, that is, data collection was either a single or occasional sampling event; or continuous, that is, sampled on a regular or continuous basis. Sampling programs varied through time. Figure 20 shows the number of inventory holders who presently employ discrete, continuous or both sampling programs.

Inventories which are no longer active were not captured in Figure 20.

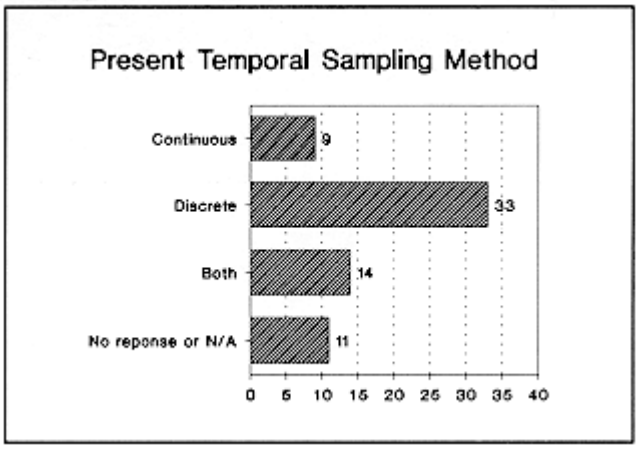

Figure 20: Number of inventory holders who presently incorporate discrete, continuous or both temporal sampling methods.

2.15 DATA GAPS

Data gaps were reported in 37 of the 67 inventories. Nine inventories were reported not to have any data gaps and to 21 inventory holders the question of data gaps was either not applicable or there was no response. Reasons for data gaps included:

• no resources	• technical hurdles
• liability issues	• not all surveyed data entered into a data base

Figure 21 graphically displays the number of inventories which report data gaps.

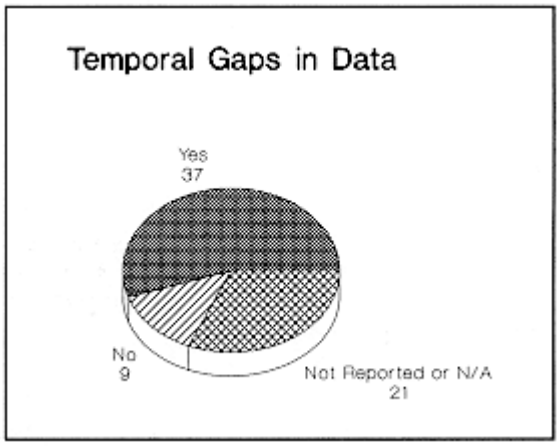

Figure 21: Number of inventory holders which reported data gaps.

2.16 PERIOD OF RECORD

The period of record was reported for 43 inventories and the record period was either unknown or not reported for the remainder. Some atmospheric files exist from the late 1870's, groundwater files from the late 1880's and surface water records from the early 1900's. The majority of files however have been in existence since the 1960s. For specific information by inventory, refer to Appendix A.

2.17 METHODOLOGIES EMPLOYED TO COLLECT DATA

The information supplied on the methodologies employed to collect data took three general forms:

- equipment used
- measuring process employed
- both the equipment and the measuring process employed

Almost all respondents supplied information in this category. Representative responses include:

- methods documented by AES
- visual estimates of depth
- electronic sensors feeding data loggers
- measuring sticks put into ground
- field Hach kit chemical analysis

- water equivalent: snow pillow with manometer and encoder

2.18 ACCURACY AND COSTS OF MEASUREMENTS

Comments on accuracy of measurements ranged from poor to excellent. Responses include:

- very stringent procedures
- moderate accuracy
- Federal standards
- below Environment Canada Standards
- as accurate as maps and as staff are experienced

Comments on costs to measure variables were dependent on what the respondent identified as an expense. Since the question in the survey was not specific enough, there was a wide range of responses. Costs referenced included:

- water sample analysis ranging from $5 to $1000 per sample
- AES's annual operating budget for B.C. - 6.9 million dollars
- travel, wages and equipment costs

3 USERS OF WATER AND WATERSHED INFORMATION

Users of water and watershed information are the people and organizations whose area of interests are:

• mining	• domestic water supplies
• irrigation	• industrial water supplies
• agricultural	• hydroelectric power production
• commercial	• fish and wildlife maintenance and enhancement
• recreational	• preservation of environmental and aesthetic values

For a list of data users who responded to the "Users of Water Inventory Data" questionnaire, refer to Appendix B.

3.1 POTENTIAL FUTURE USERS OF WATER AND WATERSHED INFORMATION

Inventory holders listed current users of their data (See Figure 22). There is no distinction between the frequency of requests and the volume of information requested.

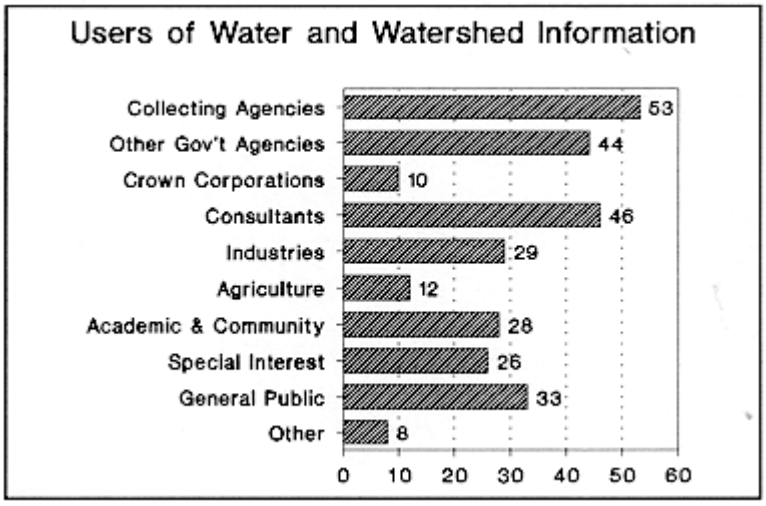

Figure 22: Number of inventory holders who identify different groups using their data.

Inventory holders were specifically asked to identify future potential users of their respective inventories. Many referred to their list of current users along with selected others. Examples include:

• developers	• Federal, provincial and municipal departments
• watershed planners	• anyone interested in water quality or quantity
• consultants	• fisheries assessment planning
• industry	• anyone interested in water recreation
• legal community	• anyone requiring meteorological or fire weather information
• Aboriginal Peoples	• anyone conducting contaminant or environmental studies
• conservation societies	

3.2 WHAT DATA ARE USED

Water data are used to establish resource status, to monitor and to manage water resources. Inventory holders tend to manage water resources more than non-holders. Specific uses of water data include:

- mitigation of a problem
- resource evaluation
- impact assessment
- development proposals
- forecasting potential hazards
- locating water supplies

Figure 23 shows the type of information employed by users of water and watershed data. Refer to Appendix C for more specific information.

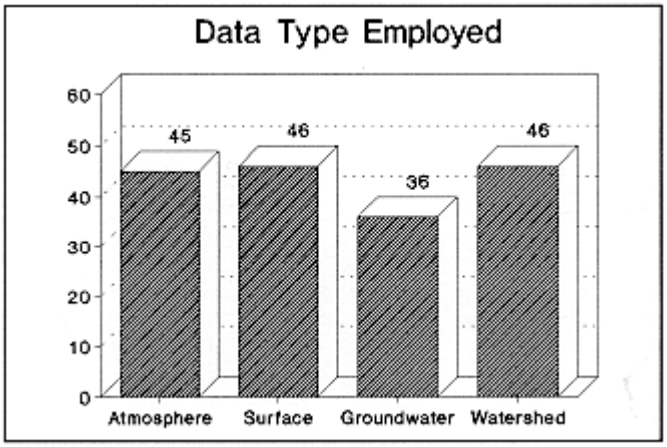

Figure 23: Number of data users who employ different water and watershed information.

3.3 HOW DATA ARE USED

Water data are used to allocate water resources, to mitigate drought and floods; and to conserve and
effectively use the water resource. Specifically, reported uses of water data include:

- establishing existing uses of water
- identifying hydrologic characteristics
- establishing information about snow packs
- forecasting streamflows
- modelling water quality
- locating water supplies

3.4 HOW OFTEN DATA ARE EMPLOYED

Figure 24 summarizes the reported frequencies at which different types of water data are employed by data users.

Type of Water Information	Daily	Weekly	Monthly	Annually
QUANTITY				
Volume	21	15	17	7
Movement	11	7	14	2
Location	17	13	10	5
Time				
- frequency	13	8	18	7
- duration	13	8	15	8
Availability	10	8	18	7
Ownership	3	5	8	8
Other	1	2	2	1
QUALITY				
Physical	11	10	12	6
Chemical	11	9	12	5
Biological	11	7	11	4

USE				
Licensing	8	6	15	12
Waste permit	5	7	9	7
Other	6	3	4	4

Figure 24: The reported frequency which water data are employed by data users.

3.5 FORMAT PRESENTATION

Inventory holders reported clients were presented data in both hard copy and electronic forms.

Figure 25 shows the different methods by which data was presented to the clients. Figure 26 shows
the different methods by which data was presented to them from the inventory holders.

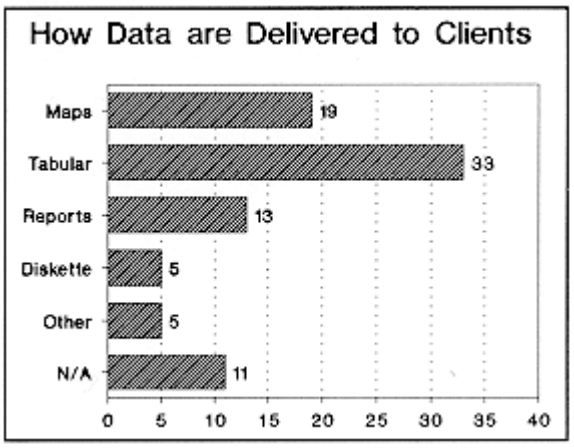

Figure 25: Number of inventory holders who reported the different methods by which data was delivered to the clients.

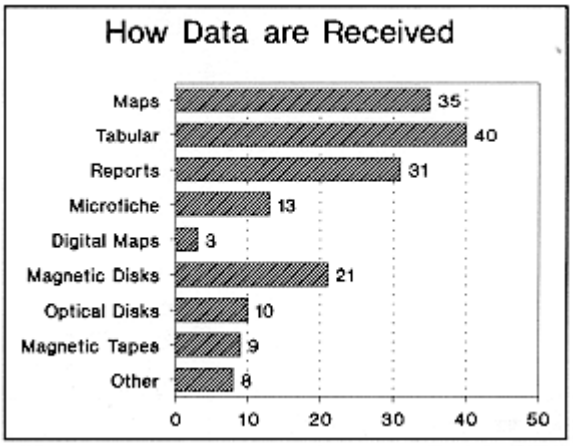

Figure 26: Number of data users who reported the different methods in which they received data from the inventory holders.

3.5.1 SHORTCOMINGS IN PRESENTATION OF INFORMATION

Comments on shortcomings, problems or concerns with current methods of presenting water and watershed information include:

- difficult to ascertain what data are available

- mapping scales are insufficient
- data sources too spread out
- data sources not computerized
- too many standards
- water utility well information not available
- too much detail, too little coverage
- inappropriate units of water measurement for water licensing

3.6 PRESENT NEEDS

3.6.1 PRESENT NEEDS MET BY INVENTORIES

Present needs of data users are being met to varying degrees (See Figure 27).

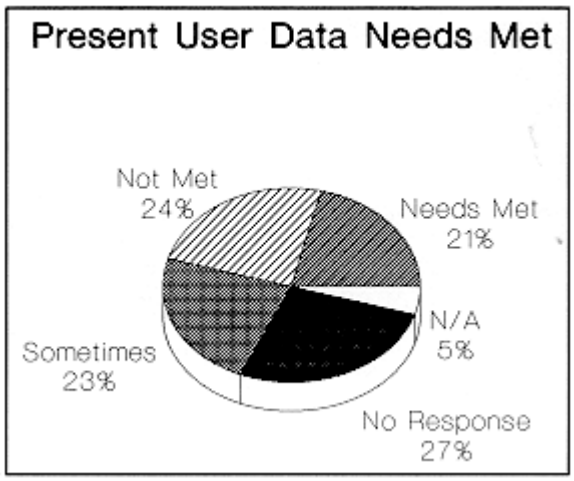

Figure 27: Percentage of data users who stated whether or not current inventories met their present data needs.

Ways in which present needs are being met include:

• rapid access and statistical reports*	• provides quick overview*
• database custom made*	• coverage of major watersheds okay

Ways in which present needs are not being met include:

- data not accessible enough
- don't know what data are available
- little or no computerized water quality data or standardization of results
- data not on GIS
- data out of date
- need more watershed information
- need flow data on smaller creeks*
- variable data quality*
- difficult to cross-reference information*
- need increased spatial coverage
- comparison of flow upstream and downstream of water users

Note: * indicates responses are from holders of inventories who are also users of water and watershed information.

3.6.2 ADEQUACY OF COVERAGE: SPATIAL OR TEMPORAL

Users of water and watershed information indicated a number of areas where data coverage was inadequate. Spatial and temporal gaps in the data include:

- not enough Water Survey of Canada stations on small catchment basins
- insufficient precipitation stations at high elevations
- need more spatial coverage in remote areas
- need more information on groundwater extraction
- inadequate water well location maps for eastern and northern British Columbia
- need greater spatial coverage of streamflow and sediment data
- post-1982 well logs need to be catalogued
- need more temporal coverage in remote areas

3.6.3 DATA ACCESSIBILITY

Users of water and watershed data vary considerably in their responses to data accessibility. Figure 28 reveals the percentage of data users surveyed who found the data accessible.

Comments generally stated:

• atmospheric data difficult to obtain	• many different agencies involved
• surface water data fairly accessible	• very accessible - if you know where to look
• pre-1982 groundwater data accessible	• "can't access what is not there"

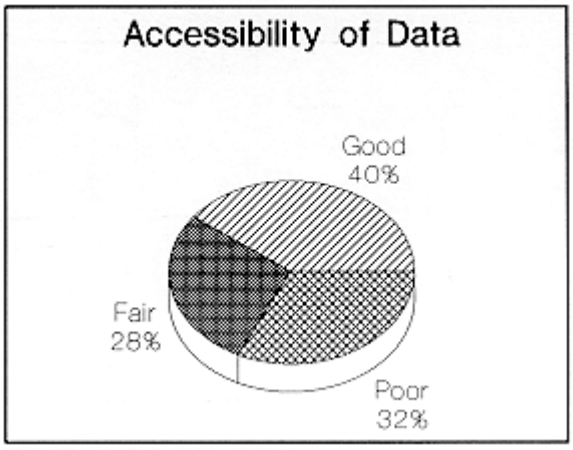

Figure 28: How data users perceived the accessibility of water and watershed data (in percent).

Data users acquired data by different means (See Figure 29). Knowing the right contact person

greatly enhances data accessibility. Computer access to data is generally restricted to government personnel.

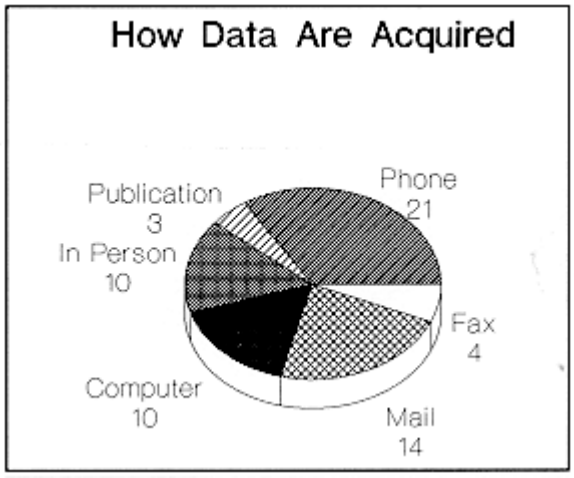

Figure 29: Number of data users who reported different methods in which they acquired data.
Note: computer access is used primarily by government agencies.

3.7 FUTURE NEEDS

Inventory holders identified additional data which would assist them in meeting their needs as users of water and watershed information. These include:

• soil moisture	• waste discharge points digitized
• toxicity data	• detailed digital ground and surface water databases
• digitized well locations	• integrate water licensing database with other databases
• comments on data reliability	•

Other users of water and watershed information identified the following needs:

• larger scales of mapping	• central database
• information on water demand and use	• groundwater pollution hazard maps
• broader spatial coverage of water data	• database of water information sources
• more baseline data on potential water supplies	•

Figure 30 identifies the information requested, by type, to better meet user needs.

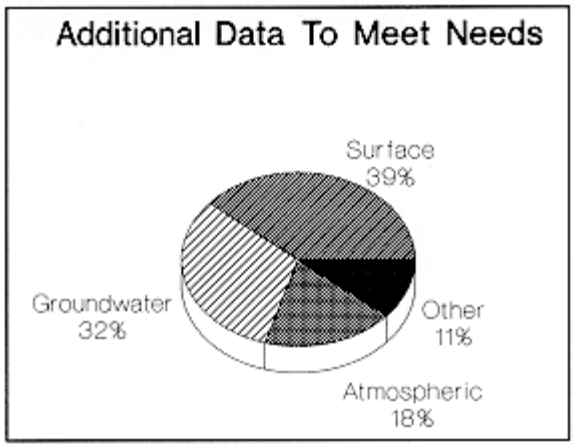

Figure 30: Additional information requested, by type, to better meet user needs (in percent).

3.8 MAPPING SCALE USED

Figure 31 shows mapping scale employed by data users. Figure 32 reveals the percentage of users who stated the mapping scales employed met their needs. 6% of those users stated that their mapping scale needs varied depending on the task. 25% of data users noted that a larger scale would better meet their needs. Nine respondents preferred the larger 1:20,000 over the smaller 1:50,000 they were presently using. Three respondents preferred an even larger scale. Figure 33 reveals the number of respondents who prefer larger scales.

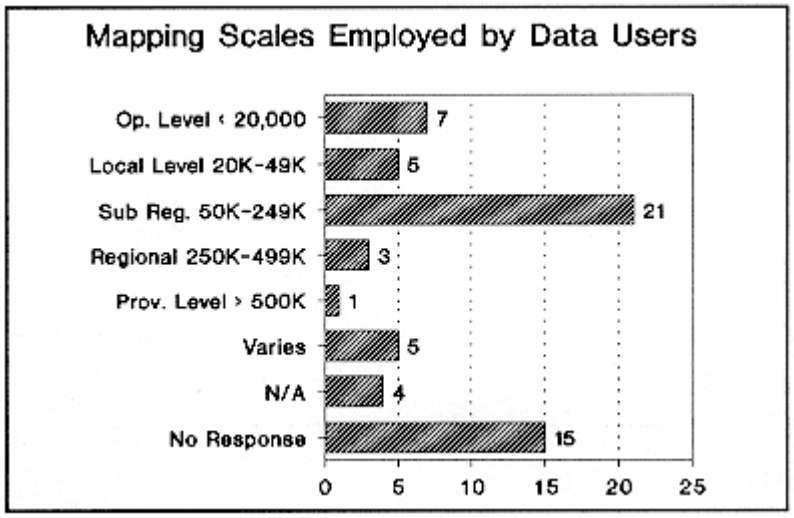

Figure 31: Number of data users who employ a specific mapping scale size.

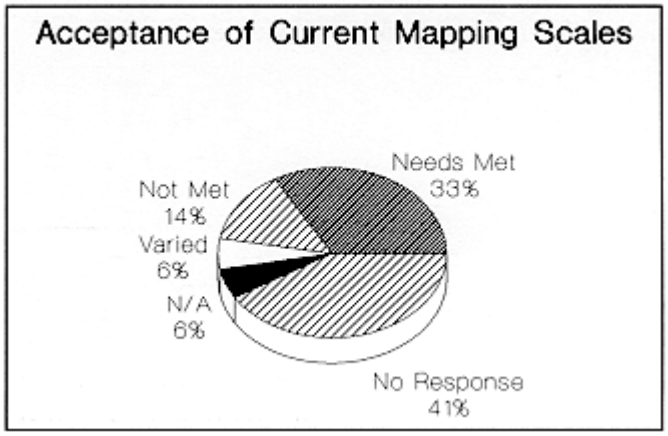

Figure 32: Data users who stated whether or not the mapping scale

employed met their needs (in percent).

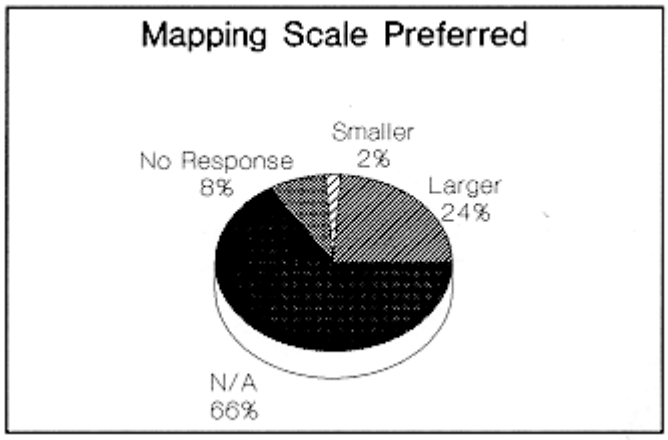

Figure 33: Number of data users who prefer a different mapping scale.

3.9 DATA COSTS

Very little information on the costs to collect data was provided. Only 5% of those surveyed responded to the question of data collection costs.

4. CURRENT LINKAGES AND INTERFACES WITH OTHER INVENTORIES

4.1 DISCUSSION OF CLISP AND CORE

4.1.1 CLISP

In 1989 the government of British Columbia developed the Corporate Land Information Strategic Plan (CLISP). This strategic plan is to enhance the sharing and exchange of land related information across government. The Land Information Strategic Committee (LISC) was created to guide the implementation of this strategy.

The objectives stated in the RIC Terms of Reference are complementary to those of the Land Information Strategic Committee. LISC will provide through the government operating policy document, the Land Information Management Framework (LIMF), standards for accessing, sharing and exchanging data via the Land Information Infrastructure (LII). These standards affect the activities of RIC. Some of the areas impacted by the LIMF standards are :

- The information or description (metadata) of the datasource to be used by users and the LII to order, query and access data from the source.
- Standards related to the initial capture of data, including NAD'83 as the geodetic reference and the use of standard base maps, as supplied by the Surveys and Resource Mapping Branch for 1:2,000,000, and 1:250,000 and 1:20,000 to ensure vertical integration (i.e. legitimate overlaying) between datasources.
- Other data capture standards, especially as relates to capture of the map (or spatial) data.
- Standards for developing the common or corporate data model, which is one of the main tasks of RIC, that will provide users with a common or single view of the different resource databases free of structural or semantic (definition) problems, such that data from the different sources is without confusion or conflict when used together.
- Other technical standards for linking to the LII to facilitate exchange and sharing of data.

These standards apply as appropriate to both existing and planned datasources. The LIMF and information on theses standards is available from the GLIDE (Government Land Information Data Exchange) Unit.

4.1.2 CORE

The Commission on Resources and Environment (CORE) was established to independently and publicly advise Cabinet on Legislation, policy and allocation decisions related to all land use issues and processes in British Columbia.

CORE is to ensure the effective, integrated management of the land and natural resources of British Columbia. One vehicle used to accomplish this goal includes creating a process for planning for a variety of uses on resource lands. CORE was commissioned to coordinate provincial agencies to provide the resource inventory required to support this planning process.

The task of developing and disseminating land information is largely undertaken by RIC and LISC. Assuming these organizations meet their objectives of providing needed resource inventories and the ability to share information from these inventories, the role of CORE is likely to remain that of an observer.

Resource Inventory holders however could experience an increased demand for information as CORE focuses on a particular are in the province.

4.2 HOW INVENTORIES MEET PRESENT LAND USE NEEDS

Water and watershed inventories meet current land use needs in a variety of ways. These inventories assist in resource protection, management, status and impact assessment, and in land use planning. Specific examples of how inventories meet present land use needs include:

- assisting in municipal zoning and development
- assisting in resolving resource use conflicts
- land use planning
- assessing flooding potential
- assessing fishing and recreation potential
- protecting environment
- industrial discharge permitting
- integral part of any hydrological study
- defining fire hazard conditions
- siting aquaculture facilities
- defining biological capability

4.3 EXISTING LINKAGES

Inventory holders provided an extensive list of other information required to maintain inventories and generate products. Inventory holders are linked to two major categories of

data: water data and non-water data.

Water data include:

- water quality
- water quantity
- water use
- watershed characteristics

Non-water data include:

• cadastral	• topographic	• geology - bedrock, surficial
• land use	• recreation	• effluent discharge
• ecological	• vegetation	• flora and fauna

Figure 34 shows the number of holders who identify the data category used to maintain inventories and generate products.

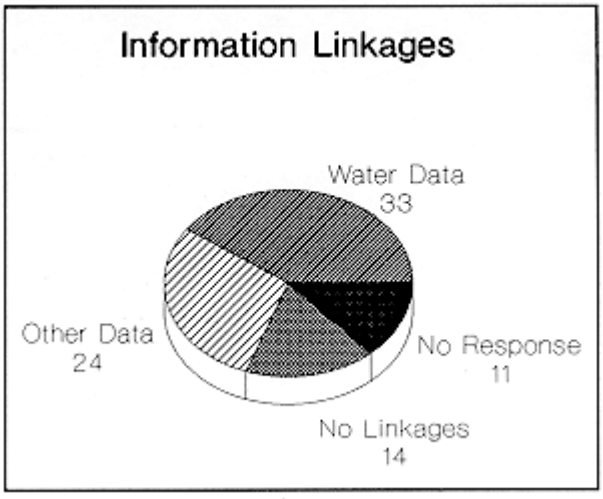

Figure 34: Number of holders who identify the data categories used to maintain inventories and generate products.

4.4 CURRENT PRODUCTS GENERATED FROM EXISTING LINKAGES BETWEEN INVENTORIES

Products generated and services rendered from existing linkages between inventories include:

- design and construction of dykes
- compliance of water quality standards
- evaluate industry's environmental performance
- forecast reservoir inflows
- Snow Survey Bulletin
- fire weather indices
- regulation of water utilities
- inventory of water well data
- bylaw provisions for floodplain
- distribution and abundance of fisheries resources

For more information on current products generated and services rendered, refer to Appendix B.

4.5 GAPS AND OVERLAPS

There are data gaps in both water quantity and quality information. Data gaps occur in the more remote regions of the province and where there are resource conflicts. Gaps in water data collected are discussed in more detail in Sections 3.8.1 and 3.8.2.

When questioning both inventory holders and users of water and watershed data, there was only one reference to data overlap. However, as Section 2.2 (Data Types Collected) indicates: 23 inventories collect atmospheric data, 46 collect surface data and 23 collect groundwater data.

To further identify gaps and overlaps in data collection it will be necessary to establish where, when and how these different agencies collect their data.

4.6 FUTURE LINKAGES

Both inventory holders and users of water and watershed data identified future fields of study. These study areas will use existing linkages and may establish new ones. Future study subjects suggested by inventory holders include:

- assessing geological attributes of aquifers
- estimating/indicating contaminant loading and transport pathways
- cataloguing local water use and availability of water for land use development policies
- mapping aquifers sensitive to contamination
- helping decide what new protected areas should be established

Inventory holders suggested a number of new inventories. These include:

- measure overall ecosystem health and stability
- measure more biological parameters
- environmentally sensitive species
- classify watersheds
- measure drift thickness
- satellite imagery of land use

Of 67 inventory holders surveyed, 14 provided suggestions for new inventories, 19 stated non new inventories would assist them and 34 did not respond.

Users of water data were more responsive. 27 of 51 respondents supplied suggestions on future needs for water data. Suggestions included:

- information on ground and surface water near permitted waste discharge sites
- same information, but at different locations
- flow data for smaller streams
- precipitation and streamflow data in new resource conflict areas
- up-to-date well information
- identify future sources of drinking water
- determine biological capability of lakes and streams
- determine wilderness recreation potential of lakes and rivers
- coordinated management structures

Users of water data identified the following potential new inventories:

- locations of known or potential contaminant sources
- watershed boundaries at 1:20,000 scale
- digital elevation models
- more extensive water quality information
- groundwater pollution hazards maps
- water well consumption by climatic zone needed for setting minimum well capacity
- incidence of *Giardia lamblia* (beaver fever)

- inventories of groundwater aquifers
- wildlife resources, other than deer and waterfowl

5. FINDINGS AND RECOMMENDATIONS

This section provides comments and recommendations, based on the two questionnaires sent to inventory holders and data users.

As explained previously this report was commissioned by RIC in recognition that good inventory information is "vital to the land use planning process." In conjunction with other improved inventories of natural resources information, the aim of this work is to foster more effective management of the Province's resources and facilitate response to the changing needs of an expanding client base.

To effectively manage all the diverse water data collected in the province is a major and complex undertaking. Organizations collect data, acquire both water and non-water data from other organizations, use those data to derive additional data and send both original and derived data to other organizations.

There is growing support among both collectors and users for the development of a common structure through which to identify, organize and share data. It can equally be stated that good water and watershed inventory information is also vital to the water use planning process.

5.1 COLLECTIONS, STORAGE, INTERPRETATION AND DISSEMINATION OF WATER RESOURCE DATA

FINDINGS:
Availability of data:

- Much of the data required is already being collected by numerous interjurisdictional participants.
- Sharing of data is cumbersome and ineffective.
- There is no mechanism to facilitate the overall coordination and sharing of these data.

Suitability of water data for planning purposes:

- The majority of water data collected are suitable for both operational or management planning purposes.

- Although mapping scales employed usually meet the needs of the agencies which collected the data, they do not always meet the needs of the data users.

- Very often different standards, methods and types of equipment are employed to measure the same variable. The standards followed to collect, analyze, interpret and report data vary a great deal from one organization to another, and collection standards are not always documented.

- Various different location systems and coordinate systems are employed by organizations to locate their sample points or delineate the areas represented by their inventories.

Ability to integrate water data with each other:

- It is difficult to integrate and compare similar types of data due to:
  - the absence of formal names for some of the inventories and data types,
  - sampling at different times,
  - different sampling procedures,
  - different methods of describing and recording data,
  - the unavailability of comprehensive data element definitions,
  - different data structures from one inventory to another for the same data elements, and
  - absence of statistical analysis and methods for contrasting.

Overlaps and Gaps in the data:

- Individual inventories have temporal and spatial gaps within them, which lead to potentially incomplete useful data.
- It is not known what overlaps or gaps exist between inventories because the scope of this study precluded knowing which water bodies are being sampled, when, how or why.

(A) RECOMMENDATIONS:

Develop a detailed data architecture for all subject areas, data entities, characteristics and coded data values that support the management of the Province's water resources.

The common water data architecture should include definitions of all identification and location systems and all coded data values currently in use, with a focus on reconciling to one another.

Common coded data values should be identified for long-term migration to a common data standard (in coordination with the Corporate Land Information Strategic Plan (CLISP)) and a table of coded data values should be used for short-term translation.

The data architecture should encompass a data dictionary of standard or common data definitions, a directory identifying the location and availability of the Province's water data, and procedures for keeping that directory current and making it readily available.

The data architecture should be used as a basis for understanding, sharing, and integrating water data in all other projects where water data are used.

BENEFITS OF IMPLEMENTING RECOMMENDATIONS:

Developing a detailed common architecture will:

- provide a framework for the definition, collection, consolidation, sharing and use of the Province's water data,
- provide the basis for a more detailed inventory of the Province's water data which currently exists in a variety of organizations,
- promote the consistent and efficient sharing of water data between resource agencies and provide a base for development of a data sharing infrastructure of water data, and
- provide a base for the adoption of a standard location system for water bodies, a standard identification system for water bodies, and the use of standard coded data values.

IMPACT OF NOT IMPLEMENTING RECOMMENDATIONS:

If these recommendations are not implemented, additional data that are not compatible with existing data will be collected. This will result in:

- limited or difficult data sharing,
- data that are not readily identified,

- inappropriate use of data, and
- redundant data capture and maintenance.

5.2 COMPREHENSIVE WATER DATA INVENTORY

FINDINGS:

Primary water data sources:

- Data are collected by a variety of agencies.
- The majority of primary water data sources are represented by this survey.
- Sources identified by this survey probably possess most of the primary water data collected in British Columbia.
- However, numerous minor collectors of primary data are not captured in this survey, these will total in the hundreds.

Secondary water sources:

- A number of water and watershed inventories contain secondary water data and other non-water data.
- Secondary and non-water data are used to support the computation of primary water data or the generation of some other product.

(B) RECOMMENDATIONS:

Perform a more comprehensive inventory of the Province's water resources at the data element level.

Inventories which collect water data for supportive purposes should also be included. Potential inventories would come from: satellite imagery, water utilities, the academic community, irrigation districts, municipal governments, and consulting companies.

Identify the major flows of water data among organizations. Identify points where data are altered or additional data are derived.

This water data inventory should be done within a common water data architecture and should build on the inventory already contained in this report.

BENEFITS OF IMPLEMENTING RECOMMENDATIONS:

The benefits of performing a more comprehensive inventory of the Province's water resources at the data element level will include:

- facilitating and promoting the sharing of water data,
- providing improved data availability for implementing any other tasks identified by RIC, Committee on Resources and the Environment (CORE), Land Information Strategic Committee (LISC) or other organization,
- providing the information for developing a water data sharing infrastructure,
- identifying data that currently exists and additional data that will be required in the future, and
- permit greater understanding of complex relationships (eg. water-fish use) depend on different, but related, inventories.

IMPACT OF NOT IMPLEMENTING RECOMMENDATIONS:

Impacts of not implementing recommendations include:

- repeated duplication of efforts and associated costs of water data collection,
- continued misunderstanding of the state of the Provinces water resources and water-related resources, and
- continued ongoing difficulty in making informed water resource policy and management decisions.

5.3 WATER RESOURCE STUDIES

FINDINGS:

Products generated:

- Water data are often used to derive other data or to generate other products.
- Products include a wide variety of water resource studies.

- Water resource studies have been completed, are in progress, or are pending.
- Water resource studies are often uncoordinated, overlapping or redundant.

(C) RECOMMENDATIONS:

Identify water studies in progress or pending and make information about these studies generally available.

Develop a clearing house for water resource studies and information. Such a clearing house would maintain a bibliography and maintain and provide access to a central library of the actual physical studies.

Past studies should be included in this bibliography. If there is only one physical copy, the location where it is housed could be included in the bibliography. If more than one copy exists or the demand warrants, a second copy could be placed in the central library.

The outside community (eg. academic, industry and private consultants) should be encouraged to participate in this clearing house of water information.

BENEFITS OF IMPLEMENTING RECOMMENDATIONS:

Benefits of implementing recommendations include:

- promoting coordination and integration of studies related to the Province's water resources,
- preventing possible overlap and redundant effort, and
- helping to minimize expenditures for obtaining information about the Province's water resources.

IMPACT OF NOT IMPLEMENTING RECOMMENDATIONS:

Not implementing recommendations will lead to:

- continued overlapping study projects,
- unnecessary expenditures, and
- inconsistent findings and redundant efforts.

5.4 IMPROVEMENTS IN WATER DATA SHARING

FINDINGS:

Ability to share water data:

- A framework is lacking through which water information can be shared in a meaningful manner.
- Formal data names or data definitions either do not exist or are not readily accessible.

Ability to access data:

- Access is usually controlled by the organization which maintains the inventory.
- Access to inventories varied considerably.
- In some cases, confidentiality restricted access to a few select personnel.
- Locating and gaining access to water data from another organization is often a difficult and time consuming process.
- Accessing data may require travelling to multiple locations, searching and copying of paper files, and the time and assistance of the organization which has the data, to find and sort through the data.
- When such data are obtained they may not be in a readily useable format and they may not be directly relatable to data already collected.

(D) RECOMMENDATION:

Conduct a feasibility study to identify and implement an infrastructure for sharing water data, both public and private. This should be accomplished in consultation with the Land Information Strategic Committee.

BENEFITS OF IMPLEMENTING RECOMMENDATION:

Identifying and implementing a water data sharing infrastructure will:

- provide an improved process for sharing water data,
- prevent unnecessary water data capture,

- reduce time and expense of gaining access to needed water information, and
- improve the usefulness and quality of water data by basing data sharing on a common data architecture.

IMPACT OF NOT IMPLEMENTING RECOMMENDATIONS:

Not implementing an infrastructure for water data sharing will result in:

- continued difficulty and unnecessary expense and time in gaining access to needed water data,
- continued costs for redundant data collections, and
- limited improvement in the quality and usefulness of available water data.

5.5 HOW INVENTORIES WOULD MEET FUTURE LAND USE NEEDS

FINDINGS:

- Technology is changing how the inventories are maintained.
- Technology is changing how data are collected, analyzed, interpreted and reported.
- Current inventories are meeting many, but not all, of the needs of the inventory holders.
- Demands of users are being met in some areas but not in others.
- There is an ever increasing demand put on the inventories by an expanding client base.
- Access to the inventories varies and users are demanding easier access.
- Management needs are changing in such a way that new analytical tools are needed, and there is an increasing need for the integration of many complex inventories.

(E) RECOMMENDATIONS:

Provide for the adoption of new methodologies and technology in an environment

which supports the sharing and integration of data.

This would be assisted by the establishment of a common data architecture (section 5.1),and a repository in which the status and definitions of the logical and physical structures of the different inventories would reside.

Identify where current and future needs can be met using data found in existing inventories. This could be accomplished by the establishment of a more comprehensive directory of water and water shed inventories (section 5.2). By identifying what data are collected and where, a reference could be provided which would tie data users to data sources, identify gaps and overlaps in the spatial and temporal coverage, and identify different data not yet collected.

Make inventories more accessible to the data user. This can be accomplished through a data sharing infrastructure as discussed in section 5.4.

BENEFITS OF IMPLEMENTING RECOMMENDATIONS:

Fostering the adoption of new methodologies and technology will:

- promote the consistent and efficient sharing of water data between resource agencies,
- improve the usefulness and the quality of the water data, and
- identify the additional data that will be required in the future.

IMPACTS OF NOT IMPLEMENTING RECOMMENDATIONS:

Impact of recommendations not being implemented will result in:

- limited or difficult data sharing,
- redundant data maintenance, and
- repeated duplication of efforts and associated costs of water data collection.

5.6 HOW INVENTORIES CAN BEST BE INTEGRATED WITH OTHER INVENTORIES

FINDINGS:

- The number of inventory holders which commented on how their

respective inventories could best be integrated with other land inventories can be seen in Figure 35.

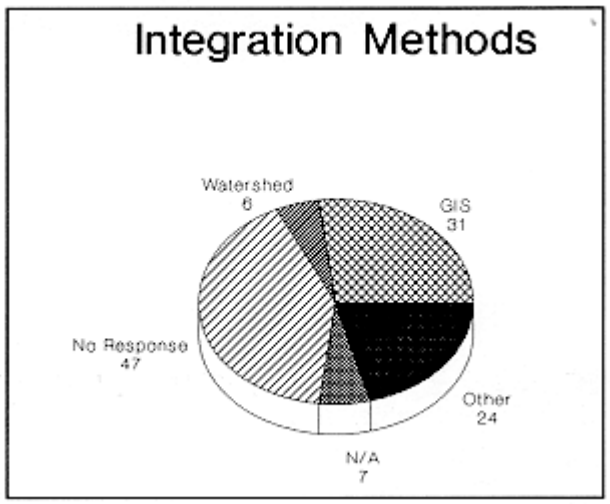

Figure 35: Number of respondents who suggested different types of integration methods.

- A GIS was perceived as the method best suited to meet the spatial data needs of the inventory holder.
- The drainage basin was the unit chosen by a number of respondents as the medium to integrate inventories.
- Other suggestions for better integration between inventories include: common geographic reference system; common names, terms and definitions; common standards; and communication of results and findings to appropriate agencies.

(F) RECOMMENDATIONS:

Assess and identify capabilities needed for storing, analyzing, and displaying all water and watershed data, through a GIS or some other capability.

This would include establishing whether or not current GIS initiatives have the potential to capture all data from the many diverse organizations which hold water and watershed information. This could be accomplished during implementation of a common data architecture (section 5.1).

BENEFITS OF IMPLEMENTING RECOMMENDATION:

Properly implementing any new integration technology or methodology will:

- allow for smoother transition for implementing a GIS or some other capability, and
- promote a common language between the different inventories of the Federal and Provincial governments and other organizations.

IMPACTS OF NOT IMPLEMENTING RECOMMENDATIONS:

Impact of recommendations not being implemented will result in:

- continued incompatibility between data bases,
- cooperation between the different organizations which hold water and watershed information will continue to be hampered, and
- continued difficulty and unnecessary expense in gaining or providing access to needed water data.

6. CONCLUSIONS

This report identified the major water and watershed inventories in the province of British Columbia. It focused on the status of those inventories and the needs of present and future users of water and watershed information. Based on two surveys, the following observation can be made:

- There is growing support among both collectors and users of information for the development of a common structure through which data can be identified, organized and shared.
- There is a large amount of valuable water and watershed information which has been, or is being collected in the province of BC. However, no one agency knows all of the data which are being collected or the areas those data represent.
- If all existing data were made known and available, more needs would probably be met. Cooperative data sharing is hindered because:

- different terms of reference are being used for the same variables and processes,
- formats and scales employed are not standardized, and
- different standards are being employed to collect, analyze, interpret and report the data.

A water resource information management plan is needed to guide the implementation of the findings of this report, and to provide for additions or amendments to the inventories as necessary. An integral part of this management plan would include a process which improves cooperation between the major data collection agencies.

If the organizations which capture water and watershed data are to meaningfully contribute to the process of improving the general status of resource inventories in this province, the plan should guide the completion of the following steps:

A. Develop a detailed data architecture for all water and watershed subject areas, which is compatible with any RIC initiative.

B. Perform a more comprehensive inventory of the Province's water and watershed resources at the data element level.

C. Identify water studies completed, in progress or pending and make information about these studies generally available through a central library.

D. Conduct a feasibility study to identify and implement an infrastructure for sharing water data, both public and private.

E. Provide the environment to adopt new methodologies and technologies which support the sharing and integration of data.

F. Assess and identify capabilities needed for storing, analyzing, and displaying all water and watershed data, through a GIS or some other capability.

APPENDIX A

SUMMARY OF INVENTORIES

Agassiz Climate Station
Agency: Agriculture Canada, Research Branch, Agassiz Research Station
Data Type: rain, snow, humidity, evaporation
Measurements: volume, time, physical
Period of Report: daily - 1889 to present; hourly since 1990
Medium: tabular, magnetic disks
Contact: Eric Taylor Phone: 664-9123

Alpine Monitoring Systems
Agency: MOTH, Operations, Highway Maintenance, Snow Avalanche Programs
Data Type: rain, snow
Measurements: volume, location, time
Period of Report: 1978 to present, seasonal October 31 - May 15
Medium: magnetic disks, tapes
Contact: Gordon Bonwick Phone: 387-7516 Fax: 356-8143

Ambient Water Quality Database
Agency: ELP, Water Management, Water Quality
Data Type: precipitation, stream/river, lake, reservoir
Measurements: volume, location, time, ownership, physical, chemical
Period of Report: Fed-Prov Agreement 85-present; objectives 85-present
Medium: magnetic disks
Contact: G. Bruce Holms Phone: 387-9508 Fax: 356-8298

Aquaculture Licensing and Revenue Administration System
Agency: MAFF, Aquaculture & Commercial Fisheries, Aquaculture Operations, Resource Analysis
Data Type: stream, reservoir, groundwater
Measurements: volume, movement, location, ownership, chemical
Period of Report: 1989 to present
Medium: Text, some maps, digital map, ALRAS tapes
Contact: Mona Jane Phone: 356-1605 Fax: 356-7280

Aquatic Plant File
Agency: ELP, Water Management Division, Water Quality
Data Type: stream, spring, lake, reservoir
Measurements: volume, location, biological
Period of Report: since early 1970's
Medium: maps, herbarium specimen, magnetic disks
Contact: Dr. P. Warrington Phone: 387-9513 Fax: 356-8298

ARDSA Projects
Agency: MAFF, Financial Development Programs Branch
Data Type: quality and quantity of water affecting agriculture
Measurements: volume, movement, location, time, availability, ownership, physical, biological
Period of Report: n/a
Medium: text, maps
Contact: H. Sasaki Phone: 356-1828 Fax:356-0044

ARIS (Assessment Report Indexing System)
Agency: MEMPR, Minerals, Geologic Survey, Geoscience Information,

Assessment Reports
Data Type: stream sediment
Measurements: time, metal content, chemical
Period of Report: since 1947 - mainly during summer months
Medium: test, tabular, microfiche, maps, magnetic disks
Contact: Talis Kalnins Phone: 356-2286

BC Hierarchial Watershed Coding System
Agency: ELP, Water Management Division, Hydrology
Data Type: stream, lake, reservoir
Measurements: location, length, gradient, order
Period of Report: digitized from 1985 to 1990
Medium: tabular, graphic plot, digital maps, magnetic tapes
Contact: Tom Webber Phone: 356-5149 Fax: 356-5496

Biological Database
Agency: ELP, Water Management Division, Water Quality
Data Type: biology and taxonomic data
Measurements: time, ownership, taxonomy presence/absence, biological
Period of Report: Dataset at Zenon Environmental Labs 1985-present
Medium: text, microfiche, magnetic disks
Contact: G. Bruce Holms Phone: 387-9508 Fax: 356-8298

Canadian Climate Archive
Agency: Environment Canada, AES, Scientific Services Division
Data Type: precipitation, rain, snow, hail, humidity, evaporation
Measurements: volume, movement, location, time, availability, physical, chemical
Period of Report: range from less than 1 year to greater than 100 years
Medium: text, tabular, microfiche, maps, magnetic disk, tapes
Contact: Earl Coatta Phone: 664-9156 Fax: 664-9195

CGDS - Computerized Groundwater Database System
Agency: ELP, Water Management, Hydrology, Groundwater, Inventory & Mapping
Data Type: groundwater
Measurements: volume, movement, location, availability, ownership, physical, chemical, biological
Period of Report: accepted data 1961-present
Medium: magnetic disks
Contact: Rod Zimmerman Phone: 387-9496 Fax: 356-5496

Coal File
Agency: MEMPR, Mineral Resources, Geological Survey, Economic Geology, Coal
Data Type: groundwater
Measurements: location, level
Period of Report: coal reports submitted annually
Medium: geophysical & drillers logs, magnetic disks
Contact: Maria Holaszko Phone: 387-7187 Fax: 356-8153

Contaminants Survey in Columbia River
Agency: DOE, Inland Waters Directorate, Environmental Surveys Branch, Environmental Studies Division
Data Type: stream, river, lake, reservoir
Measurements: physical, chemical, biological
Period of Report: Columbia River CRIEMP - November 1991, more to come
Medium: text, tabular, maps, digital maps, magnetic disks
Contact: Cris Baldazzi Phone: 666-8007 Fax: 666-3325

Contaminated Site Inventory or Register
Agency: ELP, Environmental Protection, IWHC, Contaminated Sites & Toxicology
Data Type: stream, runoff, groundwater
Measurements: volume, movement, location, ownership, contaminants, physical, chemical
Period of Report: specific to site study
Medium: text, tabular, maps, reports, magnetic disks
Contact: Roger Ord Phone: 356-8386 Fax: 387-9935

Data for Managing the Greater Vancouver Water District
Agency: Water Engineering & Construction, Watershed Management
Data Type: rain, snow, humidity, stream
Measurements: volume, movement, location, time, availability, physical
Period of Report: varies, some from early 1930's
Medium: text, tabular, maps, digital maps, lightening load
Contact: Wayne Mather Phone: 432-6411 Fax: 432-6419

DCP Hydromet Database (BC Hydro)
Agency: Hydrotechnical Department
Data Type: rain, snow, stream, river, ponded water
Measurements: volume, movement, location, time, availability, ownership
Period of Report: automated Hydromet Network, 1980-92
Medium: magnetic tapes, tapes
Contact: W. Q. Chin Phone: 663-2747 Fax: 666-3597

Dioxin Survey 1988-89
Agency: DOE, Inland Waters Directorate, Environmental Surveys Branch, Environmental Studies Division
Data Type: stream, river, lake, reservoir
Measurements: physical, chemical, biological
Period of Report:
Medium: text, tabular, maps, digital maps, magnetic disks
Contact: Cris Baldazzi Phone: 666-8007 Fax: 666-3325

Drinking and Recreational Water (WASCS - under development)
Agency: MOH, Environmental Health, Protection Branch
Data Type: stream, spring, lake, reservoir, groundwater
Measurements: location, time, ownership, physical, chemical, biological
Period of Report: usually continuous data since 1985
Medium: text, tabular, lab reports
Contact: Barry Willoughby Phone: 387-2696 Fax: 356-8850

Environmental Quality Objectives: Water Ecosystem
Agency: DOE, Conservation & Protection, Inland Waters Directorate, Integrated Program Branch, Environmental Quality Objective
Data Type: stream, lake, reservoir, groundwater
Measurements: physical, chemical, biological
Period of Report:
Medium: text
Contact: Fred Mah Phone: 666-8000 Fax: 666-6713

Fire Weather Network
Agency: MOF, Operations, Protection, Fire Management
Data Type: rain, humidity
Measurements: volume, time
Period of Report: automated since 1970 - 240 fixed sites
Medium: magnetic disks
Contact: Eric Meyer Phone: 356-5250 Fax: 387-5685

Fish/Sediment Lake Database
Agency: ELP, Water Management Division, Water Quality
Data Type: lake, sediment, lake morphology
Measurements: volume, location, physical, chemical, biological
Period of Report: 1983 to present
Medium: VAX data files
Contact: Colin McKean Phone: 387-9511 Fax: 356-8298

Flood Control Investigation and Report
Agency: ELP, Water Management Division, Floodplain Management Branch, Flood Control and Response
Data Type: stream, high water, River cross-section
Measurements: volume, movement, location, time, level
Period of Report: site specific & as required since 1940's
Medium: text, maps, drawings, magnetic disks, tapes
Contact: Don Finlay Phone: 387-9537 Fax: 387-3429

Floodplain Management Plans
Agency: ELP, Water Management Division, Floodplain Management, Regional Operations & Planning Section
Data Type: stream
Measurements: volume, movement, location
Period of Report:
Medium: text
Contact: Neil Hamilton Phone: 387-3427 Fax: 387-9540

Floodplain Maps
Agency: ELP, Floodplains Management Branch
Data Type: rain, snow, stream, lake, reservoir
Measurements: volume, movement, location
Period of Report:
Medium: maps, digital maps in future
Contact: Maps BC Phone: 387-1441 Fax: 387-3022

Geothermal Development
Agency: MEMPR, Mines, Geological Survey Branch
Data Type: deposit from ponded water
Measurements: chemical
Period of Report: A one time project- summer 1990
Medium: tabular, maps
Contact: B. N. Church Phone: 356-2855 Fax: 356-8153

Greater Vancouver Water Dist Water Quality Data
Agency: Water Engineering & Construction, Quality Control
Data Type: stream, reservoir
Measurements: volume, physical, chemical, biological
Period of Report: since 1950's; tributary data since 1989
Medium: text, tabular, maps
Contact: Judy Smith Phone: 451-6004 Fax: 451-60192

Greater Victoria Water District
Agency: Water District
Data Type: rain, stream, reservoir
Measurements: volume, movement, time, physical, chemical, biological
Period of Report: 1990 to present
Medium: tabular; magnetic disks
Contact: Stewart Irwin Phone: 478-1715 Fax: 474-4012

Groundwater (Regional Aquifer Analysis)
Agency: EMR, Cordilleran Division, Geological Survey of Canada
Data Type: just beginning our inventory
Measurements: movement, location, physical, chemical
Period of Report: just beginning
Medium: text, tabular, maps - digital maps planned
Contact: Brian Ricketts Phone: 666-6022 Fax: 666-1124

Groundwater Monitoring Well Database
Agency: ELP, Environmental Protection
Data Type: groundwater
Measurements: location, ownership
Period of Report: during 1989
Medium: magnetic disks
Contact: Rod Zimmerman Phone: 387-9464 Fax: 356-5496

Groundwater Potential Mapping (East Coast Vancouver Island)
Agency: ELP, Water Management Division, Hydrology, Groundwater, Inventory & Mapping
Data Type: precipitation, lake, groundwater
Measurements: location, availability, physical, chemical
Period of Report:
Medium: some text, maps
Contact: Rod Zimmerman Phone: 387-9464 Fax: 356-5496

Groundwater Section NTS Files
Agency: ELP, Water Management Division, Hydrology, Groundwater, Inventory & Mapping
Data Type: precipitation, overland flow, ponded
Measurements: volume, movement, location, time, availability, ownership, physical, chemical, biological
Period of Report: 1888 to present
Medium: text, tabular, maps
Contact: Rod Zimmerman Phone: 387- 9464 Fax: 356-5496

Hydrology Studies
Agency: ELP, Water Management Division, Hydrology, Hydrology
Data Type:
Measurements: volume, movement, location, time, availability
Period of Report: 1975 to date
Medium: text; 52,020 files
Contact: C. H. Coulson Phone: 387-9487 Fax: 356-5496

NAQUADAT
Agency: DOE, Inland Waters Directorate, Environmental Surveys, Operations
Data Type: stream, lake
Measurements: physical, chemical
Period of Report: since 1979
Medium: text, magnetic disks, tapes
Contact: Jen-ni Ströh Phone: 666-8011 Fax: 666-3325

Naquadat Groundwater Chemistry Database
Agency: DOE, Inland Waters Directorate
Data Type: groundwater
Measurements: location, physical, chemical
Period of Report: 1954 to 1980
Medium: magnetic disks
Contact: Rod Zimmerman Phone: 387-9464 Fax: 356-5496

Observation Well Network
Agency: ELP, Water Management Division, Hydrology, Groundwater, Engineering
Data Type: groundwater levels
Measurements: volume, movement, location, availability, ownership, physical, chemical, biological
Period of Report: since 1961; up to 30 years per well
Medium: text, maps, magnetic disks
Contact: Mike Wei Phone: 356-5062 Fax: 356-5496

Physiographic Databank
Agency: DOE, Inland Waters Directorate, Environmental Surveys Branch, Networks
Data Type: mean elevation, slope, stream density
Measurements: location
Period of Report:
Medium: text, tabular, maps, tapes
Contact: Paul Whitfield Phone: 666-8009 Fax: 666-3329

Project File and Freshwater Database (FWD)
Agency: DOE, Environmental Protection, Pollution & Abatement, Environmental Effects Monitoring, Freshwater
Data Type: stream, lake
Measurements: volume, movement, availability, physical, chemical, biological
Period of Report: 1984 to 1990 - Ability to collect less each year
Medium: tabular, magnetic disks
Contact: Bryan Kelso Phone: 666-5193 Fax: 666-6858

Project Library
Agency: MEMPR, Mineral Resources, Mine Development Assessment Branch
Data Type: stream, lake, reservoir, groundwater
Measurements: volume, movement, location, time, availability, ownership, physical, chemical
Period of Report: ongoing
Medium: text, tabular, maps, sometimes with company
Contact: Bob Paul Phone: 356-2195 Fax: 387-5985

QA Round-Robin Data
Agency: ELP; Environmental Protection; Evaluation, Economic, & Lab Services; Lab Services & Systems Management Section
Data Type: water, effluents
Measurements: chemical
Period of Report: LRTAP & FPQA since 1985; EDQA since 1991
Medium: magnetic disks
Contact: Malcolm Clark Phone: 387-9947 Fax: 356-7197

Regional Geochemical Survey (RGS) Database
Agency: MEMPR, Mineral Resources, Geological Survey, Environmental Geology, Applied Geochemistry
Data Type: stream sediment and waters
Measurements: physical, chemical
Period of Report: 1976 to present, during summer field season
Medium: tabular, maps, floppy diskettes
Contact: Wayne Jackaman Phone: 356-6249 Fax: 356-8153

Research on Efficient Use of Nitrogen in Agriculture
Agency: Agriculture Canada, Research Branch, Agassiz Research Station
Data Type: rain, soil and air temperature, soil moisture
Measurements: volume, movement, time, physical, chemical, biological
Period of Report: variety of projects, 1 to 5 years long
Medium: tabular, magnetic disks
Contact: B. J. Zebarth Phone: 796-2221 Fax: 796-2221

Research Water Quality Monitoring
Agency: MOF, Research, IRM
Data Type: precipitation, rain, stream, river
Measurements: volume, time, chemical
Period of Report: 1974-91; 1989-91; 1982-91
Medium: text, magnetic disks
Contact: Steve Chatwin Phone: 387-5887 Fax: 387-0646

SEAM
Agency: ELP, Environmental Protection; Evaluation, Economic & Lab Services, Lab Services & Systems Management
Data Type: rain, snow, stream, spring, lake
Measurements: volume, location, availability, ownership, physical, chemical, biological
Period of Report: 1965 to present
Medium: magnetic disks
Contact: Nellie Peppin Phone: 387-9962 Fax: 356-7197

SEAM
Agency: ELP, Water Management Division, Environmental Protection, Water Quality
Data Type: stream, lake, reservoir
Measurements: physical, chemical, biological
Period of Report: 1970 to present
Medium: text, tabular, microfiche, maps, tapes
Contact: Rick Nordin Phone: 387-9517 Fax: 356-8298

Small Hydro Database
Agency: MEMPR, Energy Resources Division, Energy Projects Analysis Branch
Data Type: stream
Measurements: location, ownership
Period of Report: 1989 to present
Medium: text; database
Contact: Denise Mullen Phone: 356-2154 Fax: 387-1339

Snow
Agency: ELP, Water Management Division, Hydrology, Hydrology Operations, Snow Surveys
Data Type: snow depth and water equivalent
Measurements: volume, time, depth
Period of Report: 300 sites - began in 1935
Medium: tabular, microfiche, film, tapes - VAX data file
Contact: Janis Matthews Phone: 387-9485 Fax: 356-5496

Snow Pillow Station Data
Agency: ELP, Water Management Division, Hydrology, Hydrology Operations, Snow Surveys
Data Type: precipitation, temperature, snow water equivalent
Measurements: volume, time
Period of Report: 1986 to present
Medium: tapes; VAX data file
Contact: Helmut Ovie Phone: 387-7669 Fax: 356-5496

Stream/Lake Inventory
Agency: ELP, Fisheries, Conservation, Stock Management
Data Type: stream, watershed, gradient
Measurements: volume, movement, location, time, availability, ownership, physical, chemical, biological, velocity, depth distribution
Period of Report: 1970 to present
Medium: text, tabular, maps, graphs, tapes
Contact: Ron Ptolemy Phone: 387-9582 Fax: 387-9750

Surface Water Data
Agency: DOE, Environmental Surveys Branch
Data Type: rain, stream, lake, reservoir
Measurements: volume, movement, location, time, availability, ownership, physical, chemical, biological
Period of Report: Fraser River at Hope, 1912 to present; Others 10-20 years
Medium: tabular, optical disks, magnetic disks, tapes
Contact: C. Robinson Phone: 666-3858 Fax: 666-3325

Surficial Geology Map Index of British Columbia
Agency: MEMPR, Geological Survey Branch, Environmental Geology, Surficial Geology
Data Type: surficial geology
Measurements:
Period of Report: since 1989 - maps of surficial geology in BC
Medium: tabular, maps, magnetic disks
Contact: Peter Bobrowsky Phone: 356-7763 Fax: 356-8153

System Operations Hydmet
Agency: BC Hydro
Data Type: precipitation, snow water equivalent, reservoir
Measurements: volume, movement, location, time, availability, peak
Period of Report: Hydro project - 1920 to present
Medium: text, snow flight line data, magnetic disks
Contact: Brian Fast Phone: 293-5851 Fax: 293-5813

Undeveloped Watersheds of BC
Agency: MOF, BC Forest Service, Recreation Branch
Data Type: undeveloped watersheds with less than 2% human disturbance
Measurements:
Period of Report: data continuous & collection completed
Medium: maps, report, digital maps
Contact: Terje Vold Phone: 387-8482 Fax: 356-5909

Ungulate Winter Flight Mapping
Agency: ELP, Wildlife Branch
Data Type: snow
Measurements: depth
Period of Report:
Medium: maps
Contact: Bruce Pendergast Phone: 387-9770 Fax: 356-9145

Unpublished Hydrometric Data
Agency: ELP, Water Management Division, Hydrology, Hydrology Operations, Hydrometric Surveys
Data Type: stream, river, lake, reservoir
Measurements: volume, movement, level
Period of Report: miscellaneous periods from 1913
Medium: text, tabular
Contact: Bob Richards Phone: 387-9480 Fax: 356-5496

Various Research, Management Projects in BC
Agency: ELP, Wildlife
Data Type: snow
Measurements: location, time, snow depth
Period of Report: As far back as records go
Medium: text, tabular, maps
Contact: Myke Chutter Phone: 387-9797 Fax: 356-9145

Various Water Quality Programs
Agency: DFO, Habitat Management Division, Fisheries Branch, Water Quality Unit
Data Type: effluent, stream, sediment, biota
Measurements: physical, chemical, biological
Period of Report: since 1989 - dioxin program ongoing
Medium: text, tabular, magnetic disks
Contact: Steve Samis Phone: 666-0280 Fax: 666-7907

Water Licence Records
Agency: ELP, Water Management Division, Water Rights, Water Licensing
Data Type: stream, spring, lake, reservoir
Measurements: volume, location, time, availability, ownership
Period of Report: data originates from early 1900's
Medium: maps, files, digital maps, magnetic disks
Contact: Gary Robinson Phone: 387-5981 Fax: 387-1878

Water Quality Check Program Data
Agency: ELP, Water Management Division, Hydrology, Groundwater, Inventory & Mapping
Data Type: groundwater
Measurements: physical, chemical, biological
Period of Report: 1980 to present
Medium: text, tabular
Contact: Rod Zimmerman Phone: 387-9464 Fax: 356-5496

Water Use Studies
Agency: DOE, Conservation & Protection, Environmental Evaluations & Planning, Socioeconomic Division
Data Type: stream, lake, reservoir, groundwater
Measurements: seasonal volume of use by sub-basin
Period of Report: since 1985
Medium: text
Contact: Roger McNeill Phone: 666-6956 Fax: 666-6756

Water Utility Database
Agency: ELP, Water Management Division, Water Rights, CWSS
Data Type: stream, spring, lake, reservoir, groundwater
Measurements: volume, location, availability, ownership, physical, biological
Period of Report: 1942 to date
Medium: text, maps, magnetic disks
Contact: John R. Wigmore Phone: 387-6341 Fax: 356-8298

Water Well Location Mapping
Agency: ELP, Water Management Division, Hydrology, Groundwater, Inventory & Mapping
Data Type: groundwater
Measurements: location
Period of Report: accepted data - 1961 to present
Medium: maps
Contact: Rod Zimmerman Phone: 387-9464 Fax: 356-5496

Water Well Records Files
Agency: ELP, Water Management Division, Hydrology, Groundwater, Inventory & Mapping
Data Type: groundwater
Measurements: volume, movement, location, availability, ownership, physical, chemical, biological
Period of Report: accepted data - 1961 to present
Medium: text, microfiche
Contact: Rod Zimmerman Phone: 387-9464 Fax: 356-5496

Watershed Characteristics
Agency: ELP, Water Management Division, Hydrology, Hydrology, Watershed Studies
Data Type: watershed physiographic characteristics
Measurements:
Period of Report: n/a
Medium: tabular, maps
Contact: D. Reksten Phone: 387-9475 Fax: 356-5496

Watersheds in the Coastal Temperate Forests of BC
Agency: Earth Life Canada Foundation & Ecotrust/Conservation International
Data Type: primary watersheds, area, development
Measurements:
Period of Report: approximately a 1 year program
Medium: text, maps, computer database
Contact: Keith Moore

Well File (Oil & Gas Wells) - Hard Copy
Agency: MEMPR, Energy Resources, Engineering & Operations
Data Type: lithology information - GR log
Measurements: location, level
Period of Report: approximately the mid-1940's to present
Medium: paper files
Contact: Bruce Hanwell Phone: 356-2752 Fax:

Wetlands of the Fraser Lowland - An Inventory 1989
Agency: Environment Canada, Canadian Wildlife Service
Data Type: wetlands
Measurements: location, ownership, extent
Period of Report:
Medium: text, tabular reports, maps, digital maps, magnetic disks
Contact: Peggy Ward Phone: 946-8546 Fax: 946-7022

APPENDIX B

Recipients of Water & Watershed Task Force
"Questionnaire for Users of Water Inventory Data"

Name		Agency	Phone / fax
Terry Anderson	(P)	Water Mgmt, ELP Kootenay	354-6372 / 354-6332
Jurgen Baumann	(C)	Entech Environmental Cons	688-8915 / 688-6691
Tim Bekhuys	(C)	Tera Planning	222-8372
David Buxton	(C)	Knight & Piesold	685-0543
Jim Card	(P)	Water Mgmt, ELP VI Reg	758-3951 / 755-2473
Eddy Carmack	(F)	Inst of Ocean Sciences	363-6585
T. R. Carter	(O)	Assoc of BC Irrigation Dist.	861-1021
Inge Cathers	(O)	NRS Block Bros Realty	754-4401 / 754-7819
Tom Chamberlin	(P)	Fish & Wildlife, ELP Skeena	847-7279 / 847-7491
Adrian Chantler	(C)	Steffen Robertson & Kirsten	681-4196 / 687-5532
Allan Chapman	(P)	Hydrology Section EL&P	387-9476 / 356-5496
Hal Coulson	(P)	Hydrology, EL&P	387-9481 / 356-5496
Allan Dakin	(C)	Piteau Associates Eng	986-8551 / 985-7286
John Deniseger	(P)	Env Protection, ELP, VI Reg	758-3951 / 755-2473
Rob Dickin	(C)	Gartner Lee	299-4144 / 299-1455
Bill Duncan	(P)	Env Protection, ELP Northern	565-6443 / 565-6629
B. Elsdon	(O)	BCBC, Port Coquitlam	
Peggy Evans	(C)	Golder Associates Ltd	879-9266 / 879-5014
Melody Farrell	(F)	Habitat Mgmt, DFO - Van	
M. C. Gow	(P)	Env Protection, ELP Lwr M'land	582-5272 / 584-9751
Robert Grace	(P)	Fish & Wildlife, ELP S. Int	371-6289 / 828-4000
Hugh Harris	(C)	ERM Canada	684-4434 / 669-6968
E. Heatherington	(F)	Pacific Forestry Centre, MOF	363-0600 / 363-0775
L. S. Hundal	(C)	HBT AGRA Ltd	374-1347 / 374-2944
Bruce Ingimundson	(C)	Thurber Engineering Ltd	727-2201 / 727-3710
Peter Iwasiuk	(O)	Country Squire Realty	534-9261
Lidia Jaremovic	(F)	DFO, Fraser River T. F.	666-0017
Barry Jones	(P)	Weather Room, MoF V'ncvr Reg	
Dave King	(P)	Fish & Wildlife, ELP Northern	565-6422 / 565-6629

Name		Agency	Phone / fax
Allan C. Kraus	(O)	Dewdney-Alouette Reg Dist	462-8294 / 826-5843
Bruce Letvak	(P)	Hydrology Section EL&P	387-9477 / 356-5496
E. Livingston	(C)	Pacific Hydrology Consultants	738-9232 / 736-8359
Denis Lowen	(C)	KPA Engineering	388-6676 / 388-4014
Paul Marquis	(P)	Water Mgmt, ELP Skeena Reg	847-7275 / 847-7491
Brad Mason	(F)	Coordination, Inventories & Restoration, DFO	666-7015
Elvin Masuch	(O)	Erickson Imp Dist, Creston	428-2612/ hm -4461
Lesley McMahon	(O)	Nanaimo Realty	247-2003 / 247-9551
Robin McNeil	(P)	Water Management Branch, EL&P	387-9452 / 356-5496
Johnny Mikes	(O)	Canadian River Expeditions	738-4449 / 736-5526
Rick Morley	(P)	Fish & Wildlife, ELP Kootenay	354-6344 / 354-6332
W. Obedkoff	(P)	Hydrologic Engineer, ELP	387-9474 / 356-5496
Sam Olynyk	(O)	Revelstoke Public Works	
Leo Pauloski	(P)	Water Mgmt EL&P - Penticton	490-8200
Larry Pommen	(P)	Water Mgmt, EL&P	387-9516
Don Reksten	(P)	Hydrology, EL&P	387-9472
R. P. Richards	(P)	Surface Water Ops, ELP	387-9480 / 356-5496
Guy Roberts	(C)	Stanley Associates Engineering	597-0422
Ken Rood	(C)	N'west Hydraulics Consultants	980-6011
Erich Schulz	(P)	Soils and Engineering, MAFF	356-1684 / 387-3522
Yaroslav Shumuk	(C)	KPA Engineering	388-6676 / 388-4014
Annette Smith	(C)	NORECOL Env. Consultants	682-2291
Les Swain	(P)	Water Mgmt, EL&P	387-9518
Vic Swiatkiewicz	(P)	Fish & Wildlife, ELP Lwr M'land	584-8822 / 584-9751
Eric Terhorst	(C)	Dames and Moore	683-5585 / 683-7758
Joe Truscott	(P)	Aquaculture & Comm Fisheries MAFF	387-9570 / 356-7280
J. Van Der Eerden	(C)	Associated Engineering	293-1411 / 291-6163
Robert Wallwork	(C)	Hay & Company Consultants	875-6391

(F) - Federal (P) - Provincial (C) - Consultant (O) - Other