FRASER RIVER ACTION PLAN

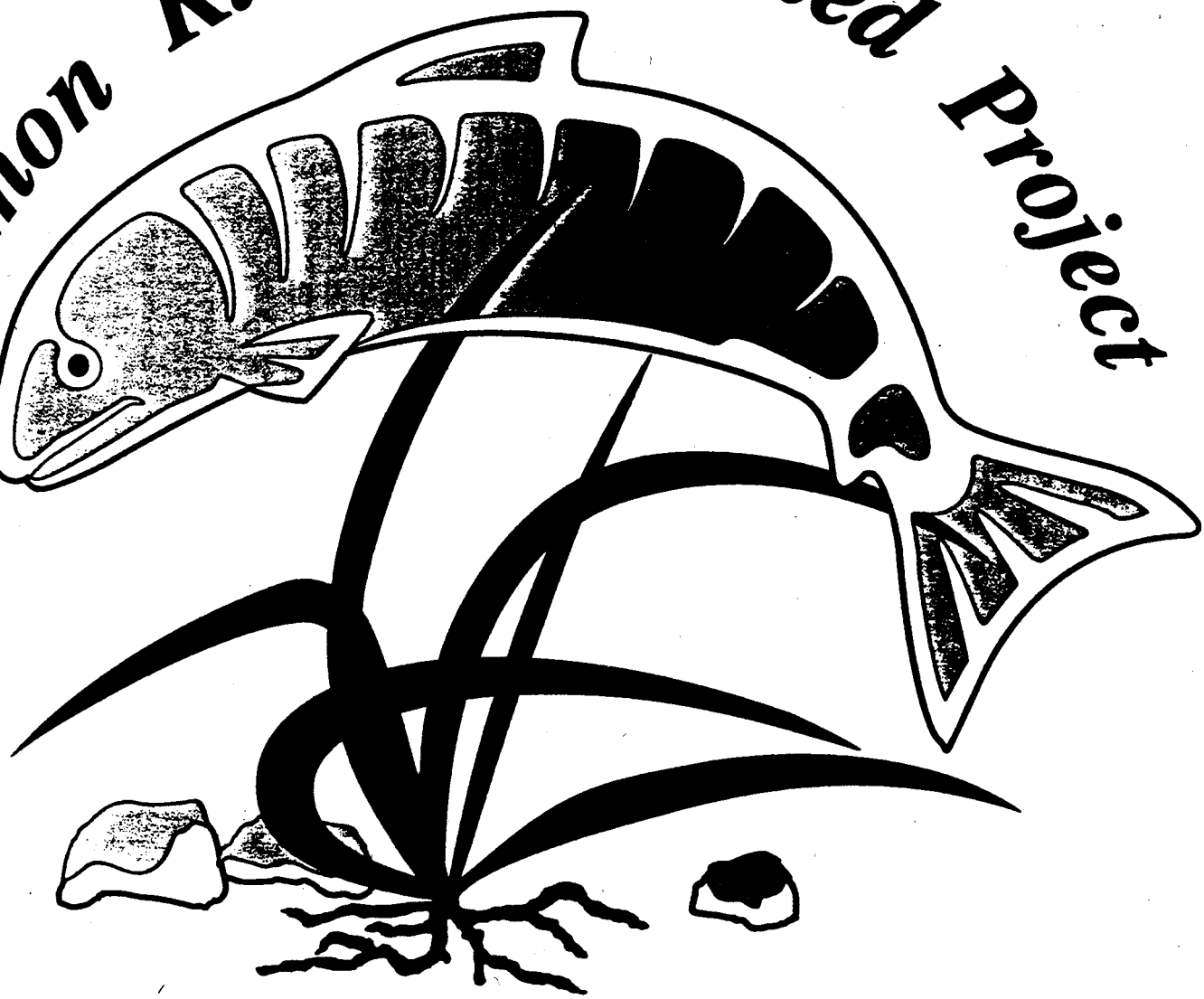
Salmon River Technical Co-ordination Workshop

February 13, 1995
Salmon Arm, B.C.

DOE FRAP 1995-01

Environment Canada
Environnement Canada

Salmon River Watershed Project



SALMON RIVER TECHNICAL CO-ORDINATION WORKSHOP

FEBRUARY 13, 1995

LIONS CLUB HALL, SALMON ARM

SALMON RIVER TECHNICAL CO-ORDINATION WORKSHOP

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Compiled by:

Kelly Hamm

Science Division
Environmental Conservation Branch
Environment Canada
Pacific and Yukon Region
North Vancouver, British Columbia

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TABLE OF CONTENTS

PAGE

INTRODUCTION

The Salmon River Technical Co-ordination Workshop was held on February 13, 1995 in Salmon Arm at the Lions Club Hall. The workshop was organized with the assistance of the Salmon River Watershed Roundtable. Over 50 people attended, 38 of which were registered and are listed in Appendix C. Participants took advantage of this workshop to exchange information and to make contacts for future studies. The objectives of the meeting were:

- to provide a forum for information exchange and dialogue,
- to promote co-operation among scientists, and
- to integrate current research/study results into the knowledge base to support the development of ecosystem objectives.

Seventeen papers were presented yielding a wide range of topics. There were 3 papers presented on ecosystem objectives, 3 on monitoring, 2 on water quality, 1 on water use, 2 on forestry, 3 on habitat assessment/rehabilitation and restoration, 2 on GIS and 1 on climate change.

A session facilitated by Neils Christiansen of the Salmon River Watershed Roundtable provided a chance for the participants to discuss the integration of current research/studies into the knowledge base to support the development of ecosystem objectives. Participants were put into work groups to propose "kernels" of technical wisdom that they thought residents of the watershed needed to know. The work groups organized the "kernels" of technical wisdom into the following categories: Human Impacts, Understanding water and its Use, Community Stewardship, Value of Riparian Zones, Habitat Restoration, Rehabilitation and Conservation, and Fish Habitat Requirements. It was proposed that fact sheets be developed which can be used to support the development of ecosystem objectives for the Salmon River Watershed.

The following is a documentation of the abstracts presented by the various researchers as well as abstracts of other projects involved in the Salmon River Watershed. Overheads of presentations are included in the appendix.

SECTION 1:

PRESENTATION ABSTRACTS

A FRAMEWORK FOR DEVELOPING GOALS, OBJECTIVES AND INDICATORS FOR ECOSYSTEM HEALTH: TOOLS FOR ECOSYSTEM-BASED MANAGEMENT

Salmon River Technical Workshop

Janet M. Stavinga
Guy R. Rochon
Amanda J. Brady
Michael P. Wong

Guidelines Division, Evaluation and Interpretation Branch, Ecosystem Conservation Directorate, Environment Canada, 351 St. Joseph Blvd., 8th Floor, Hull, Quebec, Canada K1A 0H3; tel.: (819) 953-1550; fax: (819) 953-0461.

February 13, 1995

Abstract

The rise of environmental issues on public and hence political agendas has created an increased demand for succinct, understandable, and representative information about the environment. A framework for developing goals, objectives and indicators of ecosystem health, which describes a method to aid the development or selection of ecosystem health indicators, is one mechanism for meeting these information requirements. This framework, developed under the auspices of the Canadian Council of Ministers of the Environment (CCME), combines the scientific development of indicators with an objective-setting process which allows for input from stakeholders who utilize ecosystem resources (e.g., community groups, industry, indigenous peoples, land owners).

The principles underlying this framework are based upon those of an 'ecosystem approach' to environmental planning, management, and decision-making. The framework therefore emphasizes the need to acknowledge and integrate societal values and economic considerations, in addition to environmental conservation and protection goals, into these activities. Elements of this framework have appeared in many ecosystem-based projects across North America, (e.g., Great Lakes, Northern River Basins Study, Atlantic Coastal Action Program). The framework incorporates successful elements of these different programs, and offers consistent terminology to describe these elements. The process recommended involves the sequential development of ecosystem health 'goals' and 'objectives' which describe the desired state of an ecosystem, as articulated by stakeholders within that ecosystem through a participatory, consensual process. Indicators are then developed as a means to tract progress toward the attainment of these objectives. Increased use of ecosystem goals, objectives and indicators will help redirect environmental monitoring toward more anticipatory processes, and will link data collection efforts to society's environmental, social, and economic values, goals, and priorities. The most significant implementation challenges will include identifying appropriate measures of ecosystem health, and effectively integrating community involvement.

SALMON RIVER WATERSHED
ECOSYSTEM GOALS AND OBJECTIVES

Salmon River Technical Workshop

Tyhson Banighen
Socio-Environmental Policy Planner
Salmon River Watershed Project

February, 13 1995

Abstract

EVOLUTION OF THE SALMON RIVER WATERSHED ECOSYSTEM

General Objective

The first steps in developing goals, objectives and indicators of ecosystem health is the coalition and dissemination of the existing ecosystem knowledge base in the form of a report. This report will provide all ecosystem stakeholders with a common knowledge base to assist in future decision-making processes. This information will be made available to citizens at six watershed planning workshops that are scheduled to occur in the watershed over the next six month period. The report will provide important information for members of the public by giving a broad overview of historical and future forces which either have had or likely will have an influence upon the evolution of the Salmon River watershed ecosystem.

Specific Objectives

Specific objectives for the study are grouped into three areas: literature review, analysis of historical and possible future impacts and presentation of results.

Review

Coalition of existing ecosystem knowledge will encompass, but will not be limited to a review and description of the following:

Phase 1

* ecological information including climate, ecosystem structure and function, habitat and aquatic and terrestrial wildlife communities.

* information on the physical components of the geographical area.

Phase 2

* economic information including land use and land use changes, input, products, wastes generated and resource stocks and flows, incomes, economic

problems and opportunities for economic improvement.

* social information including demographics, human health, community values, social organization, mechanisms for community evaluation and change.

The information gathered will be categorized in terms of historical development, current status and future forces.

Historical

Historical impacts will be grouped into three major topics:

1. Non-human influences encompassing the geological, climatological and biological evolution of the watershed which have shaped the present day physical structure, hydrology, soils, flora and fauna. This will include the delineation and description of the major ecosystems within the watershed.

2. Aboriginal influences in terms of the extent, culture and impact of the aboriginal people living in the watershed from the first settlement to the present.

3. Cultural impacts since European settlement including dates of settlement, major types of activities such as logging and agriculture and various phases of these activities with regards to the impact on the human and non-human aspects of the watershed.

Future

The study will attempt to identify the major forces likely to exert an influence on the watershed ecosystem over the next several decades by five or ten year periods such as population pressure, decline in petroleum as a source of energy, global warming and major shifts in the world economy likely to effect, directly or indirectly, the economy of the watershed and the potential for economic niches.

Presentation of Results

The review of the geological, climatological, biological and (social and economic) evolution of the watershed and likely consequences of future human and non-human influences. The review will become more detailed as it progresses from the distant past to the present and will be presented in a report that is readable by both professional and lay people.

COMMUNITY DEVELOPMENT OF ECOSYSTEM OBJECTIVES

Salmon River Technical Workshop

Neils Christiansen
Salmon River Watershed Roundtable

February 13, 1995

Abstract

The Salmon River Watershed Roundtable is developing ecosystem goals and objectives for the Salmon River watershed in the interior of B.C. through a community wide process. The process is following the Ecosystem Objectives Framework developed by Environment Canada and is described in *The Salmon River Planning Guide* adopted by the Roundtable in October of 1994.

Principles

The Roundtable considers several principles (described in the *Guide*) fundamental to the development of both short and long term ecosystem goals as well as an action plan to achieve those goals. These principles include consensus based planning among all stakeholders in the watershed, sustainable living, the ecosystem approach and a plan which is operationally useful to all decision makers (public and private) in the watershed.

Work Plan

A group of 31 stakeholders in the watershed participated in a two day workshop facilitated by the Institute of Cultural Affairs during which they developed a work plan to be followed during the next nine months in developing the watershed community's ecosystem objectives and action plan. The work plan identifies several major tasks to be completed, their "victory" goals, learns and time lines of activity. The task forces and their intents are summarized below.

Community Outreach - designs, promotes through personal contact and facilitates community meetings.

Education Awareness & Volunteers - media promotion and volunteer coordination.

Information Access - Identifies useful historical and technical information and presents it in readable form.

Groundwater Legislation - Collates and presents legislative information on ground water.

Coordinating Partnerships - Agreements with the First Nations and government stakeholders on their involvement and support of the ecosystem goals and action plan.

SALMON RIVER CORRIDOR RESTORATION PROJECT

Salmon River Technical Workshop

Michael Crowe
Department of Fisheries and Oceans

February 13, 1995

Abstract

Over the last year, the Dept. of Fisheries and Oceans participated in the Salmon River Watershed Restoration Project as part of its ongoing commitment to restore salmonid productivity to the Salmon River. During 1994, the Restoration Project participated in stream and riparian habitat rehabilitation projects on 14 separate properties along the river. Some of the Rehabilitation work was a continuation of projects begun up to three years ago as DFO, SNFC, or Salmon River Watershed Roundtable Projects. Each project was tailored to the specific habitat concerns to be addressed at each site. Some consisted of simple planting programs, others included livestock exclusion fencing, and a number required a stream bank stabilization component. The tree revetments, which were a common bank stabilization technique, provided the additional benefit of creating juvenile salmonid habitat. The guiding principle of this restoration strategy was the creation of a riparian corridor along the entire length of the Salmon River. This strategy evolved out of the realization that a stream with poor riparian and instream habitat can not successfully be restored in immediate proximity to agricultural development. A sufficient buffer is required to separate the two activities. The corridor concept, in conjunction with the 1994 projects was discussed. Numerous issues and problems with the program were examined, such as; width of an adequate corridor, protecting the corridor, developing participation, and a lack of sufficient means to encourage participation.

WATER STEWARDSHIP, STREAM KEEPERS AND CITIZEN BASED DATA COLLECTION

Salmon River Technical Workshop

Kim Fulton
Water Stewardship Project Coordinator MOELP

February 13, 1995

Abstract

The Water Stewardship Program began in June of 1992 under the auspices of the British Columbia Ministry of Environment, Lands, and Parks - Fisheries Branch. A team of educators from the public school system was brought together by the Faculty of Education at Simon Fraser to develop an educational program to help schools and community groups learn about water stewardship. The project has gone through the following phases: development, field testing/ evaluation, inservice field testing. The guide is currently being printed and full scale implementation will begin in March with province wide workshops. The guide features: a definition of stewardship, assessment of prior knowledge, key concepts for water stewardship, a teaching/learning philosophy, activities to foster stewardship, case studies in stewardship, and a guide to development of action programs. So far over three hundred educators have taken part in the program.

Stream Keepers has been developed by the Department of Fisheries and Oceans to meet the need for local groups to have information on how to undertake meaningful stewardship projects. The program is composed of modules including: Stream Mapping, Water Quality, Stream Invertebrate Survey, Storm Drain Marking, Stream Clean-up, Streamside Planting, Observe Record Report, and is currently being revised and will be released for use in March of this year. Capilano College has developed the training for the trainers. Several of the modules involve the collection of data for the purpose of ongoing monitor of water and habitat quality.

Simon Fraser University Faculty of Education is working on a contract to pilot a system for data management and to make recommendations on what sort of permanent data base should be established for collecting valuable monitoring information. The collection system will be based on principles of : multiple methods of input (computer/modem, fax, and Canada Post), easy public and government access to information, minimum cost of data entry, and maximum security of data. The forms are being revised and will be ready to go in March when Stream Keepers Data is expected to start pouring.

The B.C. School Trustees Association, The B.C. Superintendents Association, and Faculty of Education and SFU have been awarded a Partners in Science Awareness Grant to do a demonstration project entitled Networking the Fraser River. The Fraser River Basin is the unifying theme around which local business, industry, First Nations groups, community organizations, government agencies, and schools will be involved in looking at science and technology applications. This collaborative effort will culminate in a public event, "River Awareness Week" at which portraits of the Fraser River and working data about its ecology and economy will be made available to the public. We will be illustrating the wide array of information necessary to understanding and enhancing the health and economic life of the river.

Water Stewardship, Stream Keepers, the Data Base Project, and the Networking the Fraser River fit together beautifully and are powerful educational tools to help protect, preserve and restore our precious aquatic ecosystems.

CITIZEN BASED ENVIRONMENTAL MONITORING PROGRAM FOR THE SALMON RIVER WATERSHED PROJECT

Salmon River Technical Workshop

Tyhson Banighen
Socio-Environmental Policy Planner
Salmon River Watershed Project

February 13, 1995

Abstract

Project Summary

The prime goal of the Salmon River Watershed Project is to achieve and maintain a healthy watershed environmentally, socially and economically. The intent of the Community Based Environmental Monitoring Program is to increase public awareness of the state of the environment in the watershed. Community groups through out the watershed will be trained to man 20 monitoring sites from the head waters to the mouth of the river. Training could include hydrology, water quality, climate, vegetation, land use, soils, transport and socio-economic information. Every attempt will be made to integrate the citizen monitoring program into existing government monitoring programs with a common methodology set and data storage and retrieval system. Therefore, the monitoring program is a joint initiative between government, scientists and watershed citizens.

Project Goals

The project goals are:

1. to work with and integrate existing monitoring programs undertaken by government agencies and to share data.

2. to increase citizen participation in the Roundtable and its programs by reaching out and involving citizens in the monitoring program.

3. to empower local citizens to make informed decisions based on scientific information that will maintain or enhance the quality of life in the watershed and effect the way people live and work in the watershed.

4. to establish a baseline inventory of the health of the watershed now and to monitor its health into the future.

5. to monitor the ecosystem objectives that citizens will determine as part of the watershed wide planning process.

6. to track the success of watershed projects from a scientific perspective.

7. to use the monitoring data to assist in the design of new watershed programs.

8. to compile data over time to determine the system dynamics of the watershed from an ecological, social and economic perspective so the Roundtable can make informed planning and implementation decisions.

9. to monitor the effectiveness of each initiative the Roundtable undertakes.

Project Benefits

Citizens will learn the techniques and value of monitoring the health of their watershed. By initially establishing a baseline of the watershed health they will be able to monitor changes over time and if necessary design ecosystem restoration programs to restore the health of the watershed.

SALMON RIVER BIOMONITORING PROGRAM

Salmon River Technical Workshop

Joseph M. Culp and Kevin J. Cash,
National Hydrology Research Institute
Environment Canada

February 13, 1995

Abstract

The traditional approach to environmental management in North America was based largely on the assessment of chemical concentrations within receiving environments and has more recently been replaced by an ecosystem approach to environmental assessment that: (1) recognizes the complex and interactive nature of the ecosystem; (2) recognizes that human populations are part of the ecosystem and must use resources in a sustainable fashion; (3) places an emphasis on the collection and synthesis of integrated knowledge of ecosystem structure and function; (4) adopts an holistic perspective and; (5) attempts to develop management strategies that are ecological, anticipatory and ethical. Within the ecosystem approach, monitoring of benthic invertebrates has been shown to provide valuable information concerning ecosystem health. The composition and structure of benthic invertebrate communities in flowing waters is closely linked to the surrounding terrestrial landscape and instream environment gradients. Furthermore, benthic community composition is modified within watersheds, particularly in response to hydrologic gradients. Because of these qualities riverine invertebrate communities are ideal candidates for use as ecosystem health indicators in mountain watersheds. Measuring ecosystem health using these techniques is not only effective but also involves sampling techniques that can be easily learned by individuals with little or no scientific training. We propose to establish a baseline data set measuring benthic community structure within the Salmon River Basin and to develop, in consultation with the Salmon River Watershed Round Table, a monitoring program for the Salmon River that will incorporate local knowledge and assist in the development of environmental objectives and bioindicators. We also propose to develop a simple but rigorously designed scientific monitoring program that could be carried out by volunteers. The study proposed here can be divided into three phases. First staff from the National Hydrology Research Institute (NHRI) will undertake a process of consultation with members of the Salmon River Watershed Round Table. This process will consist of identifying the concerns and objectives of the Round Table and identifying the types of data required to fill those objectives. This phase will also serve to identify the nature and extent of volunteer participation in any ongoing monitoring program.

In the second phase sampling sites will be identified and a field monitoring program will be developed. During this period volunteers will also be trained in the proper collection and analysis of field data and identification of key invertebrate taxa. In the third phase the transfer of monitoring technology will be completed and the volunteer group would continue monitoring efforts. Data collected by volunteers would be checked and validated by NHRI personnel using standard quality assurance/quality control (QA/QC) techniques during the initial two years. Thereafter QA/QC guidelines will be developed so as to allow the citizens group, along with local consultants or government personnel to continue this process of data standardization. Representative invertebrate samples will be archived by the Royal British Columbia Museum following their established protocol.

WATER USE SURVEY OF THE LOWER SALMON RIVER

Salmon River Technical Workshop

Dennis Einarson
Environmental Protection, MOELP

February 13, 1995

Abstract

The Salmon River has been identified as an area with both water quantity and quality concerns. Low summer flows have led to water volume concerns for irrigation users and losses of salmonid spawning and rearing habitat. High freshet flows in the spring lead to severe erosion of the river bed.

A survey is being conducted along the river main stem to look at specific water uses and near stream land uses. To date the survey has been completed between Glenemma and Shuswap Lake. Preliminary results show 111 water licenses, 150 wells and 15 ponds along this portion of the river. City water is used for domestic and stock watering near Salmon Arm, with only 29 water licenses, 30 wells and two ponds in this section. There are five shallow wells, three as domestic sources and two for irrigation, within fifty feet of the river. Outside Salmon Arm to Glenemma all domestic water supplies are from individual or small community water systems from wells or small tributary streams. There are 82 water licenses, 120 wells and 13 ponds in this section. Fifteen wells are used for irrigation. Nine wells, seven as domestic sources and four as irrigation sources, and four ponds are within 50 feet of the river.

Overall we see that water is being used from both surface and ground water sources. Some near stream wells and ponds are being used for irrigation. The quantity of water used along the river has yet to be verified. The survey will be reviewed before continuing.

RIVERSIDE FOREST PRODUCTS
SALMON RIVER WATERSHED ACTIVITIES

Salmon River Technical Workshop

Gerry Wellburn
Riverside Forest Products Ltd.

February 13, 1995

Abstract

Harvesting Activities

Proposed Harvesting for the next 6 years within Salmon River Watershed (from Five Year Development Plans)
- Annual Harvest of approximately 610 hectares per year with a volume of 175,000 cubic meters (5,000 truck loads of logs).
- This volume represents direct employment of approximately 210 and including spin-off jobs represents 560 total jobs.
- Most of the harvesting is within Tree Farm 49 with a minor amount in the Okanagan Timber Supply Area.
- Most of the harvesting proposed is clearcut logging.
- All plans are reviewed by the Ministry of Forests and Environment and Department of Fisheries and Oceans. Pre-Harvest Silvicultural Prescriptions for individual cut blocks are also reviewed in the field by these agencies.
- Riverside is responsible for reforesting all blocks following harvest and extensive silvicultural programs are ongoing.

Water

- Roads are audited by a Professional Hydrologist and remedial work is completed promptly.
- Roads are deactivated when they are no longer needed.
- Skid roads are water barred and grass seeded to prevent erosion.
- A comprehensive road plan is prepared annually.
- No machine buffer strips are marked along all creeks before harvesting takes place. Operation of logging equipment within the buffer area is prohibited.
- Riparian areas require buffer and/or leaves strips along them.
- All stream crossings road and skid trail require prior approvals.
- Riverside in partnership with the Salmon River Roundtable will apply for Forest Renewal funding for a class 1 watershed assessment of the Salmon River. This will enable both parties to determine the levels of harvesting within the watershed.

Other

- A protected area around Blackwell Lake has been proposed.
- M.O.E. has recently completed Forest Ecosystem Network mapping for TFL 49.

WATERSHED INFORMATION AVAILABLE FROM THE BC MINISTRY OF FORESTS

Salmon River Technical Workshop

Paul Birzins
Integrated Resource Management

February 13, 1995

Abstract

A presentation was delivered that outlines the various layers of information that is required to prepare for Land and Resource Management Planning Processes and the Forest Practices Code. Overlays of GIS maps on a base map of the Salmon Arm Forest District were presented. Watershed, fisheries, past and planned logging, proposed protected areas, site productivity, age classes, visual quality objectives, land classification, operability and wildlife were among some of the maps shown. Emphasis was made on having a sound data base prior to initiating a planning process. Gaps in data were also identified (i.e. standard soil classifications) and there was discussion on how this information is being gathered. As each forest district prepares for the Forest Practices Code and strategic planning processes (CORE or LRMP), a substantial information base is being gathered throughout the Salmon River Watershed.

TRENDS IN THE SALMON RIVER WATER QUALITY - HEADWATERS TO MOUTH

Salmon River Technical Workshop

Bob Grace
R.P. Bio., Regional Environmental Protection Program

February 13, 1995

Abstract

Pre-objective water quality monitoring was conducted at fourteen sites on the Salmon River during freshet (May) and summer low flow (Aug.) in 1989. The results from 5 weekly sampling runs in each period were averaged for each site to graphically show trends in water quality. The means for Non-filterable Residue, Faecal Coliform Bacteria, Total Phosphorus and Dissolved Phosphorus were plotted from the headwaters to the mouth of the Salmon River. Trends for each parameter were noted, along with possible reasons for increases or decreases in concentration in river water quality. Also presented is a major low-level melt event on Feb. 25, 1986. This graph shows the major increase in nutrients as a result of agricultural runoff in the Westwold area. Major areas of impact are from Westwold to Falkland and from Silver Creek to the mouth. This type of monitoring could be repeated to observe improvements in water quality as a result of river restoration work in the watershed.

DFO - FRAP INVOLVEMENT ON THE SALMON RIVER

Salmon River Technical Workshop

Tony Cheong
DFO, Fraser River Action Plan

February 13, 1995

Abstract

FRAP currently has four projects underway in the Salmon River Watershed: a channel stability analysis (M. Miles); a review of the Salmon River Watershed Roundtable (W. Falkner); an assessment of private conservancy options (Deen Selwood); and an instream flow study (D. Burt). Early results of the channel stability analysis indicate that channel widths and bank erosion rates have increased between 1951 and 1987 in many of the areas cleared of vegetation for agricultural purposes. A draft report is expected before March 15. The review of the Roundtable with respect to structural development, organization, budgets, efficiency and effectiveness, and the views of participants and local residents is underway. Most of the background information has been collected and interviews completed - a report on this roundtable will be completed by early April followed by the assessment of the Nicola Valley Watershed Roundtable. Work on private conservancy options is proceeding with the development of a "tools matrix" outlining the various options and their associated characteristics (duration, monitoring maintenance, etc.) and advantages and disadvantages. A draft report is expected in late March. The instream flow study discussion was presented by D. Burt.

QUANTITATIVE ASSESSMENT OF SALMONID HABITAT IN THE SALMON RIVER

Salmon River Technical Workshop

Dave Burt
D. Burt and Associates, Nanaimo
Mike Wallis
Wallis Environmental Aquatics Ltd., Salmon Arm

February 13, 1995

Abstract

In October 1994, a fish habitat study was undertaken on the Salmon River under sponsorship of DFO's Fraser River Action Plan. The objectives were to: 1) Estimate spawning and rearing habitat in the Salmon River at the October flow regime, 2) Determine spawning and rearing capacity at this flow, and 3) Identify priority areas on the river for protection and rehabilitation actions. Information presented at the workshop included the methods used to collect the field data, the procedure used to analyze the data, and the applicability of this approach to watershed management.

The field methods resulted in the establishment of a total of 84 transects in 8 reaches of the Salmon River from Shuswap Lake to Westwold. Transects were placed in riffle, run, and pool habitats with a minimum of 4 transects per habitat type for each reach. Depth, velocity, and substrate data were collected at regular intervals along each transect. Bank profiles were measured using transit and rod equipment. Habitat types were mapped 200 m upstream and downstream of each transect.

Data analysis consisted of 2 steps. The first involved the coupling of transect data with habitat suitability curves to obtain weighted usable area (WUA). The second step involved applying optimum loading estimates to WUA to determine rearing and spawning capacities. Extrapolation techniques were used to estimate WUA and productive capacity for the whole river below Westwold. Stratification of the river into reaches increased the precision of this analysis.

The usefulness of this habitat assessment technique for watershed management becomes particularly apparent after 3 to 4 sets of data are collected for each transect at different flow regimes. For example, it allows quantification of the affects of low flows and high temperatures on available fish habitat and fish production. It can be used to determine realistic fish production goals. The technique can be used to determine whether sufficient habitat is available for fry stocking proposals. During the planning of watershed initiatives, the results can be used to express the proposed initiative in terms of gains in fish habitat and fish production. Similarly, the results can be used to monitor the ongoing progress of initiatives after implementation.

PAST AND FUTURE CLIMATES OF THE SALMON RIVER BASIN

Salmon River Technical Workshop

Eric Taylor
Science Division
Environment Canada

February 13, 1995

Abstract

This paper examines the climatic history of the Salmon River Basin from 1921 - 1992 from the data of two long-term climate stations in the region. In eastern sections of the basin precipitation is steadily increasing through most of the year. In western sections there is no annual trend in precipitation, though winters are getting slightly drier and summers are getting wetter. There has been little annual temperature trend, though winters are warmer in the west, and summer and autumn are cooler in the east.

Global climate change is expected to produce a warmer climate in the Salmon River Basin over the next 100 years. Precipitation will also be redistributed. The climatic water balance of the region will likely change due to global warming. This will result in lower soil moisture in the summer, longer periods of drought, less snow cover in the winter and earlier runoff in the spring.

APPLICATION OF GIS TO THE DEVELOPMENT OF ECOSYSTEM OBJECTIVES FOR THE SALMON RIVER WATERSHED
Work to be completed by March 31, 1995

Salmon River Technical Workshop

John Power
Environment Canada

February 13, 1995

Abstract

Building the base map layer. Twenty TRIM 1:20,000 scale maps will be translated into ArcInfo and thematic layers generated. The maps will be mosaiced together into a single large map. To this will be added; locations of points of diversion, groundwater wells, information gathered and mapped by AquaMetrix consultants. The basin outline is being transferred from paper 1:50,000 scale maps to the TRIM base. We are gathering and incorporating many additional layers of information.

Work planned for the new fiscal year (April 1, 1995)

Set up desktop mapping system (ArcView 2) in the watershed office. (to enable community input to the sustainable decision making process). This will include creating customized map layers for use on a desktop PC, specifying hardware and software requirements, installing the software and setting up maps on the system.

In consultation with the Roundtable develop maps of current and projected states of the watershed based on different development scenarios.

Carry out analyses using ArcInfo GIS. Some suggestions include: looking at potential erosion based on slopes, soil types and clearcutting, modelling impact of non-point source inputs of pesticides and fertilizers on water quality, and looking at environmental impact of new development e.g. loss of range, habitat.

Desirable layers of information

Theme	Source	Map Layers
Range/Habitat information	MOF	range mapping
Cadastral mapping	MELP, Victoria, District of Salmon Arm (?)	base cadastral maps, parcel maps..
Blue Line Atlas	BCE Fisheries	stream centrelines
Agriculture and Soils	MAFF, Kamloops	pasture crop and livestock
	MELP, Kamloops	
	AgCan - Vancouver	soil type and slope stability
		Federal soil mapping(?)
Forestry	MOF, Salmon Arm	clearcut areas(?)
Aquifers	MELP, Victoria	aquifer boundaries(?)

Desirable Data Sources (Tabular Data)

Water Licensing Information	MELP, Victoria	tie to POD's
Groundwater Database	MELP, Victoria	tie to well locations

Costs of Meeting Objectives

Costs incurred by the GIS Section are planned to be underwritten by the Ecosystem Objectives Section of Environment Canada.

Objective	Cost
Build up an archive of digital base maps and layers of environmental information.	$15,000.
Develop interactive GIS tools to assist in the development of ecosystem objectives.	$11,000.
Develop maps of current and projected states of the watershed based on different development scenarios.	$11,000.
Assist the Roundtable in setting up a desktop mapping system in their office to allow community members to participate in sustainable decision making.	$8,000.

SCENARIOS AND COMPUTERS IN A WATERSHED CONTEXT

Salmon River Technical Workshop

Hans Schreier
RMES, University of B.C.

February 13, 1995

Abstract

The presentation was in two parts: a) a demonstration of a hypertext product on resource conflict resolution and b) a brief discussion on what can be accomplished with GIS/hypertext and graphics system to address the resource issues in the Salmon River. The first part was a computer demonstration to show how we can examine wildlife/forestry/recreation conflicts in a GIS -model framework and how this can be used as a tool for decision support. The demonstration was from a watershed project in the Revelstoke area and uses multiple accounts methods and simulation models to examine current conflicts and forecast future problems using different scenarios. Forest harvesting, Caribou habitat use, and Winter recreation are the land uses that were highlighted.

In the second part emphasis was placed on approaches that can be used to address water management issues for multiple uses in the Salmon watershed. Data requirements, type of models and type of scenarios were discussed and suggestions were made on how to compare water uses between the different stakeholders and how to develop future scenarios with different trade-off assumptions.

WHAT "KERNELS" OF TECHNICAL WISDOM DO RESIDENTS OF THE WATERSHED NEED TO KNOW?

Human Impacts	Understanding Water and its Use	Community Stewardship	Value of Riparian Zone	Habitat Restoration, Rehabilitation & Conservation	Fish Habitat Requirements
5 yr. cut block plan	Surface and ground water use	Resource Centre phone number	Riparian cover	Does large debris maintain the channel	Fish habitat distribution and carrying capacity
Stocking density	Basic groundwater education	Reestablish a sense of value	Economic benefit to stream restoration	Understand the difference between restoration and rehabilitation	Current salmon habitat
Nutrient mngt.	Quantity of water used	Instill a sense of community stewardship	The river is the channel plus riparian zone	Recognize river as dynamic	Factors effecting salmon production
Hobby farms	Effect of nutrient loading on ecosystem health	Begin project on indigenous reserves	Benefits for landowners to protect riparian zone	Restoration techniques	Basic requirement to maintain salmon populations
Clearcut effects in relation to wildlife	Water quality and quantity	What can I do, as a citizen to stop downward slide of ecosystem quality	Value of riparian corridor		
Incremental vs. cumulative effects	Local hydrological cycle	Long term viability of habitat			
Historical trends in fish, water quality, flows & humans	Stream flows	Positive result will not happen overnight			
Community water systems					
Trends into future					
Land use Options					
Land use					
Base map inventory					
Human impacts (forestry, agriculture, transport & urban)					

* **Individual items proposed by pairs of participants**
* **Items clustered into categories by group consensus**
* **Category names chosen by group consensus**

SECTION 2:

ABSTRACTS FOR OTHER PROJECTS IN THE WATERSHED

SETTING ECOLOGICAL GUIDELINES FOR THE FRASER RIVER BASIN

Trefor B. Reynoldson
Aquatic Ecosystem Restoration Branch
National Water Research Institute

Abstract

As part of the Fraser River Action Plan a classification of unpolluted sites in the Fraser River basin based on benthic invertebrate fauna and selected bioassay endpoints is being established. From this a determination of the degree to which site classifications can be predicted from physio-chemical variables will be made. This will allow procedures to be developed for prediction of key elelments of the fauna expected at a site from environmental features unaffected by human activity. Furthermore we will select key species and that show the most robust predictive response for assessing environmental quality and changes in environmental quality. The information can be used to develop numerical biological guidelines for determining the need for environmental regulation based on the invertebrate fauna.

In this project four sites in the Salmon River were included. At each site samples were taken for benthic and planktonic community structure, chemical (water and sediment) and physical characterization (Table 1).

Table 1. Selected site Characteristics from Salmon River Locations

SITE	Date	Lat	Lon	Temp	Oxygen	Cond	pH
SAL01	27/10/94	50 19 13	119 57 78	6.62	14.45	237	8.63
SAL02	27/10/94	50 33 1	119 50 2	5.08	14.43	218	8.63
SAL03	27/10/94	50 33 14	119 21 2	6.98	13.16	418	8.47
SAL04	27/10/94	50 37 17	119 21 91	6.77	12.73	416	8.38

RESULTS FROM NATIVE FISHERIES PROJECTS
September 1992 - March 1993

Murray Ross
Shuswap Nation Fisheries Commission

Abstract

The Salmon River is located in the eastern region of the Fraser River basin in British Columbia. It flows from its headwaters at Douglas Lake east through to Falkland, ther north into the south arm of Shuswap Lake near Salmon Arm. Throughout the last century the Salmon River watershed has been altered by agricultural development, forestry practices and water removals contributing to a significant decline in fish abundance. These fisheries resources were historically an extremely important component of the diet of the Shuswap Native people. Working in cooperation with the multi-agency Salmon River Restoration Committee, the Neskonlith Indian Band developed a training project designed to collect preliminary fisheries information and promote public education of the resource. Project activities conducted by the Neskonlith Fisheries Crew included salmon spawning ground surveys, riparian mapping, catch monitoring of the Aboriginal fishery, streambank stabilization, and a watershed management survey.

Two spawning ground surveys were conducted, and resultant population estimates were compared with population counts taken from the Department of Fisheries and Oceans (DFO) enumeration fence. The estimate obtained for both the chinook and coho population size was considerably lower than DFO counts indicating that this method was not very effective in the Salmon River. The pattern of spawner distribution throughout the watercourse can be used in relative terms only.

Riparian mapping was completed from the mouth of the river to 5 km upstream of Falkland to measure and record key streambank processes such as erosion and beaver dam sites. Bank erosion was found to be wide spread (7.6% of the length of the river - 72 sites), while beaver dams were more localized. Implication to migrating salmon and salmon habitat restoration are discussed.

A controlled Aboriginal fishery was conducted on returning coho salmon. The catch monitor reported a harvest of 18 fish taken during a one night fishery on October 17 - 18.

A survey of landowners/residents with river front property in the Salmon River watershed was designed and conducted during December. The survey aimed to encourage landowners to become involved in local watershed management planning in the Salmon River watershed, both by aiding in their understanding of the problems and by recording their suggestions and recommendations. The rate of response was 41.9% (54 questionnaires returned out of 129 distributed). Responses to the questions indicated a high interest in environmental issues surrounding the Salmon River and in helping to alleviate them. It was found that there is a need for improved knowledge about the cause and effect relationships around fisheries, pollution and bank stabilization issues. There was some disagreement about responsibility for monitoring and management action and a need for technical assistance in the form of either knowledge, funding or both.

AQUATIC AND RIPARIAN ECOSYSTEM STRUCTURES IN RELATION TO HUMAN IMPACTS IN CENTRAL INTERIOR STREAMS OF THE THOMPSON RIVER DRAINAGE

Bob Vadas
CWS - SFU Research Associate in Wildlife Ecology

Abstract

An investigation into ecosystem structure has been initiated in two Thompson River tributaries, namely the Salmon and Nicola rivers, to assess agricultural and other human impacts in the stream valleys. Six sites on each river were surveyed in the fall of 1994. Information collected from each site included the abundance and diversity of fishes, aquatic and streamside (riparian) invertebrates, and riparian vertebrates (especially birds), as well as stream-habitat and fish-diet data. Biological and habitat variables will be compared among sites to establish the importance of the integrity of riparian vegetation to the quality and diversity of instream habitat and to the animals that live along and within the water. Habitat and fish surveys will be repeated in the fall of 1995, and water-quality (pollution) studies will be added to the program.

APPENDIX A

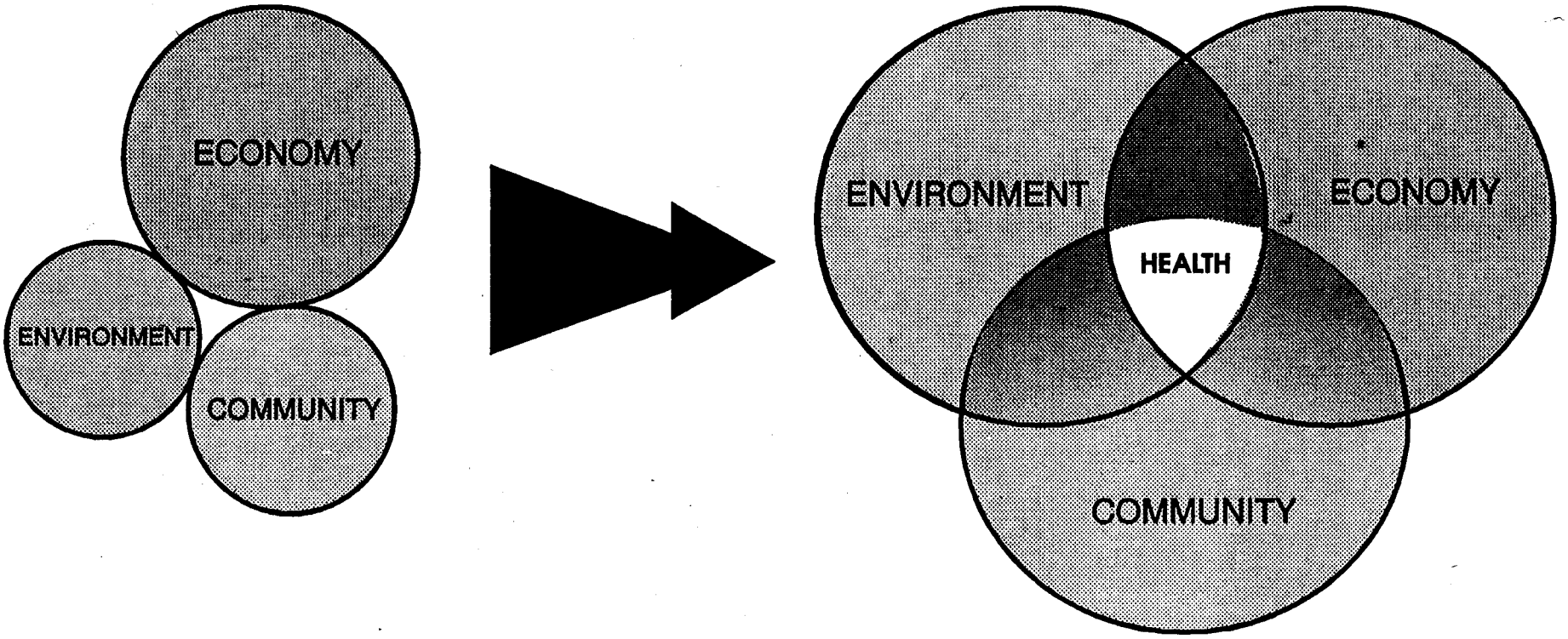
Presentation Overheads

A FRAMEWORK FOR DEVELOPING GOALS, OBJECTIVES AND INDICATORS FOR ECOSYSTEM HEALTH: TOOLS FOR ECOSYSTEM-BASED MANAGEMENT

Janet Stavinga

Evaluation and Interpretation Branch
Environment Canada

The Shift from Traditional to Ecosystem-Based Decision-Making



Traditional

Ecosystem Approach

New Words for Old Ideas?

- Ecological Integrity
- Biodiversity
- Sustainable Forestry/Agriculture/Fisheries
- Sustainability
- Ecosystem Health

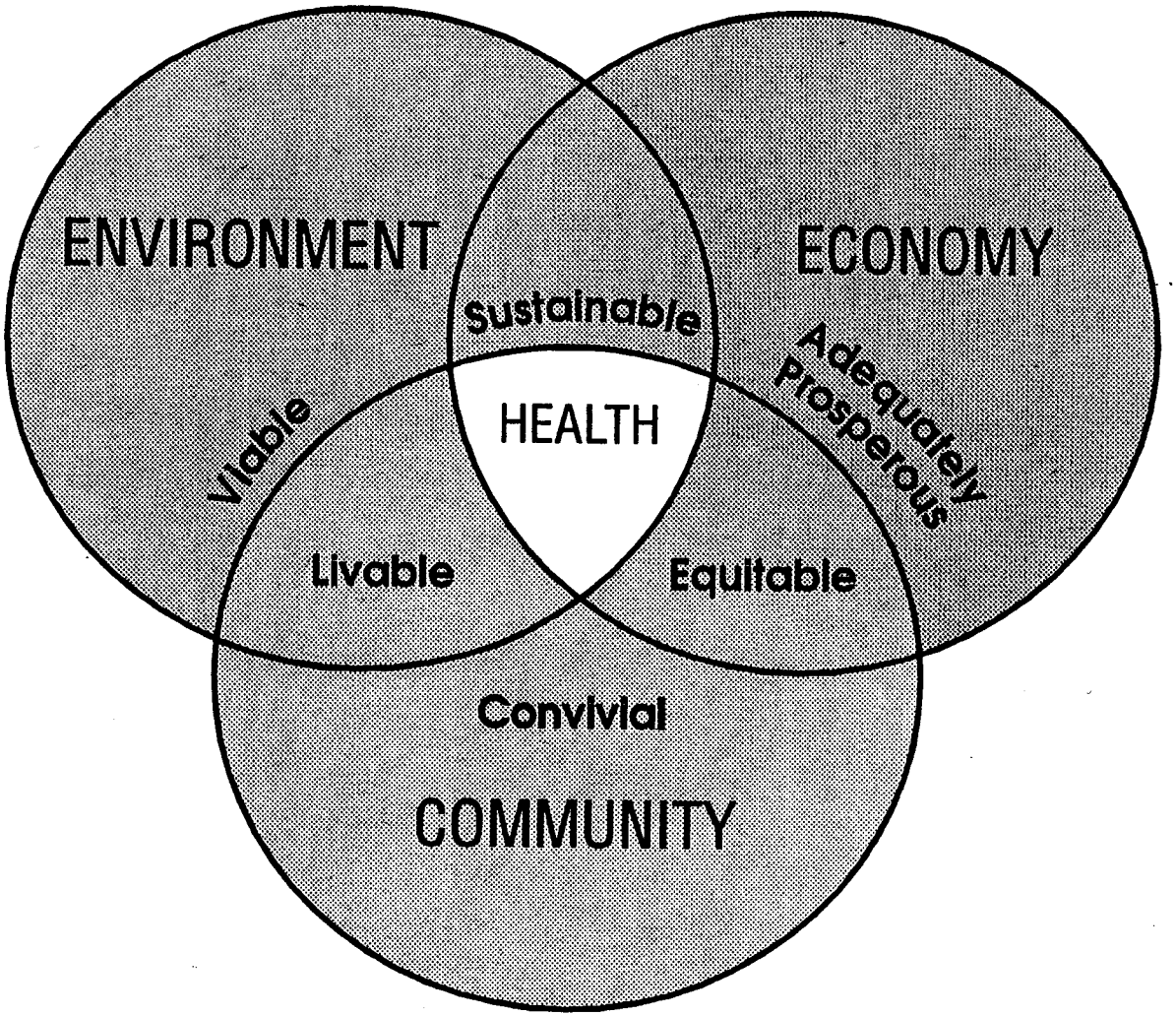
= to facilitate sustainable resource use and
to perpetuate healthy, self-organizing ecosystems*

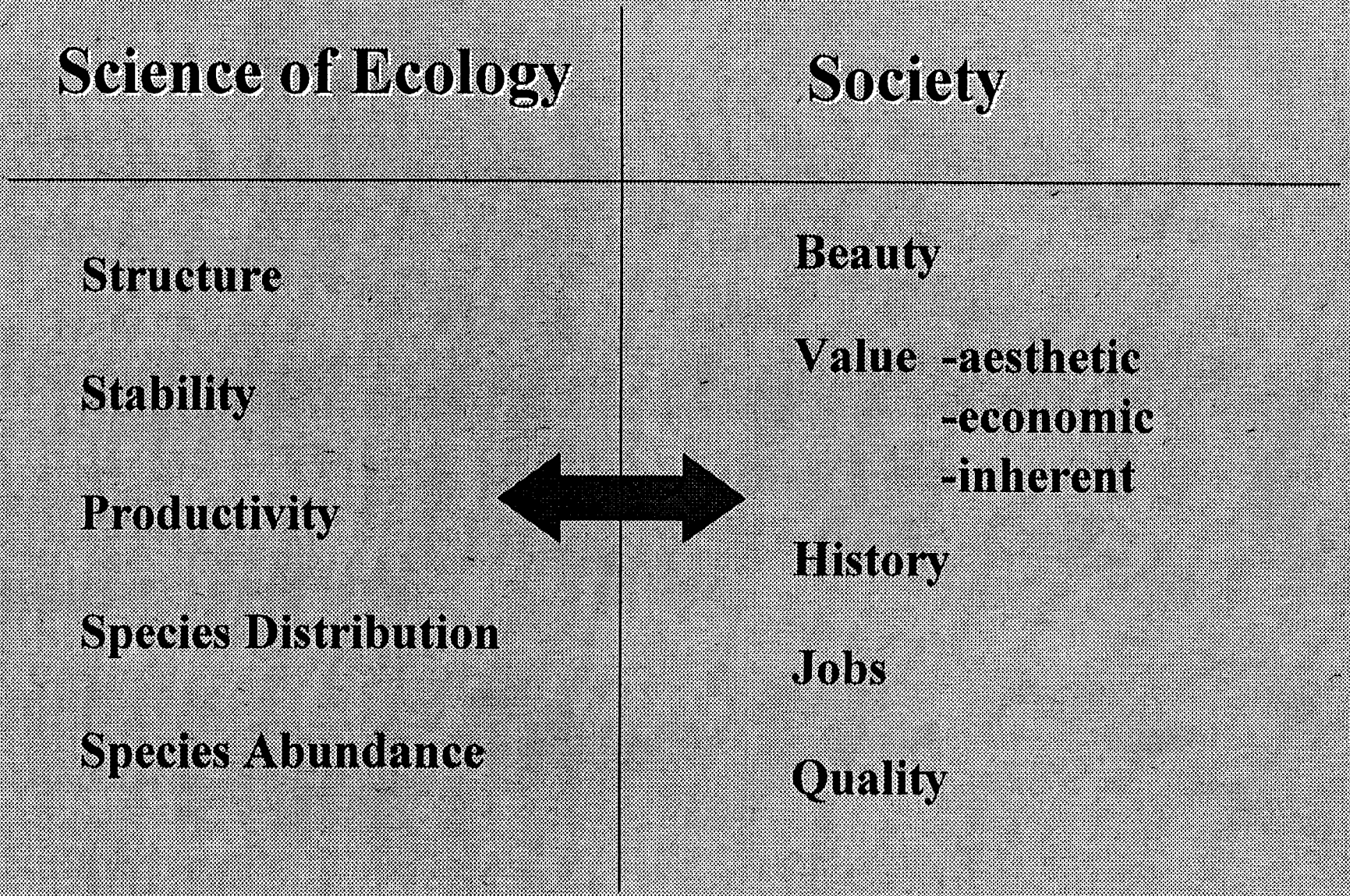
* Robert J. Steedman, 1994. Ecosystem Health as a Management Goal.

Ecosystem Health Indicators

- **Background**
  - convergent evolution
  - new words for old ideas
- **CCME Framework**
  - review of existing initiatives
  - Framework components
  - examples
  - challenges
- **Lake Ontario Ecosystem Objectives Working Group**
  - goals
  - objectives
  - indicators
- **Challenges**
  - jurisdictional
  - scientific
  - process

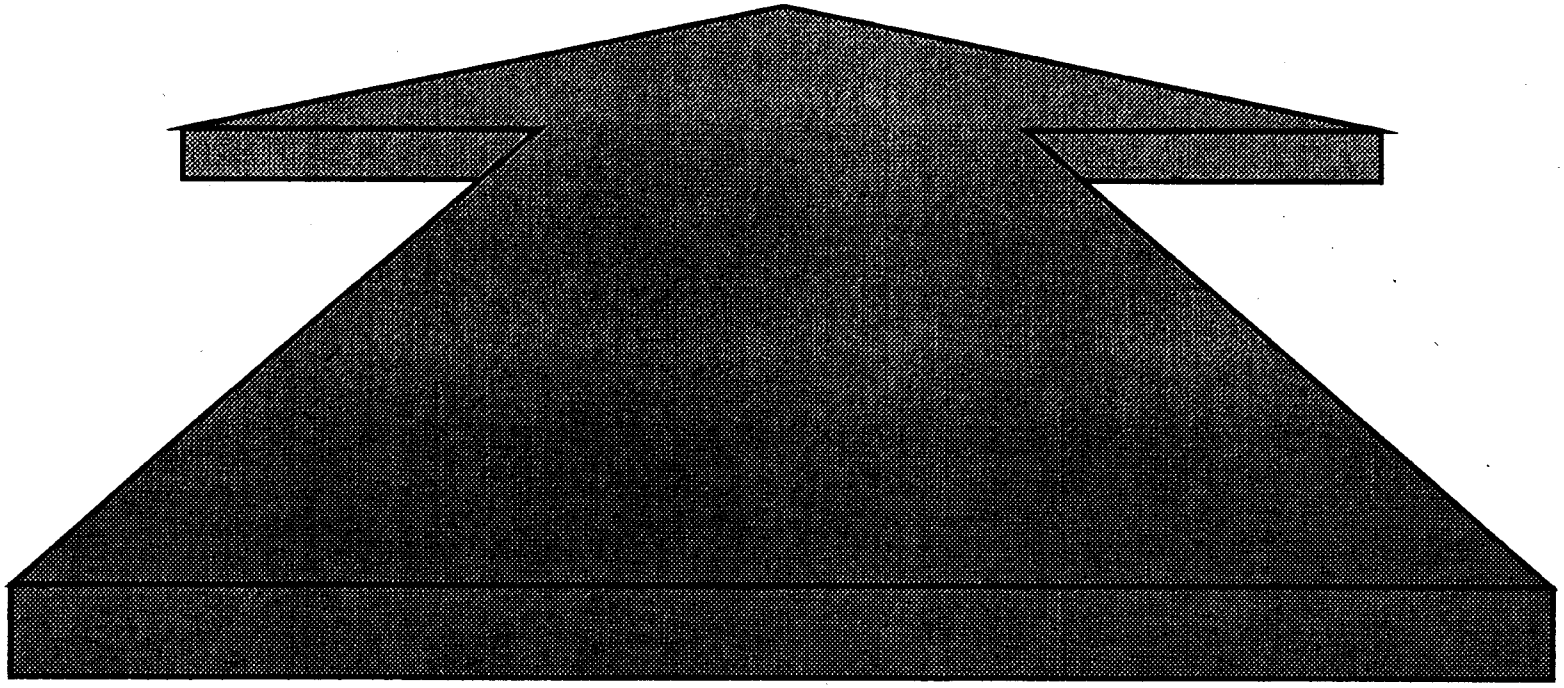
The Ecosystem Approach




Science of Ecology
Society
Structure
Stability
Productivity
Species Distribution
Species Abundance
Beauty
Value -aesthetic
-economic
-inherent
History
Jobs
Quality

Framework for Developing Goals, Objectives and Indicators of Ecosystem Health: Tools for Ecosystem-Based Management

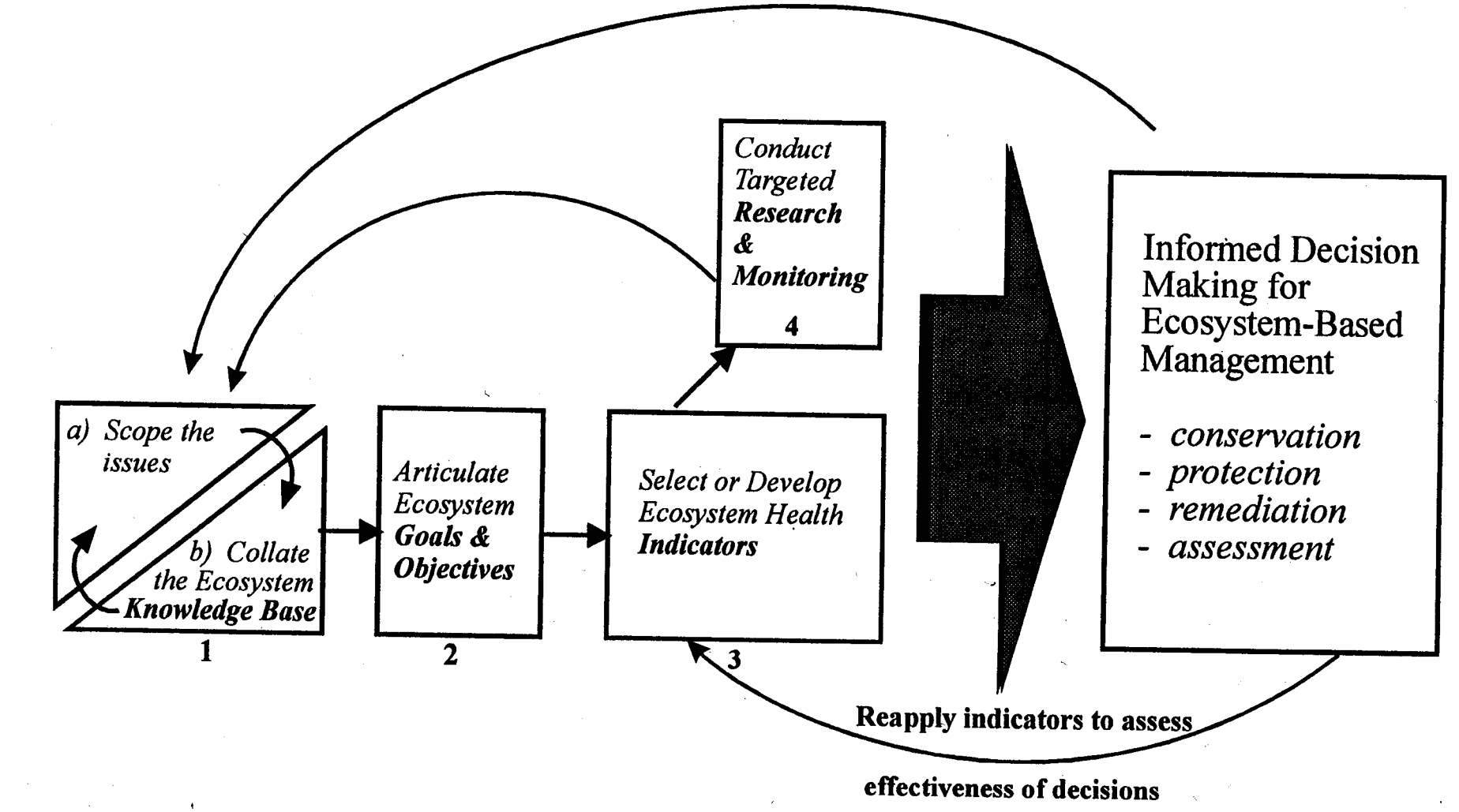
INFORMED DECISION-MAKING

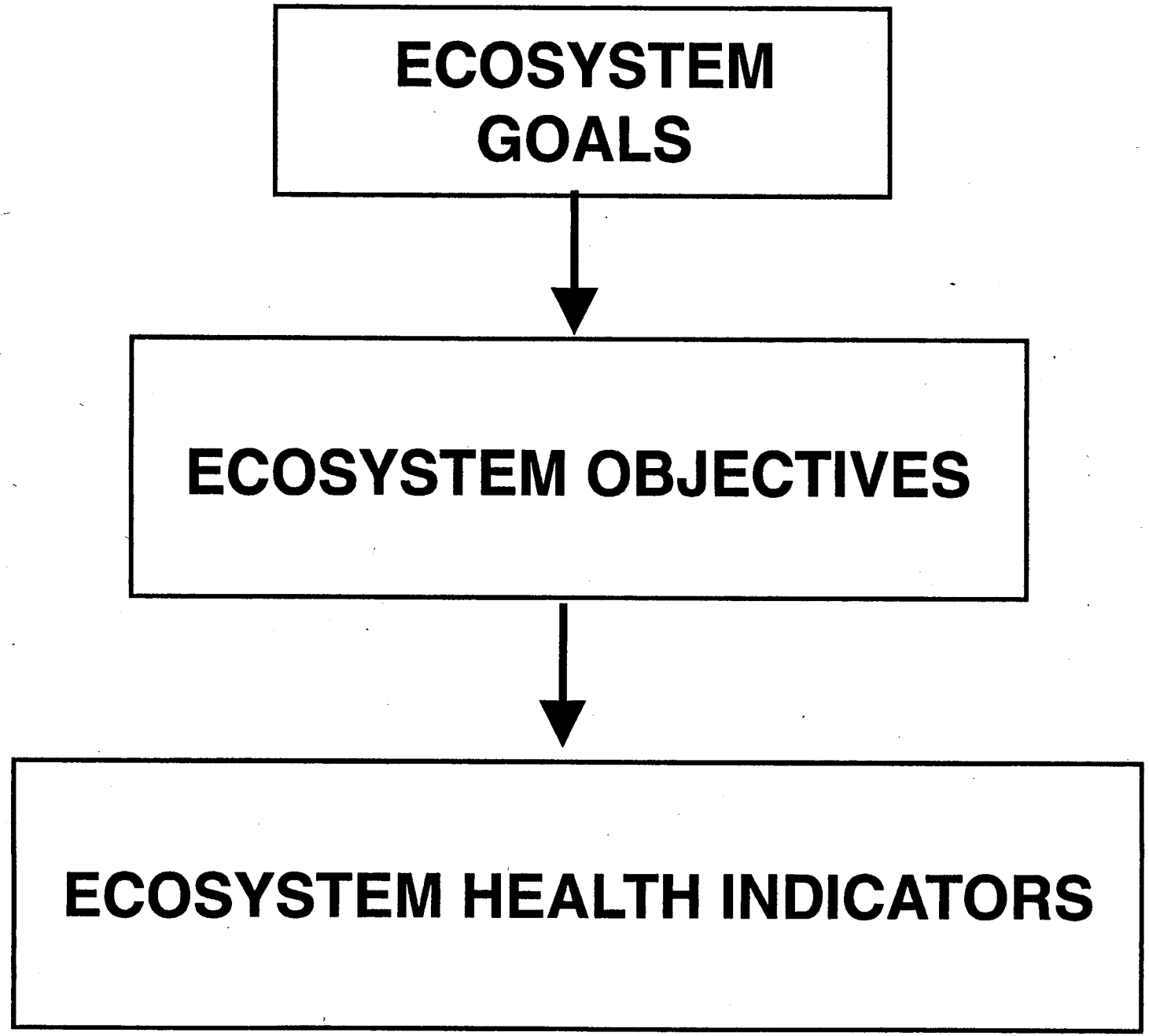


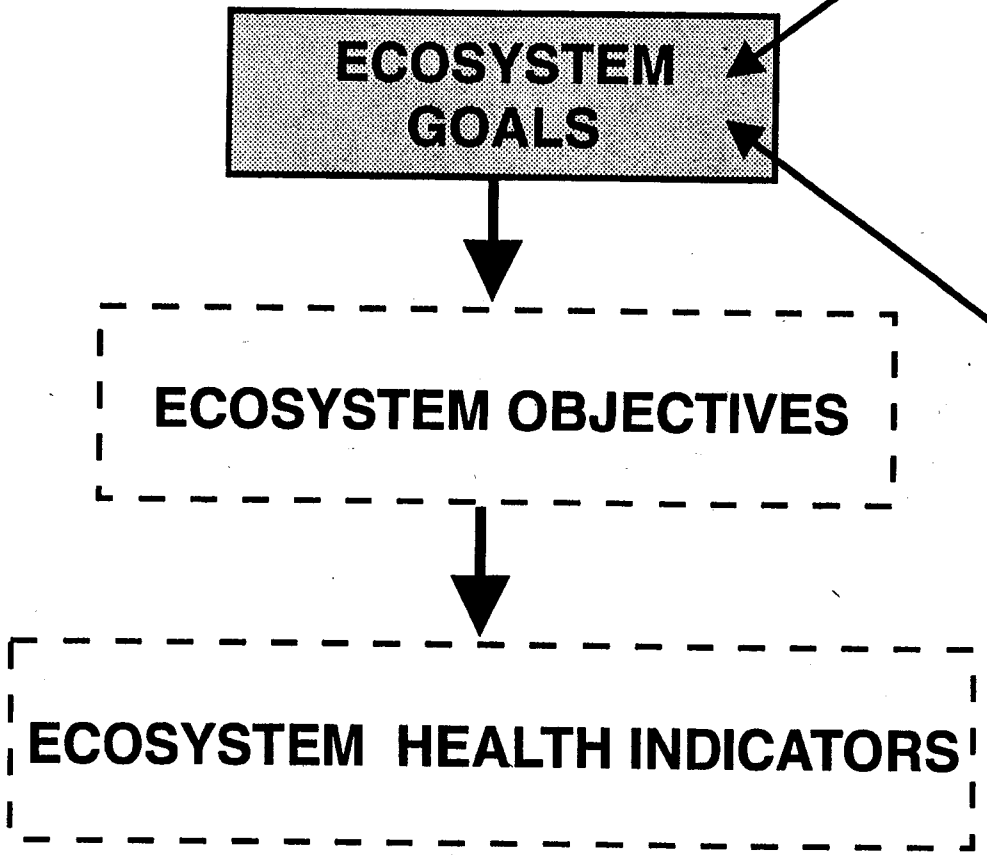
Information Bases

- Traditional Knowledge
- Ecosystem Sciences
- Social Values
- Economic Goals
- Natural Resources

Framework for Developing Goals, Objectives and Indicators of Ecosystem Health: Tools for Ecosystem-Based Management




ECOSYSTEM GOALS
ECOSYSTEM OBJECTIVES
ECOSYSTEM HEALTH INDICATORS



Lake Ontario Examples:

- "ecosystem should be maintained to support self-reproducing, diverse, biological communities"
- "we shall conduct our activities with responsible stewardship"

Lake Superior Examples:

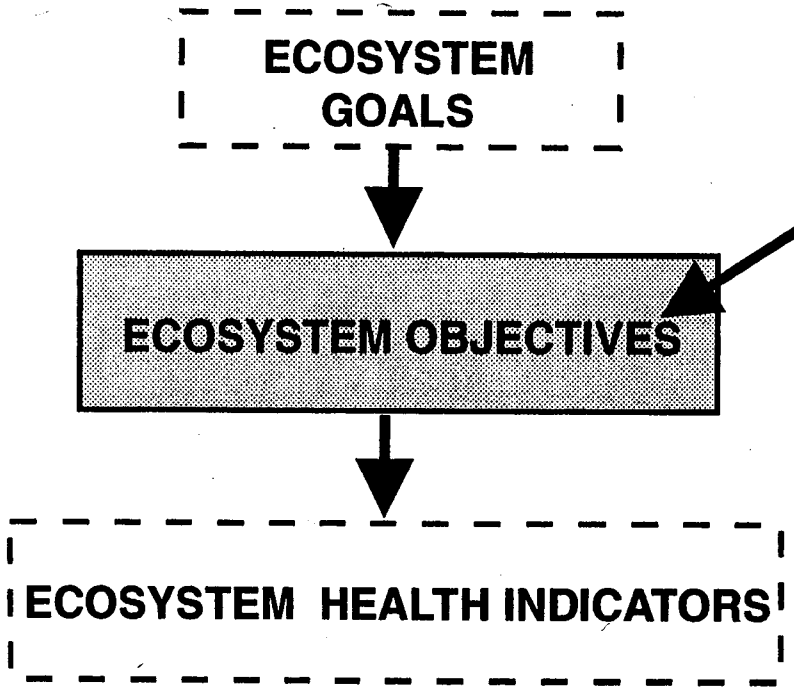
We seek a Lake Superior watershed:

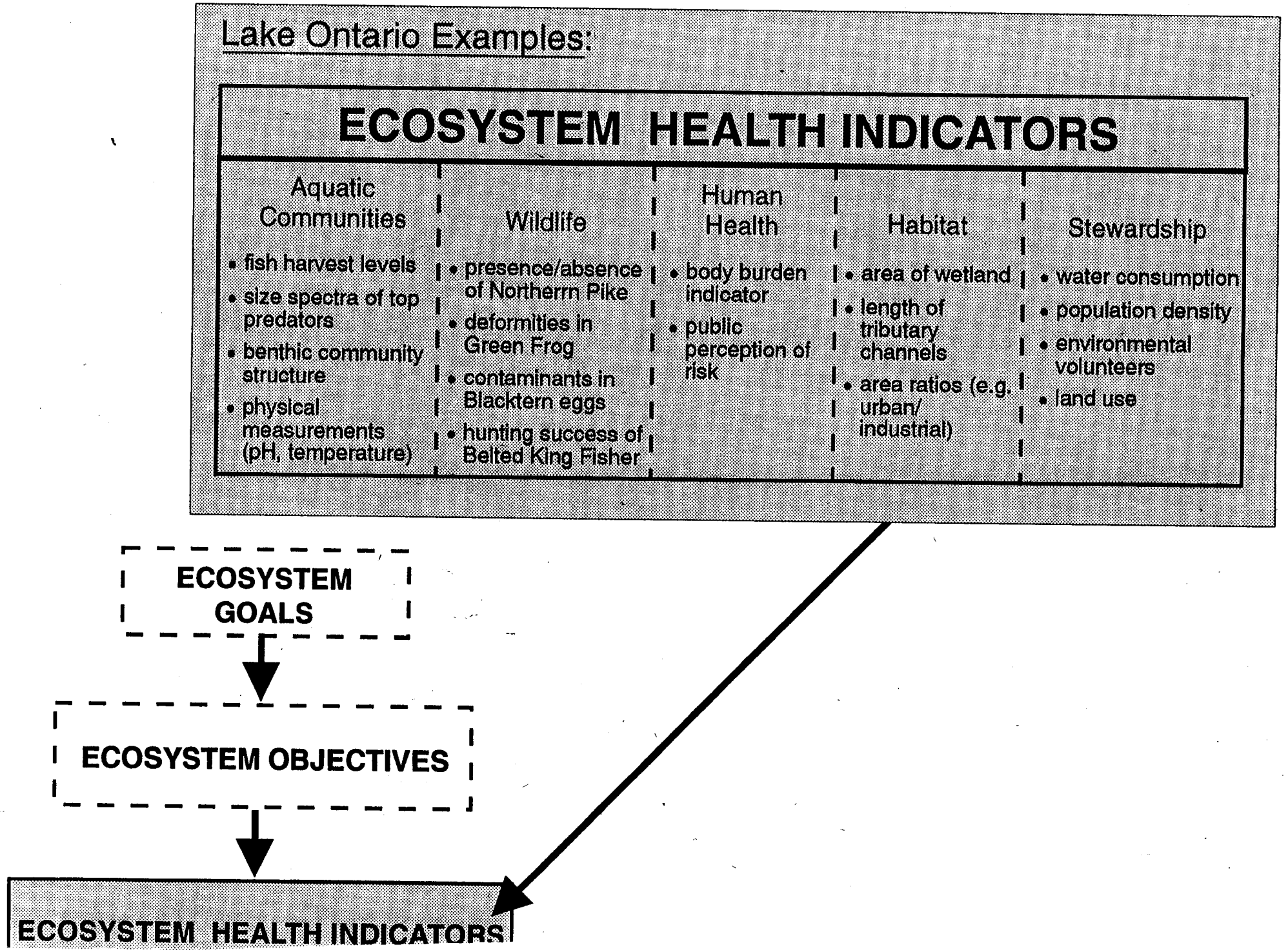
- "that is free of toxic substances at levels that threaten fish, wildlife and human health"
- "where wild shorelines and islands are maintained"
- "where development is biologically sound and conducted in an environmentally benign manner"

Lake Ontario Examples:

ECOSYSTEM OBJECTIVES

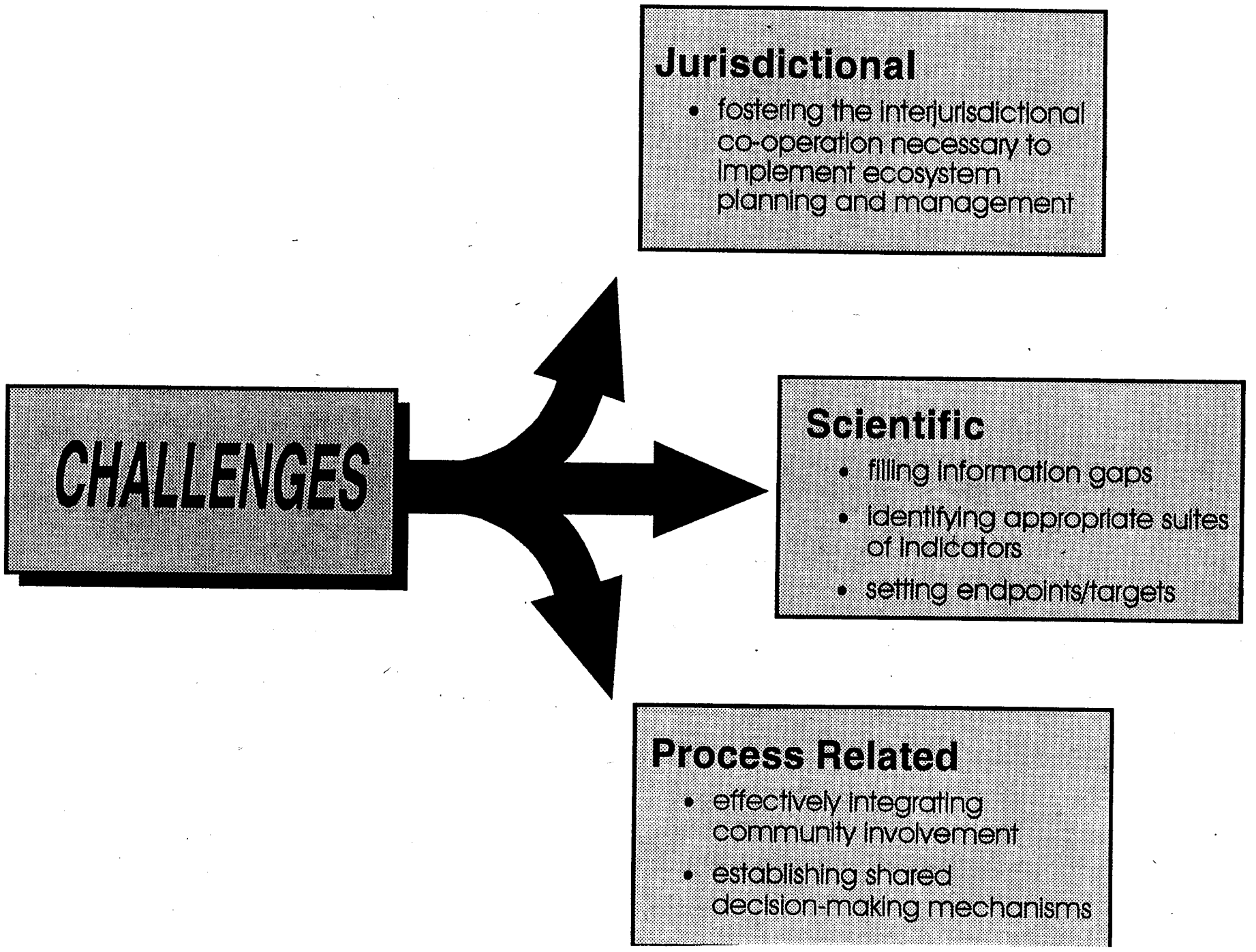
Aquatic Communities	Wildlife	Human Health	Habitat	Stewardship
• diverse, healthy, reproducing and self-sustaining communities in dynamic equilibrium	• healthy diverse and self-sustaining wildlife community	• biota free from contaminants at levels that affect human health	• habitats of sufficent quality and quantity to support healthy productive plants & animals	• human activities shall embrace environmental ethics




Lake Ontario Examples:
ECOSYSTEM HEALTH INDICATORS
Aquatic Communities
• fish harvest levels
• size spectra of top predators
• benthic community structure
• physical measurements (pH, temperature)
Wildlife
• presence/absence of Northerrn Pike
• deformities in Green Frog
• contaminants in Blacktern eggs
• hunting success of Belted King Fisher
Human Health
• body burden indicator
• public perception of risk
Habitat
• area of wetland
• length of tributary channels
• area ratios (e.g. urban/ industrial)
Stewardship
• water consumption
• population density
• environmental volunteers
• land use
ECOSYSTEM GOALS
ECOSYSTEM OBJECTIVES
ECOSYSTEM HEALTH INDICATORS

Take Home Messages

- community involvement is key in objective setting
- scientific knowledge is key in indicator development
- information needs drive monitoring activities
- suites of indicators are needed to effectively report on ecosystem health


CHALLENGES
Jurisdictional
• fostering the interjurisdictional co-operation necessary to implement ecosystem planning and management
Scientific
• filling information gaps
• identifying appropriate suites of indicators
• setting endpoints/targets
Process Related
• effectively integrating community involvement
• establishing shared decision-making mechanisms

Activities

	Flagships	CCME	International
1993	Community Involvement in Decision-Making	Developing Ecosystem Health Indicators	
1994	Working In Multistakeholder Processes		International Symposium on Ecosystem Health
1995		Publish Framework	

WATER STEWARDSHIP, STREAM KEEPERS AND CITIZEN BASED DATA COLLECTION

Kim Fulton

Water Stewardship Project Coordinator MOELP

The Stewardship Series

Water Stewardship

A Guide for Teachers, Students and Community Groups

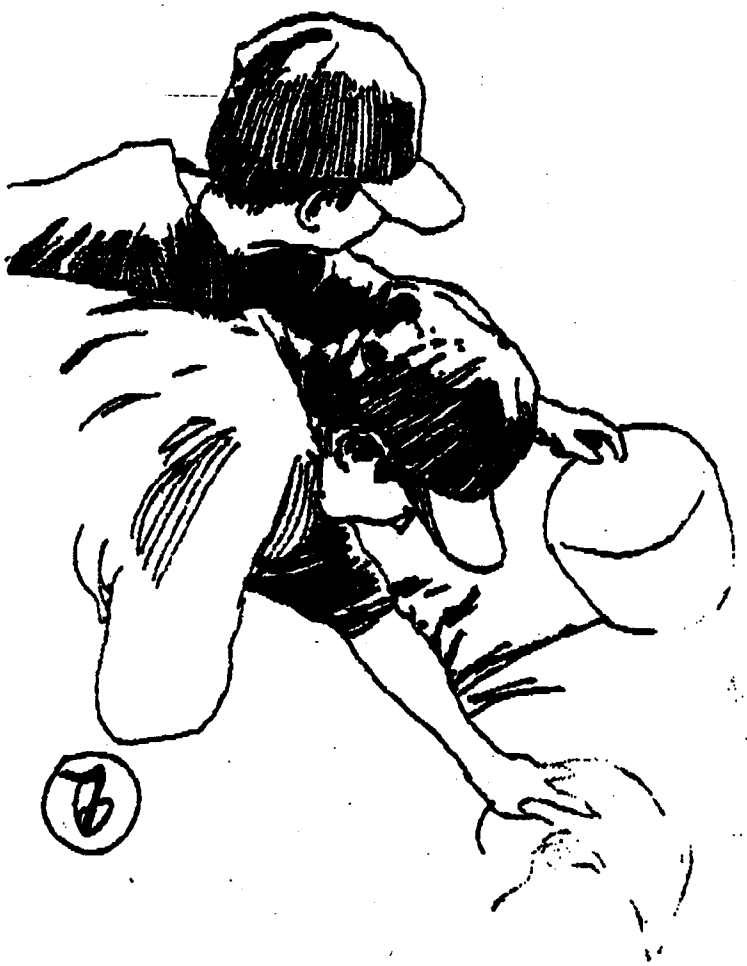
Canada

Province of British Columbia

Chapter Two

STEWARDSHIP AND ENVIRONMENTAL LITERACY

"The real substance of conservation
lies not in the physical projects of government,
but in the mental processes of citizens."
Aldo Leopold



Key Concepts for Water Stewardship

- **1. Water is essential for life.**

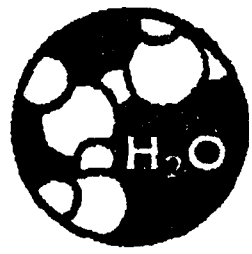
All life on earth requires water. Without water there would likely be no life on Earth. While there may be frozen water or some water vapour on some of the other planets in the solar system, most are either too hot or too cold to have any liquid water. No traces of life as we understand it have been found on any of the other planets in our solar system.

- **2. All living things depend on water.**

Different life forms have different water requirements, but all need water in some form. Different life forms may compete for water when water is scarce. Thus, water is a limiting factor in the environment.

- **3. Water is a unique material.**

Water can exist as a solid, a liquid, or a gas. It dissolves many different types of materials. It is polar, that is, water molecules attract each other and tend to stick together in drops and films.



- **4. All water is part of the hydrological or water cycle.**

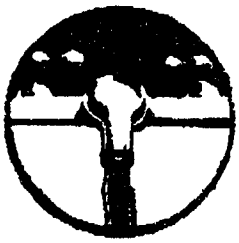
Water passes through this cycle as it changes from a liquid, to a gas (water vapour), and back to a liquid again. Water may also be found as a solid (ice and snow). Water is an integral part of the weather/climate system.

- **5. Streams, lakes, and rivers, as well as other water bodies are part of larger systems known as Watersheds.**

Watersheds are characterized by the contours of the landscape, the vegetation covering the land, soil and rock formations, and prevailing patterns of climate in a region.

- **6. Watersheds are dynamic.**

They change and evolve over time as a result of geological and biological processes as well as human activities.



- **7. Humans are major users of water.**

As animals, we humans need water for our lives, but we also use water in our technological processes to make things, generate electricity, grow food, and process food. We often compete with other life forms for water.

- **8. Water is finite.**

There is only so much water available on earth at any given time. The amount of potable (drinkable) water, suitable for use by humans without advanced treatment is very limited.

- **9. Aquatic habitats are essential elements of the biosphere.**

Aquatic habitats are home to a wide variety of plant and animal species and are necessary to maintain biodiversity. Many life forms exist for all or part of their life cycles in aquatic habitats. When water is used or contaminated with toxins, the habitat can be destroyed and species may be lost, resulting in a loss of overall biological diversity.

- **10. Contaminants and toxins can move within water.**

Contaminants have harmful effects on life forms, including humans, which are far removed in time and place from the sources of the toxins.

- **11. There are a number of careers and vocations working with water, aquatic habitats, and their management.**

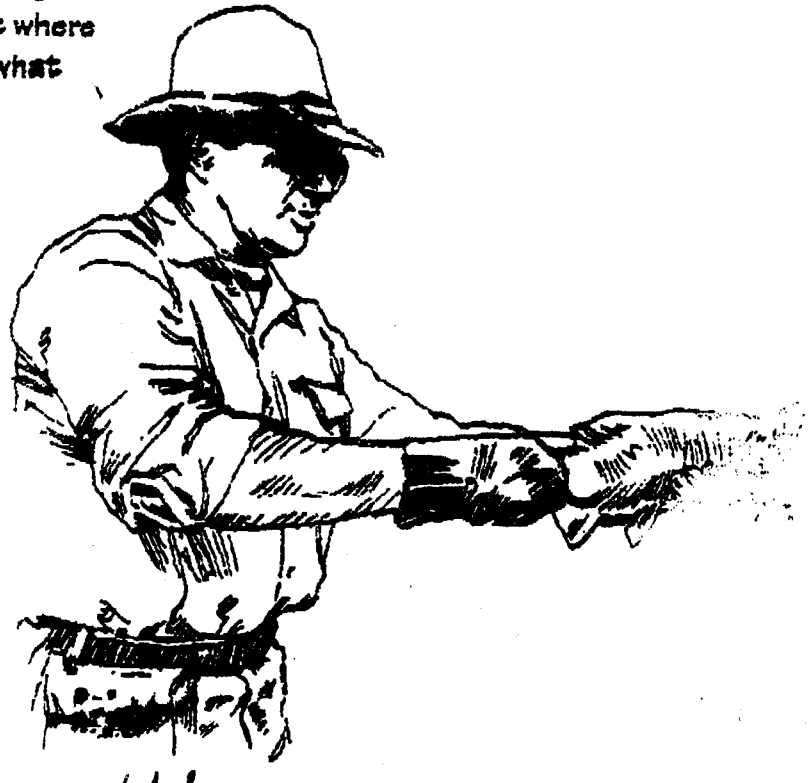
- **12. Different human cultures have different values about water and different patterns of use.**

The concept of water stewardship should be examined from the perspectives of differing cultures and value systems.

Chapter Six

CLASSROOMS IN ACTION— CASE STUDIES IN STEWARDSHIP

"When as today, signals from the Real World clash with the expectations of the world view constructed by our particular culture, then the time is right for a new look, a change to better glasses, keener insight, improved theories about where we are, who we are, and what we should be doing."
Stan Rowe



Chapter Seven

DEVELOPING SCHOOL ACTION PROGRAMS

"Always act in such a way that the principles underlying your actions could become the principles of humanity."
Immanuel Kant

Communication and Interaction Guidelines for Action Work

Avoid stereotyping others.

Do your homework - become an expert on your topic.

Follow the Force Field

Avoid Scapegoating

Recycle

Be Persistent - Stick with it!

Three Levels of Action

Level 1 -
Actions which result in a distinct end product within a fairly short time period

Level 2 -
Actions which result in ongoing environmental processes to not only accomplish a given project outcome but to also sustain it in perpetuity.

Level 3 -
Actions which result in some level of policy change

The Monday Group Class Commandments:

* **Take only Positive Positions...Be for something**...rather than against something! If you are against something you must be for something else...What is it? What is your wish? Be positive!

* **Do Your Homework...Become an expert**...read on the subject, interview experts, study until you know enough that your peers and community members view you as an "expert", or at least well informed on the topic.

* **Eliminate Stereotyping...Individualize**...Treat everyone as an individual of "high moral worth". Recognize that each person holds her/his own viewpoints within a group, organization or agency. Stereotyping is more often than not misleading and limiting, frequently closing action options rather than opening them.

* **Keep a Balanced View...Empathize**...examine all sides of the issue and as you become more knowledgeable of the other stakeholders make the effort to see it and feel it from their viewpoint..."walk in their shoes" so to speak. Personally contact and meet with others with different views from yours to get to know them and why they see it differently.

* **Probe the Force Field...Become aware of who and what else is involved in your chosen issue or problem.** Know who is also involved with your issue and how their position is aligned or different from yours and what strategies you might use to accommodate their interests. When you encounter a "block", back off, reconsider your options, design a plan and move on toward your goal.

* **Remain Flexible...Keep your options open**...be willing to adjust or change your position in the light of new information or data. Stay focused and decisive in action but open in mindset.

* **Accept Responsibility...Eliminate Scapegoating**...rather than making excuses or blaming others when you don't succeed at meeting your goal...accept that your team did not do everything it needed to do as effectively as it needed to do it. So, look to what you might have done better the first time and create an action plan and strategy for what you are going to do next to succeed.

* **RECYCLE...Be Persistent**...Try, try again, until you are successful. When you don't succeed the first time you never start the second try at the same point, as you have learned a great deal in your first attempt. So, recycle through the process again! Attain Success!

SALMON RIVER BIOMONITORING PROGRAM

Joseph M. Culp and Kevin J. Cash

National Hydrology Research Institute
Environment Canada

SALMON RIVER BIOMONITORING PROGRAM

Joseph Culp, Kevin Cash
National Hydrology Research Institute

Study Objectives

- Development of a baseline data set measuring benthic community structure within the Salmon River Basin
- Develop, in consultation with the Salmon River Round Table, a citizens-based biomonitoring program for this basin
- Transfer of required monitoring techniques to citizens group
- Evaluation of monitoring program

PHASE 1

- Identification of concerns and issues of the Round Table
- Review of data relating to landscape, hydrology, geomorphology etc. in order to establish habitat and sampling blocks within the basin
- Identification of potential sampling sites
- Review of existing volunteer-based environmental monitoring programs

PHASE 2

- Establishment of full-scale sampling program (late spring - fall 1995)
- Processing and analyses of benthic community samples
- Begin transfer of sampling technology to local volunteers

PHASE 3

- Further modification of study design
- Complete transfer of sampling technology to local volunteers
- Apply quality assurance/quality control (QA/QC) procedures to samples collected by volunteers
- Finalization and critique of volunteer-based monitoring program - Recommendations for future QA/QC procedure, analyses and reporting procedures

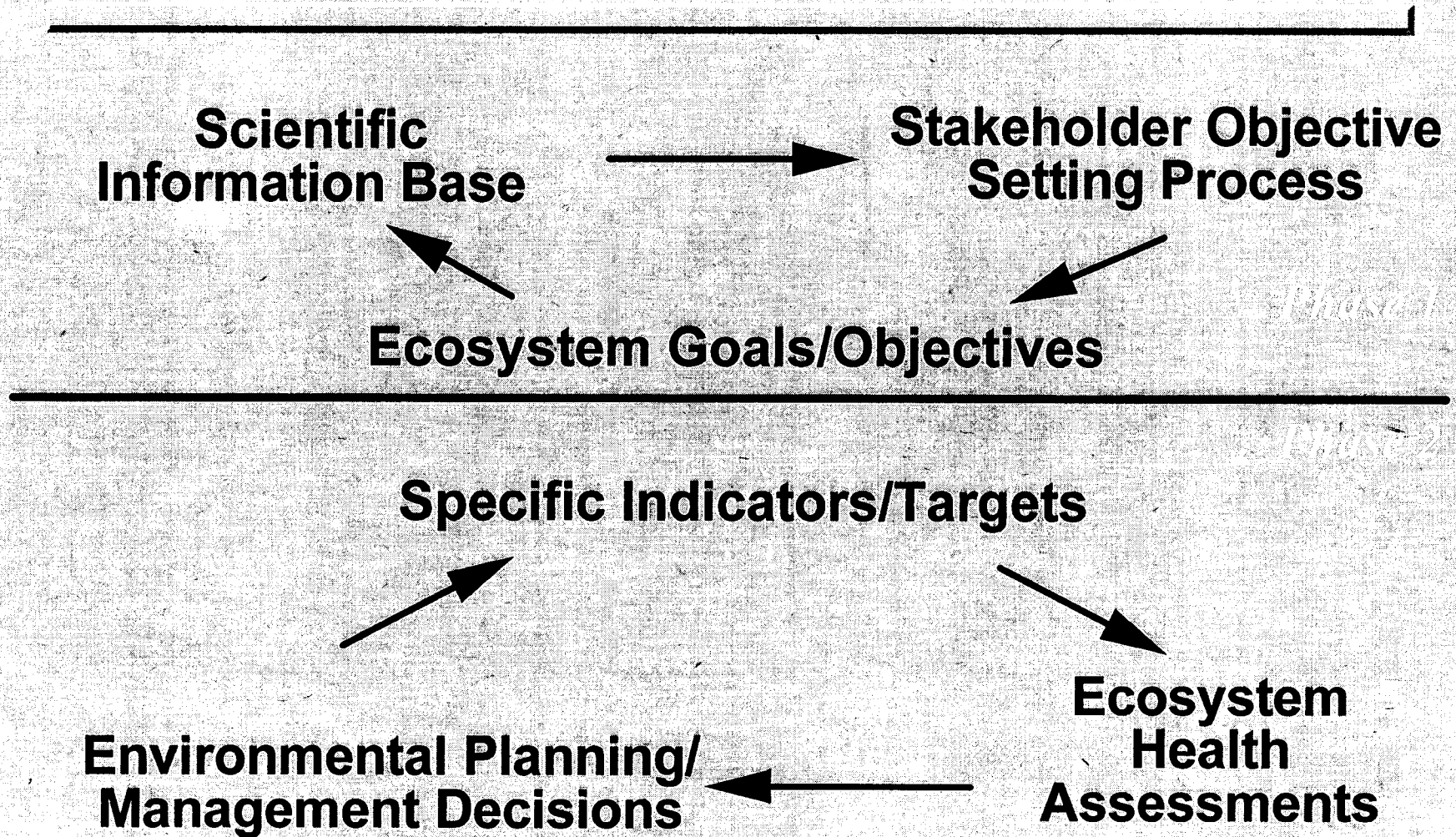
Benthic Community Structure as an Indicator of Ecosystem Health

- Composition and structure of benthic community closely linked to terrestrial and instream environmental gradients
- Benthic community structure highly representative of local conditions
- Sampling and analysis techniques are well developed and widely used
- Specific sampling and identification techniques easily transferred to non-scientific participants

Ecosystem Approach to Environmental Management

- Recognition of the complex and interactive nature of the ecosystem
- Recognition that human populations are part of the ecosystem and must use resources in a sustainable fashion
- Emphasis on the collection and synthesis of integrated knowledge of ecosystem
- An holistic perspective, interrelating systems at different scales
- Development of management strategies that are ecological, anticipatory and ethical

Development of Ecosystem Objectives & Indicators



WATER USE SURVEY OF THE LOWER SALMON RIVER

E.D. Einarson, RPBio

Environmental Protection
MOELP

Purpose and Objectives:

The purpose of our work is to produce an accurate picture of the water resource, including ground water, along the main stem of the Salmon River.

The primary objective of the survey is to locate and identify all surface and near river ground water uses along the main stem of the Salmon River.

The survey questionnaire would serve to update land use, livestock information and water licensing information.

As it turns out survey has also become a vehicle for the collection of public opinions and concerns regarding erosion, water quality and water quantity along the Salmon River.

Materials and Methods:

There was no cook book to follow so we made up our own. This method has its bad points and its good points. Our cook book goes like this:

1. The first step was to identify the study area and become familiar with the issues.

2. The second step was to acquire maps and legal descriptions of all subject properties along and near the Salmon River main stem.

- The District of Salmon Arm provided me with maps and a list of properties which included the registered owners names and addresses.

- The Columbia-Shuswap Regional District also provided maps, a list of subject properties and copies of the BC Assessment Authority Tax Roll Copy.

3. The third step was to place names and addresses on my working maps.

4. Next I acquired the Water License information for the main stem and cross referenced them with streamside properties.

5. Non-stream side properties with water licenses were added to the list.

6. With all the players identified we next tackled the questionnaire. Notices were published in the local papers, and letters of introduction for myself and the Coop student as well as the project information were written for distribution with the questionnaires.

7. The Questionnaire was put together by Grant Rogers. The questions were primarily directed at determining if surface or ground water was used at the property.

- We tried to quantifying the water use by asking questions about the irrigation equipment, it's specification, details of the farm's watering cycle, and the total area irrigated.

- When the residents was unable to provide details of well yields they were estimated from depth, diameter and pump sizes. The source of the ground water was determined by depth of the well and distance from the river or tributary streams.

- The number and type of livestock on the farms or ranches gave us an estimation of water used by stock and other livestock details.

8. Next we visited all the residents we had identified and asked if they would answer the questionnaire. 99.99% did! At this point several new water users were identified and added to the list.

9. A sketch was made of the land use, crop types, irrigation uses, placement of irrigation equipment, live stock location, fencing details, location of wells, ponds and tributary streams.

10. This information was transferred to the field maps and summarized in table form.

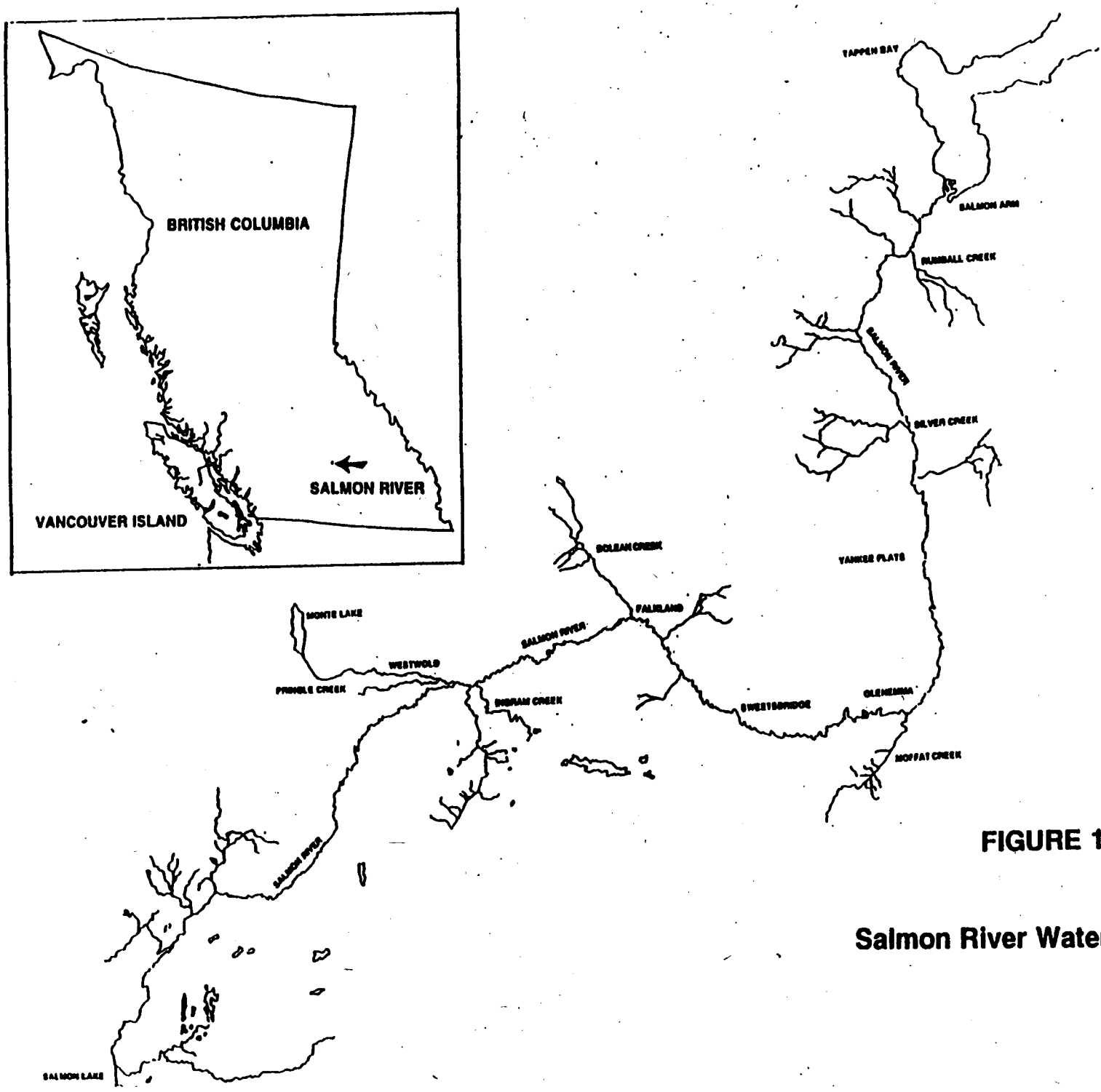
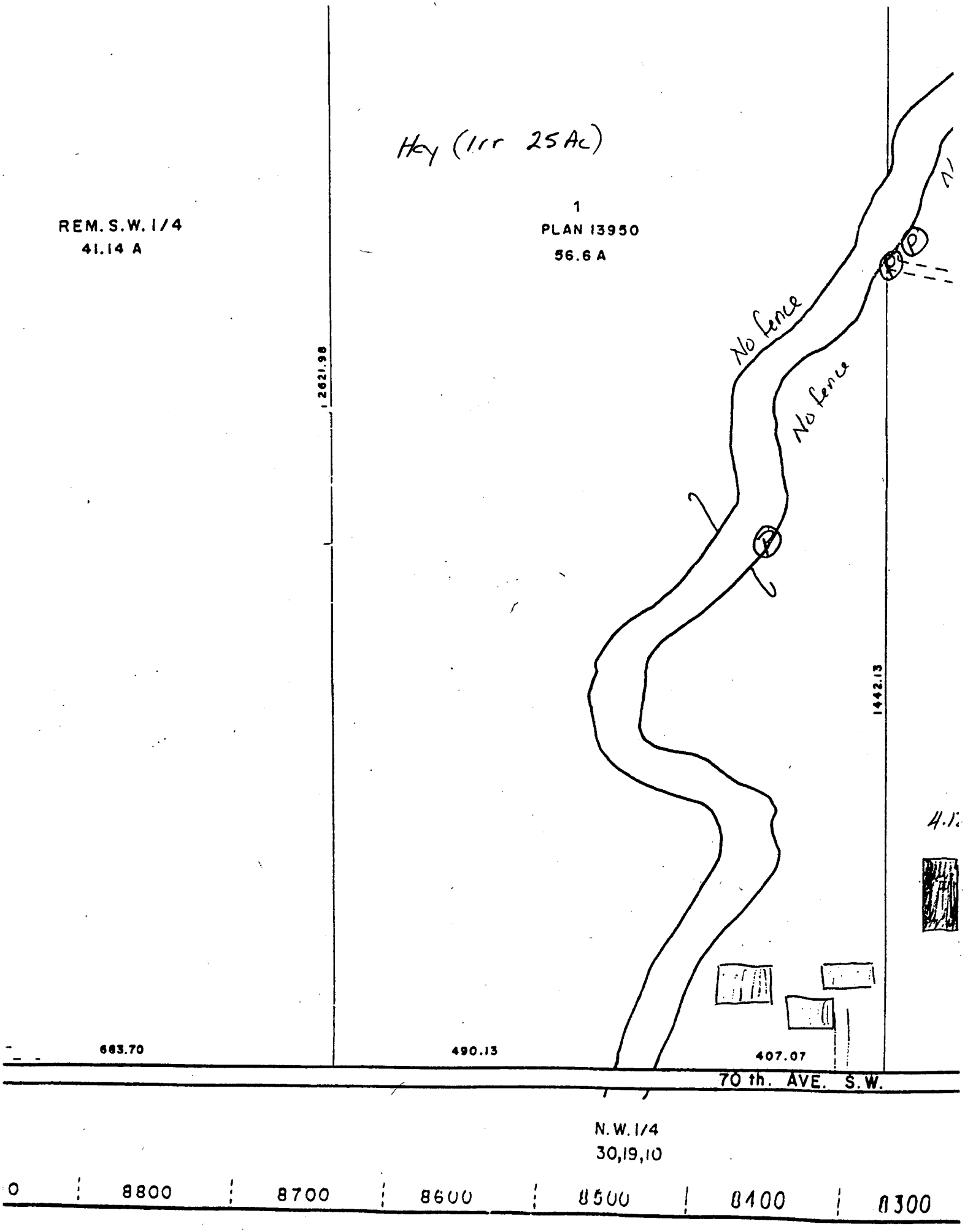


FIGURE 1.1

Salmon River Watershed Study Area


Hay (Irr 25Ac)
REM. S.W. 1/4
41.14 A
1
PLAN 13950
56.6 A
No fence
No fence
2621.98
1442.13
683.70
490.13
407.07
70 th. AVE. S.W.
N.W. 1/4
30,19,10
0
8800
8700
8600
8500
8400
8300

Lot A, Plan 12124, Section 19, Township 19, Range 10, Meridian 6, Kamloops Div of Yale Land District, Except Plan 19278, PID # 009-462-309

AREA 20 | SCHL 89 | JURIS 789 | ASSESSMENT ROLL NUMBER 06291.000 | EQTY 01
BULK MAIL

DAVID N HAWES
WENDY I HAWES
RR 1 SITE 5-20
SALMON ARM BC V1E 4M1

REG	SECT	LIB	LOC	DEFINED AREA	IMPR DIST	N.C.	SERVICE AREA	PREVIOUS ROLL VALUE
08	D	C					ELNS	$101,600

L. CON	INDIAN BAND	SPEC BAND	SPEC (REQ)	TEN	T/SECT	SUPP	ALR	UPC	MAN CL	L USE	ACT USE
			BZ	01			1		0140	60	180

DIMENSIONS	LANDS FILE	DOCUMENT NUMBER	NEIGH	PROPERTY LOCATION
3 32.28		S85134F	200	103 109 BRANCHFLOWER RD

	CLASS	ACTUAL VALUE
LAND	9	38,500
IMPRTS	1	78,300
		116,800

Lot 1, Plan 19278, Section 19, Township 19, Range 10, Meridian 6, Kamloops Div of Yale Land District, Except Plan 21229, PID # 005-152-542

AREA 20 | SCHL 89 | JURIS 789 | ASSESSMENT ROLL NUMBER 06292.000 | EQTY 01
BULK MAIL

MARGOT R MCLAWS
RR #1 SITE 5-7
SALMON ARM BC V1E 4M1

REG	SECT	LIB	LOC	DEFINED AREA	IMPR DIST	N.C.	SERVICE AREA	PREVIOUS ROLL VALUE
08	D	C					ELNS	$55,200

L. CON	INDIAN BAND	SPEC BAND	SPEC (REQ)	TEN	T/SECT	SUPP	ALR	UPC	MAN CL	L USE	ACT USE
			BZ	01			2		0081	63	000

DIMENSIONS	LANDS FILE	DOCUMENT NUMBER	NEIGH	PROPERTY LOCATION
3 1.18	-	KD17301	200	25 BRANCHFLOWER RD

	CLASS	ACTUAL VALUE
LAND	1	21,000
IMPRTS	1	49,300
		70,300

Lot 1, Plan 21229, Section 19, Township 19, Range 10, Meridian 6, Kamloops Div of Yale Land District, PID # 007-552-564

AREA 20 | SCHL 89 | JURIS 789 | ASSESSMENT ROLL NUMBER 06293.000 | EQTY 01
BULK MAIL

JACK E DAMON
RR 1 SITE 5-23
SALMON ARM BC V1E 4M1

REG	SECT	LIB	LOC	DEFINED AREA	IMPR DIST	N.C.	SERVICE AREA	PREVIOUS ROLL VALUE
08	D	C					ELNS	$38,000

L. CON	INDIAN BAND	SPEC BAND	SPEC (REQ)	TEN	T/SECT	SUPP	ALR	UPC	MAN CL	L USE	ACT USE
			BZ	01			2		0080	63	000

DIMENSIONS	LANDS FILE	DOCUMENT NUMBER	NEIGH	PROPERTY LOCATION
3 0.41		R49679F	200	9 BRANCHFLOWER RD

	CLASS	ACTUAL VALUE
LAND	1	15,700
IMPRTS	1	33,900
		49,600

Lot 2, Plan 21229, Section 19, Township 19, Range 10, Meridian 6, Kamloops Div of Yale Land District, PID # 007-552-599

AREA 20 | SCHL 89 | JURIS 789 | ASSESSMENT ROLL NUMBER 06294.000 | EQTY 01
BULK MAIL

THOMAS J DAVIES
JULIE A DAVIES
PO BOX 413
SALMON ARM BC V1E 4N5

REG	SECT	LIB	LOC	DEFINED AREA	IMPR DIST	N.C.	SERVICE AREA	PREVIOUS ROLL VALUE
08	D	C					ELNS	$47,300

L. CON	INDIAN BAND	SPEC BAND	SPEC (REQ)	TEN	T/SECT	SUPP	ALR	UPC	MAN CL	L USE	ACT USE
			BZ	01			2		0080	63	000

DIMENSIONS	LANDS FILE	DOCUMENT NUMBER	NEIGH	PROPERTY LOCATION
3 0.41		KC92748	200	14 SALMON RIVER RD

	CLASS	ACTUAL VALUE
LAND	1	15,700
IMPRTS	1	45,500
		61,200

PSC F93-1997 10-8

BRITISH COLUMBIA ASSESSMENT AUTHORITY
1993 AUTHENTICATED ROLL COPY

Lot 2, Plan 19278, Section 19, Township 19, Range 10, Meridian 6, Kamloops Div of Yale Land District, PID # 008-111-375

AREA 20 | SCHL 89 | JURIS 789 | ASSESSMENT ROLL NUMBER 06295.000 | EQTY 01
BULK MAIL

PHYLLIS S STROBL
JOHN STROBL
RR #1 SITE 5-24
SALMON ARM BC V1E 4M1

REG	SECT	LIB	LOC	DEFINED AREA	IMPR DIST	N.C.	SERVICE AREA	PREVIOUS ROLL VALUE
08	D	C					ELNS	$108,700

L. CON	INDIAN BAND	SPEC BAND	SPEC (REQ)	TEN	T/SECT	SUPP	ALR	UPC	MAN CL	L USE	ACT USE
			BZ	01			1		0140	60	060

DIMENSIONS	LANDS FILE	DOCUMENT NUMBER	NEIGH	PROPERTY LOCATION
3 3.52		KD87261	200	22 SALMON RIVER RD

	CLASS	ACTUAL VALUE
LAND	1	42,800
IMPRTS	1	97,400
		140,200

Lot B, Plan 12124, Section 19, Township 19, Range 10, Meridian 6, Kamloops Div of Yale Land District, Except Plan 35311, PID # 007-075-731

AREA 20 | SCHL 89 | JURIS 789 | ASSESSMENT ROLL NUMBER 06296.000 | EQTY 01
BULK MAIL

OLIVE P BATTERSBY
RR 1 SITE 5 - 15
82 SALMON RIVER DR
SALMON ARM BC V1E 4M1

REG	SECT	LIB	LOC	DEFINED AREA	IMPR DIST	N.C.	SERVICE AREA	PREVIOUS ROLL VALUE
08	D	C					ELNS	$130,600

L. CON	INDIAN BAND	SPEC BAND	SPEC (REQ)	TEN	T/SECT	SUPP	ALR	UPC	MAN CL	L USE	ACT USE
			BZ	01			1		0090	60	180

DIMENSIONS	LANDS FILE	DOCUMENT NUMBER	NEIGH	PROPERTY LOCATION
3 76.970		X174725	200	82 SALMON RIVER RD

	CLASS	ACTUAL VALUE
LAND	9	49,300
IMPRTS	1	96,100
		145,400

Lot 1, Plan 35311, Section 19, Township 19, Range 10, Meridian 6, Kamloops Div of Yale Land District, PID # 002-882-019

AREA 20 | SCHL 89 | JURIS 789 | ASSESSMENT ROLL NUMBER 06296.100 | EQTY 01
BULK MAIL

	CLASS	ACTUAL VALUE
LAND	1	38,600

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority PUC YYYY/MM/DD	Quantity/Units	Duty
C055575	0241464	45.4 AC OF L 11 OF BLK 2 OF L 463 KDYD PLAN 4063	COX LOIS A B WESTWOLD SALMON RIVER WUC 4014 W 32ND AVE VANCOUVER BC V6S1Z6 ------ WESTWOLD SALMON RIVER WUC C/O STEVE PRINGLE A-7 BULMAN RD WESTWOLD BC V0E3B0	1879/05/20 IRR	136.20 AF	3.0
F011942	0265775	139.1 AC OF ELY 7.5 CHAINS OF L 465; ELY 47.5 CHAINS OF L 467 & 466 KDYD	PARKLAND HOLDINGS LTD WESTWOLD SALMON RIVER WUC BOX A 7 KING WESTWOLD BC V0E3B0 ------ WESTWOLD SALMON RIVER WUC C/O STEVE PRINGLE A-7 BULMAN RD WESTWOLD BC V0E3B0	1917/05/15 IRR	417.00 AF	3.0
C041515	0296873	60 AC OF L A OF L 2 GP 9 YALE-LYTTON OF L 471 KDYD & FRAC SE 1/4 SEC 26 TP 17 R 13 W6M PLAN 21105	LANFRANCO CAMILLO BOX B-3 KING WESTWOLD BC V0E3B0	1970/07/23 IRR	180.00 AF	3.0
C041121	0316100	35 AC OF AMENDED L 2 OF L 2 GP 9 YALE-LYTTON & L 471 KDYD PLAN 10451 LYING S OF CNR R/W (PLAN A326)	HARVEY JOSEPH A BOX 7 WESTWOLD BC V0E3B0	1972/11/08 IRR	105.00 AF	3.0
C040286	0285491	30 AC OF AMENDED L 3 & L 2 GP 9 YALE-LYTTON & L 471 ALL WITHIN KDYD PLAN 10451	CHABOT JUDY A BOX 102 FALKLAND B C V0E1W0	1969/04/18 IRR	90.00 AF	3.0
C030308	0261284	L 519 KDYD EXC KAMLOOPS-VERNON HWY (PLAN H84) & CNR R/W (PLAN A323)	ABEL JOSEPH GENERAL DELIVERY FALKLAND BC V0E1W0	1965/03/10 LDIMP	0.00 TF	N/A

Residents and Water Licences on Salmon River

Reach	Registered Owner(s) Name and Address	Legal Discription	Plan	SEC	TWP	Range	Parcel Size (Ac)	Water licence Information			
								Date	PUC	IRR (Ac)	Quant/unit
*4.6	#CO62439 (Not on river)	3LK 1 SE 1/4	2333	31	19	10	60.15	1959/04/23	IRR	20	40 AF
4.7		Lot 1	15606	31	19	10	57.52				
4.8	#CO40962	NE 1/4 DD 4059D	9484	31	19	10	31.54	1972/04/21	IRR	31.54	30 AF
4.9	#CO43455	NE 1/4 E 1/2 DD 4059D		31	19	10	45.03	1973/08/09	IRR	25	50 AF
4.10	#CO43204 #CO43203	Lot 3	2006	6	20	10	8.6	1973/08/29 1973/08/29	DOM IRR	 6	500GD 12 AF

No.	Registered Owner(s) Name and Address	Legals Plan/Sec/Tp/R	Prcl Size (Ac)	Water Licence Inform				Current Data			Surface		Ground Water					
				Date of licence	Use	Irr (ac)	Lic'd (AF)	Er (ft)	Irr'd (ac)	Anim Unit	RR (AF)	Stock (GPD)	Depth (ft)	Yield (GPM)	D-Riv (ft)	Dom (GPD)	Stock (GPD)	RR (AF)

8/23/94 Table Templet 1

BC Environment

INFORMATION BULLETIN

Released by: Southern Interior Region
Kamloops, B.C.
July 30, 1993

SURVEY OF SALMON RIVER WATER USERS UNDERWAY

Information needed to protect the environmental and economic sustainability of the Salmon River watershed

KAMLOOPS - Staff from BC Environment's Water Quality Branch will be visiting residents along the Salmon River over the next few weeks gathering data on water and water use in the valley. The information, together with existing flow data, will help provide an accurate description of the water resource in the valley and its current uses.

The current study was sparked in part by the results of a survey completed last year for the Salmon River Restoration Committee by the Shuswap Nation Fisheries Commission. That survey revealed a high level of concern among residents and a commitment to the protection of the quantity and quality of water in the river. This second survey will look at specific water uses.

BC Environment's Water Management staff are working with the Salmon River Restoration Committee to produce an accurate picture of the water resource, including groundwater. This will provide the basis for working towards wise use of the water as well as protecting water quality and fish habitat.

The Salmon River is being considered for a pilot project on small watershed resource management under the Fraser River Management Plan. Its traditional value as a spawning stream, its widespread use of irrigation and the commitment of its residents make it an ideal place to put the theory of sustainability into practice.

Funding is available from the Federal government's Green Plan, both for research activities and restoration projects. To make the best use of this opportunity, community groups and all three levels of government are working together to gather needed information and develop a practical plan to protect and improve the Salmon River.

-more-

SURVEY OF SALMON RIVER WATER USERS

Dear Resident:

My name is Dennis Einarson and I am a biologist with BC Environment's Water Quality Branch in Vernon. I hope to visit you and your neighbours along the Salmon River over the next few weeks. I am gathering data on water and water use in the valley. The information, together with existing flow data, will help provide an accurate description of the water resource in the valley and its current uses.

The current study was sparked in part by the results of a survey completed last year for the Salmon River Restoration Committee by the Shuswap Nation Fisheries Commission. That survey revealed a high level of concern among residents and a commitment to the protection of the quantity and quality of water in the river. This second survey will look at specific water uses.

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Funding is available from the Federal government's Green Plan, both for research activities and restoration projects. To make the best use of this opportunity, community groups and all three levels of government are working together to gather needed information and develop a practical plan to protect and improve the Salmon River.

The Water Management survey is one more step in making the Salmon River an example of sustainability for all of British Columbia. Please grant me a few minutes of your time when I call. Together we can ensure that tomorrow's decisions are based on today's realities.

Sincerely

Dennis Einarson, Biologist
B.C Environment, Water Quality Branch
Vernon, 549-5565

WATER SURVEY QUESTIONNAIRE II - SALMON RIVER | **REACH No.** |

1. NAME AND ADDRESS

Surname		Given Names	
Street Address			
Mailing Address		Postal Code	
Home Phone		Message Phone	

2. PLACE OF USE - Legal description of property where water is used

Are you the owner of the property? Yes No

If not, who is?

Do you lease or rent any other property in the Salmon River Valley? Yes No

Legal Description for each parcel :

1

2

3

4

5

3.PURPOSE(S) AND QUANTITY OF WATER USED

Do you have a water licence(s)? Yes No

No. of CWL's		No. of FWL's	

Parcel No.	Tenure O/L/R	Parcel Size	IRRIGATION							DOMESTIC		STOCKWATERING	
			Water Source	Area Irrigated	Quantity	Sprinklers							
						No.	Size	Pressure	Rate	Source	(gpd)	Source	(gpd)
		(acres)	(s/g)	(acres)	(ac-ft)		(in)	(psi)	(gpm)				
1													
2													
3													
4													
5													
	TOTAL												

SUMMARY TABLE

	IRRIGATION	STOCKWATER	DOMESTIC	
SURFACE				
GROUND				
TOTALS				

4. GROUNDWATER INFORMATION

TOTAL No. of DRILLED WELLS (D)	
TOTAL No. of OPEN PIT WELLS (O)	

Well No.	Parcel No.	TYPE Drilled/ Open Pit	Date Installed (year)	Reg'td (y/n)	Dist. from River (ft)	Active y/n	Depth (ft)	Size L x W (ft xft)	Yield (gpm)	Period Use		Recharge	
										Start (month)	Finish (month)	Require (y/n)	Quantit (gal)
1													
2													
3													
4													
5													
6													

OVER --

5. LIVESTOCK INFORMATION

		Cows	Calves	Bulls	Horses	Pigs	Sheep	Goats	Chickens	
No. of Stock	Winter									
	Summer									TOTALS
Animal Units	Winter									
	Summer									

6. ADDITIONAL INFORMATION

7. SKETCH

8. REPORTED BY : _____ DATE : _____

This information is confidential and is to be used for the management of water resources and statistical purposes only.

No.	Registered Owner(s) Name and Address	Legals Plan/Sec/Tp/R	Prcl Size (Ac)	Water Licence Inform				Current Data			Surface Use		Ground Water Use					
				Date of licence	Use	Irr (ac)	Lic'd (AF)	Er (ft)	Irr'd (ac)	Anim Unit	IRR (AF)	Stock (GPD)	Depth (ft)	Yield (GPM)	D-Riv (ft)	Dom (GPD)	Stock (GPD)	IRR (AF)
3.16		Part NW 1/4 32 17 10	146.3	1953/12/10 F039568	IRR	9.0	18.0	0	35.30	10.0	18.0	0	8	5	150	500	0	0.0
				1947/06/19 F039569	IRR	10.0	20.0				20.0		13	5	200	0	7200	0.0
				1967/10/30 F039570	IRR	16.3	32.6				32.6							
		Part NE 1/4 32 17 10	2.3						0.00	0.0	0.0	0		0		0	0	0.0
3.17		Lot 1 24483 5 18 10	8.4					0	2.00	21.0	0.0	0	25	SP	100	1000	0	0.0
													8	pond	50	0	200	4.0
3.18		Lot 2 24483 5 18 10	6.3					0	0.00	0.0	0.0	0		unk	450	500	0	0.0
*3.19		ırt S 1/2 5 18 10	137.9	1947/06/19 F039195	IRR	10.0	20.0											
				1953/12/10 F039196	IRR	9.0	18.0											
				1967/09/28 C043310	IRR	20.0	40.0											
3.20		Lot1 25302 5 18 10	3.7					50	0.00	4.0	0.0	0	16	unk	200	500	40	0.0

Progress to date:

To date survey has been complete to Schwebs Bridge (Glenemma). The listing of properties is continuing upstream. The survey will continue after it is reviewed.

Results of the lower section of the river are still in draft form. I will present them to Water Management Kamloops for review as soon as possible.

Problems Areas:

There was no proven methodology to follow. We didnot know if this method would work or if the information collected would be accurate, or useful in determining the number of users or quantification of the water used..

1. Accuracy of information. I only list information volunteered by the owner or noted during preliminary field ground-truthing.

2. Areas are estimated from property maps and residents answers, not measured.

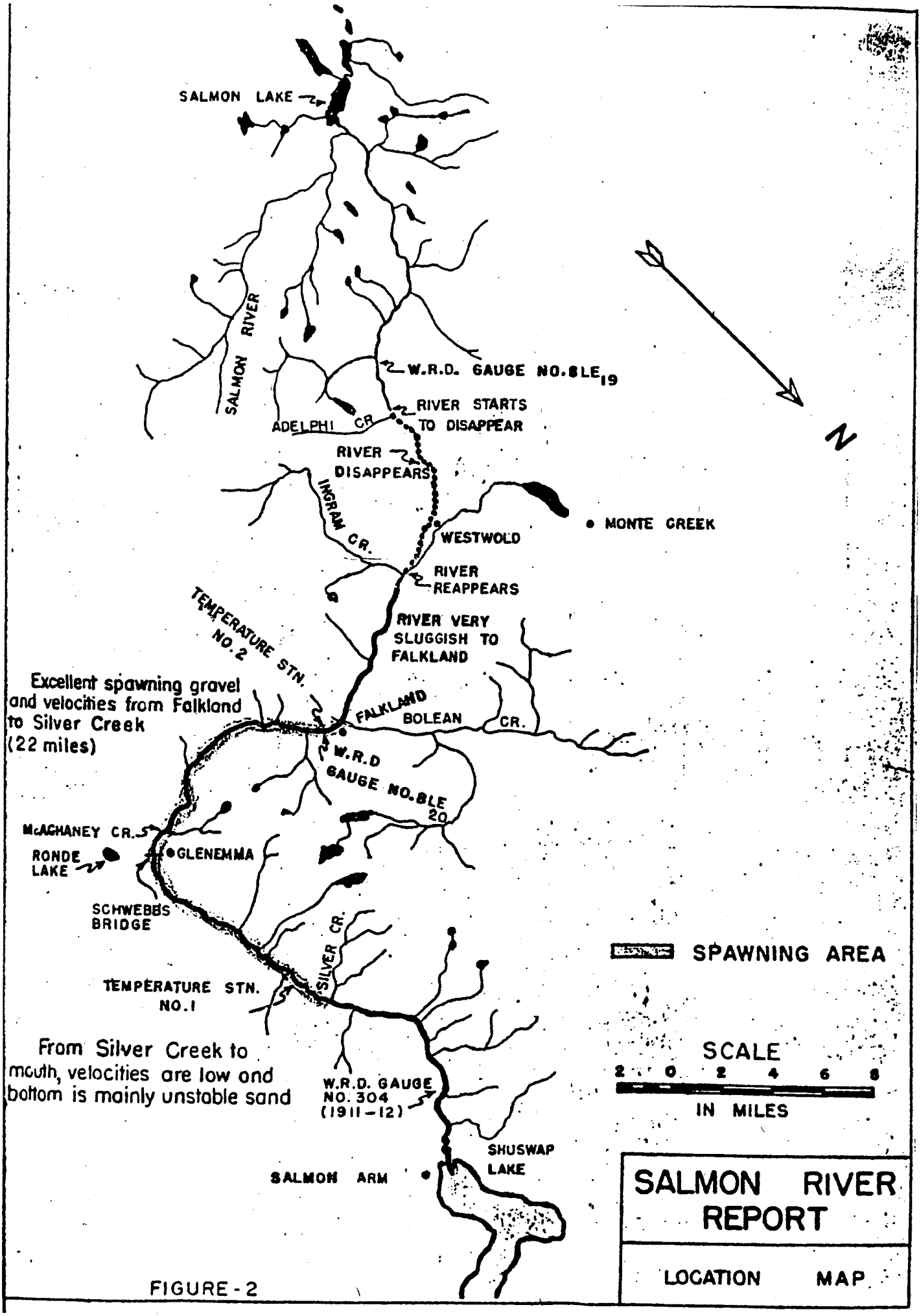
3. Smaller irrigation users do not follow a consistent annual cycle, their intermittent water methods may lead to under or over estimations of use.

4. Most people do not know their own well information. Well logs are not complete and as such are not effective in verifying well information. Also, the well logs do not give location, only the owners name. The property ownership may have changed several times since the well log was submitted.

5. I have listed all wells I have encountered on properties along the river. Need to determine a zone of concern!

6. To determine water volume used we need the flow rate (GPM), length of time irrigated and area irrigated. 1993 was a wet year and many people didn't use their irrigation. 1994 was a dry hot year and irrigation use was up.

7. Time. It has taken longer then expected to complete the survey. Although other duties can be blamed for some of the delay, they can not be blamed for it all.



SALMON RIVER REPORT

LOCATION MAP

FIGURE - 2

Preliminary findings:

There are 111 water licenses on the river between Glenemma and Shuswap Lake.

Within the District of Salmon Arm:

- City water is used for Domestic and Stock watering.
- There are 29 water licenses in this area.
- There are 30 wells and 2 ponds.
- The Median well depth is 20 feet.
- The median well distance from the river is 300 feet.
- There are 5 wells within 50 feet of the river (2 IRR/3DOM).
- Several owners have WL on tributary streams.

Between Glenemma and District of Salmon Arm:

- All DOM is from wells or tributary streams on private or community systems.
- There are 82 water licenses in this area.
- There are 120 wells and 13 ponds.
- The median well depth is 20 feet.
- The median distance is 100 feet.
- There are 15 Ground water Irrigation users.
- There are 9 wells within 50 feet of the river (4 IRR/7 DOM) and 4 ponds (1 IRR)
- None of registered domestic water licenses are used.

Overall:

- Water is being used from both surface and ground sources.
- Near stream wells and ponds are being used for Irrigation.
- The number of near stream wells and ponds is quite low.
- The quantity of water used from surface and ground sources has yet to be verified.

Residents Concerns & Comments

Below are some of the comments we have heard from concerned citizens along the river.

1. Beavers are the problem. They cut down trees and dam the river. Cows then get blamed for eating vegetation.

2. Fences through river catch debris and create hazards.

3. Fencing along the river will be expensive. Universal set backs won't be fair. Some areas do not need fencing.

4. Limiting stock access will have to be site specific. A single access point may not be feasible at some points on the river.

5. Bad placement of Waterworks and pump houses have caused erosion.

6. Do you need a Water license for dugouts and wells next to the river.

7. Have dikes been tried to prevent flooding over low banks?

8. Rip Rap, how do I get it?

9. They should just use logs secured to river banks for stabilization.

10. The spiling projects have had good and bad results.

11. Vegetation is eaten by both beavers and cows. The big Cotton woods along the river are not too good because their shallow roots washout very easily.

12. Aquatic plants like water hemlock must be removed from the river.

13. Fishing, illegal over fishing and fisheries traps, have lead to the fish crisis not the erosion.

14. Water temperature is cooler where the river is shaded so it should have new trees planted.

15. Water quality:
- Manure has always been part of the natural environment.
- Animal waste is food for the fish.

- Cows always use to walk in the creek and then the water was clear!!
- Septic tanks in some areas are too close to river? This is the source of poor water quality.
- Fertilizing near river and farm drainage are causing problems.
- Manure handling - barnyards and manure piles too close to the river.

16. Water quantity:
- The water was always low. Some years it did not flow at all.
- There is some unlicensed garden irrigation in the summer.
- There is some unlicensed agricultural irrigation.
- There are some water licenses that are in good standing, but are not being used.

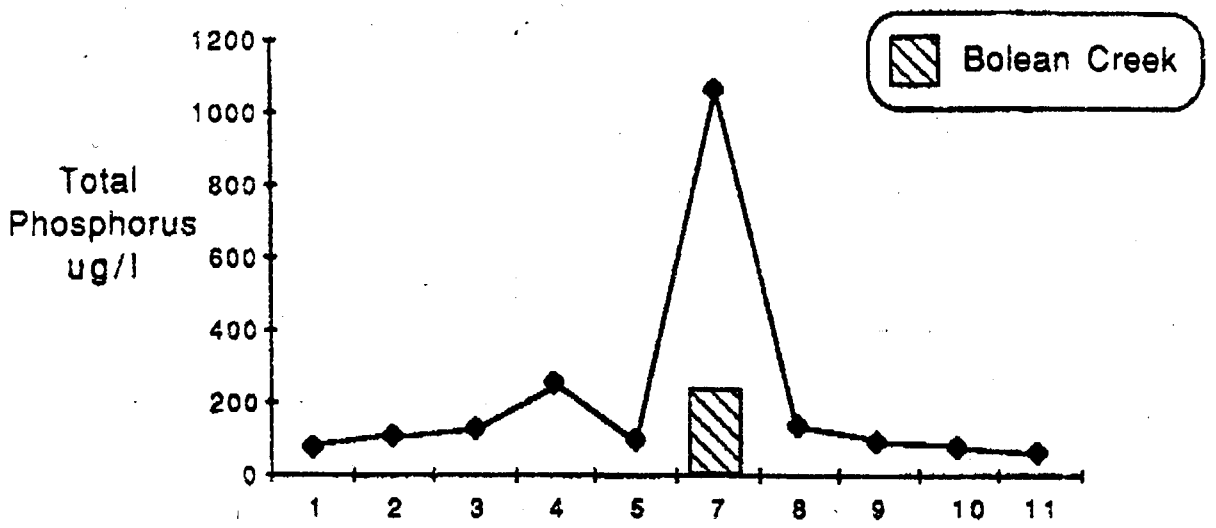
17. Runoff from logging actives is washing fine silts into the river.

18. Debris in river is causing the river to move to new channels.

19. Irrigation practices - Rain gauges should be used to measure water. There are several places where the pumps are always running, over irrigating the fields. These should be stopped. We should also look for better equipment efficiencies and better crops.

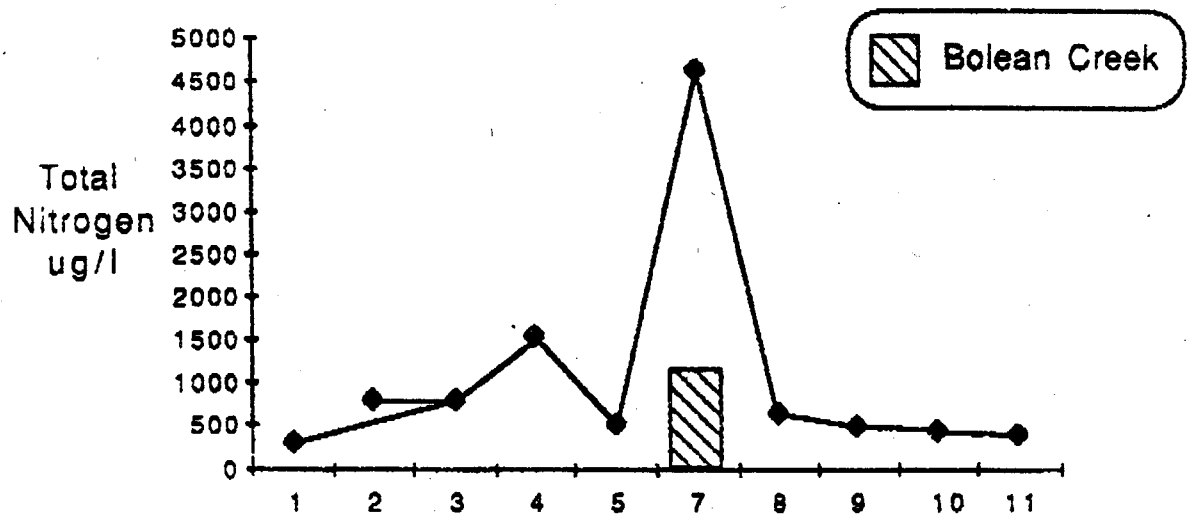
TRENDS IN THE SALMON RIVER WATER QUALITY - HEADWATERS TO MOUTH

Bob Grace
R.P. Bio., Regional Environmental Protection Program



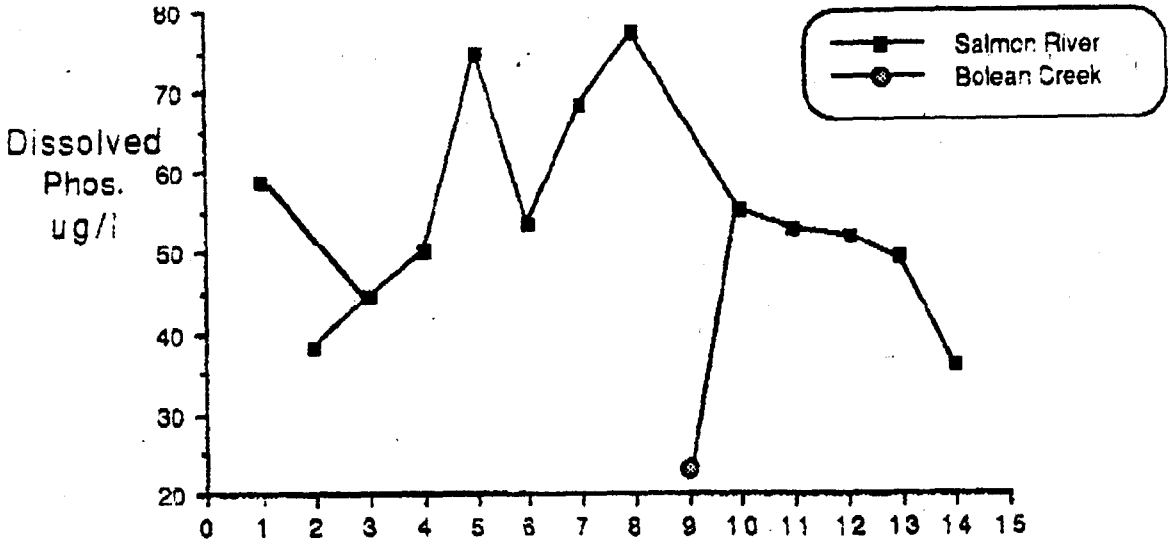
1-U/S McInnis Ck, 2-McInnis Ck, 3-D/S Culvert, 4-U/S Weyman Ck, 5-U/S Adelphi Ck, 7-U/S Falkland, 8-U/S Glenemma, 9-U/S Silver Ck,. 10-D/S Silver Ck, 11-At Hwy #1

Fig. 36 Total Phosphorus Concentrations in the Salmon River, Feb. 25, 1986



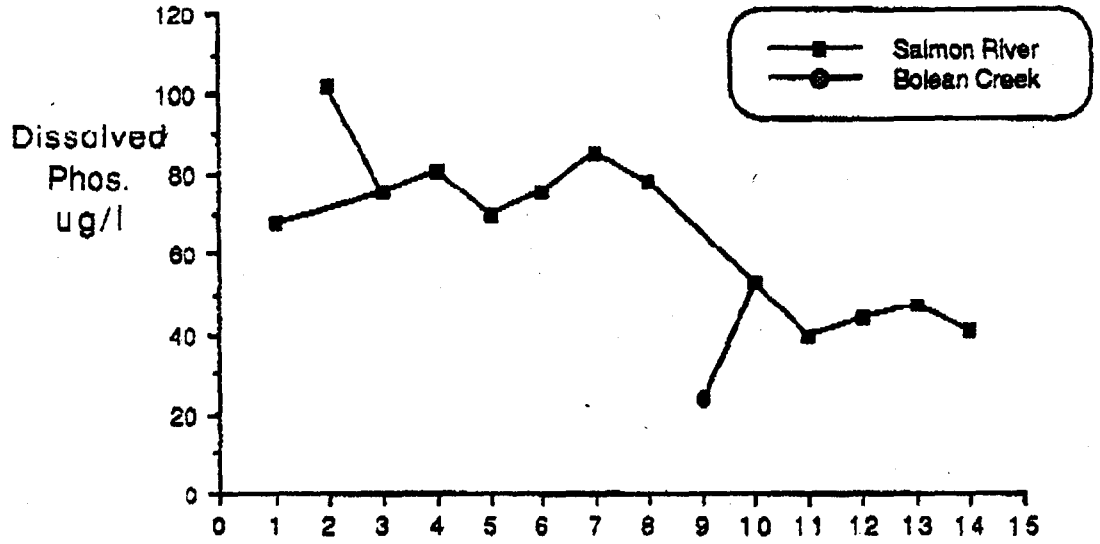
1-U/S McInnis Ck, 2-McInnis Ck, 3-D/S Culvert, 4-U/S Weyman Ck, 5-U/S Adelphi Ck, 7-U/S Falkland, 8-U/S Glenemma, 9-U/S Silver Ck,. 10-D/S Silver Ck, 11-At Hwy #1

Fig. 37 Total Nitrogen Concentrations in the Salmon River, Feb. 25, 1986



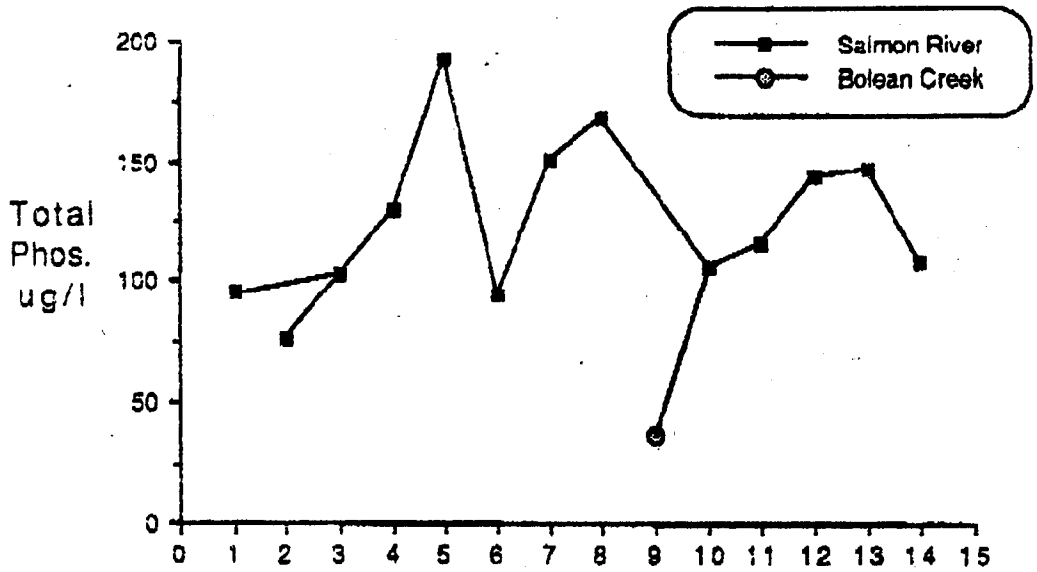
1-U/S McInnis CK, 2-McInnis Creek, 3-D/S Culvert, 4-D/S D Lk Ag
5-U/S Weyman Ck, 6-U/S Adelphi Ck, 7-at reappear, 8-U/S Falkland
9- Bolean Ck, 10-D/S Falkland, 11-U/S Glenemma, 12-U/S Silver Ck
13 D/S Silver Ck, 14-at Hwy #1

Fig. 46 Average Dissolved Phosphorus Concentrations in the Salmon River During May of 1989



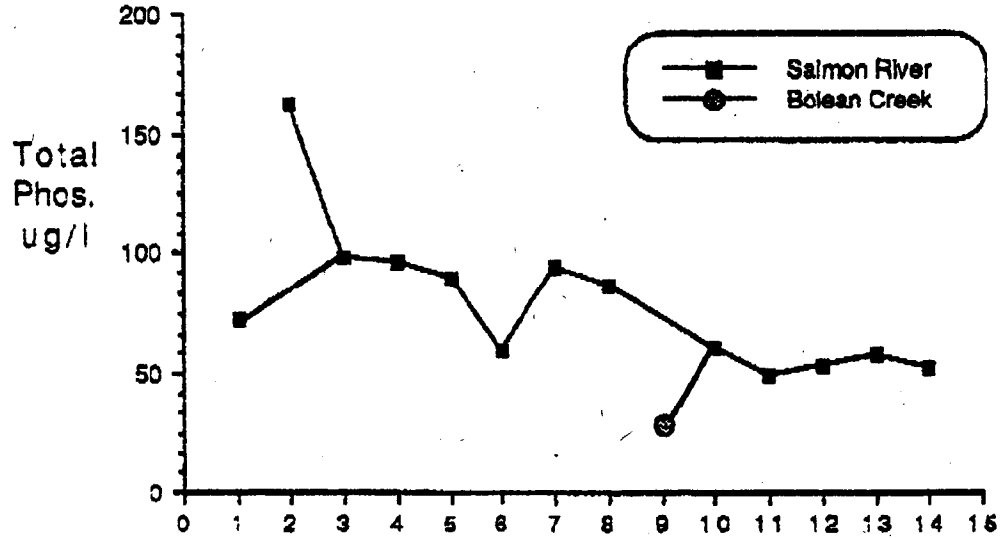
1-U/S McInnis CK, 2-McInnis Creek, 3-D/S Culvert, 4-D/S D Lk Ag
5-U/S Weyman Ck, 6-U/S Adelphi Ck, 7-at reappear, 8-U/S Falkland
9- Bolean Ck, 10-D/S Falkland, 11-U/S Glenemma, 12-U/S Silver Ck
13-D/S Silver Ck, 14-at Hwy #1

Fig. 52 Average Dissolved Phosphorus Concentrations in the Salmon River During August of 1989



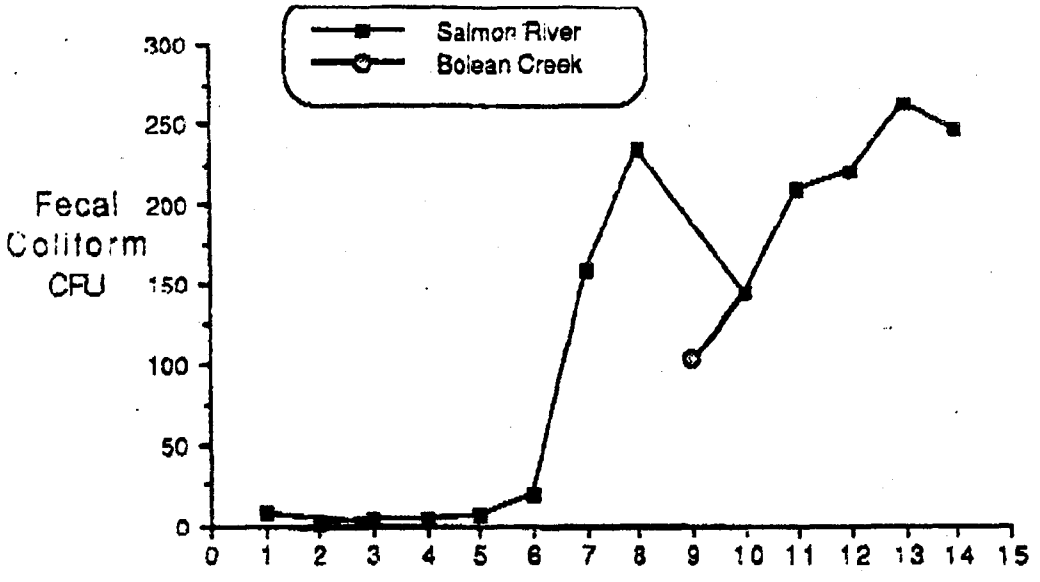
1-U/S McInnis CK, 2-McInnis Creek, 3-D/S Culvert, 4-D/S D Lk Ag
5-U/S Weyman Ck, 6-U/S Adelphi Ck, 7-at reappear, 8-U/S Falkland
9- Bolean Ck, 10-D/S Falkland, 11-U/S Glenemma, 12-U/S Silver Ck
13-D/S Silver Ck, 14-at Hwy #1

Fig. 47 Average Total Phosphorus Concentrations in the Salmon River During May of 1989



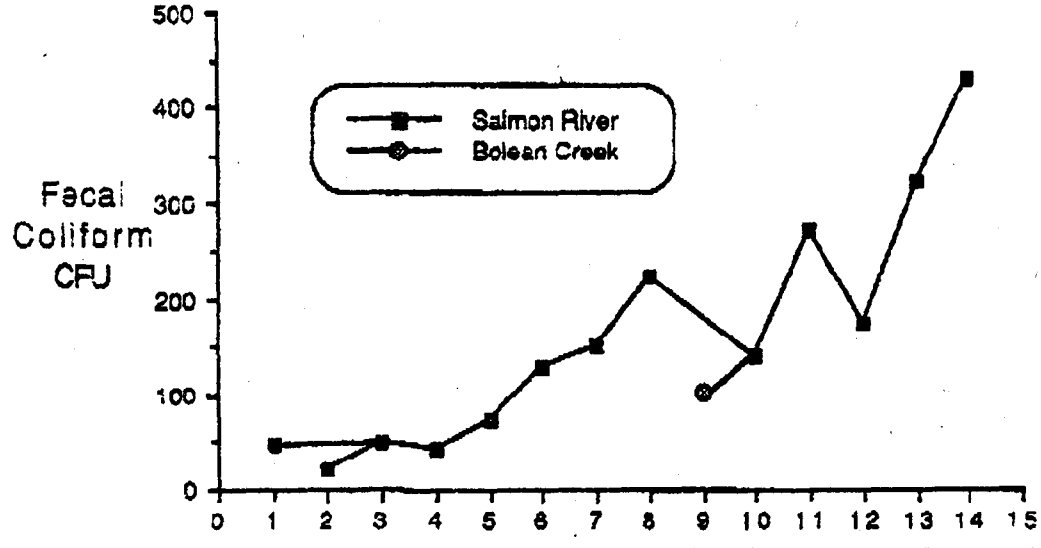
1-U/S McInnis CK, 2-McInnis Creek, 3-D/S Culvert, 4-D/S D Lk Ag
5-U/S Weyman Ck, 6-U/S Adelphi Ck, 7-at reappear, 8-U/S Falkland
9- Bolean Ck, 10-D/S Falkland, 11-U/S Glenemma, 12-U/S Silver Ck
13-D/S Silver Ck, 14-at Hwy #1

Fig. 53 Average Total Phosphorus Concentrations in the Salmon River During August of 1989



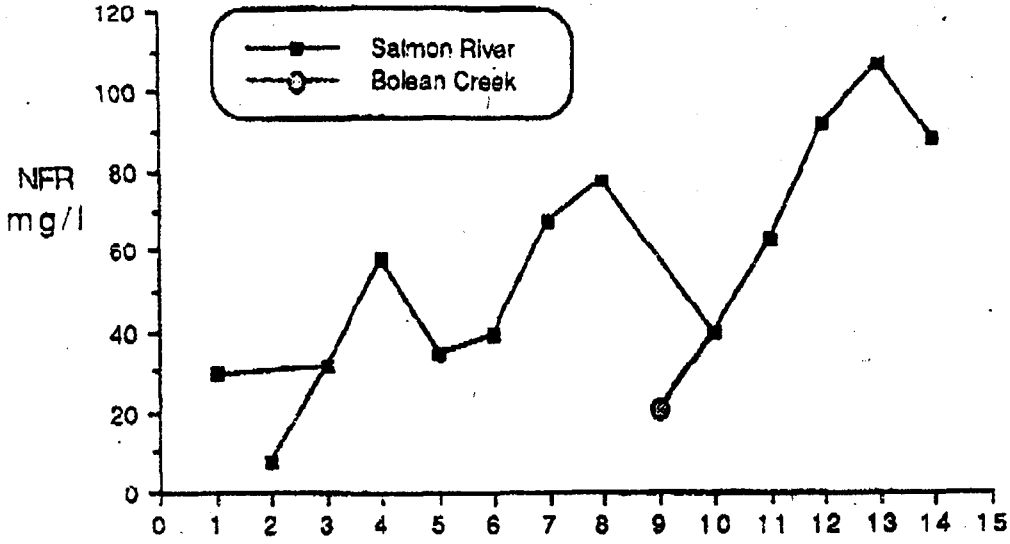
1-U/S McInnis CK, 2-McInnis Creek, 3-D/S Culvert, 4-D/S D Lk Ag
5-U/S Weyman Ck, 6-U/S Adelphi Ck, 7-at reappear, 8-U/S Falkland
9- Bolean Ck, 10-D/S Falkland, 11-U/S Glenemma, 12-U/S Silver Ck
13-D/S Silver Ck, 14-at Hwy #1

Fig. 48 Average Fecal Coliform Concentrations in the Salmon River During May of 1989



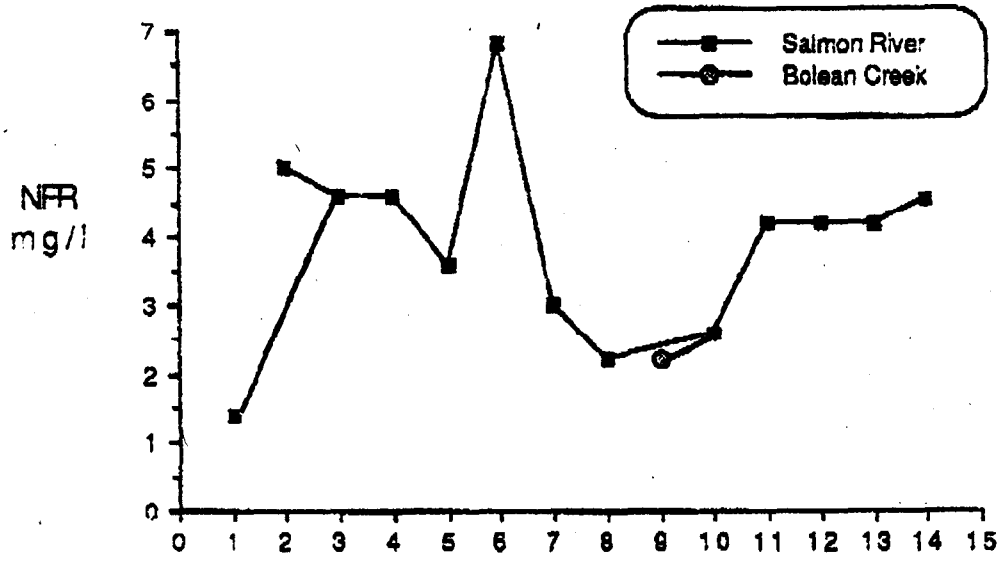
1-U/S McInnis CK, 2-McInnis Creek, 3-D/S Culvert, 4-D/S D Lk Ag
5-U/S Weyman Ck, 6-U/S Adelphi Ck, 7-at reappear, 8-U/S Falkland
9- Bolean Ck, 10-D/S Falkland, 11-U/S Glenemma, 12-U/S Silver Ck
13-D/S Silver Ck, 14-at Hwy #1

Fig.54 Average Fecal Coliform Concentrations in the Salmon River During August of 1989



1-U/S McInnis CK, 2-McInnis Creek, 3-D/S Culvert, 4-D/S D Lk Ag
5-U/S Weyman Ck, 6-U/S Adelphi Ck, 7-at reappear, 8-U/S Falkland
9- Bolean Ck, 10-D/S Falkland, 11-U/S Glenemma, 12-U/S Silver Ck
13-D/S Silver Ck, 14-at Hwy #1

Fig. 49 Average Nonfilterable Residue Concentrations in the Salmon River During May of 1989



1-U/S McInnis CK, 2-McInnis Creek, 3-D/S Culvert, 4-D/S D Lk Ag
5-U/S Weyman Ck, 6-U/S Adelphi Ck, 7-at reappear, 8-U/S Falkland
9- Bolean Ck, 10-D/S Falkland, 11-U/S Glenemma, 12-U/S Silver Ck
13-D/S Silver Ck, 14-at Hwy #1

Fig. 55 Average Nonfilterable Residue Concentrations in the Salmon River During August of 1989

QUANTITATIVE ASSESSMENT OF SALMONID HABITAT IN THE SALMON RIVER

Dave Burt
D. Burt and Associates

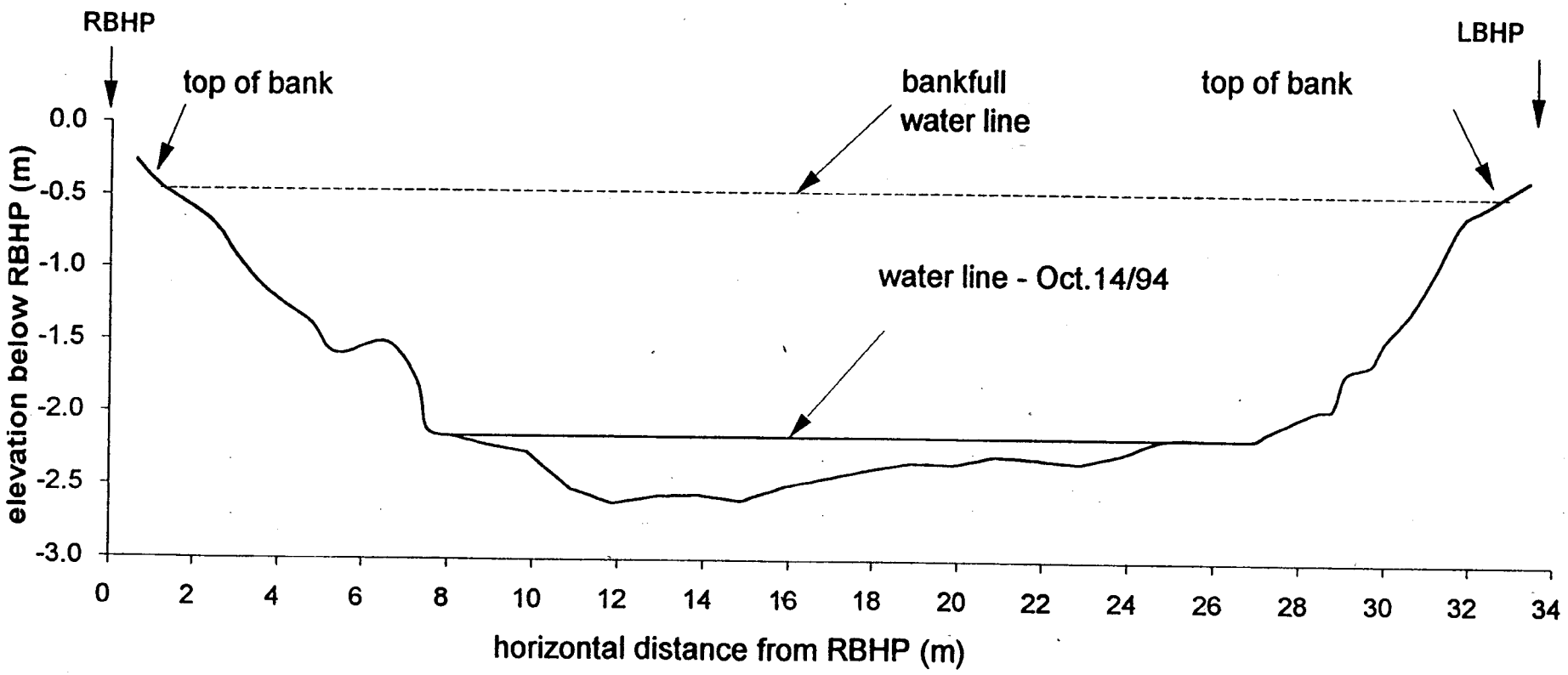
Mike Wallis
Wallis Environmental Aquatics Ltd.

Parameters Monitored

- hydraulic habitat type: riffle, run or pool
- wetted width, channel width and transect width
- oxygen and temperature profiles
- depth, velocity and substrate at regular intervals across the wetted width
- cross sectional channel profiles using transit and rod.
- site location using GPS
- sketch map and photos of transect site
- % cover overstream and in stream LOD and Vegetation were estimated
- habitat mapping u/s and d/s of transect (WW,length, substr, cover)

(2)

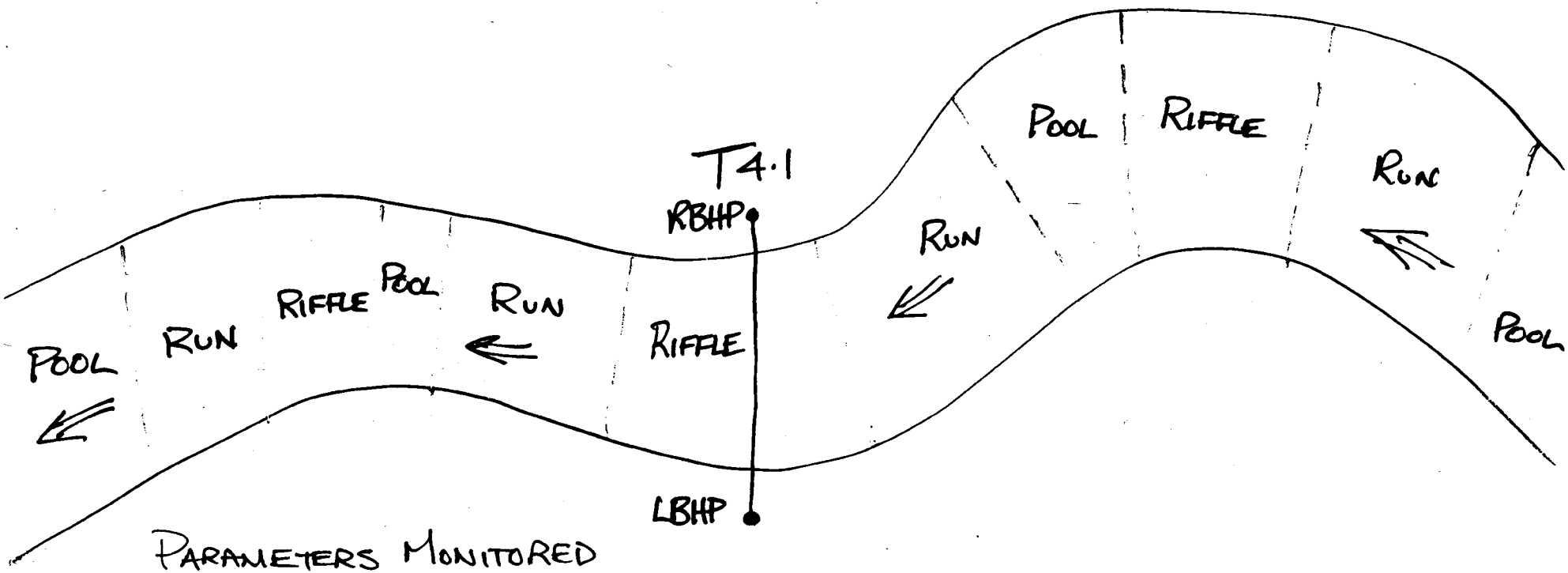
Salmon River Channel Profile - Transect 4.1, Oct. 14/94



Depth
Velocity
Substrate

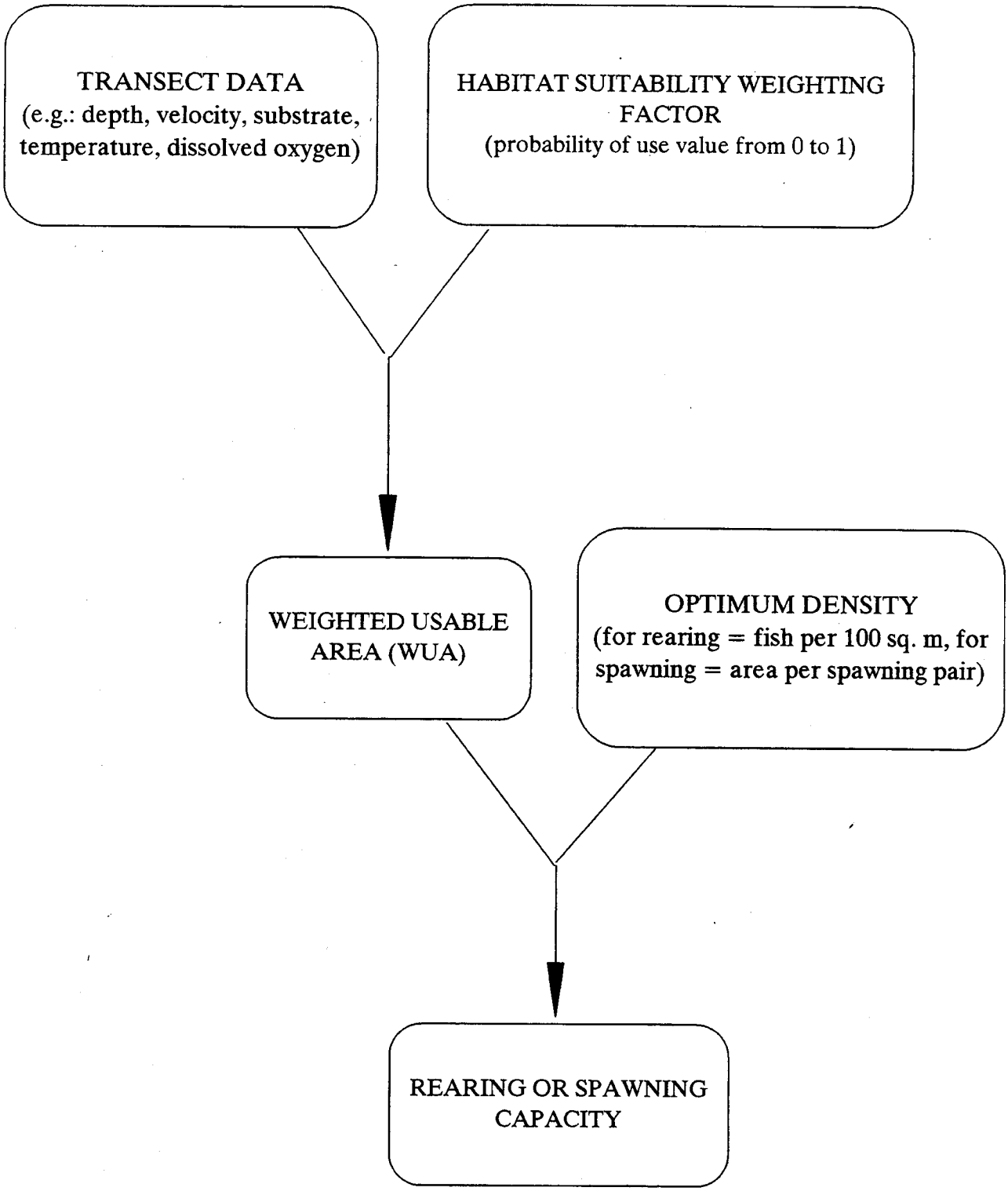
Xsec profile

HABITAT MAPPING U/S D/S FROM TRANSECT TO DETERMINE PROPORTION OF EACH HABITAT TYPE WITHIN A REACH.



PARAMETERS MONITORED

- Wetted Width
- Length
- Substrate
- % Cover


TRANSECT DATA
(e.g.: depth, velocity, substrate, temperature, dissolved oxygen)
HABITAT SUITABILITY WEIGHTING FACTOR
(probability of use value from 0 to 1)
WEIGHTED USABLE AREA (WUA)
OPTIMUM DENSITY
(for rearing = fish per 100 sq. m, for spawning = area per spawning pair)
REARING OR SPAWNING CAPACITY

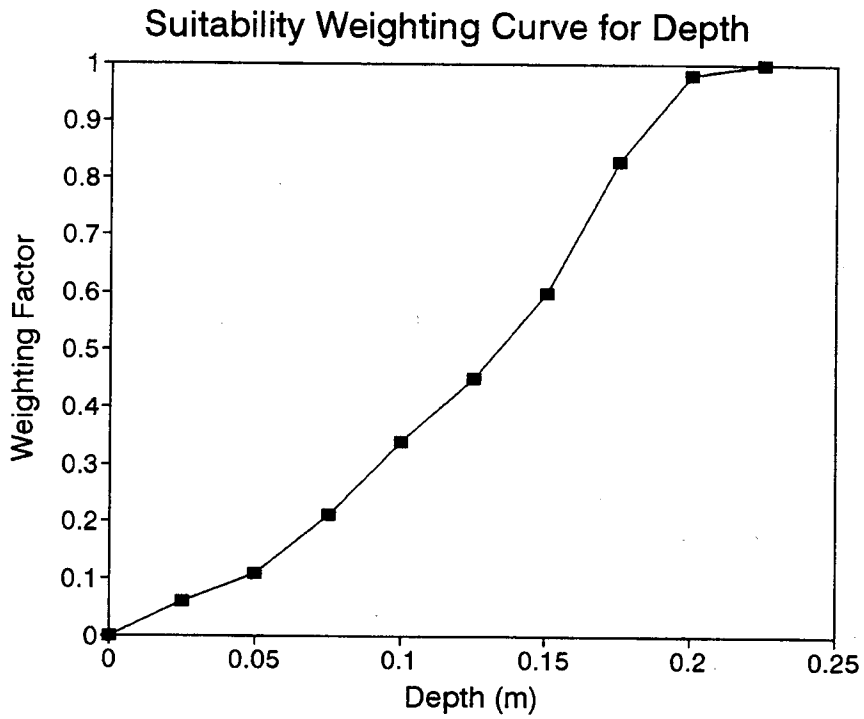
EXAMPLE OF TRANSECT DATA

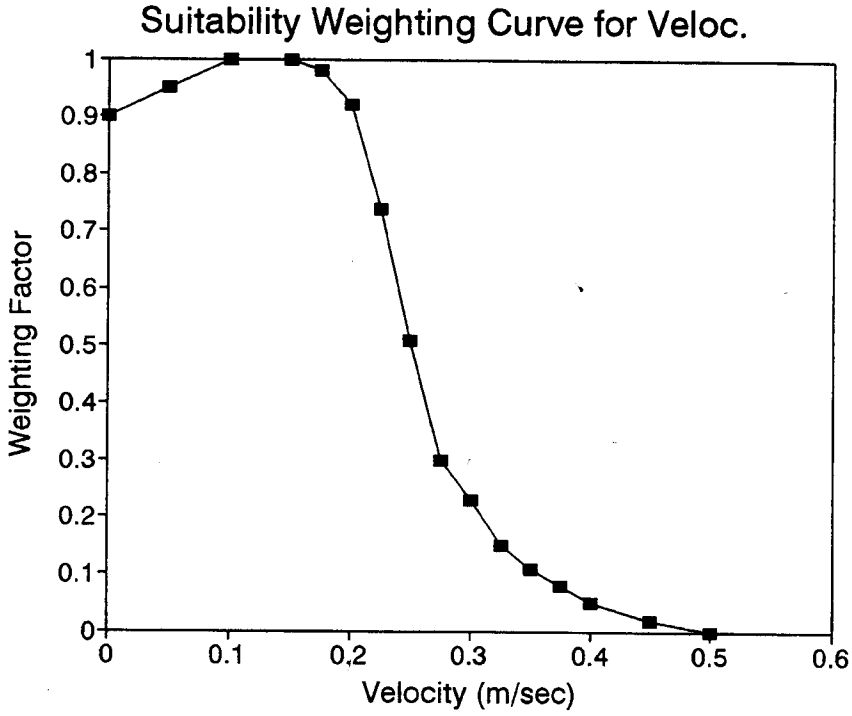
TRANSECT 4.1

Station	Depth	Velocity	Substrate (%)					
(m)	(m)	(m/s)	fi	sg	lg	sc	lc	bo
7.9	0	0	0	0	25	75	0	0
8.9	0.06	0.21	0	0	25	75	0	0
9.9	0.11	0.48	0	0	25	75	0	0
10.9	0.36	0.46	0	0	25	75	0	0
11.9	0.46	0.22	0	0	0	90	10	0
12.9	0.41	0.33	0	0	0	90	10	0
13.9	0.4	0.26	90	10	0	0	0	0
14.9	0.44	0.24	100	0	0	0	0	0
15.9	0.34	0.45	0	30	30	35	5	0
16.9	0.28	0.6	0	20	30	45	5	0
17.9	0.22	0.3	0	0	20	65	15	0
18.9	0.17	0.31	0	15	15	60	10	0
19.9	0.18	0.47	0	0	0	100	0	0
20.9	0.12	0.38	0	0	0	100	0	0
21.9	0.14	0.37	0	0	0	100	0	0
22.9	0.17	0.14	0	0	0	100	0	0
23.9	0.1	0.07	25	0	25	40	10	0
24.9	0	0	15	30	40	10	5	0
25.9	0	0	20	20	40	10	10	0
26.9	0	0	0	0	0	40	60	0
Average	0.20	0.26	13	6	15	59	7	0
Max	0.46	0.6						

Note: stations are from right bank to left bank (facing downstream)

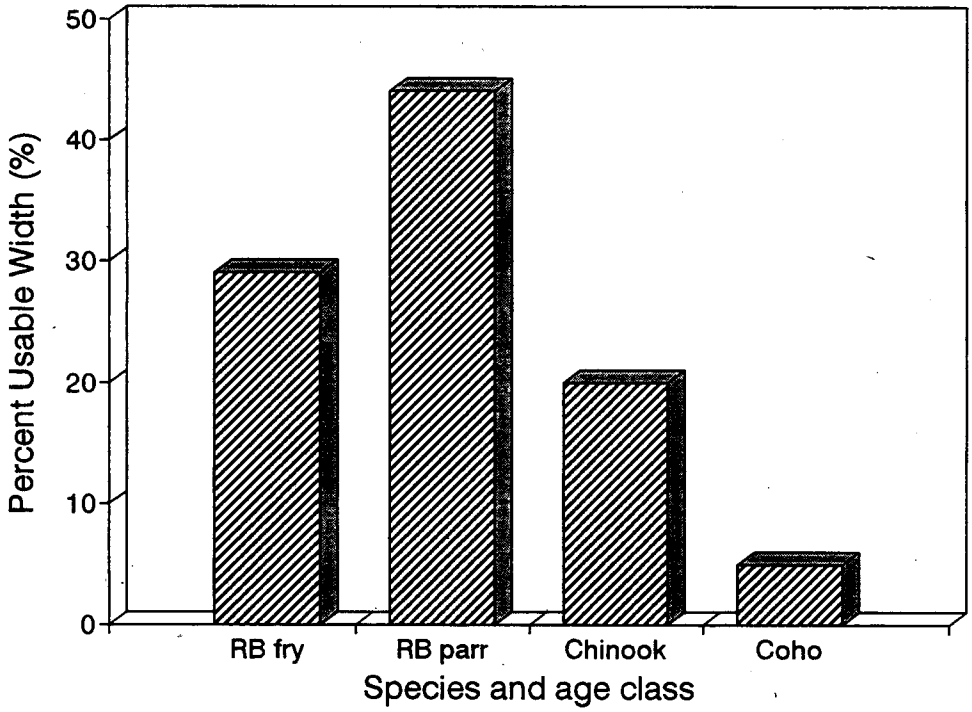
Age 0+ Chinook



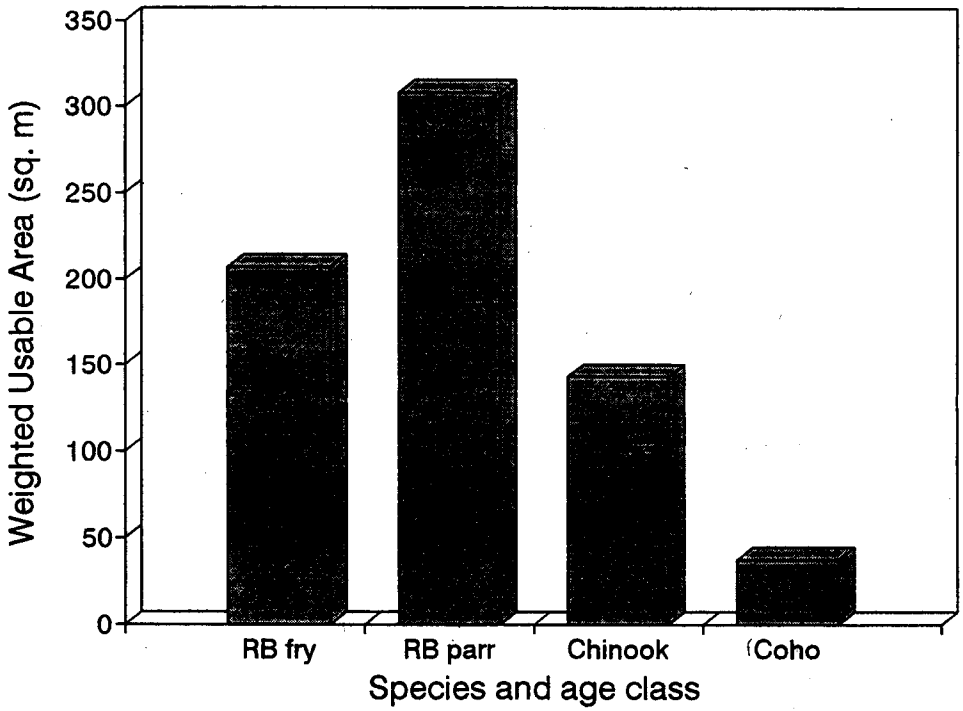


TRANSECT 4.1

Usable Width By Species



Weighted Usable Area By Species



CALCULATION OF REARING CAPACITY

CHINOOK

A) Calculate optimum density

Optimum density calculations are based on an alkalinity model developed by Ron Ptolemy (MoELP, Victoria).

FPU = sq. root(alkalinity) x 36.3 / size

Where:
FPU = fish per 100 sq. m = density
alk = total alkalinity (mg/l)
size = mean weight (g) per size class

B) Apply optimum density (FPU) to weighted usable area (WUA)

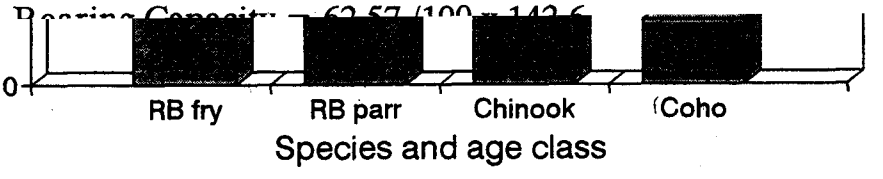
Rearing Capacity = FPU / 100 x WUA

EXAMPLE CALCULATION:
CHINOOK REARING CAPPACITY IN THE RIFFLE AT TRANSECT 4.1

Input parameters:
Alkalinity - 154 mg/l (Aquametrix, in prep.)
Size - 7.2 g (Aug. 18, 1981; Whelen et al. 1982)
WUA(T4.1) - 142.6 sq. m

FPU = sq. root(alkalinity) x 36.3 / size
FPU = sq. root(154) x 36.3 / 7.2
FPU = 62.57 fish per 100 sq. m

Rearing Capacity = FPU /100 x WUA
Rearing Capacity = 62.57 /100 x 142.6



USE OF TECHNIQUE AS A MANAGEMENT TOOL

Applicability of Quantiative Assessment of salmonid Habitat to Management of the Salmon River Watershed

* Assess affects of low flows and high temperature during summer on available fish habitat and fish production

* Identify key factors limiting salmonid production

* Assessment of target production goals

* Assessment of proposed fry transplant proposals

* Planning tool

* Public confidence for watershed proposals

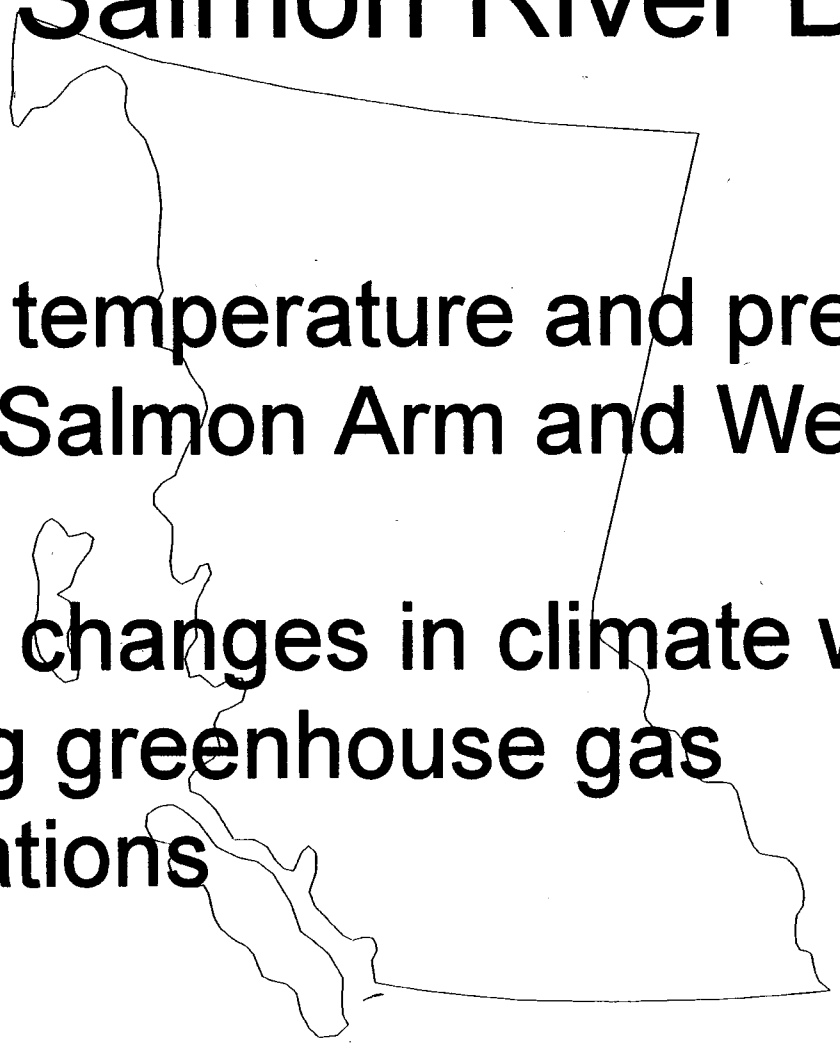
* Tracking tool for monitoring progess of watershed initiatives

PAST AND FUTURE CLIMATES OF THE SALMON RIVER BASIN

Eric Taylor

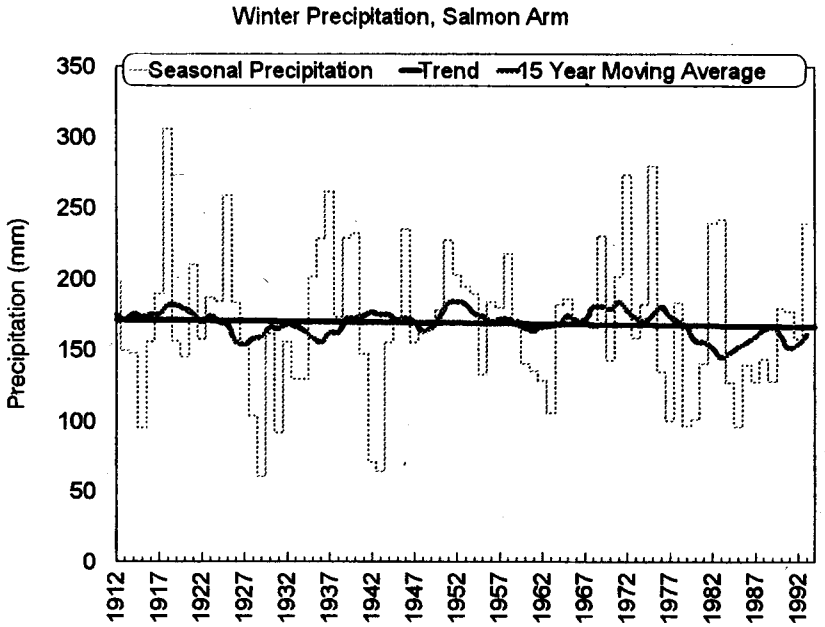
Science Division
Environment Canada

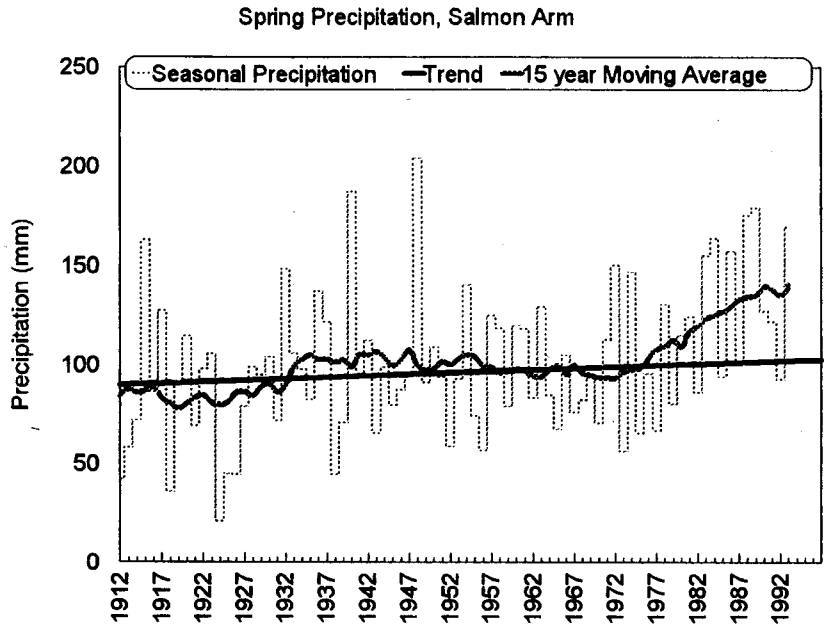
Past and Future Climate Trends in the Salmon River Basin

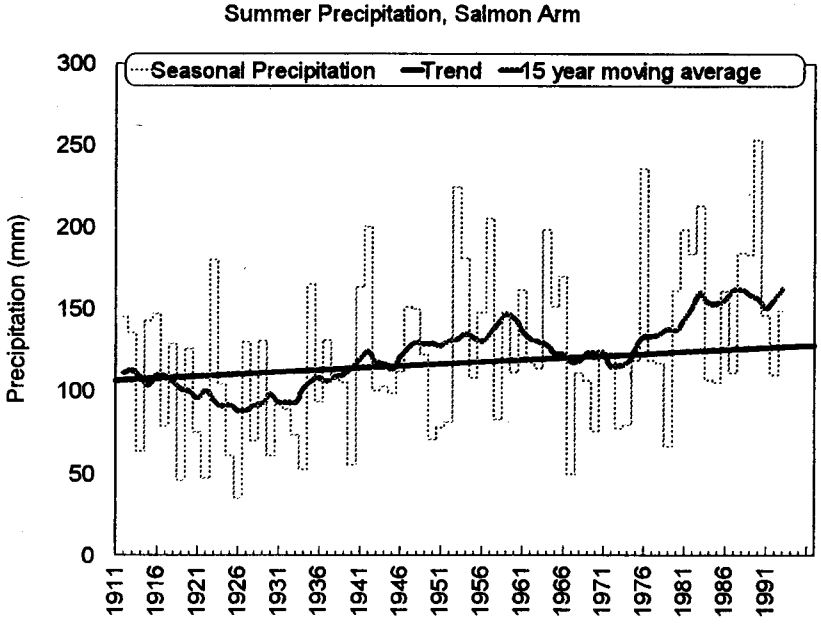


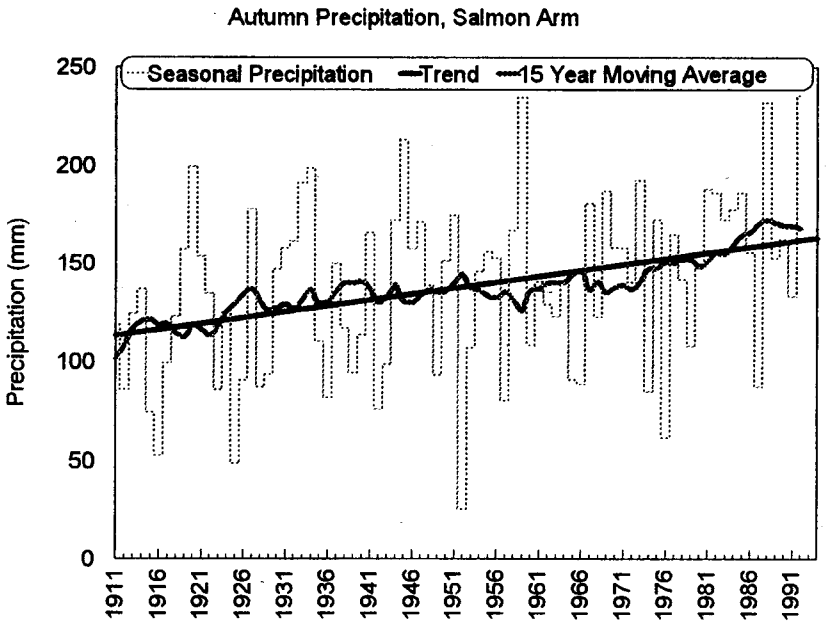
- Historical temperature and precipitation trends at Salmon Arm and Westwold
- Expected changes in climate with increasing greenhouse gas concentrations

Precipitation trend: Salmon Arm



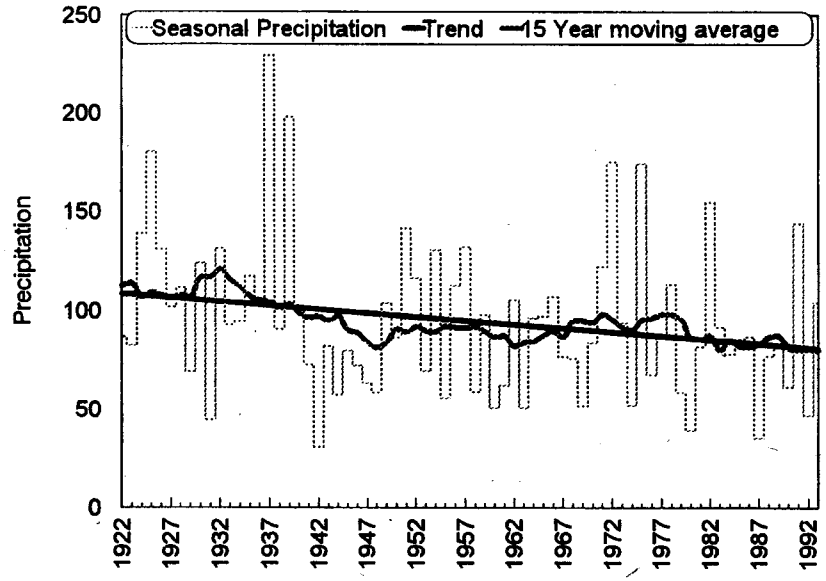




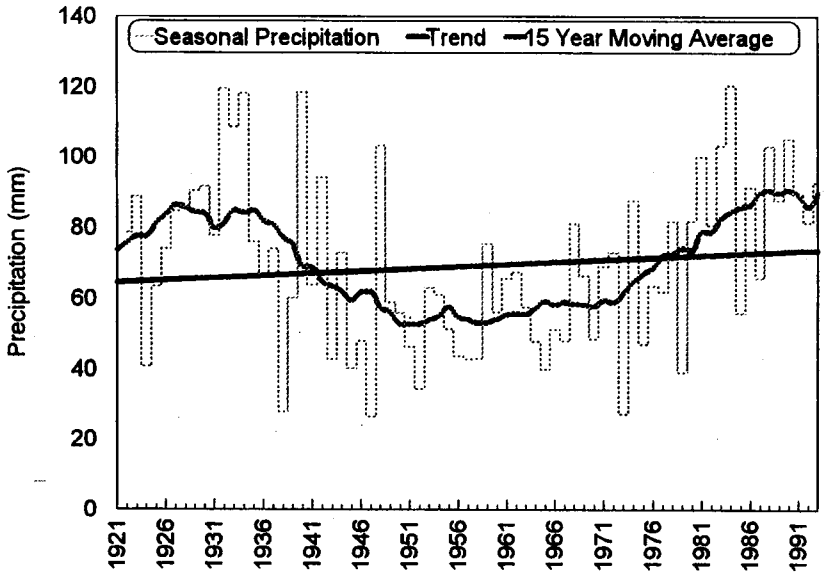


Precipitation Trend: Westwold

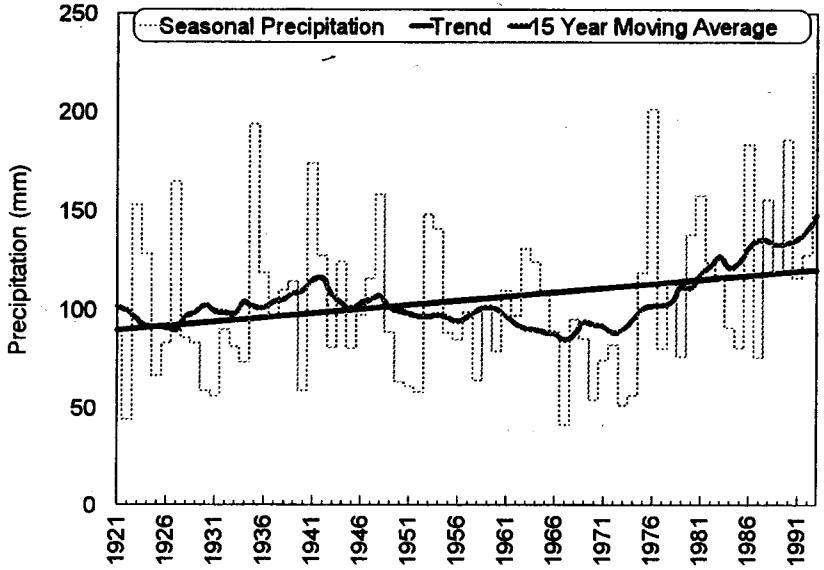
Winter Precipitation, Westwold



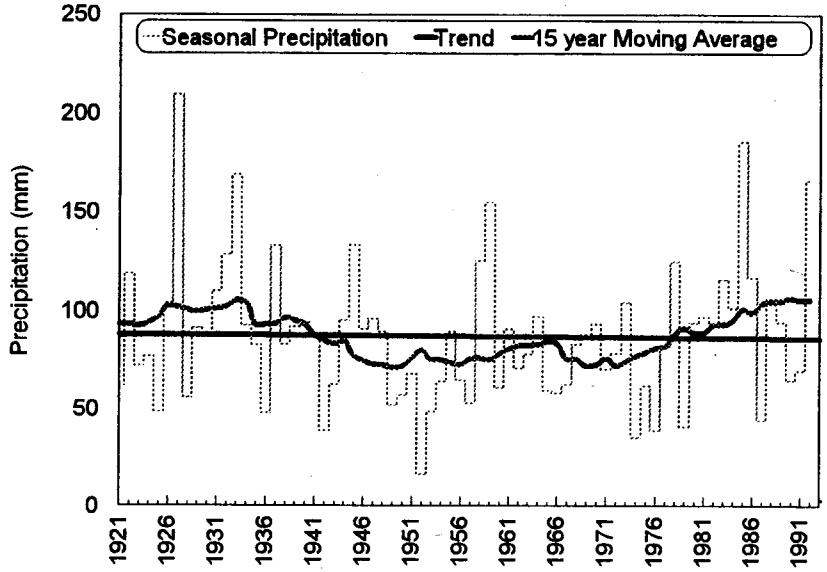
Spring Precipitation, Westwold



Summer Precipitation, Westwold

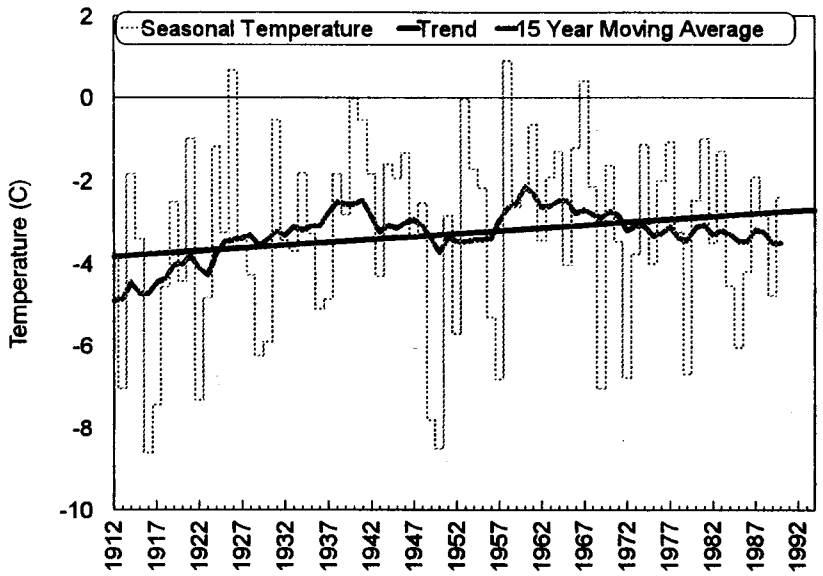


Autumn Precipitation, Westwold

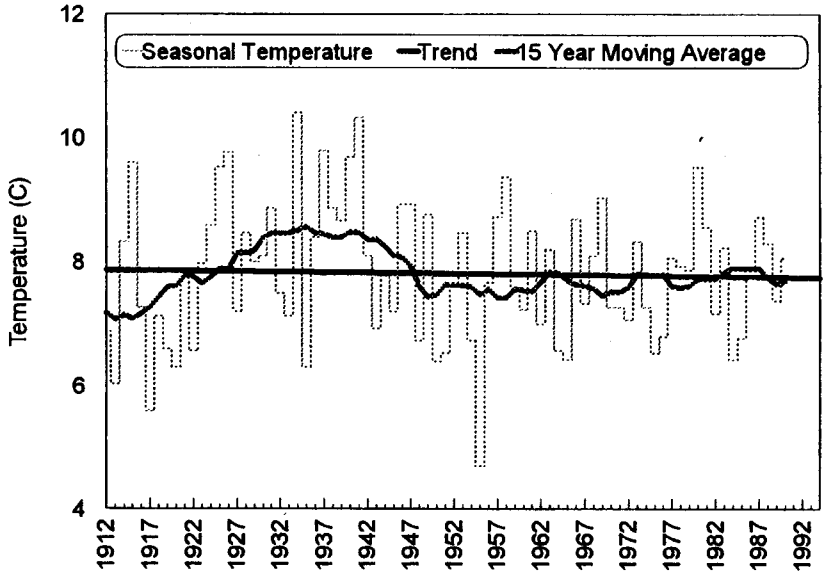


Temperature Trend: Salmon Arm

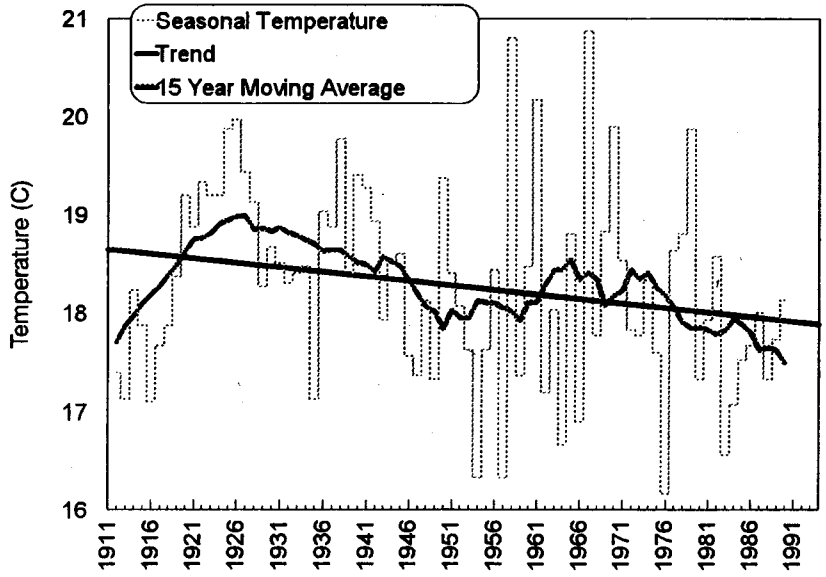
Winter Temperature, Salmon Arm



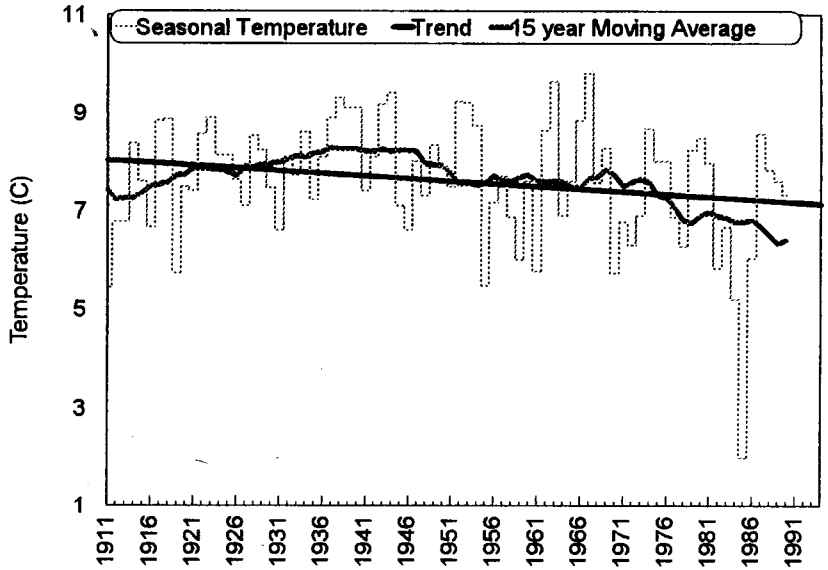
Spring Temperature, Salmon Arm



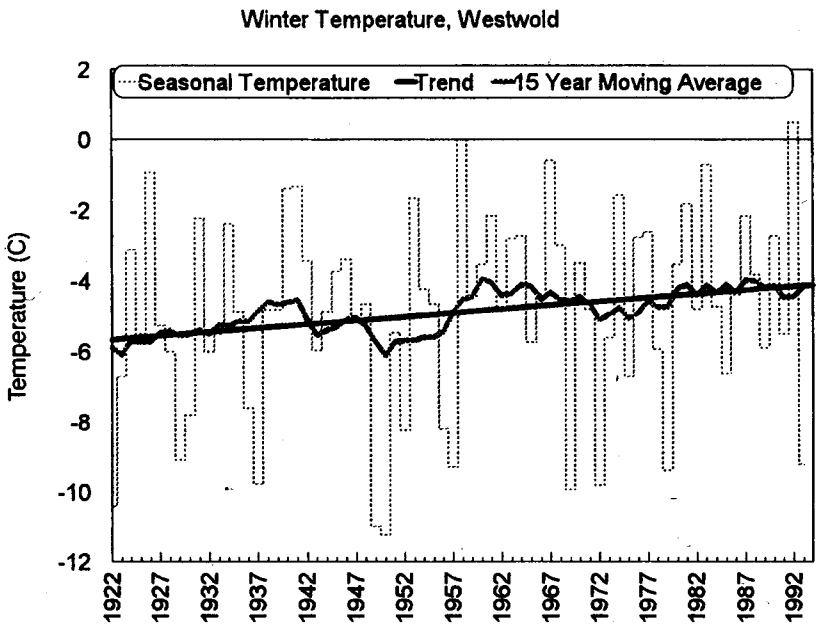
Summer Temperature, Salmon Arm

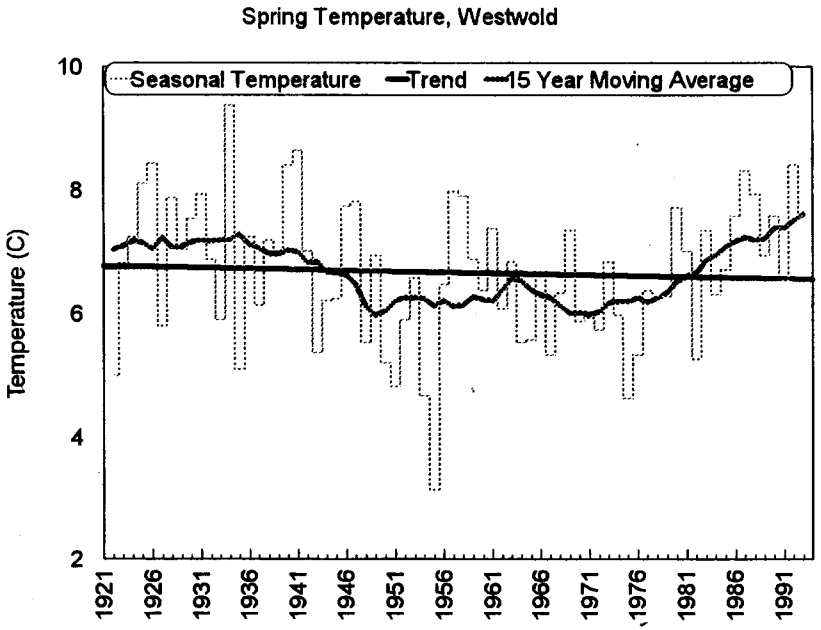


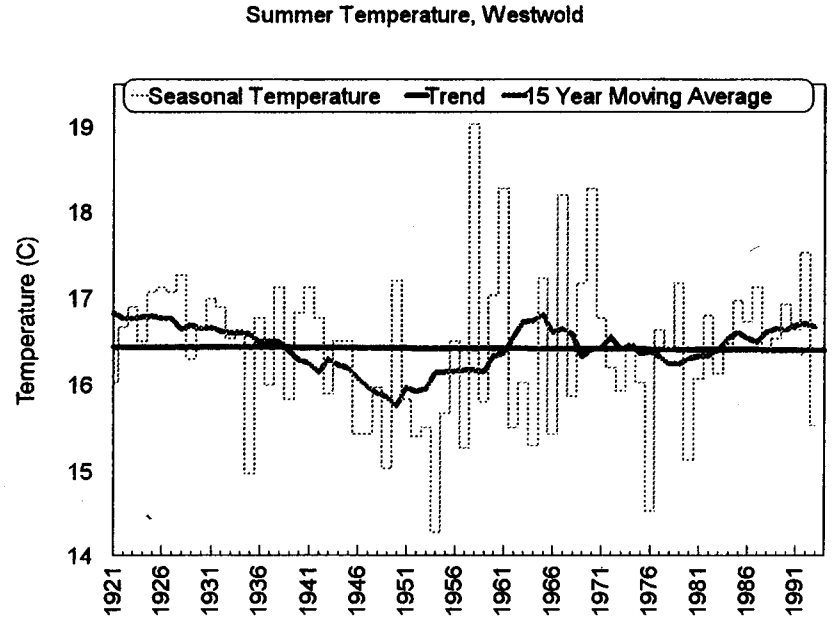
Autumn Temperature, Salmon Arm

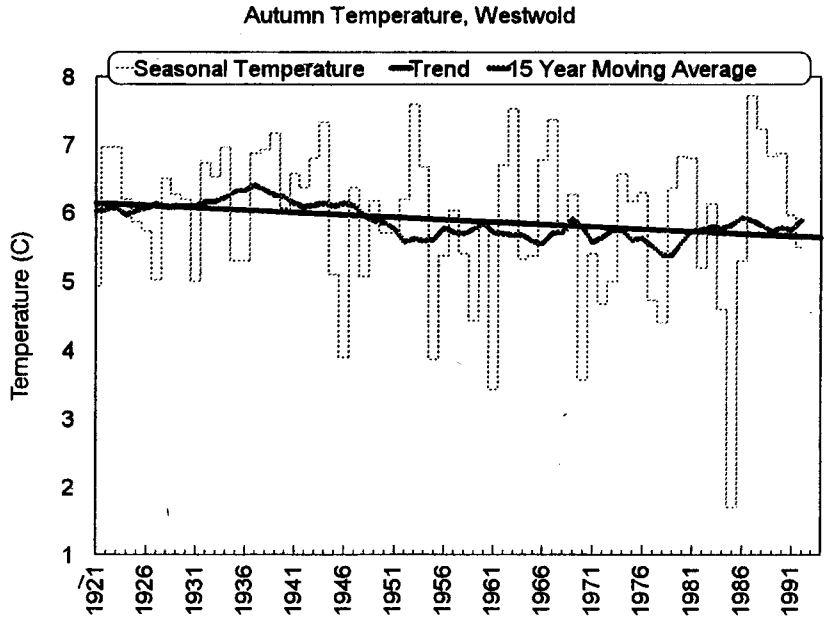


Temperature Trend: Westwold

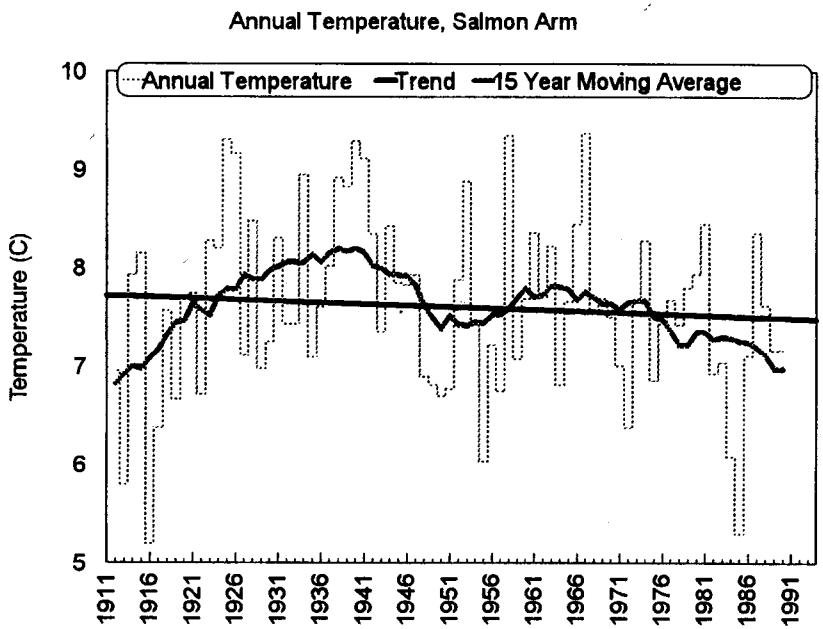


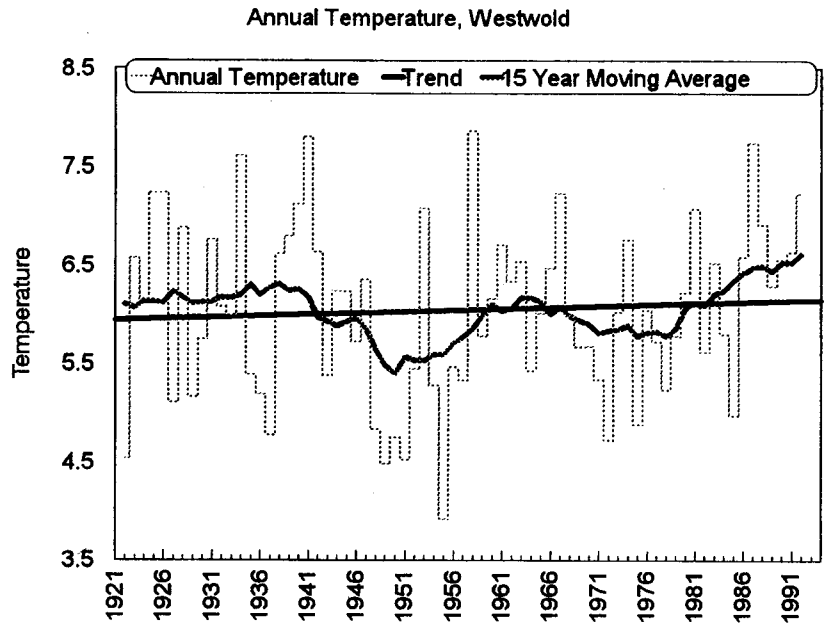




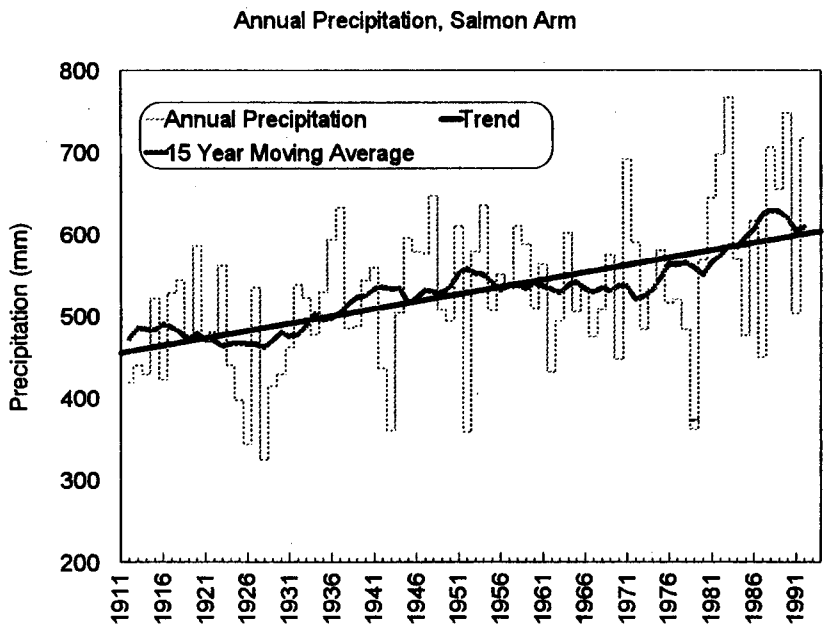


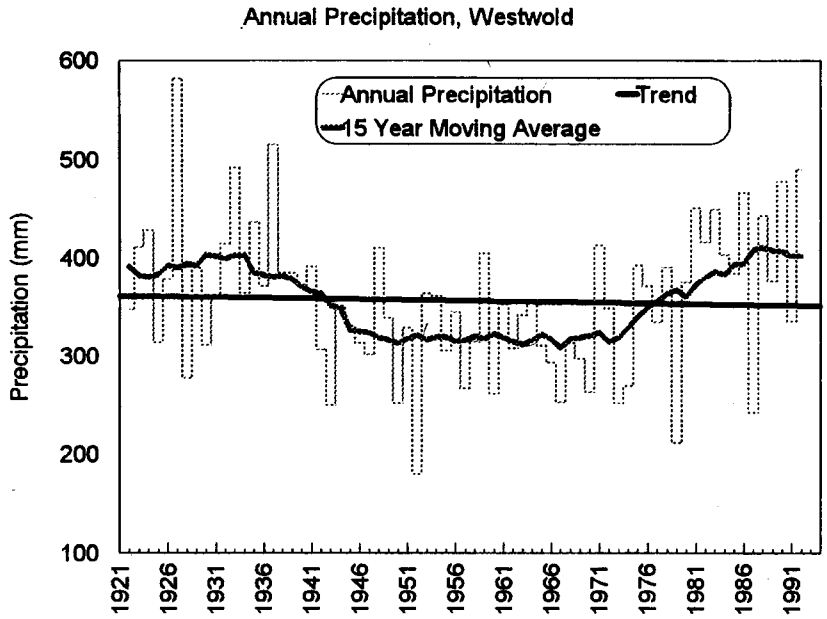
Annual Temperature Changes





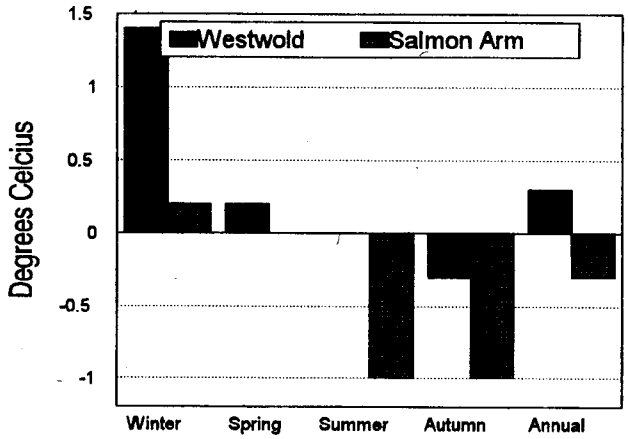
Annual Precipitation Changes



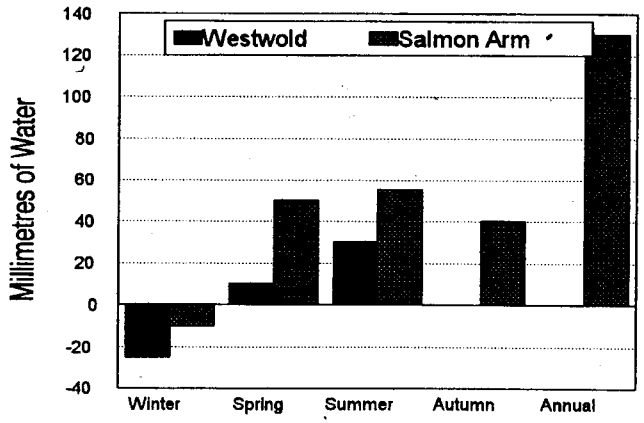


Salmon River Climate Changes 1921-1990

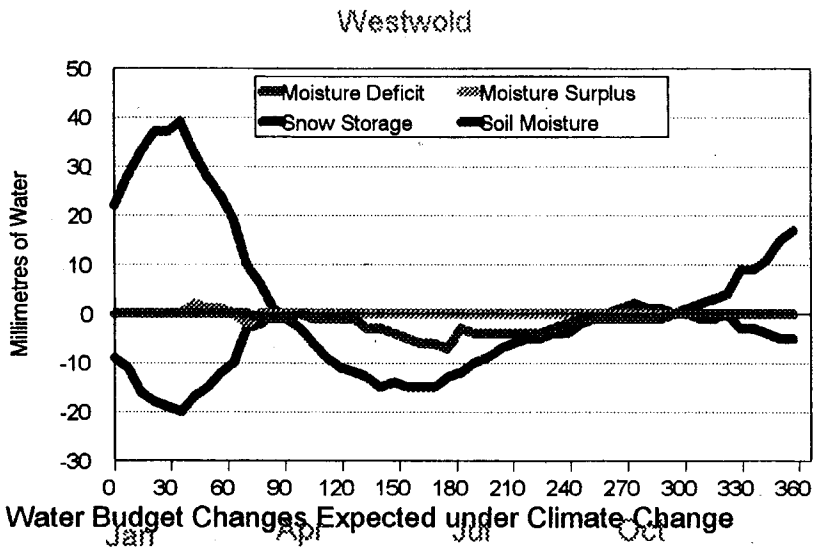
Temperature



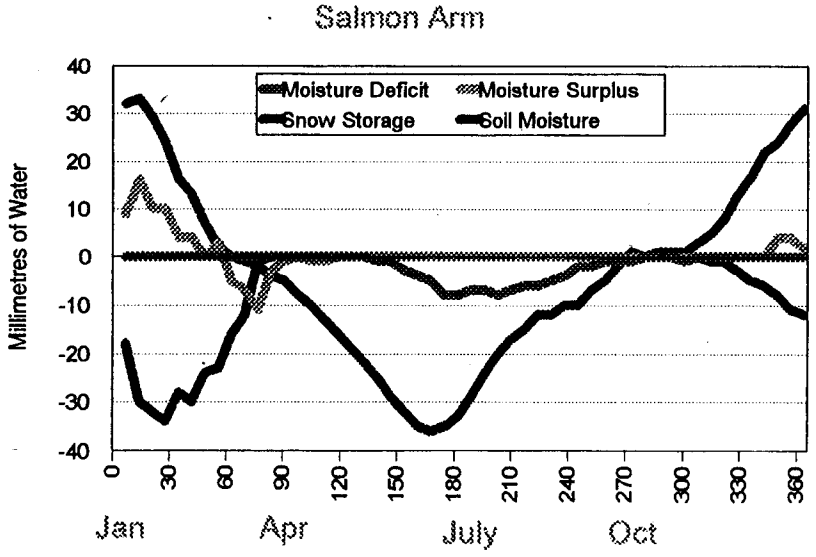
Precipitation



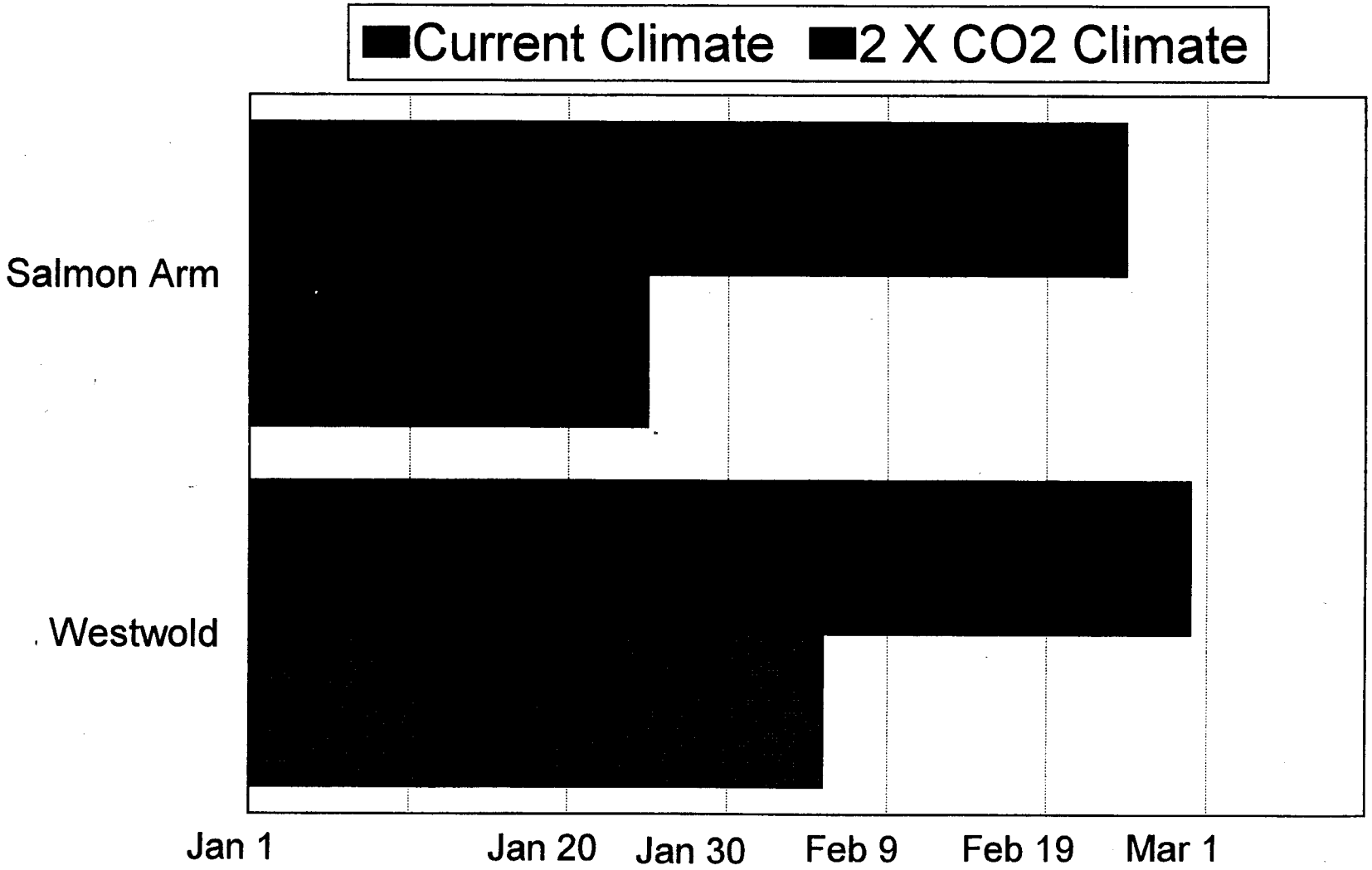
Water Budget Changes Expected under Climate Change



Water Budget Changes Expected under Climate Change

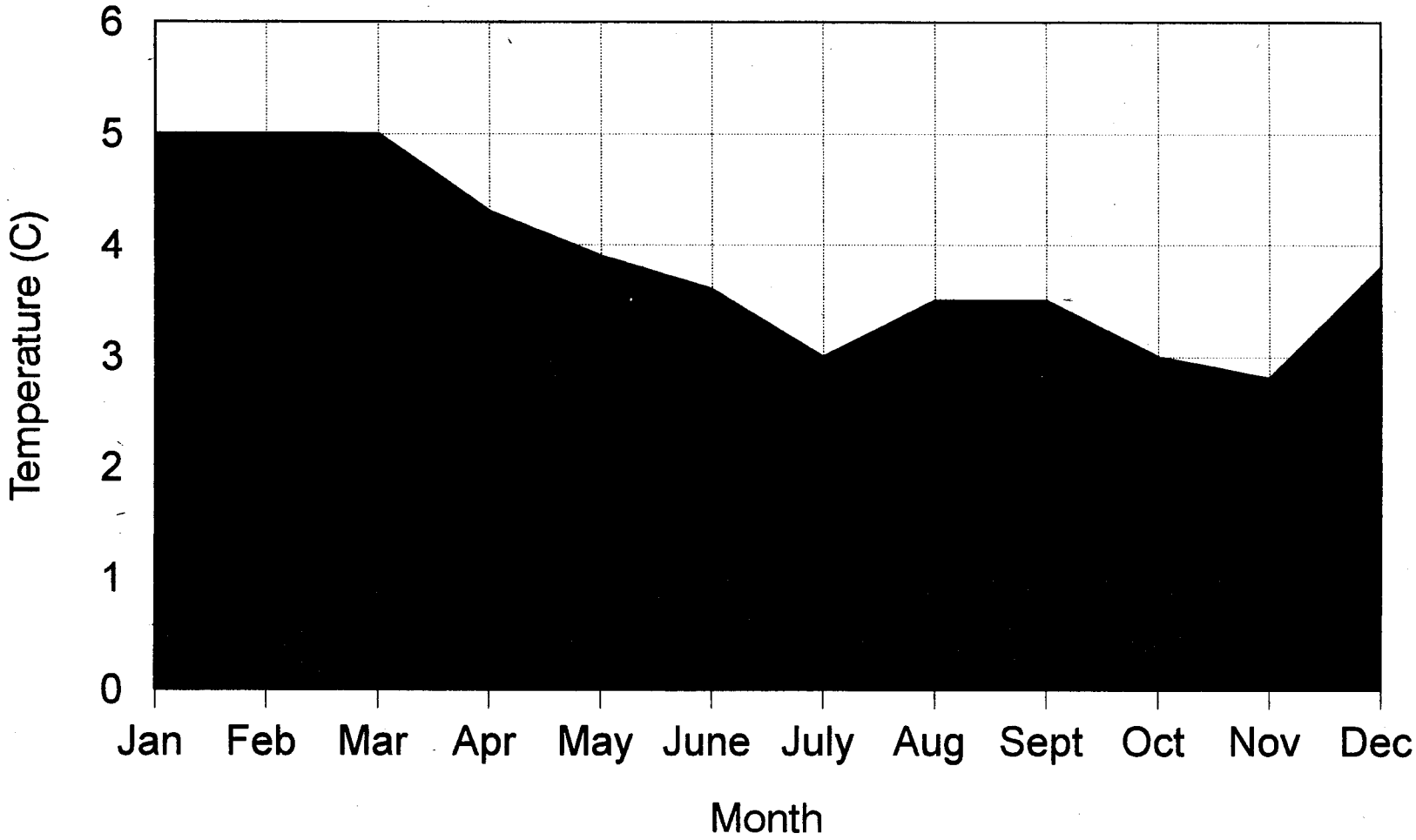


Average Last Day of Snowcover in Spring



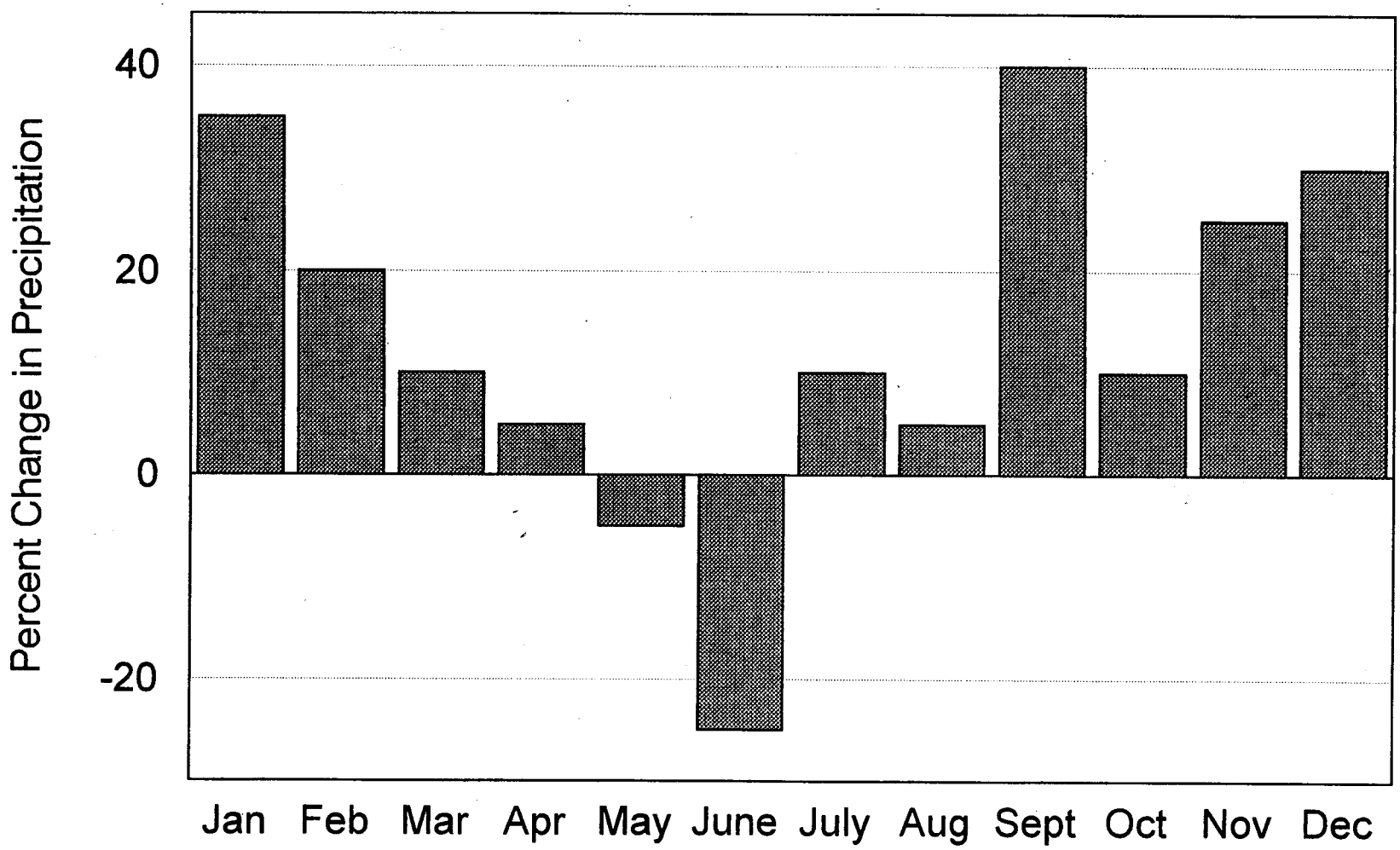
Temperature Changes Expected

Salmon River Valley

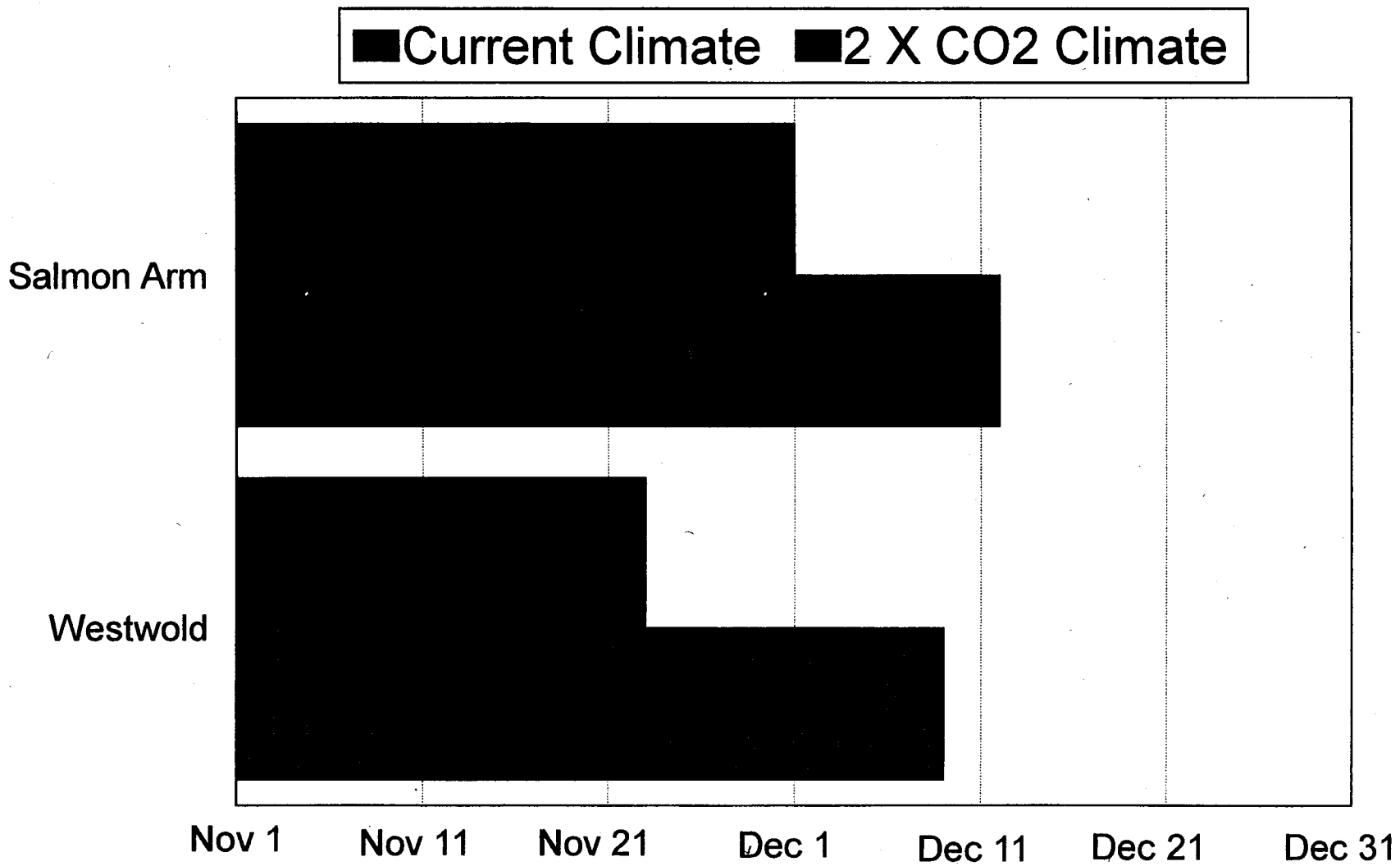


Precipitation Changes Expected

Salmon River Valley

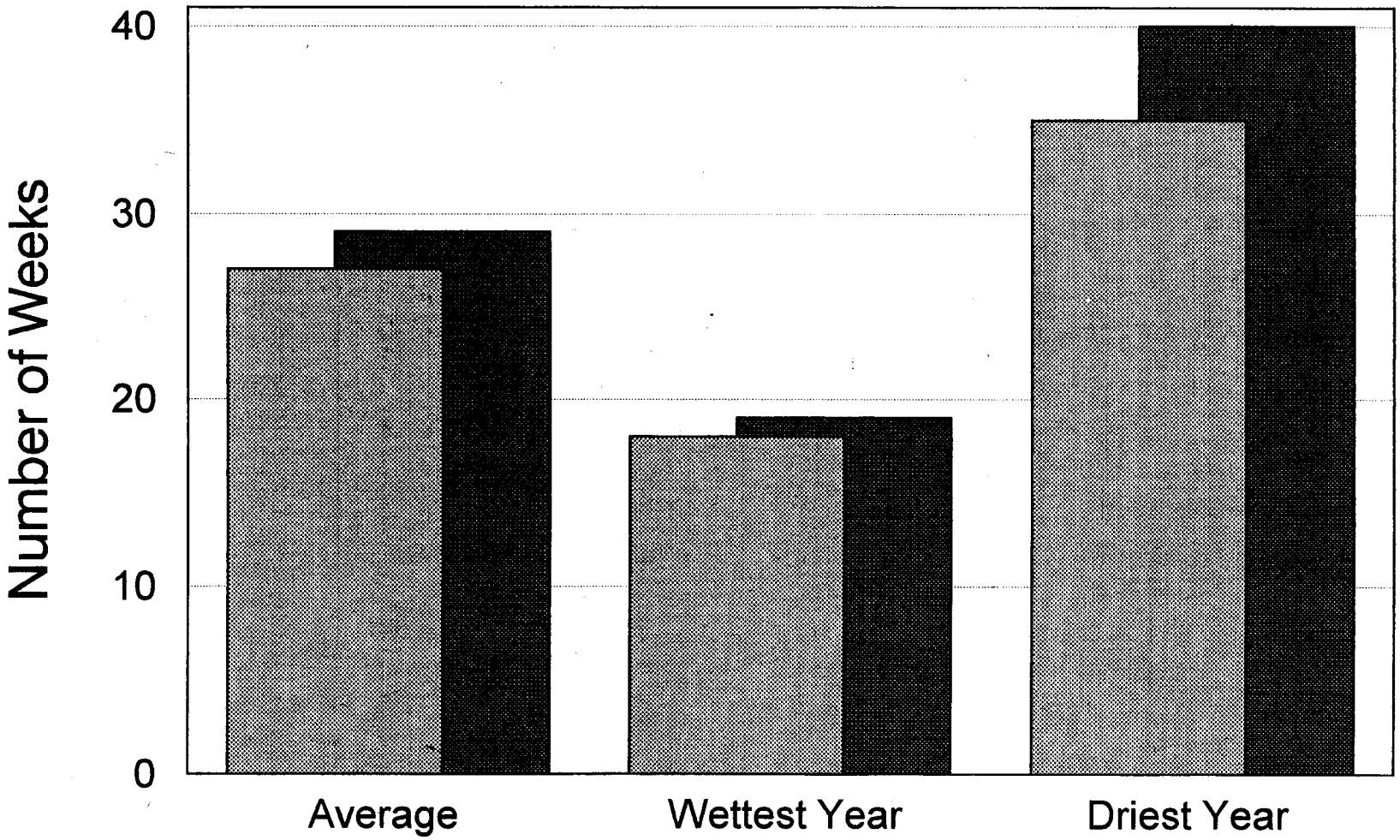


Average Last Snow-free day in fall



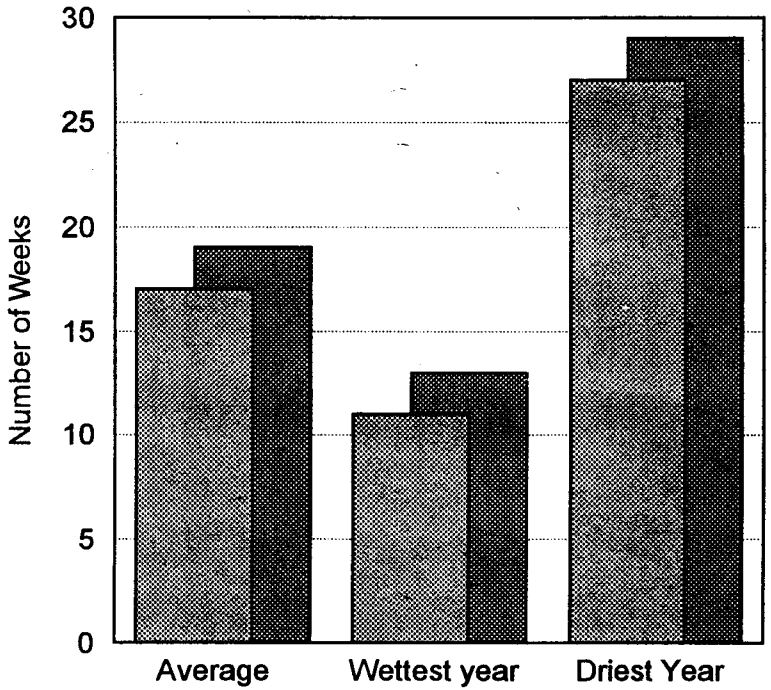
Number of Weeks of Moisture Deficit

Westwold

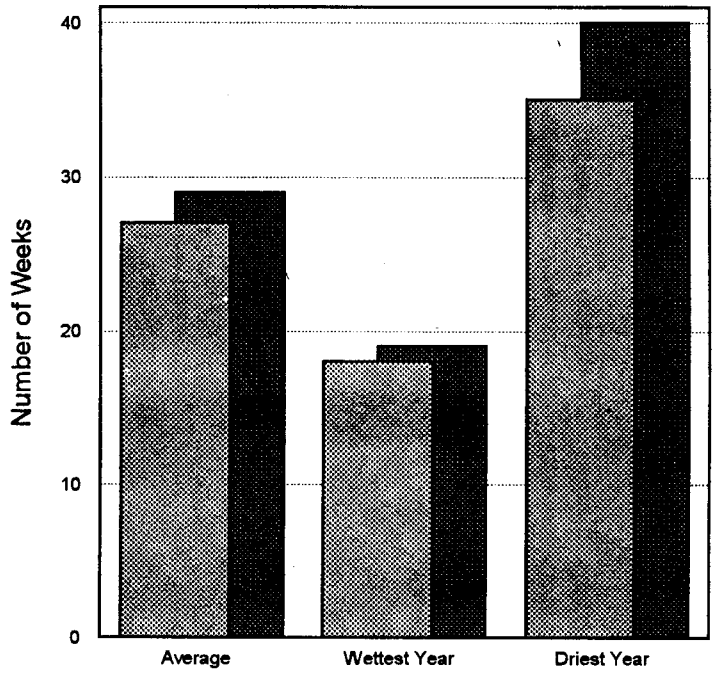


Number of Weeks of Moisture Deficit

Salmon Arm



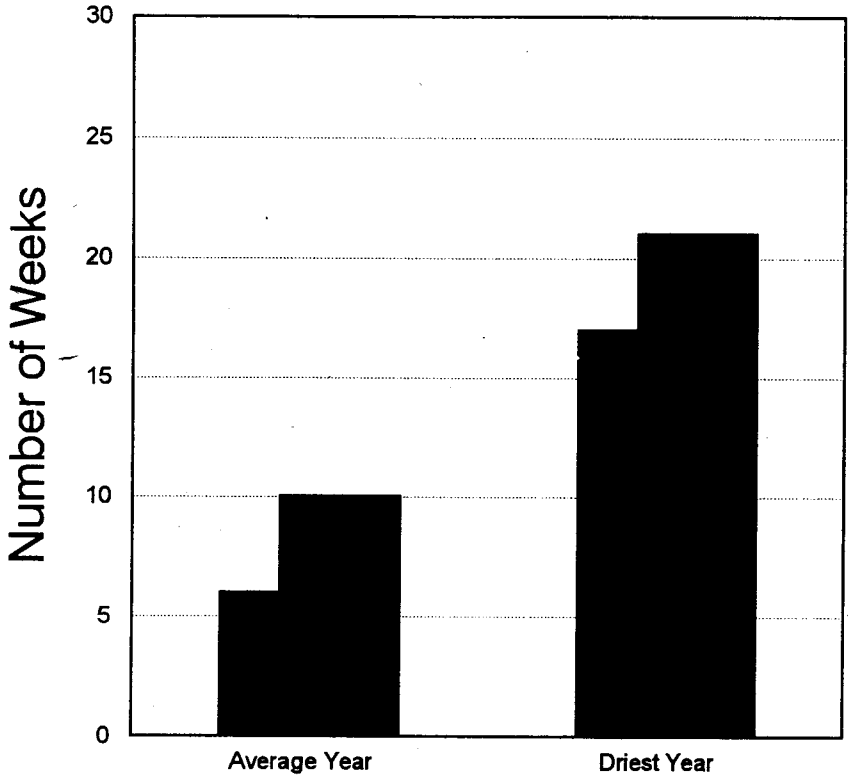
Westwold



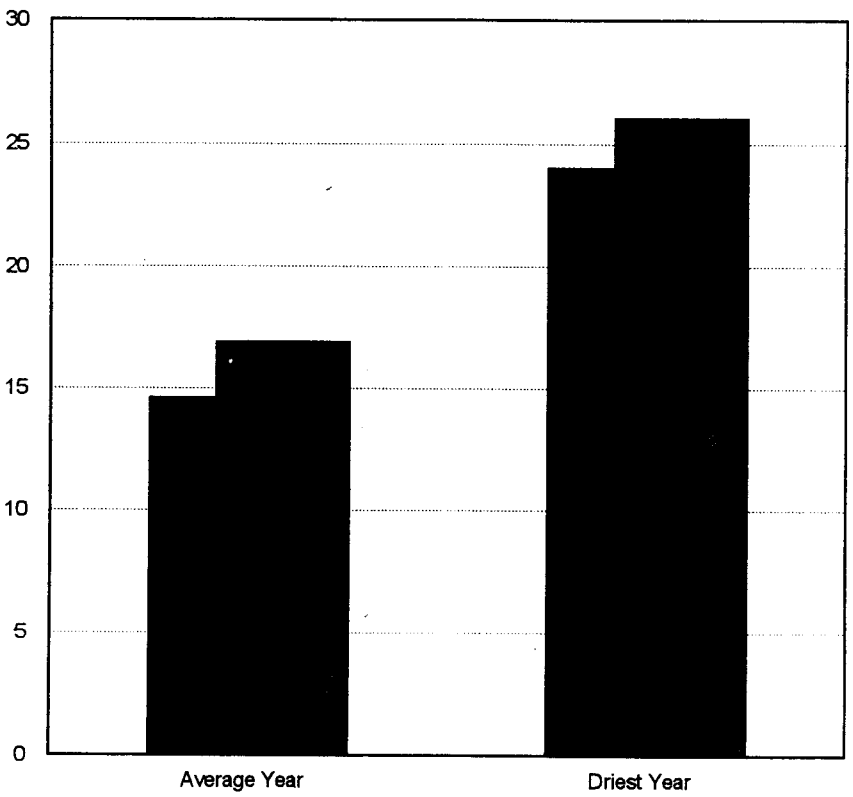
Current Climate 2 X CO2 Climate

Number of Weeks of Reduced Soil Moisture

Salmon Arm



Westwold

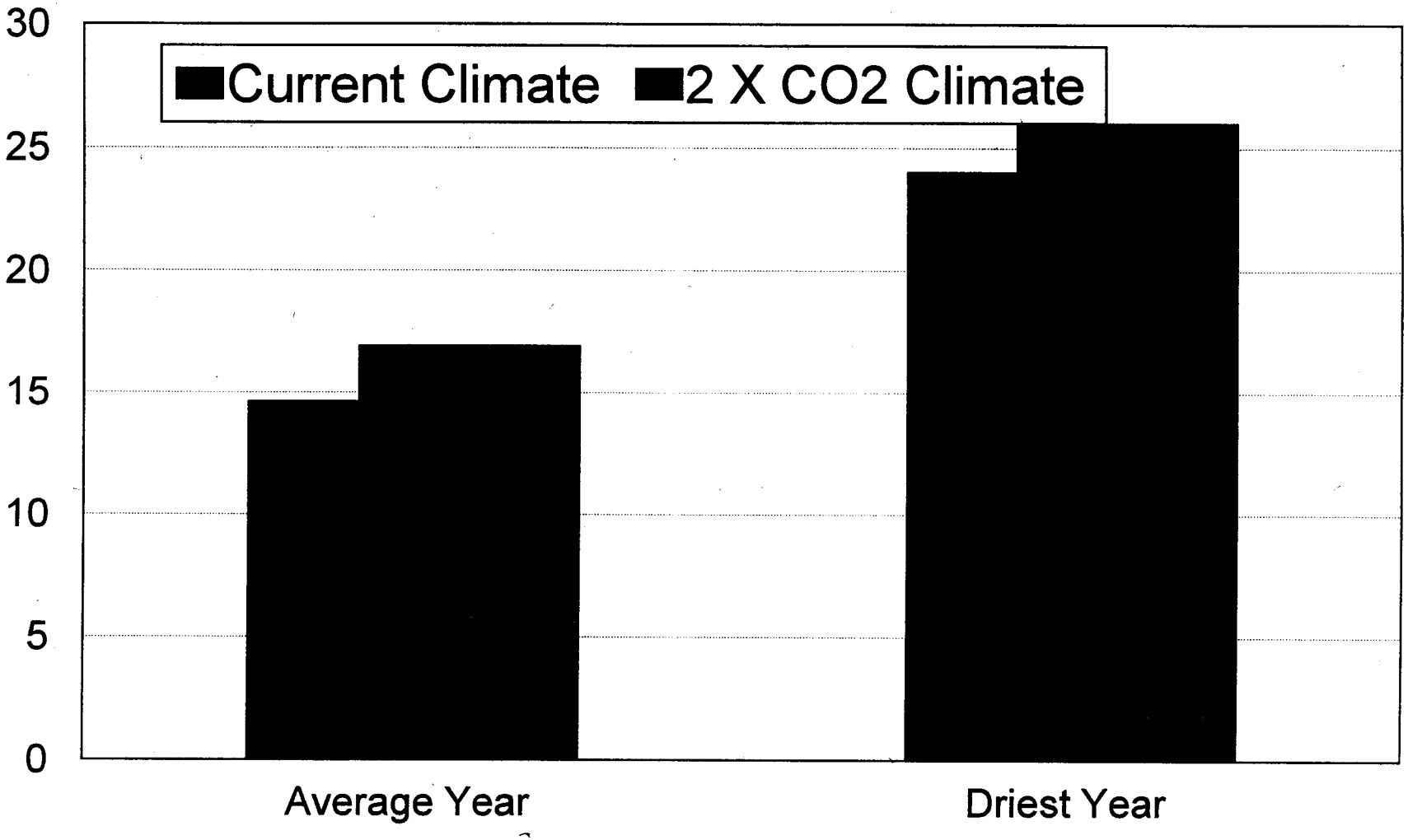


Current Climate 2 X CO2 Climate

Soil moisture less than 20 millimetres of water

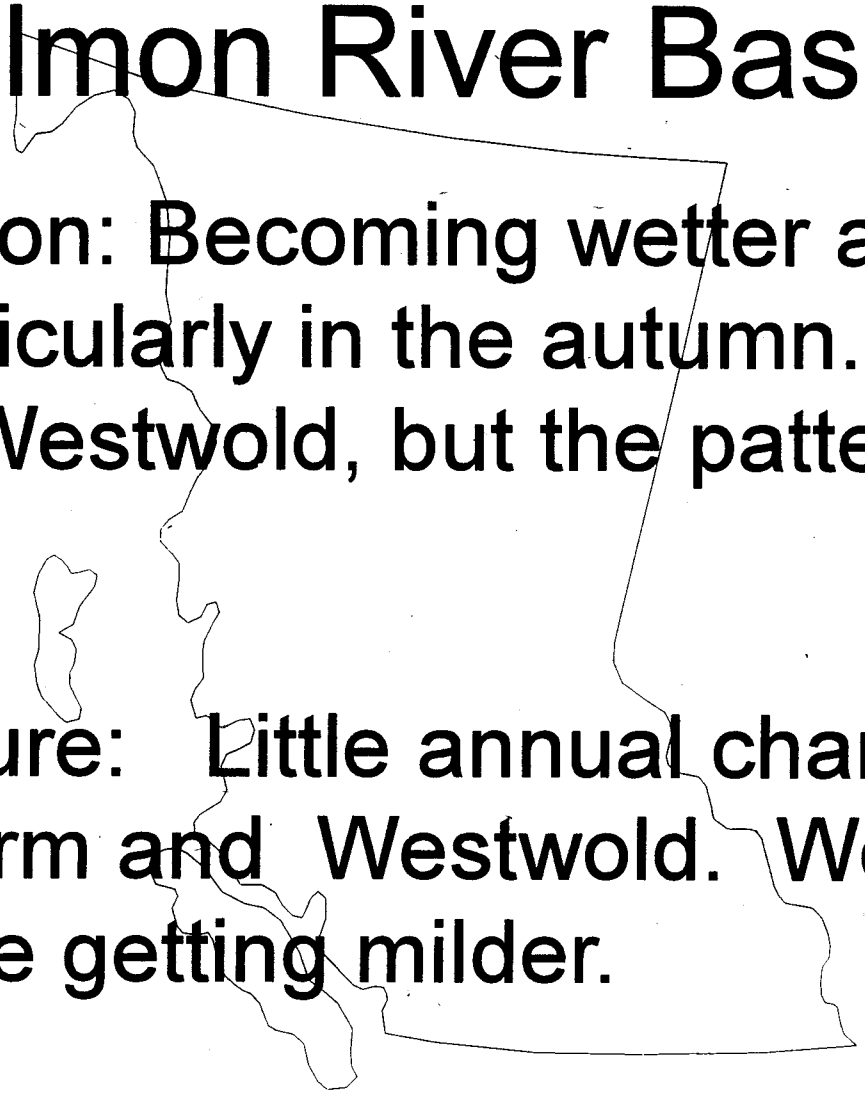
Number of Weeks of Reduced Soil Moisture

Westwold



Soil moisture less than 20 millimetres of water

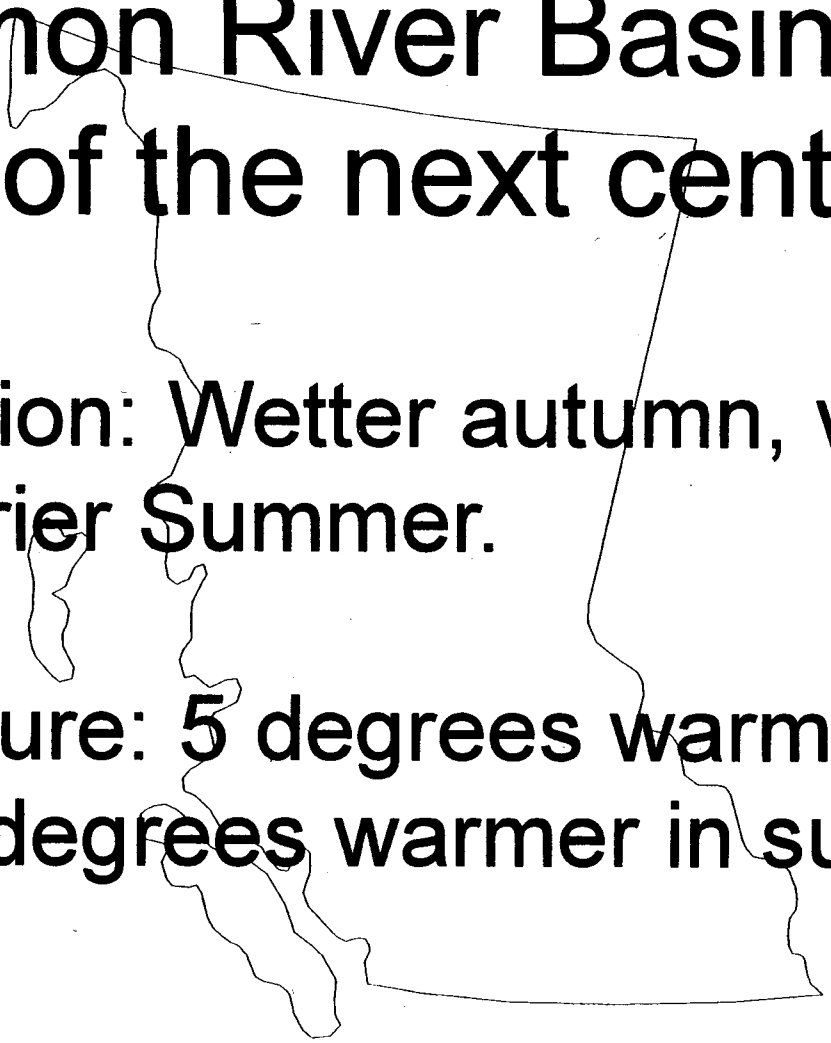
Historical climate trends in the Salmon River Basin



- Precipitation: Becoming wetter at Salmon Arm, particularly in the autumn. No overall trend at Westwold, but the pattern is changing.

- Temperature: Little annual change at Salmon Arm and Westwold. Westwold winters are getting milder.

Future climate trends expected in the Salmon River Basin by the end of the next century



- Precipitation: Wetter autumn, winter and spring. Drier Summer.
- Temperature: 5 degrees warmer in winter, 3 degrees warmer in summer.

APPLICATION OF GIS TO THE DEVELOPMENT OF ECOSYSTEM OBJECTIVES FOR THE SALMON RIVER WATERSHED

John Power

GIS SECTION
Environment Canada

GIS Section, Environment Canada

Work to be completed by March 31

- Building the base maps
- 20 TRIM 1:20,000 scale maps
- translation into ArcInfo and generation of thematic layers
- mosaicing the maps together

- adding point locations of
- points of diversion
- groundwater wells

- incorporating information gathered and mapped by AquaMetrix consultants

- transferring the basin outline from paper 1:50,00 scale maps to the TRIM base

- gathering and incorporating additional layers of information

Work planned for the new fiscal year (April 1, 1995)

- Set up desktop mapping system (ArcView 2) in the watershed office. (to enable community input to the sustainable decision making process)
- create customized map layers for use on the desktop PC
- specify hardware and software requirements
- install software and set up maps on the system

- In consultation with the Roundtable develop maps of current and projected states of the watershed based on different development scenarios.

- Carry out analyses using ArcInfo GIS. Some suggestions include:
- Look at potential erosion based on slopes, soil types and clearcutting
- Model impact of non-point source inputs of pesticides and fertilizers on water quality
- Look at environmental impact of new development e.g. loss of range, habitat

Desirable layers of information

Theme	Source	Map Layers
Range/Habitat information	MOF	range mapping
Cadastral mapping	MELP,Victoria, District of Salmon Arm (?)	base cadastral maps, parcel maps..
Blue Line Atlas	BCE Fisheries	stream centrelines
Agriculture and Soils	MAFF,Kamloops MELP, Kamloops AgCan - Vancouver	pasture crop and livestock soil type and slope stability Federal soil mapping(?)
Forestry	MOF, Salmon Arm	clearcut areas(?)
Aquifers	MELP, Victoria	aquifer boundaries(?)

Costs of Meeting Objectives

Costs incurred by the GIS Section are planned to be underwritten by the Ecosystem Objectives Section of Environment Canada.

Objective	Cost
Build up an archive of digital base maps and layers of environmental information.	$15,000.
Develop interactive GIS tools to assist in the development of ecosystem objectives.	$11,000.
Develop maps of current and projected states of the watershed based on different development scenarios.	$11,000.
Assist the Roundtable in setting up a desktop mapping system in their office to allow community members to participate in sustainable decision making.	$8,000.

Desirable Data Sources (Tabular Data)

Water Licensing Information	MELP, Victoria	tie to POD's
Groundwater Database	MELP, Victoria	tie to well locations

Table 1. Incidence of bank erosion in the Salmon River watershed (fall, 1992)

	STREAM SECTION	Total Section Length (m)	# Erosion Sites	Total Length of Sites(m)	% of Section Length
23	Hwy 1. Br. to Falkland	5,060	1	95	1.9
22	Falkland to A Frame	4,003	3	443	11.1
21	A Frame to Dear Road	5,107	12	712	13.9
20	Dear Road to Cedar Hill Road	4,601	14	594	12.9
19	Cedar Hill Road to Babij Farm	2,971	6	322	10.8
18	Babij Farm to Primrose Lane	2,926	3	214	7.3
17	Primrose Lane to Schwebb's Br.	987	2	184	18.6
16	Schwebb's Br to Heywood-Armstrong Rd	2,556	7	304	11.9
15	Heywood-Armstrong Rd to Spallumcheen Br.	4,257	5	262	6.2
14	Spallumcheen Bridge to Kaiser	1,609	3	434	27.0
13	Kaiser to Campbell's Bridge	658	1	79	12.0
12	Campbell's Br. to Damon Farm	484	1	79	16.3
11	Damon Farm to Sallenbach Road	449	3	249	55.5
10	Sallenbach Road to Brown Road	1,341	1	10	0.7
9	Brown Road to Haines Road	2,002	5	320	16.0
8	Haines Road to Crimson Maple Farm	1,043	1	12	1.2
7	Crimson Maple Farm to Johnson Road	1,364	1	32	2.3
6	Johnson Rd. to Branchflower Rd.	4,647	2	70	1.5
5	Branchflower Rd. to 80th Ave. Bridge	3,809	1	73	1.9
4	80th Ave. Br. to Mt Ida Hall Br.	2,738	0	0	0
3	Mt Ida Hall Br. to 50th St. Br.	1,929	0	0	0
2	50th St. Br. to Highway Br.	2,224	0	0	0
1	Highway Br. to Mouth	1,810	0	0	0
	TOTALS	58,817	72	4,488	7.6

RESULTS FROM NATIVE FISHERIES PROJECTS
September 1992 - March 1993

Murray Ross
Shuswap Nation Fisheries Commission

Table 2. Incidence of beaver dams in the Salmon River watershed (fall, 1992)

	STREAM SECTION	Total Section Length (m)	# Beaver Dams	#Beaver Dams per km
23	Hwy 1. Br. to Falkland	5,060	0	0
22	Falkland to A Frame	4,003	0	0
21	A Frame to Dear Road	5,107	3	0.6
20	Dear Road to Cedar Hill Road	4,601	0	0
19	Cedar Hill Road to Babij Farm	2,971	0	0
18	Babij Farm to Primrose Lane	2,926	1	0.3
17	Primrose Lane to Schwebb's Br.	987	0	0
16	Schwebb's Br to Heywood-Armstrong Road	2,556	0	0
15	Heywood-Armstrong Rd to Spallumcheen Br	4,257	0	0
14	Spallumcheen Bridge to Kaiser	1,609	1	0.6
13	Kaiser to Campbell's Bridge	638	4	6.1
12	Campbell's Br. to Damon Farm	484	0	0
11	Damon Farm to Sallenbach Road	449	0	0
10	Sallenbach Road to Brown Road	1,341	0	0
9	Brown Road to Haines Road	2,002	0	0
8	Haines Road to Crimson Maple Farm	1,043	0	0
7	Crimson Maple Farm to Johnson Road	1,364	0	0
6	Johnson Rd. to Branchflower Rd.	4,647	1	0.2
5	Branchflower Rd. to 80th Ave. Bridge	3,809	0	0
4	80th Ave. Br. to Mt Ida Hall Br.	2,738	0	0
3	Mt Ida Hall Br. to 50th St. Br.	1,929	1	0.5
2	50th St. Br. to Highway Br.	2,224	1	0.4
1	Highway Br. to Mouth	1,810	1	0.6
	TOTALS	58,817	13	0.02

SALMON RIVER SPAWNING GROUND COUNTS

Dates: Sept 14 - 21 1992 **Species:** CHINOOK

Observers: MARTY HALL
TERRY WILLIAMS

Fish Countability: POOR - FAIR
Water Temperature: 16° C

Section	Singles	Pairs	Single on Redd	Empty Redd	Carcasses
Above Highway Bridge	n/t	n/t	n/t	n/t	n/t
Highway Bridge to Falkland	10	7	0	0	0
Falkland to A Frame	0	0	0	0	1
A Frame to Dear Road	5	1	0	6	0
Dear Road to Cedar Hill Road	2	0	0	3	0
Cedar Hill Road to Babij Farm	0	0	1	3	0
Babij Farm to Primrose Lane	4	1	1	4	0
Primrose Lane to Schwebb's Br.	1	0	0	3	0
Schwebb's Bridge to Heywood-Armstrong Road	0	0	0	0	0
Heywood-Armstrong Road to Spallumcheen Bridge	0	0	0	0	0
Spallumcheen Bridge to Kaiser	0	0	0	2	0
Kaiser to Forbes Road	1	2	0	3	0
Forbes Road to Sallenbach Road	0	0	0	0	1
Sallenbach Road to Brown Road	0	0	0	1	0
Brown Road to Haines Road	0	0	0	0	0
Haines Road to Crimson Maple Farm	0	0	2	0	0
Crimson Maple Farm to Johnson Road	2	0	0	0	0
Below Johnson Road	n/t	n/t	n/t	n/t	n/t
SUBTOTAL	25	11	4	25	2
(X multiplication factor)	1.0	2.0	1.5	2.0	1.0
TOTALS	25	22	6	50	2

TOTAL ESTIMATED SPAWNING GROUND COUNT: 105

SALMON RIVER SPAWNING GROUND COUNTS

Dates: Nov 9 to Nov 13 1992 **Species:** COHO

Observers: MARTY HALL
TERRY WILLIAMS

Fish Countability: POOR - FAIR
Water Temperature: 5 - 7° C

Section	Singles	Pairs	Single on Redd	Empty Redd	Carcasses
Above Highway Bridge	n/t	n/t	n/t	n/t	n/t
Highway Bridge to Falkland	9	7	3	2	2
Falkland to A Frame	26	17	3	0	0
A Frame to Dear Road	37	4	1	1	1
Dear Road to Cedar Hill Road	8	12	5	4	0
Cedar Hill Road to Babij Farm	3	3	3	2	0
Babij Farm to Primrose Lane	6	7	2	2	1
Primrose Lane to Schwebb's Br.	1	1	0	0	0
Schwebb's Bridge to Heywood-Armstrong Road	1	3	2	1	0
Heywood-Armstrong Road to Spallumcheen Bridge	3	5	0	5	2
Spallumcheen Bridge to Kaiser	3	3	1	4	0
Kaiser to Forbes Road	2	6	0	5	0
Forbes Road to Sallenbach Road	0	3	0	0	0
Sallenbach Road to Brown Road	1	1	0	0	0
Brown Road to Haines Road	0	0	0	9	0
Haines Road to Crimson Maple Farm	3	9	0	8	2
Crimson Maple Farm to Johnson Road	5	28	7	3	2
Below Johnson Road	n/t	n/t	n/t	n/t	n/t
SUBTOTAL	108	109	27	46	9
(X multiplication factor)	1.0	2.0	1.5	2.0	1.0
TOTALS	108	218	41	92	9

TOTAL ESTIMATED SPAWNING GROUND COUNT: 468

APPENDIX B

SALMON RIVER WATERSHED ROUNDTABLE TECHNICAL CO-ORDINATION WORKSHOP

FEBRUARY 13, 1995

AGENDA

8:30 - 8:35	Welcoming	Dorothy Argent
8:35 - 8:40	Opening Remarks	Fred Mah
8:40 - 9:00	A Framework for Developing Ecosystem Health, Goals, Objectives and Indicators	Janet Stavinga
9:00 - 9:20	Knowledge Base Requirements in Support of Ecosystem Objectives	Tyhson Banighen
9:20 - 9:40	Community Development of Ecosystem Objectives	Neils Christiansen
9:40 - 10:00	Results From Native Fisheries Projects, 1992 - 1994	Murray Ross
10:00 - 10:20	COFFEE	
10:20 - 10:40	Salmon River Corridor Restoration Project	Michael Crowe
10:40 - 11:00	Water Stewardship, Stream Keepers and Data Collection	Kim Fulton
11:00 - 11:20	Citizen Monitoring Program for the Salmon River	Tyhson Banighen
11:20 - 11:40	The Establishment of an Aquatic Ecosystem Monitoring Program for the Salmon River	Kevin Cash/ Joseph Culp
11:40 - 12:00	Water Use Survey - Lower Salmon River	Dennis Einarson

12:00 - 13:00	LUNCH	
12:45	Video - Kingfisher Environmental Interpretive Centre	
13:00 - 13:20	Riverside Forest Products Activities in the Watershed	Gerry Wellburn
13:20 - 13:40	Watershed Information Available From the BC Ministry of Forests	Paul Birzins
13:40 - 14:00	Salmon River Water Quality - Headwaters to the Mouth	Bob Grace
14:00 - 14:20	DFO - FRAP Involvement on the Salmon River	Tony Cheong
14:20 - 14:40	Assessment of Salmonid Habitat in the Salmon River Using Physical Habitat Simulation Techniques	Mike Wallis / Dave Bert
14:40 - 15:00	Past and Future Climate in the Salmon River Basin	Eric Taylor
15:00 - 15:20	COFFEE	
15:20 - 15:40	Application of GIS to the Development of Ecosystem Objectives for the Salmon River Watershed	John Power
15:40 - 16:00	Scenarios and Computers in a Watershed Context	Hans Schreier
16:00 - 17:30	Integrating Current Research/ Studies into the Knowledge Base to Support the Development of Ecosystem Objectives	FACILITATOR - Neils Christiansen

APPENDIX C

SALMON RIVER TECHNICAL CO-ORDINATION WORKSHOP - FEBRUARY 13, 1995

Registered Attendees

Dorothy Argent
SRWR Chair
Box 3308
Salmon Arm, B.C.
V1E 4S1
phone # - (604) 832-7574
fax # - (604) 832-7574

Tyhson Banighen
Salmon River Watershed Project
Box 3308
Salmon Arm, B.C.
V1E 4S1
phone # - (604) 832-0153
fax # - (604) 833-4676

Paul Birzins
Resource Officer
Integrated Resource Management
Salmon Arm Forest District
Bag 100, Salmon Arm, B.C.
V1E 4S4
phone # - (604) 832-1401
fax # - (604) 832-1696

Robert Bison
MOELP
1259 Dalhousie Drive
Kamloops, B.C.
V2C 5Z5
phone # - (604) 371-6244
fax # - (604) 828-4000

Neil Brookes
Kingfisher Environmental
Interpretive Centre
RR 2, Site 14A, Comp. 6
Enderby, B.C.
V0E 1V0
phone # - home -
(604) 838-6569
I.C. - 838-0004
fax # - (604) 838-6020

Dave Burt
D. Burt & Associates
Fisheries Biologist
2245 Ashlee Road
Nanaimo, B.C.
V9R 6T5
phone # - (604) 753-0027
fax # - (604) 753-0027

Mark Cantwell
School of Resource & Environmental
Management
Simon Fraser University
#206 - 5095 Newton St.
Burnaby, B.C.
V5H 1T5
phone # - (604) 436-4138
fax # - (604) 291-4968

Kevin J. Cash
National Hydrology Research Institute,
Environment Canada
11 Innovation Boulevard
Saskatoon, SK
S7N 3H5
phone # - (306) 975-4010
fax # - (306) 975-5143

Tony Cheong
FRAP, Fisheries and Oceans
#1220 - 555 West Hastings
Vancouver, B.C.
V6B 5G3
phone # - (604) 666-8027
fax # - (604) 666-0417

Neils Christiansen
SRWR
Box 3308
Salmon Arm, B.C.
V1E 4S1
phone # - (604) 832-7574
fax # - (604) 832-7574

Kavyo Crawford
SRWR
Box 3308
Salmon Arm, B.C.
V1E 4S1
phone # - (604) 832-0153/ 832-8268
fax # - (604) 833-4676

Michael Crowe
Department of Fisheries & Oceans
1278 Dalhousie Drive
Kamloops, B.C.
V2C 6G3
phone # - (604) 374-2329
fax # - (604) 372-9771

Joseph M. Culp
National Hydrology Research
Institute, Environment Canada
11 Innovation Boulevard
Saskatoon, SK
S7N 3H5
phone # - (306) 975-5742
fax # - (306) 975-5143

Sarai Danby
Bar-ten Springs Ent.- Agroforestry
Contracting Company
RR 2, Comp.26, S-5
Mabel Lake, B.C.
V0E 2G0
phone # - (604) 547-6727
home- (604) 547-9695
fax # - (604) 547-6727

Sandy D'Aquino
Head, Socio-Economics
Environment Canada
224 West Esplanade
North Vancouver, B.C.
V7M 3H7
phone # - (604) 666-3513
fax # - (604) 666-6756

Dennis Demontier
Department of Fisheries & Oceans
1278 Dalhousie Drive
Kamloops, B.C.
V2C 6G3
phone # - (604) 374-9533
fax # - (604) 372-9771

Dennis Einarson
Environmental Protection
BC Ministry of Environment
#3, 4320 - 29th Street
Vernon, B.C.
V1T 5B8
phone # - (604) 549-5565
fax # - (604) 549-5436

Kim Fulton
Simon Fraser University
MOELP
Comp. 7, Henderson Drive
RR 1 Armstrong, B.C.
V0E 1B0
phone # - (604) 546-9660
fax # - (604) 546-2561
e.mail - kfulton@cln.etc.bc.ca.

Bob Grace
Environmental Protection
BC Environment
1259 Dalhousie Drive
Kamloops, B.C.
V2C 5Z5
phone # - (604) 371-6289
fax # - (604) 828-4000

Kathy Grant
Resource Management and
Environmental Studies
436E - 2206 East Mall
University of British Columbia
Vancouver, B.C.
V6T 1Z3
phone # - (604) 822-6224
fax # - (604) 822-9250
e.mail - klynn@unixg.ubc.ca.

Colin Gray
Head, Research Section
Environmental Conservation Branch,
Environment Canada
224 West Esplanade
North Vancouver, B.C.
V7M 3H7
phone # - (604) 666-2917
fax # - (604) 666-6756

Ken Gray
Environmental Intern
E-Team project
Kingfisher Environmental Interpretive
Centre
RR 2, Site 15, C-6
Enderby, B.C.
V0E 1V0
phone # - (604) 838-6259

Kelly Hamm
Environment Canada
224 West Esplanade
North Vancouver, B.C.
V7M 3H7
phone # - (604) 666-8014
fax # - (604) 666-6713

Susan Kikcio
Kingfisher Environmental
Interpretive Centre
RR 2, Site 17A, C-7
Enderby, B.C.
V0E 1V0
phone # - (604) 838-6948
fax # - (604) 838-6020

Fred Mah
Head, Environmental Integration
Section
Environment Canada
224 West Esplanade
North Vancouver, B.C.
V7M 3H7
phone # - (604) 666-8000
fax # - (604) 666-6713

Mel Maxnuk
BC Ministry of Environment
#3 - 4320 29th Street
Vernon, B.C.
V1T 5B8
phone # - (604) 549-5566
fax # - (604) 549-5436

Connie Miller-Retzer
Biological Consultant
#18 - 8800 Adventure Bay Rd.
Vernon, B.C.
V1T 6L7
phone # - (604) 558-3677

Scott Orth
Golder Associates Ltd.
243 - 1889 Springfield Road
Kelowna, B.C.
V1Y 5V5
phone # - (604) 860-8424
fax # - (604) 860-9874

Keith Perry
Environment Canada
224 West Esplanade
North Vancouver, B.C.
V7M 3H7
phone # - (604) 666-1183
fax # - (604) 666-6713

John Power
GIS Section
Environment Canada
224 West Esplanade
North Vancouver, B.C.
V7M 3H7
phone # - (604) 666-3859
fax # - (604) 666-3325

Hans Schreier
Resource Management &
Environmental Studies
2206 East Mall
University of British Columbia
Vancouver, B.C.
V6T 1Z3
phone # - (604) 822-4401
fax # - (604) 822-9250

Ron Smith
BC Ministry of Environment
Water Management
1259 Dalhousie Drive
Kamloops, B.C.
V2C 5Z5
phone # - (604) 371-6200
fax # - (604) 828-4000

Janet Stavinga
Evaluation & Interpretation
Environment Canada
Place Vincent Massey
351 St. Joseph Boulevard
Hull, Quebec
K1A 0H3
phone # - (819) 997-1029
fax # - (819) 953-0461

Bruno Tassone
Environmental Monitoring Division
Environment Canada
224 West Esplanade
North Vancouver, B.C.
V7M 3H7
phone # - (604) 666-6207
fax # - (604) 666-3325

Eric Taylor
Head, Climate Section
Environment Canada
#700 - 1200 West 73rd Ave.
Vancouver, B.C.
V6P 6H9
phone # - (604) 664-9123
fax # - (604) 664-9195

Mike Wallis
Wallis Environmental
Aquatics Ltd.
Box 1066
Salmon Arm, B.C.
V1E 4P2
phone # - (604) 832-6024
fax # - (604) 832-5452

Barry Watson
GIS Section
Environment Canada
#700 - 1200 West 73rd. Ave
Vancouver, B.C.
V6P 6H9
phone # - (604) 664-9153
fax # - (604) 664-9195

Gerry Wellburn
Riverside Forest Products
Bag 5000
Armstrong, B.C.
V0E 1B0
phone # - (604) 546-3171
fax # - (604) 546-2245