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2007 Northern Interior Information Needs Assessment for Watershed Management



2007 Northern Interior Information Needs Assessment for Watershed Management

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EXECUTIVE SUMMARY

This report summarizes the results of a qualitative study designed to document important issues, research gaps, and extension needs related to watershed management of forested watersheds in the Northern Interior of British Columbia. The purpose of the assessment was to gather respondent input to:

- assist in strategic planning for the FORREX Watershed Management Extension Program (WMEP), and
- inform FORREX clients of the extension needs and knowledge gaps identified by respondents.

Respondents were asked to describe their most important research and (or) extension needs around stated topics, including: water quantity and quality; groundwater; watershed restoration; small streams and riparian zones; fish and aquatic habitat; climate change; monitoring and data collection; communication and data availability; water resource governance; social and future issues; and mountain pine beetle.

The survey results indicated an interrelationship between many of the survey topics; that is, most respondents identified issues, research gaps, and extension needs that were common to more than one survey topic. The survey results also showed no single watershed management research or extension need prevails above all others; rather, a wide range of needs exists.

Five important themes requiring research and extension emerged from this survey:

1. Quantifying the effects of forest disturbance (especially the mountain pine beetle infestation and harvesting) on water quantity and quality.
2. Reducing uncertainty around potential climate change impacts on water resources.
3. Increasing hydrologic knowledge and education for professionals, the public, and First Nations.
4. Developing water resource monitoring capacity.
5. Evaluating operational tools for predicting the effects of forest disturbance on water resources.

In the Northern Interior, many concerns centred on the effects of, and recovery from, the ongoing mountain pine beetle infestation and crossed the themes of hydrology, aquatic ecology, and social issues.

This report presents respondent perceptions collected during the survey; it does not attempt to relate the authors' interpretations of this input. As such, it complements a concurrent project for the Southern Interior region of British Columbia (Redding *et al.* 2008), as well as a previously completed study on coastal information needs (Pike 2004).

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1 INTRODUCTION

The FORREX Watershed Management Extension Program (WMEP) provides extension services on topics that directly or indirectly affect water resources in terrestrial and aquatic ecosystems. The goal of the program is to increase communication, understanding, and application of innovative knowledge and research results. Identifying issues, knowledge gaps, and resulting extension needs are critical elements of the program's extension delivery.

This report documents important issues and information needs related to watershed management in the Northern Interior of British Columbia. This project builds on a number of other studies that address watershed management information needs (see: Pike 2004; Redding 2007a; Redding 2007b). The survey results also highlight some conclusions that are similar to those reached in a provincial survey of natural resource practitioners (Morford and Hollstedt 2007).

The survey assessment was undertaken to gather input that would further guide WMEP development in meeting clients' needs and to assist in the strategic planning of the Northern Interior WMEP.

2 METHODS

2.1 Study Design

The WMEP's Northern Interior Needs Assessment had two primary objectives.

1. to identify issues, research gaps, and extension needs specific to the Northern Interior; and
2. to determine the most critical issues and (or) needs.

FORREX selected key informants to respond to the survey; these respondents were interviewed over the telephone. This approach was deemed most suitable given the objectives of the assessment and resource constraints.

A list of potential respondents was compiled and prioritized. Selection was based on the respondents' profession, and their experience and (or) employment position within their organizations. All respondents were known to be familiar with watershed management issues in the Northern Interior. Confidentiality and anonymity were assured to encourage respondents to speak freely about the issues. In total, 25 interviews were conducted between September and October 2007.

2.2 Study Delivery

A letter of introduction and copy of the survey questions were sent by email to respondents in advance (see Appendices A and B). A consultant (K. Nickurak) conducted the telephone interviews. During each interview, the interviewer entered notes either directly into a table or onto the questionnaire (Appendix B). Due to time constraints, two respondents preferred to send their comments via email. When all interviews were completed, the consultant sorted the responses by theme and topic into a draft report. FORREX reviewed these findings and generated the final report.

2.3 Study Limitations

This needs assessment is part of a process that is identifying relevant watershed management needs for British Columbia and was designed to provide FORREX with input to plan its WMEP. As it was intended to be a qualitative, non-random study, many respondents can be placed into more than one client group. It is also important to note that all respondents may not have had the same level of understanding and

(or) insight when providing input on current issues and research and extension needs. The timing of the interviews (September–October) prevented the interviewer from making contact with a number of people, especially forest industry representatives. In addition, no interviews were conducted with members of the range management sector because the interviewer was unable to contact key informants or schedule interviews.

This summary report also does not offer any interpretation of the respondents’ input—it merely presents what was collected in the survey.

3 RESULTS

3.1 Profile of Respondents

Respondents were asked to select from a list of nine categories that described field or area of practice (see Appendix B). They were asked to select their primary area of practice and, if applicable, a secondary category (Table 1).

Respondents were asked to select an affiliation that best applied to them. Seven categories were listed in the survey and, if necessary, respondents could select more than one (Table 2).

TABLE 1 Respondents’ area or field of practice

Field or area of practice	Primary	Secondary
1 Forestry	10	3
2 Agriculture	0	0
3 Mining	0	1
4 Biology (e.g., wildlife conservation)	0	5
5 Fisheries	6	4
6 Geosciences and Engineering	1	1
7 Water Supply and Licensing	1	0
8 Power Supply (e.g., micro-hydro, wind)	0	1
9 Other ^a	7	4

^a Responses falling within the “Other” category included: wilderness protection and land use planning; environment; community and regional planning; hydrometeorology; water quality (protection and monitoring); pollution prevention; and conservation and wilderness tourism. Secondary fields of practice included rivers and lakes, watersheds, and all fields listed.

TABLE 2 Respondent affiliation

Affiliation	Primary	Secondary
1 Forest Industry	2	0
2 Provincial Government	8	0
3 Other Government Agencies	1	1
4 First Nations	1	2
5 Consultants/Academics	9	3
6 Community/Stewardship Group/NGO	2	0
7 Other ^a	2	0

^a Two respondents specified “reservoir operator” and “incorporated society” as a primary affiliation in the “Other” category.

3.2 Survey Responses

Respondents were asked to identify their research and extension needs in the following areas:

- water quantity
- water quality
- groundwater
- watershed restoration
- small streams and riparian zones
- fish/aquatic habitat
- climate change
- monitoring and data collection
- communication and data availability
- water resource governance
- social issues
- future issues
- mountain pine beetle
- other issues

Points raised about research and extension in the mountain pine beetle category were inserted into the relevant topical sections to reduce duplication. “Research need” was defined as an area where respondents felt information is lacking or non-existent. “Extension need” was defined as an area where information exists, but is not reaching the people who need it. However, many of the needs or gaps noted may be considered as related to both research and extension.

3.2.1 Water Quantity

Water quantity generated the greatest amount of interest among respondents most likely because the flow regime exercises a strong control over many other water-related values (e.g., water quality, habitat, etc.). The effect of the current mountain pine beetle infestation on flows was a major source of uncertainty for respondents. Respondents’ specific research and extension information needs related to water quantity included the following.

RESEARCH NEEDS

- The magnitude and frequency of peak flows, low flows, and water yield under natural and disturbed conditions.
- The long-term impacts of large-scale disturbance related to the mountain pine beetle on streamflows.
- The hydrologic recovery of areas affected by the mountain pine beetle.
- Information about the effects of changes in flows on infrastructure.
- The tools (models) required to estimate streamflows (peaks flows and low flows) in large watersheds (third order and larger)
- The prediction of the effects of disturbance and climate change for ungauged watersheds of various sizes.
- The effects of large-scale hydro power impoundments and diversions on streamflow regimes.
- The effects of micro-hydro diversions on streamflow regimes and flow.
- The effects of surface water withdrawals by the oil and gas industry.
- The potential hydrological impacts of expanded range and agricultural development in central British Columbia.
- The effects of the mountain pine beetle infestation on snowpacks.
- The modelling of different levels/stages of the mountain pine beetle infestation in relation to its effects on watersheds.
- The hydrologic effects of increasing the road network to accommodate large-scale salvage harvesting.

- The hydrologic impacts of increased mining activity after the mountain pine beetle infestation.

EXTENSION NEEDS

- Continued extension on the effects of forest disturbance (e.g., mountain pine beetle infestation and harvesting) on hydrology and geomorphology.
- The evaluation of available tools for predicting changes in hydrology following large-scale disturbance.

OTHER ISSUES

- Maintain and expand hydrometric monitoring network (i.e., the lack of monitoring stations in the north will impede the detection and quantification of climate change and disturbance impacts).

3.2.2 Water Quality

Information needs related to water quality were fairly general, with a number of respondents linking potential water quality issues back to water quantity. Respondents' specific research and extension information needs related to water quality included the following.

RESEARCH NEEDS

- The cumulative effects of forest management and disturbance (mountain pine beetle and salvage harvesting) on sediment, stream temperature, and physical and chemical water quality.
- The refinement of stream temperature guidelines on a watershed or sub-regional basis.
- The development of stream temperature prediction models for operational use.
- The increased monitoring of water quality related to the mountain pine beetle infestation and salvage harvesting (i.e., the current monitoring network is insufficient).
- A better understanding of surface water–groundwater interactions on water quality.
- The testing of management practices to ensure that they protect water quality values.
- The determination of whether riparian buffers provide water quality value beyond temperature.
- A determination of how climate change will affect physical and chemical water quality.
- The effects of the mountain pine beetle infestation on sediment movement in affected watersheds.

EXTENSION NEEDS

- The development and implementation of environmental monitoring capacity for aquatic values.
- Extension on the effects of climate change on physical and chemical water quality.

3.2.3 Groundwater

Respondents' information needs for groundwater related to uncertainty about the extent of the resource. This will become a more urgent issue as groundwater extraction for human use increases in the Northern Interior. Their specific research and extension information needs related to groundwater included the following.

RESEARCH NEEDS

- An improved inventory and characterization of aquifers.
- A determination of how large-scale disturbances related to the mountain pine beetle infestation and salvage harvesting will affect the ability of groundwater to buffer stream temperatures.
- A determination of how coal bed methane extraction will affect groundwater in the Northern Interior.
- The recharge rates for local and regional aquifers from forested areas.
- The effects of land use changes (from forestry to agriculture) on groundwater resources in the Central Interior following the mountain pine beetle infestation.

EXTENSION NEEDS

- Information on the prediction of water table response to the mountain pine beetle infestation and salvage harvesting, and the operational consequences this will cause.
- Information on the use of groundwater in fish habitat enhancement.

OTHER ISSUES

- Improved legislation around groundwater extraction and quality to protect the resource in the long term.

3.2.4 Watershed Restoration

Respondents identified a lack of evaluation of previous restoration efforts as an area of primary information need. Their specific research and extension information needs related to watershed restoration included the following.

RESEARCH NEEDS

- A review of past watershed restoration successes and failures (e.g., from the 1990s Watershed Restoration Program) to determine whether it was good value for the funds spent.
- A determination of which harvesting systems will protect existing watershed integrity.
- The impacts of road deactivation on watershed health.
- The survey and inventory of improperly installed and un-maintained culverts to guide removal and (or) replacement.
- Local trials to determine the most appropriate methods of watershed restoration in different regions in the Northern Interior.

EXTENSION NEEDS

- The development of restoration prescriptions to deal with large forest disturbances, such as the mountain pine beetle infestation and salvage harvesting.
- The development of extension programming based on past restoration efforts (e.g., Nechacko River channel structures for fish habitat) to guide future works.
- Extension and training around effective road deactivation planning and techniques.

3.2.5 Small Streams and Riparian Zones

Although stream temperature has been a driving factor for the protection of riparian areas, new values are emerging. Respondents' specific research and extension information needs related to small streams and riparian zones included the following.

RESEARCH NEEDS

- The impacts of land use on small (first-order) streams and the effectiveness of riparian buffers on maintaining resource and environmental values.
- A determination of water yields in first-order headwater streams.
- Improved capacity to model hydrological and ecological processes and management impacts on small streams.
- Information about the impacts of loss of coarse woody debris (and future inputs) on small streams and aquatic health.
- The effects of increasing range use on small streams and aquatic health after the mountain pine beetle infestation and salvage harvesting.
- Confirmation that current management methods for small streams are effective in protecting small stream processes (e.g., Prince George District Manager Policy).
- A determination of whether riparian buffers actually protect what they are intended to protect.

EXTENSION NEEDS

- Development of operational tools to assess riparian zones for management.
- Improved dissemination of the results of past and current research on small streams.

3.2.6 Fish and Aquatic Habitat

Many of the information needs identified under this category also relate to the previous category on small streams and riparian zones. Respondents' specific research and extension information needs related to fish and aquatic habitat included the following.

RESEARCH NEEDS

- The effects of forest management on fish habitat.
- An inventory of habitat quantity for salmonids.
- A determination of how the life history requirements of various fish species integrate with forest management needs and how this information can be used to develop models to predict fish habitat requirements and management priorities.
- The measurement of watershed health in areas of development to determine potential changes in habitat quality, and monitoring changes over time.
- An inventory of stream-crossing barriers to fish passage (e.g., existing structures, railways, highways, and resource roads); an issue for fish passage: upgrade or decommission crossings.
- The testing and comparison of different operational management strategies to ensure their effectiveness.
- The cumulative impacts on smaller fish streams (e.g., spring salmon use really small streams).

EXTENSION NEEDS

- A synthesis of methods for assessing low flows for fish habitat.
- Provision of tools to identify overwintering habitats for different fish species.

3.2.7 Climate Change

Respondents identified the uncertainty around the effects of climate change on water resources in the Northern Interior as a primary barrier to long-term watershed management planning. Their specific research and extension information needs related to climate change included the following.

RESEARCH NEEDS

- The effects of climate change on water quantity and quality, and the implications for watershed management.
- The effect of climate change on the spatial distribution of snow accumulation and melt.
- The interaction of climate change with various forest disturbance types and its effect on water resources.
- Modelling of various climate change scenarios to better understand hydrological systems, and to help identify where to direct mitigation efforts.
- The determination of the relationships between changing physical conditions (e.g., water temperature) and aquatic species composition.
- Predictive modelling of changes in forest species composition and subsequent effects on hydrology.
- The potential impacts of climate change on hydropower generation.

EXTENSION NEEDS

- Identification of the silvicultural options that will reduce the effects of climate change on hydrology.

OTHER ISSUES

- Access to long-term data sets to assess changes.
- More hydrometric monitoring and climate stations in the north to better quantify and predict the effects of climate change.
- Access (preferably online) to Ministry of Forests and Range and Ministry of Transportation climate station data.

3.2.8 Monitoring and Data Collection

Respondents noted a lack of hydrometric monitoring stations in the north, which are necessary to detect and quantify the effects of disturbance and climate change. Their specific extension information needs related to monitoring and data collection included the following.

EXTENSION NEEDS

- Extension on the design and implementation of cost-effective watershed monitoring.
- Synthesis of monitoring data needs for use by diverse clientele.

OTHER ISSUES

- The small number and loss of hydrometric monitoring stations is a major impediment to quantifying the effects of disturbance and climate change.
- Climate data is necessary for mid- and high-elevation locations to better predict hydrologic response.
- Long-term data on stream temperature and an expanded monitoring network to cover a range of stream sizes and watershed conditions.
- A long-term commitment to data collection will ensure that data is available to address future watershed management issues.

3.2.9 Communication and Data Availability

Respondents noted that, for ease of use, data sources should be accessible and employ consistent formats. Their specific extension information needs related to communication and data availability included the following.

EXTENSION NEEDS

- Access to detailed information, particularly government articles, that are not primary publications and are currently difficult to obtain.
- Linkages, provided by FORREX, to research projects and unpublished reports.
- Greater information synthesis to increase its utility.
- Strategic targeting of information for specific audiences to avoid information overload and to ensure that critical messages get out.
- Address interoperability issues between data types collected and published by different organizations as this requires lots of resources to be expended by various organizations using different data sources to answer specific questions.

OTHER ISSUES

- Need to follow American communication/data delivery model (i.e., in which publicly funded bodies required to post reports on the Internet).
- Improve availability of soil maps and data reports.
- Provide user-friendly search engines and portals that are regularly maintained and updated (i.e., requires dependable funding).

3.2.10 Water Resource Governance

Respondents identified the need to build capacity in communities to gain more control of resources; improved groundwater legislation and evaluation of whether the legislation is effective were also recognized needs. Respondents' specific extension information needs related to water resource governance included the following.

RESEARCH NEEDS

- Effectiveness evaluation of legislation and guidelines.

EXTENSION NEEDS

- Information for communities about gaining more control over local resources.
- Extension aimed at simplifying complex legislation and responsibilities around water.
- Facilitation of First Nations governance around water resources, especially in multi-jurisdictional watersheds with competing interests and mandates.
- Assistance for community groups to develop governance structures geared to local resource management.

OTHER ISSUES

- Groundwater legislation and licensing to protect aquifer water quality and sustainability.
- *Forest and Range Practices Act* vague on how to prove negative effects.

3.2.11 Social Issues

Most social issues identified by respondents revolved around education of interested parties in the basics of hydrology and watersheds to improve management. Respondents' specific extension information needs related to social issues included the following.

EXTENSION NEEDS

- Extension targeted to students, First Nations, and the general public on hydrology, watersheds, and effects of the mountain pine beetle infestation and climate change on water resources.
- More information about the social issues (economics, communities) related to watershed management.
- Short pamphlets or fact sheets targeted at the general public.
- Extension targeted at the general public on the critical evaluation of information from diverse sources.
- Translation of research results into plain language (e.g., to improve public understanding of water conservation).
- The connection of end-users to research: how is this done?
- An evaluation of the level of social acceptance of management practices; testing different strategies to gain social acceptance.
- Information about the physical and economic sides of multiple water uses and the resolution of potential conflicts.
- Extension of research on the effects of the mountain pine beetle infestation to managers and communities.

3.2.12 Future Issues

Respondents identified some other issues related to future developments that did not fit within the topical areas presented previously. Their specific information needs related to future issues included the following.

- The need for abundant clean water will be a major pressure in the face of climate change.
- A determination of the thresholds at which harvesting affects hydrology as harvesting moves to higher elevations in the aftermath of mountain pine beetle infestation.
- The cumulative long-term effects (environmental and on communities) of applying new watershed management principles (e.g., various retention strategies).
- The impacts of managing for multiple development types (e.g., forestry, mining, oil and gas, range) on water resources.
- Other forest pathogens (insects or diseases) that may have impacts in the future.
- The influence of greenhouse gas management and carbon values of forests on watershed management.
- Management of the transition from salvage harvesting to restoration of ecosystems affected by the mountain pine beetle infestation.
- The effect on hydrological values of managing species at risk.

3.2.13 Other Issues

Respondents identified some other issues that did not fit within the topical areas presented previously. Their specific research and extension information needs related to other issues included the following.

- The management of salmonid stocks for maximum sustained yield.
- The effects on watershed management of valuing carbon.
- The effects on watersheds of expanded ecosystem-based and species-at-risk management.
- The regional management of funding for research and resource management (i.e., as opposed to rolling it up to the provincial level).

3.3 Information Tools

3.3.1 Where do you receive research or extension support?

From a list of possible options for receiving research or extension support (see Appendix B), the majority of respondents indicated that they used all the support options available. Depending on the research required, not all information can be found at a single resource. Respondents also obtained important support from colleagues. In particular, respondents in the academic, consultant, and government sectors obtained resources within their own organizations.

3.3.2 What tools do you currently use to obtain research and extension support?

Respondents indicated that a variety of tools were used to obtain research and extension support, and commonly used all available tools. They identified a preference for online support, although finding information was often a challenge. Respondents repeatedly commented on the need for a better online network that consolidated research and extension support in a central location.

3.3.3 What are your current constraints in obtaining research information or extension support?

Respondents identified time and budgets as the main constraints in obtaining research information and extension support. Some respondents noted electronic access as a constraint in locating historical data and certain provincial government information.

3.3.4 What is your preferred way of receiving information?

Respondents' preferences varied regarding the methods used to receive information, and appeared to be influenced by the type of information received. For example, respondents indicated that events (e.g., workshops and conferences) provided opportunities to network, fostered discussion periods, and offered various views on research topics. On a day-to-day basis, publications and literature summaries were preferred. Multimedia was rated lower than print or electronic publications.

3.3.5 Knowledge of FORREX services?

Although many respondents had established relationships with FORREX and had used FORREX services, the interviews indicated that respondents had a range of knowledge about its services. Some were not aware of FORREX, and others had limited knowledge of FORREX and did not use its services on a regular basis.

3.3.6 What FORREX services have you used?

Streamline topped the list of FORREX services used, followed by the WatershedEXT listserv, *JEM*, *LINK*, and the FORREX Web site.

3.3.7 What do you like and dislike about the services provided by FORREX?

In general, respondents indicated strong support for FORREX and its work. Many respondents noted that the *Streamline Watershed Management Bulletin* was useful and its relevancy was maximized through local research results. Suggestions for improvement included:

- Provide assistance in developing extension capacity in other organizations.
- Increase direct interaction between FORREX and forest industry.
- Provide more fish habitat and management articles in *Streamline*.
- Publish more summary brochures for operational problems.
- Conduct more events in the Northern Interior.
- Provide concise event summaries that include key points and lessons learned.

4 SUMMARY AND CONCLUSIONS

The survey was designed to identify watershed management research and extension needs in the Northern Interior of British Columbia from the perspective of a range of FORREX clients, partners, and contacts. Five important themes requiring research and extension emerged from this survey:

1. Quantifying the effects of forest disturbance (especially the mountain pine beetle infestation and harvesting) on water quantity and quality.
2. Reducing uncertainty around potential climate change impacts on water resources.
3. Increasing hydrologic knowledge and education for professionals, the public, and First Nations.
4. Developing water resource monitoring capacity.
5. Evaluating operational tools that predict the effects of forest disturbance on water resources.

In the Northern Interior, many concerns centred on the effects of, and recovery from, the ongoing mountain pine beetle infestation and crossed the themes of hydrology, aquatic ecology, and social issues.

The results of interviews with key informants were similar to those presented by Morford and Hollstedt (2007) in a recent survey of natural resources practitioners in British Columbia. Morford and Hollstedt (2007) found that the highest-priority watershed management topics were forest management impacts on quantity and quality, riparian management, hydrologic recovery, and silviculture, pest, and wildfire effects

on water quantity and quality. Climate change and mountain pine beetle were also considered high-priority topics. A previous watershed management information needs assessment for coastal British Columbia (Pike 2004) resulted in similar themes, but with a stronger emphasis on riparian areas and fish habitat.

The results of these surveys will be used to develop extension programming and inform research funding on the priority themes and topics. The findings on information tools will be used to improve extension delivery by the WMEP.

REFERENCES

- Morford, S. and C. Hollstedt. 2007. Revisiting a forest extension strategy for British Columbia: A survey of natural resource practitioners and information providers. B.C. Ministry of Forests and Range, Victoria, B.C. Technical Report No. 042. URL: <http://www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr042.htm>
- Pike, R. 2004. 2003 Coastal needs assessment study for watershed management. FORREX Forest Research Extension Partnership, Kamloops, B.C. File Report No. 04–03. URL: <http://www.forrex.org/publications/other/FileReports/fr04-03.pdf>
- Redding, T. 2007a. Mountain pine beetle and watershed hydrology: Preliminary results of research from British Columbia, Alberta, and Colorado. Post-workshop evaluation survey summary and results. FORREX Forest Research Extension Partnership, Kamloops, B.C. Internal Report.
- _____. 2007b. The Upper Penticton Creek Watershed Experiment: Results of a paired watershed study on the effects of forest management on water resources. Post-workshop evaluation summary and results. FORREX Forest Research Extension Partnership, Kamloops, B.C. Internal Report.
- Redding, T., S. Lepsoe, and M. Laurie. 2008. 2007 Southern Interior information needs assessment study for watershed management. FORREX Forest Research Extension Partnership, Kamloops, B.C. File Report No. 08–02. URL: <http://www.forrex.org/publications/other/FileReports/fr08-02.pdf>

APPENDIX A Introductory Letter

Dear FORREX Respondent,

As you know, watershed management issues are among the many challenges facing natural resource managers in the Northern Interior of British Columbia. FORREX's Watershed Management Extension Program is currently conducting a needs assessment to identify specific Northern Interior watershed information needs that are critical to sustainable management of forested watersheds. We are requesting your help in this process.

The focus of the Watershed Management Extension Program (WMEP) is to provide extension services on topics that directly or indirectly affect water resources in terrestrial and aquatic ecosystems. Our goal is to increase communication, understanding, and application of innovative knowledge and research results. We provide a number of products and services:

- Web site with information on WMEP, products, services and links to external sources of information;
- Publications such as *Streamline Watershed Management Bulletin* (<http://www.forrex.org/publications/streamline/streamline.asp>);
- Workshops such as "Mountain Pine Beetle and Watershed Hydrology" (http://www.forrex.org/program/water/mpb_hydrology.asp).

The program has a broad client base that includes:

- Operations (industry, government, First Nations, consulting, and interested public)
- Policy/decision-makers (government, First Nations, industry, stewardship/community groups)
- Researchers (industry, government, consulting, First Nations, and academic researchers)
- Professional associations, environmental organizations, and interested public

You are among a few key respondents we are asking to participate in this survey. Your input will be added to other extension needs identified over the last 2 years, helping to further guide our program development to meet our clients' needs. The survey will be conducted by telephone interview with Karen Nickurak (Arnica Environmental) on behalf of FORREX, following a questionnaire format. We ask you to respond not only based on your own perspective, but also from the perspectives of others you know in your field. Survey results will be made publicly available on the FORREX Web site by the end of March 2008.

For questions or more information about the Watershed Management Extension Program, please contact Todd Redding (250-807-9516, todd.redding@forrex.org).

Thank you for your participation.

Sincerely,

Todd Redding and Karen Nickurak

APPENDIX B Key Informant Survey

Southern/Northern Interior Watershed Management Needs Assessment

The FORREX Watershed Management Extension Program is conducting an information needs assessment around watershed management issues focussed on forested watersheds in the Northern Interior of British Columbia. The information gained from this survey will be used to guide the development of extension programming to best address the needs and issues in the Northern Interior. Results will be shared with other organizations to help guide their research and extension investments (e.g., FIA–Forest Science Research Program Advisory Committees, etc.).

Name:

Organization:

Position:

Geographical working region:

Contact information:

1. In which field/area do you primarily practice: Select primary and secondary (more than one if necessary)
 - Forestry
 - Agriculture
 - Mining
 - Biology (e.g., wildlife, conservation)
 - Fisheries
 - Geosciences and Engineering (e.g., terrain stability, road design)
 - Water Supply and Licensing
 - Power Supply
 - Other, please specify

2. Which sector best applies to you: Select primary and secondary (more than one if necessary)
 - Forest Industry
 - Provincial Government
 - Other Government agencies
 - First Nations
 - Consultant/Academic
 - Community/Stewardship Group/NGO
 - Other, please specify

3. Please list your key needs (research or extension) around the stated topics.

Note: A research need is where you believe that information is lacking or does not exist. An extension need is where information exists, but for some reason is not getting to the people who need it. If possible, please provide examples of specific questions related to this issue from the region. If you feel that this is an extension need, please suggest to whom the extension effort should be targeted towards.

 - Water quantity (e.g., water yield, peak flows, low flows)
 - Water quality (e.g., sediment, turbidity, temperature)
 - Groundwater (e.g., quantity, quality)
 - Watershed restoration (e.g., channel structures, road deactivation)
 - Small streams and riparian zones (e.g., riparian buffers, headwater streams)

- Fish/aquatic habitat (e.g., habitat quality, low flows, temperature)
 - Climate change (e.g., changes in precipitation type and timing, increased temperatures, changes in flow regimes)
 - Monitoring and data collection (e.g., loss of hydrometric stations, lack of high elevation climate data)
 - Communication and data availability (e.g., data and reports available on the Web)
 - Water resource governance (e.g., FRPA, water rights, policy, groundwater legislation)
 - Social issues (e.g., lack of basic hydrological understanding)
 - Future issues? (e.g., what do you see becoming critical in the next 5–10 years)
 - Mountain pine beetle and hydrology
 - Other issues?
4. Where do you currently obtain research or extension support? (i.e., professional colleagues, own organization, FORREX, networks, research institutions, government Web sites, Google?)
5. What tools do you currently use to access information?
- Online networks? (e.g., professional association Web site)
 - Publications, newsletters, journals (please provide examples)
 - Personal contacts
 - Telephone
 - Conferences
 - Other? Please specify.
6. What are your current constraints in obtaining research information or extension support? (e.g., budgets, time, web access)
7. What is your preferred way of receiving information?
- events (workshop, conference, course, field tour)
 - publications (*Streamline*, *LINK*, *JEM*)
 - print copies
 - electronic access
 - literature summaries/synthesis
 - fact sheets
 - multimedia (Web sites, streaming video)
 - other
8. Are you aware of FORREX and do you currently use their services and products?
9. Which FORREX services have you used previously? (select more than one)
- None
 - Listserv
 - Streamline Watershed Management Bulletin*
 - LINK*
 - JEM*
 - Web site
 - Other (please specify)
10. What do you like and dislike about the services provided by FORREX? Do you have suggestions for improvement?
11. Additional comments and suggestions?

