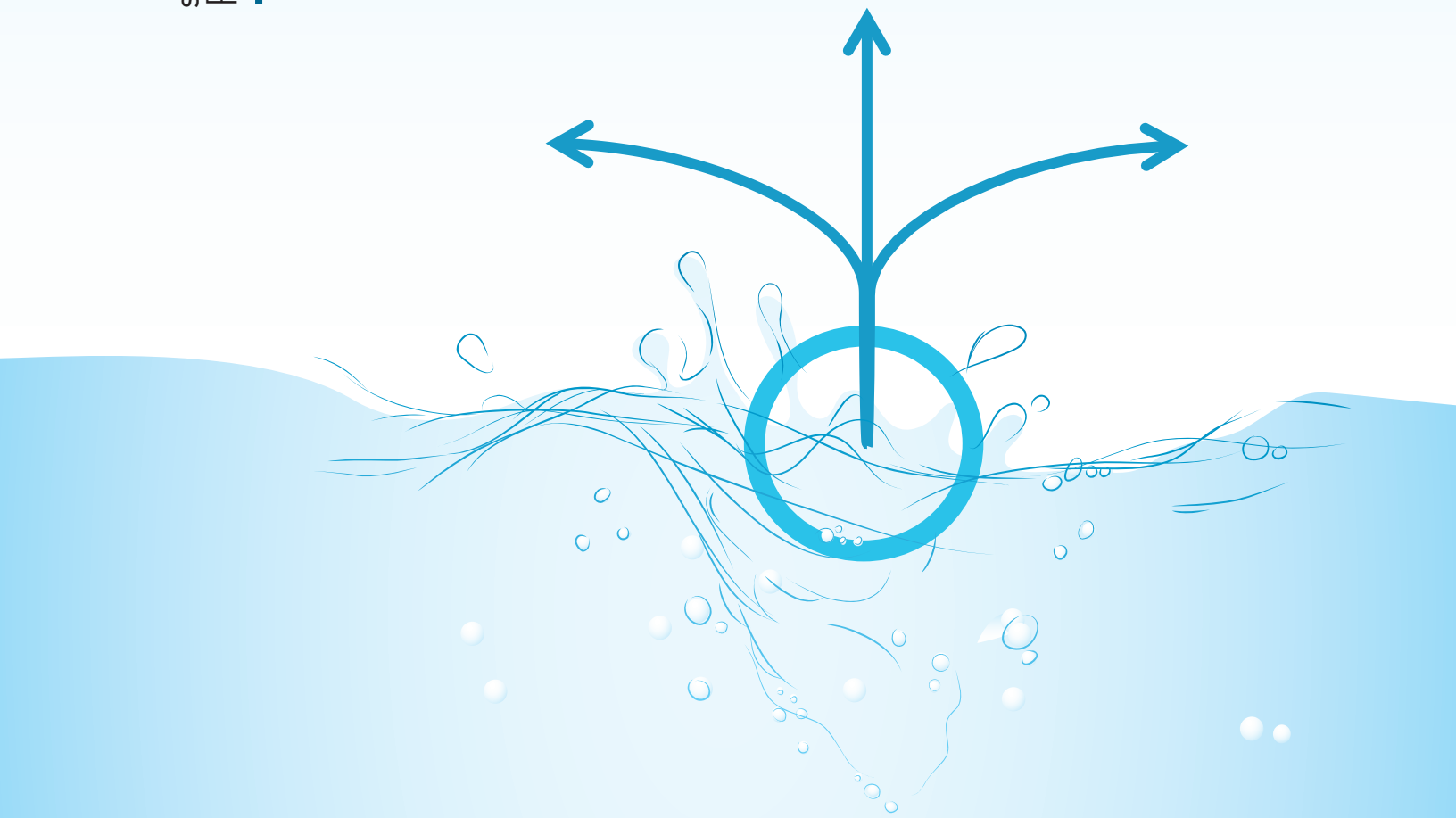
PACIFIC WATER RESEARCH CENTRE

SFU FACULTY OF ENVIRONMENT

BRITISH COLUMBIA Ministry of Environment

Summary Report

Amalgamating Local Data to Inform Water Related Decisions



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EXECUTIVE SUMMARY

Managing a watershed is a complex challenge, involving interactions between surface water and ground water resources with many physical, social, and biophysical processes operating across diverse geophysical and climatic conditions. The multitude of decision makers involved in water related decisions often need to balance the competing tasks of meeting growing demands for water while preserving the natural hydrological processes supporting the broader ecosystem. Some decision makers examine balancing water licensing needs with ecological needs while others look to decisions affecting water use priorities of the broader community and watershed health. In doing so, decision makers often depend on data available to them.

Decision makers require data on what hydrological changes may affect short and long-term water use and what potential exists for future climate risks. There are many decision makers (such as water practitioners, watershed groups, First Nations, and provincial and local governments) involved in water related decisions and how data is used, as well as what data is needed, can differ between decision makers and at different scales (local to regional to provincial) decisions are being made. As well, the dissemination of these data, and decision makers' access to it, are as important as ensuring that the data process is current and accurate. Decision makers not only require data, but a process to sort through the multitude of data available.

This report represents a summary of a pilot study in the Nechako watershed that investigated and advised on the data needed to detail hydrological systems, identify conservation and ecological flows, estimate water use demands, and quantify socio-economic benefits of water use to better support water related decision making. The study also examined the opportunity for accessing and amalgamating these data and the challenges and difficulties that might exist in amalgamating these data.

While not a focus of the study, the pilot study also explored a loose interpretation of decision making across various scales to explore data that could inform the decision-making process. The pilot study identified that future decisions affecting the Nechako watershed can be broadly grouped into the following nine decision types:

1. Development decisions
2. Environmental flow decisions
3. Data decisions
4. Climate change decisions
5. Capacity decisions

6. Pests management decisions
7. Monitoring decisions, and
8. Governance/policy/regulator framework decisions
9. Other management decisions

A review of available data in the Nechako watershed found a significant amount of data available to decision makers in the following nine categories:

1. Drinking Water
2. Environmental Change
3. Industrial Water Use
4. Physical Characteristics of the Watershed
5. Recreational Water Use
6. Social Demographics
7. Species and Habitat Water Needs
8. Traditional Knowledge
9. Values

However, a comparison of known data sources to types of data that could inform decisions in the Nechako watershed exposed several data needs. These include a need for information on hydrometric parameters, water quality data, water permitting and licensing information, and well data. Information on transportation corridors were unavailable or unknown to the study team and study participants. Finally, data on the impacts, risk, and management of wildfires is needed.

The study noted several opportunities and directions for amalgamating local data. First, the Nechako Watershed Roundtable provides a forum for collaboration and trust building needed to open conversations on data sharing. Second, co-monitoring agreements and First Nation collaborations may provide new directions for initiating data sharing programs. Joint funding programs among multiple parties (e.g. water management groups, governments, educational institutions) may increase capacity to collect and manage large data sets. Other partnerships between local academic institutions and monitoring volunteers may improve data analysis and sharing. Moreover, modifying the Environmental Assessment process could open up access to previously collected but unavailable data.

Additional opportunities for amalgamating local data can be found in new approaches for collecting data. Citizen science programs like Streamkeeper and the Canadian Aquatic Biomonitoring Network (CABIN), and student volunteer and college programs provide additional avenues for data collection and can be structured to support data sharing from the onset. Social media and online technologies provide new possibilities for recording and increasing access to Traditional Knowledge and First Nation historical records. Online reference libraries, like the UNBC data portal, also provide an opportunity to survey watershed stakeholders on available data resources as well as ease the sharing of data.

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ABBREVIATIONS

BC	British Columbia
BCTS	BC timber sales
CABIN	Canadian Aquatic Biomonitoring Network
CWS	BC Coastal Waterbird Survey, Bird Studies Canada
DFO	Fisheries and Oceans Canada
E/A or EA	Environmental Assessment
EC	Environment Canada
EcoCat	EcoCat Ecological Reports Catalogue - Province of British Columbia
FBC	Fraser Basin Council
FLNRO	BC Ministry of Forests, Lands and Natural Resource Operations
FREP	Forest & Range Evaluation Program, Province of British Columbia
GARP	Groundwater at Risk of containing Pathogens
GUDI	Groundwater Under the Direct Influence
GW	Groundwater
ImapBC	iMapBC - Province of British Columbia
LNG	Liquefied natural gas
LRDW	Land and Resource Data Warehouse, Aboriginal Mapping Network
MoE	BC Ministry of the Environment
MOU	Memorandum of understanding
NEWSS	Nechako Environment and Water Stewardship Society
NHA	Northern Health Authority
PCIC	Pacific Climate Impacts Consortium
PWRC	Pacific Water Research Centre, Simon Fraser University
RFC	River Forecast Centre
RT	Rio Tinto Alcan
SEEMPs	Socio-economic Effects Management Plans
SFU	Simon Fraser University
TEK	Traditional ecological knowledge
UFFCA	Upper Fraser Fisheries Conservation Alliance
UNBC	University of Northern British Columbia
Data Workshop	Nechako watershed local data workshop
WSA	BC Water Sustainability Act

INTRODUCTION

Managing a watershed is a complex challenge, involving interactions between surface water and groundwater resources with many physical, social, and biophysical processes operating across diverse geophysical and climatic conditions. The multitude of decision makers involved in water related decisions often need to balance the competing tasks of meeting growing demands for water while preserving the natural hydrological processes supporting the broader ecosystem. Some decision makers examine balancing water licensing needs with ecological needs while others look to decisions affecting water use priorities of the broader community and watershed health. In doing so, decision makers often depend on data available to them to work through these complex problems.

Decision makers, such as water practitioners, watershed groups, First Nations, and provincial and local governments, require data on what hydrological changes may affect short and long-term water use, what potential exists for future climate risks, and what tools are available to assist them. How data is used, as well as what data is needed, can differ between decision makers and the decisions they make differ depending on the scale (e.g. local to regional to provincial) these decisions are made. The dissemination of these data, and decision makers' access to them, are as important as ensuring that the data process is current and accurate. Decision makers not only require data, but a way or process to sort through the multitude of data available.

In the case of water related decisions, data are often held and maintained at a local community level. Identifying, cataloguing and amalgamating local data creates a challenge for watershed managers and decision makers, but it also creates the opportunity for community collaboration and investigation.

This report represents a summary of a pilot study in the Nechako watershed aimed to address this opportunity by identifying local data available (such as hydrological metering data, geological studies, watershed use plans) to inform water related decisions by various decision makers within provincial and local governments. The study was designed around the primary goal to:

> Investigate and advise on the data needed to detail hydrological systems (surface and groundwater), identify conservation and ecological flows, estimate water use demands, and quantify socio-economic benefits of water use (e.g. economic output, historical and cultural significance, health and well-being).

While not a focus of the investigation, the pilot study also explored a loose interpretation of decision making across various scales to explore data that could inform water related decision-making processes. The study did not, however, define any specific decision or define any decision context in identifying the data presented in this report. The study team recognizes that there are a multitude of contexts that define what, where, and how data is used in the decision-making process and the interpretation of data needs may differ depending on the decision-making environment and decision maker. As such, the discussion of decisions presented in this report should not be interpreted as defining the decision-making context of the Nechako watershed, but as a discussion of the types of water related decisions that can be informed by local data.

This report is intended for water practitioners, watershed groups, local governments, provincial water managers, First Nations, and other decision makers interested in exploring local data within their community. It provides a summary of outcomes from a watershed selection process, selected interviews, a Nechako watershed local data workshop (Data Workshop) and a data gap analysis, along with a discussion of common data themes observed from these activities. While the study focused on the Nechako watershed, the following sections should provide useful guidance on where community stakeholders could collaborate across a number of areas to pursue accessing and amalgamating local data to inform water related decisions.

The remainder of this Introduction discusses the approaches used to collect, analyze, and document study findings. This report also includes a number of appendices to provide detailed information on the various study components and outcomes (Appendix A - Appendix F).

The Nechako Watershed section of this report provides an introduction to the Nechako watershed and a synthesis of community issues and decision types identified at the Data Workshop.

The Data Findings section of this report includes a discussion of findings and data needed to inform various water related decisions in the Nechako watershed. It provides a comparison of known data to identified data types and a discussion of data

Limitations to this study: The goal of this study was to investigate local data that could inform water related decision making, and not necessarily represent the full range of data available in the Nechako watershed. The information discussed in this report represents a subset of data available and the study team encourages further investigation in this area. Data gaps were determined from data identified in this study and may omit an unknown data source. Moreover, due to the extent of local data identified, a discussion of every data type was not possible. Any omission of data or source of data in this discussion does not denote a lack of importance of the data to water related decision making in the Nechako watershed.

availability is included to highlight data gaps and potential data needs.

The Discussion and Conclusion section of this report reviews opportunities for amalgamating data discussed in Data Findings and the challenges and difficulties that might exist in amalgamating these data. The section also provides a summary conclusion and discussion on overall findings.

Study Approach

The majority of the study was dedicated to organizing and facilitating the Data Workshop. To prepare for the Data Workshop our study team conducted a community assessment using a criteria matrix, conducted interviews of local watershed stakeholders, prepared a watershed concept diagram, and organized and convened the Data Workshop in Prince George, British Columbia (BC). The following briefly describes each step and provides reference to study materials and study findings included as appendices. Included in these appendices are the un-edited views and data shared by workshop participants. These raw data are provided, with caution, so that readers may utilize these findings in their own investigation of local data.

Community section criteria matrix

At the onset of the study a community selection criteria matrix was used to assist in selecting a community area to host a local data workshop. While many communities across BC would benefit from this study, it was necessary to select only one community to pilot the workshop process. The matrix used to select a community included criteria on the state and availability of data in the community, such as: how likely is the community to have a water accounting model, development pressures, capacity to influence regulatory and institutional structures, basic water use trends and driving factors, pre-existing knowledge of significant data gaps, urgency of future water decisions presented in the community, and availability of local water use and demand assessment tools and other quantification studies. Our study team investigated and completed an assessment for the watersheds around Port Alberni, Osoyoos, Squamish, Nelson, Dawson Creek, Sechelt, Prince George, Surrey, and Prince Rupert. All communities were found in need of this study with Prince George in the Nechako watershed selected to maximize limited study resources.

Local interviews

Following the selection of the Nechako watershed, our study team contacted community stakeholders to discuss local watershed issues and what types of data were available in the community. Our team interviewed individuals from the Fraser Basin Council, the Nechako Environment and Water Stewardship Society, the BC Ministry of the Environment, the BC Ministry of Forests, Lands and Natural Resource Operations, and the University of Northern British Columbia. Recommendations on data sources and participants to attend the Data Workshop in Prince George BC were sought. A copy of the interview questions are provided in Appendix F

and information from these interviews further assisted in organizing and preparing materials for the Data Workshop. Data collected from these interviews are included in the listing of known data in Appendix B.

Preparing and hosting the Nechako watershed local data workshop

The bulk of this study was dedicated to preparing and delivering a data mapping workshop with stakeholders and representatives of organizations that either collect and maintain watershed data, or have knowledge about the data needed to balance water supply and demand in a watershed. The following sections describe the preparation and hosting of the Data Workshop.

> **What was heard**
>
> "Great opportunity to bring everyone together to share the knowledge and identify the needs of different groups"

Nechako watershed local data workshop objectives

The Data Workshop was an event hosted by Simon Fraser University - with support from the BC Ministry of Environment, The Fraser Basin Council, and the Nechako Environment and Water Stewardship Society - on November 25, 2016 in Prince George, BC at the Coast Inn of the North Hotel. The four Data Workshop objectives were:

1. Investigate and advise on the data needed to detail the Nechako watershed
2. Promote a discussion of data needed to inform water related decisions
3. Identify currently available data within the Nechako watershed
4. Bring community partners together to share knowledge on the opportunities and difficulties for accessing and amalgamating local data

Seventeen people from across the Nechako watershed and representing local and provincial governments/regulators, environmental non governmental organizations, First Nations, academia, and key water users were in attendance (see Appendix E). Participants were invited from various disciplines to create a cross representation of watershed viewpoints.

Process

The Data Workshop opened with a welcoming from Elder Edith Frederick, Lheidli T'enneh First Nation. The study team then presented the Data Workshop goals and collaborative guidelines to follow during the day. Participants were invited to ask questions about a previously provided Data Workshop package. A complete Data Workshop agenda is provided in Appendix D.

The overall process for the workshop is based on a systems dynamic modelling exercise (an exercise that encourages participants to consider the watershed dynamically by examining the mutual interactions, interdependence, and information feedbacks between water sources and water uses) to encourage discussion and engagement between workshop participants. A similar

method has been used in the water resources planning processes applied by the U.S. Army Corps of Engineers for drought planning purposes[1].

Participants were first asked to consider issues and decisions affecting the Nechako watershed. A listing of these issues and decisions are included in Appendix C and are further discussed in the Nechako Watershed section of this report. Following a discussion of issues and decisions, the study team walked participants through a simplified concept, paper based, model of the watershed[2] asking the questions:

- Where does water come from?
- How is it used?
- And what are the connections that must be represented?

A copy of the presented conceptual model is included in Appendix A.

Review of the conceptual model included two rounds of group discussion. In the first round, groups were to consider the questions:

- What water users are missing?
- What key sources of water are missing?
- What flows and water stocks are missing?
- What modifies these flows and stocks?

Figure 1 Workshop participants discussing key issues in the Nechako watershed

Participants recorded their thoughts on printouts of the conceptual model. Groups were then asked to consider the data and actors (i.e. water users and decision makers) represented by the conceptual model. A listing of data identified through this process is included in Appendix B and later discussed in the Data Findings section of this report.

1 http://www.sharedvisionplanning.us

2 A final version of the model is available online at http://www.sfu.ca/content/dam/sfu/rem/water/SFU-Nechako%20Watershed%20local%20data%20diagram.pdf

At the end of the conceptual model review, the study team presented a list of known local data sources identified in preparation of the Data Workshop. Participants were asked to review the data list, note discrepancies, and add known data sources/types. A listing of data recorded during this process is included in Appendix B and later discussed in the Data Findings section of this report.

Figure 2 Workshop participants deliberating changes to the Nechako Watershed Conceptual Model

World Café – answering key questions

As a component of the Data Workshop, an open-ended process was used to elicit feedback from the participants on selected key questions of interest to the study team, focused on the opportunities and difficulties for accessing and amalgamating local data. The adopted process was the World Café method used previously by the study team, but modified for the Data Workshop along the following lines:

1. Our study team organized tables based on the team groups assigned earlier in the Data Workshop.
2. The following questions were put to the Data Workshop participants:
   - How might additional data be collected to support decisions making in the Nechako watershed?
   - What are the opportunities for accessing and amalgamating the data discussed during the workshop?
   - What challenges and difficulties might exist in amalgamating the data discussed during the workshop?
   - What new data would support the decisions and issues we identified?
3. For each table, a table "host" was identified. The role of the table host was to make sure people have been introduced and heard. They also chaired and recorded the discussion on flip charts. Toward the end, the host facilitated agreement on major points where that was possible.

4. After approximately 20 minutes, everyone except the host had to leave the table and go to another table at the café.
5. When the new table guests arrived, the host briefly explained where the earlier discussion had landed, along with major points. New guests to the table described what they had found important at their previous table discussions along with any new insights they had. The host continued to record the new information, readjusting points if needed for the table.
6. Steps 4 and 5 were repeated for the length of the cafe.
7. Finally the café was "closed" with each table host briefly presenting the main points arrived at by the table.

Figure 3 Participants considering data requirements for the Nechako watershed

The World Café concluded the Data Workshop and a listing of outcomes identified during the process is included in Appendix C. Common themes and observations from all Data Workshop stages are discussed in subsequent sections of this report.

Data analysis

Following the conclusion of the Data Workshop, the study conducted an abbreviated data gap analysis to compare known data sources to overall data needs. The study team first categorized data along common data themes. The study team then utilized the Nechako watershed conceptual model (see Appendix A) and data needs identified in the Data Workshop to identify sub-categories of data types. Known data were associated with these sub-categories emphasizing other categories with deficiencies. The results from this analysis are provided and discussed in the Data Findings section of this report.

NECHAKO WATERSHED

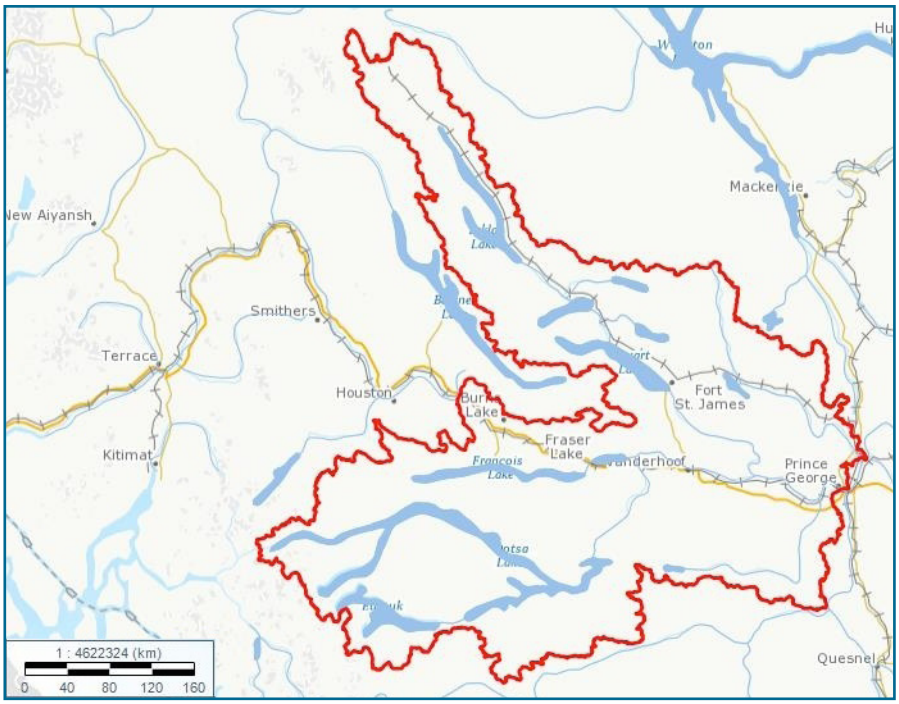


Figure 4 Map of the Nechako watershed
Source: Nechako Watershed Health Atlas, Fraser Basin Council - http://cmnmaps.ca/NECHAKO/

To examine how local data could inform water related decisions, the Nechako watershed (see Figure 4) was selected as the area of study. The Nechako watershed is located in central British Columbia in the northwest portion of the Fraser River Basin. It extends from the Babine River in the north to the Fraser River in the east to Tahtsa Lake in the west[1]. The watershed boundary is inclusive of the following systems - Stuart-Takla system in the north, the Nadina-Francois system in the west, the Eutsuk-Tahtsa system in the south and meeting the Fraser River at Prince George at its eastern boundary. The Nechako watershed provided an excellent area of study as the region represents a diverse set of water users set among industrial, residential, ecological, and cultural significant settings. The Nechako watershed has also seen an increase in community collaboration through the Nechako Watershed Roundtable.

1 Identified from the Nechako Watershed Health Atlas – available online at http://cmnmaps.ca/NECHAKO/

The recent release of the Nechako Watershed Strategy[1] highlights that the watershed is home to the municipalities of Prince George, Vanderhoof, Burns Lake, Fraser Lake, and Fort St. James. The region also includes many First Nation communities including the Carrier-Sekani Tribal Council (representing Burns Lake, Nadleh Whut'en, Nak'azdli, Saik'uz, Stellat'en, Takla Lake, Tl'azt'en and Wet'suwet'en), Cheslatta Carrier Nation, Lake Babine Nation, Lheidli-T'enneh, Nee-Tahi-Buhn Indian Band, Skin Tyee Band and Yekooche First Nation.

The Nechako watershed conceptual model (see Appendix A) illustrates how the Nechako watershed provides water for a diverse set of uses. These uses include water for hydroelectric generation, mining and agriculture, drinking water, and ecosystems. Most notably among these ecosystems is the habitat the watershed provides for fish species including trout, white sturgeon, and salmon. The watershed also provides opportunities for recreation, forestry, and resource extraction and plays an important role in First Nation cultural history.

1 Fraser Basin Council, (2016). "Towards a Healthy Nechako: Nechako Watershed Strategy - Version 1", prepared for the Nechako Watershed Roundtable. Available at http://www.refbc.com/sites/default/files/Nechako%20Watershed%20Strategy-31Oct2016-FINAL.pdf

Key watershed issues

Issues affecting the Nechako watershed were identified during the Data Workshop and are noted in Appendix C. Water use was a key issue raised by participants and includes differences between known water use and suspected actual water use, increasing demand for agriculture water (e.g. for irrigation), and lack of information on residential groundwater wells (e.g. number of wells and water use). Water quality was also a concern pertaining to issues with cryptosporidium and giardia, cyanobacteria algal blooms, industrial development impacts, and limited data on groundwater quality. Impacts from development that affected watersheds was a recurring issue. Participants had concerns related to changes in hydrology due to forestry activities, riparian area impacts from private land development, water quality impacts due to runoff from mining activities, and impacts from other industrial development. An increase in pest infestations (e.g. mountain pine beetle and spruce beetle) and the

subsequent effect on forested ecosystems along with the potential effects of climate change were also concerns. Participants felt that diminishing salmon supplies and changing fish seasons would result in cultural impacts. Participants perceived there to be a lack of government oversight resulting in reduced attention to watershed health. Further, participants were concerned about industry response to increased requests and requirements for data reporting and monitoring.

Given the data focus of the Data Workshop, workshop participants shared concerns related to a number of monitoring and data issues. These issues include lack of data for small streams with high water demand and generally a lack of baseline data on hydrological systems in the watershed. Data Workshop participants initially expressed concern about the availability of water licensing information although this concern diminished as data sources were shared by participants. Several participants identified a significant lack of data on groundwater hydrology, aquifer mapping for groundwater, and groundwater quality. Participants perceived a general lack of data about the interactions between surface water and groundwater systems raising concerns about the expanded use of groundwater. A lack of coordination between various groups collecting data generated a number of issues on standardizing and centralizing data. Other data issues discussed were related to lack of data on resident wells, compliance and monitoring data, and sediment data.

Coordination, governance, and community and culture concerns were discussed by participants at the Data Workshop. Lack of continued coordination between Nechako stakeholders was noted as well as a need to identify who is responsible for managing the outcomes (e.g. data, reports) from collaborative projects. Historical government-to-government relationships with First Nations was discussed by participants along with a need for provincial government to support decision making at the local level. Participants also noted issues related to a general lack of funding (without specifying the source or amount of funding needed) for collecting, managing, and utilizing data.

The full list of un-edited concerns and issues noted by workshop participants are provided in Appendix C. Moreover, the Nechako Watershed Strategy[1] highlights a number of additional issues and concerns in the watershed related to water quantity and quality, fish and wildlife, ecosystems, resource development and use, management approaches, data, and public engagement.

Decision Types

The study team asked Data Workshop participants to identify key decisions that may affect the Nechako watershed. The purpose in identifying these decisions was to encourage workshop participants' consideration of water related decisions that could be informed by local data. A broad discussion of decisions across many scales and possible decision

1 Fraser Basin Council, (2016). "Towards a Healthy Nechako: Nechako Watershed Strategy - Version 1", prepared for the Nechako Watershed Roundtable. Available at http://www.refbc.com/sites/default/files/Nechako%20Watershed%20Strategy-31Oct2016-FINAL.pdf

makers resulted in the decisions and decision influences (i.e. groups, organizations, institutional arrangements, or conditions that impart influence or constrain the decision-making process) noted in full in Appendix C.

The decisions affecting the watershed were then grouped by the study team into the following nine decision types:

1. Development decisions
2. Environmental flow decisions
3. Data decisions
4. Climate change decisions
5. Capacity decisions
6. Pests management decisions
7. Monitoring decisions, and
8. Governance/policy/regulator framework decisions
9. Other management decisions

Development decisions focus on mining, forestry, agriculture, and other industrial development. Participants noted that decisions are likely regarding Kenney Dam water management, a bioenergy plant in Vanderhoof, and agriculture land use. Other decisions regarding infrastructure and roads were discussed.

What was heard

"Infrastructure deficit exists for many older municipalities"

Environmental flow decisions centre around the management of flows in streams to support stream health and fish populations[1].

Data decisions relate to how to facilitate data sharing, provide levels of public access to data, and approaches for amalgamating local data.

Climate change decisions cover a broad list of decisions related to climate change adaptation planning, greenhouse gas mitigation strategies, how to incorporate climate change into decision-making processes, and how to design infrastructure to account for climate change.

Capacity decisions refer to decisions affecting funding opportunities for local groups and the personnel resources needed to work on Nechako watershed issues.

Pest management decisions guide the management of forest infestations and the subsequent impact on water quality.

Monitoring decisions focus on the requirements for watershed monitoring including pre and post monitoring design and identifying monitoring priorities.

Governance/policy/regulatory framework decisions cover a range of items related to the overall water regulatory framework, governance structures, policies and

1 While specific examples were not identified, the study team notes that the BC Water Sustainability Act states that decision makers, such as water managers, must consider the environmental flow needs of a stream in deciding on a new licence or approval application. It is likely that these decisions could relate to implementation of the Water Sustainability Act as well as ongoing stream management.

collaborations. For instance, participants at the Data Workshop discussed the application of the Provincial Cumulative Effects Framework, Socio-economic Effects Management Plans, and Regional Strategic Environmental Assessments. Other decisions discussed relate to how the Water Sustainability Act applies to fish habitats. Changes in water governance were also discussed noting a new provincial decision-making environment based on objectives and the implementation of the Water Sustainability Act with respect to First Nations inclusion in development of watershed objectives.

What was heard

"For me there is an achievable outcome here. It involves getting the right people/groups together to achieve an outcome of environmental stewardship while considering environmental values"

Other management decisions relate to decisions noted by participants regarding access to water resources for recreation and long-term operations of existing infrastructure (specific infrastructure systems not defined).

Watershed objectives

While not a specific goal of this study, the study team observed Data Workshop participants discussing how to identify and set watershed objectives. No specific measurement applicable to the Nechako watershed was recorded, however participants discussed objectives related to watershed planning, watershed values, and collaborative governance. Discussion on aquatic ecosystems also suggested that objectives are needed for measuring and assessing impact to riparian habitats from mining, range cattle grazing, land clearing, and agriculture. Water quality and water quantities were noted as needing specific objectives set.

DATA FINDINGS

This section discusses data findings from this study. It provides a comparison of known data to identified data types and a discussion of data availability is included to highlight data gaps and deficiencies. It then provides a description of needed and new data noted by Data Workshop participants.

Local data available for water related decisions in the Nechako watershed

There were many data types/sources identified in this study, which challenges the presentation of findings. To aid in this presentation our study team categorized these data along common themes. This section is organized by those data categories and a complete listing of all identified data (known, needed, and new sources) is included in Appendix B.

Data was found to be available and needed on the use of water by industry and for drinking water service delivery. Data representing Traditional Knowledge and environmental change were noted as being of key importance to future decisions. Limited data was noted on the social demographics[1] of the Nechako watershed and recreational water use. While discussion of data representing the physical characteristics of the watershed - including data on water levels and stream flows - dominated this study, followed by data on species and habitat water needs. The last category of data relates to watershed values. The local data identified for the Nechako watershed have been organized into the following nine categories:

1. Drinking Water
2. Environmental Change
3. Industrial Water Use
4. Physical Characteristics of the Watershed
5. Recreational Water Use
6. Social Demographics
7. Species and Habitat Water Needs
8. Traditional Knowledge
9. Values

Data Comparison

The following table aims to present a general comparison of known data[2] to data requirements that inform water related decisions in the Nechako watershed. The table contrasts data categories to known data sources as well as suspected data sources where decision makers may be able to locate data of this type. The table was prepared from the Nechako watershed conceptual model (see Appendix A), data needs identified in the Data Workshop (see Appendix B), and a review of known data sources (see Appendix

1 This lack of attention may come from the perception that data on social demographics is available through Census Canada and other readily accessible sources

2 Additional details on known references to listed data are provided in Appendix B.

B). This table also includes data noted in the Nechako Water Strategy Report[1]. While the table is recognizably incomplete the table identifies specific deficiencies in different data categories and the comparison will help to identify directions for future investigation as well as potential data collection efforts.

1 Fraser Basin Council, (2016). "Towards a Healthy Nechako: Nechako Watershed Strategy - Version 1", prepared for the Nechako Watershed Roundtable. Available at http://www.refbc.com/sites/default/files/Nechako%20Watershed%20Strategy-31Oct2016-FINAL.pdf

DATA CATEGORIES	KNOWN DATA/SUSPECTED DATA SOURCES
DRINKING WATER	
Landowners	
Water Licensing	Licensing/short-term use data (available online and through BC MoE water stewardship division)
Regulations	Area Based Regulations (for instance local Official Community Plans, municipal watershed plans, and future Water Sustainability Plans)
Legislative tools	
Small water systems	BC Water and Waste Association's Small water systems network; UBC RES'EAU-WaterNET
Groundwater	Nechako River Environmental Assessment Report
Surface Water	Nechako River Environmental Assessment Report; Yinka Dene 'Uza'hne Surface Water Management Policy & Guide to Surface Water Quality Standards; Water quantity project and stream gauges. (Upper Fraser Fisheries Conservation Alliance)
Water Quality	BC Ministry of Health; Water Quality Assessment And Objectives For The Nechako River (1987); Ministry of Forests, Lands and Natural Resource Operations, Northern Health
Dissolved total metals	
Turbidity	BC Lake Stewardship Society
Nutrients	BC Lake Stewardship Society
pH	BC Lake Stewardship Society
Bacterial counts	
Algae	
Total dissolved oxygen	Water monitoring program - Nadsilnich Lake Community Organization
Sediments	Fine sediment impacts to water quality – through FLNRO; Fraser Basin Watershed Plans (e.g. sediment survey in Fraser Basin - 4 sites in Nechako)
Water temperature	Freshwater Temperature - Nechako Fisheries Conservation Program technical Data Review 1988-2002
Cumulative effects	Federal Department of Health/ FLNRO
Arsenic	

DATA CATEGORIES	KNOWN DATA/SUSPECTED DATA SOURCES
Manganese	
Influences	Nechako Watershed Health Atlas - Water Quality Impacts from Forestry Activities
Monitoring points	Omineca Water Tool
Spring water	
Municipal demand	Prince George and other regional municipalities
ENVIRONMENTAL CHANGE	
Wildfires	Fire weather data
Human causes	
Land changes	LIDAR mapping (suspected but unknown to the study team)
Ecosystem causes	Winter Swan Survey
Pine beetle population	
Land use	Nechako River Environmental Assessment Report; Changing landscapes profiles
Changes to stream conditions	
Risk assessments	GARP = Groundwater at Risk of containing Pathogens
MAPS	
Forestry MAPS	BC MoE
Land codes	NC Province land code database
Changes to groundwater flows	Nechako River Environmental Assessment Report
Groundwater	Nechako River Environmental Assessment Report
Subsurface flow rates	Nechako River Environmental Assessment Report
Other uses	
Risk assessments	
Monitoring points	Omineca Water Tool
Coverage studies	
Residential development	Residential wells in Beaverley
Building codes	Regional municipalities, BC Province
Transportation corridors	BC Ministry of Transportation
Oil spills	
Truck traffic	
Infrastructure plans	
Transportation plans	
Roads	Resource Roads and Stream Crossings - Nechako Watershed Health Atlas
Rail lines	
Logging roads	
Highways	BC Ministry of Transportation

DATA CATEGORIES	KNOWN DATA/SUSPECTED DATA SOURCES
Surface flow rates	Nechako River Environmental Assessment Report; Takla Stream Monitoring Project
Change in run off to streams	Omineca Drought Management Plan
Climate	Governmental agencies (e.g Environment Canada); Nechako River Environmental Assessment Report; UNBC Integrated Watershed Research Group; Nechako Watershed Health Atlas
Rainfall	Nechako Watershed Health Atlas
Snowpack	Snow survey/water supply (RFC)
Water availability	UNBC Climate Change & Resource Development Scenarios
Air temperature	
Monitoring stations	Omineca Water Tool
Changes to timing and water flows	UNBC Integrated Watershed Research Group
Base flows	Nechako Watershed Health Atlas
River flow	Nechako Environmental Enhancement Fund; Takla Stream Monitoring Project
Seasonal flow	Nechako Environmental Enhancement Fund
Summer low flow	Water Management Plans (e.g. Prince George drinking water plan)
Winter low flow	Water Management Plans (e.g. Prince George drinking water plan)
INDUSTRIAL WATER USE	
Future demand	Water Licenses and Approvals (FLNRO); Licensed Water Volume by Sector - Nechako Watershed Health Atlas
Dust suppression	Industry data (e.g. from RT, Canfor, etc.)
Forestry and wood products	
Light industry	
Future demand	
Dust suppression	
Fire protection	
Mining	Mining water use; Industry data (e.g. from RT, Canfor, etc.)
Air Emissions	BC Ministry of Environment
Domestic	
Permitted uses	
Monitoring network	
Energy generation	Hydro electric generation
Oil and gas	LNG Environmental Stewardship Initiative; Omenica Water Tool
Bio energy	
Pulp processing	Kraft pulp processing water use
Agriculture	Agriculture water use; Climate information hub for farmers.

DATA CATEGORIES	KNOWN DATA/SUSPECTED DATA SOURCES
Fertilizer applications	
Pesticide application	
Range cattle management	
Forestry	BC Ministry of Forests, Lands and Natural Resource Operations
Changes in runoff to streams	BC Fish/Forestry interaction study
Snow dispersion	
Canopy Interception	Change in Forest Cover - Nechako Watershed Health Atlas
Impacts from clearing	BC Fish/Forestry interaction study
Forest harvesting rates	
Forestry health	Forest service (possibly BC Ministry of Forests, Lands and Natural Resource or Natural Resources Canada), BC Ministry of Environment
Spill response	Environmental Protection Officer (BC Ministry of Environment)
Coordinated spill response	
Other discharges	Waste Discharge Authorizations (BC Ministry of Environment)
Utility corridors	
Discharge monitoring	Waste Discharge Authorizations (BC Ministry of Environment)
Landfills	
Septic Systems	
Regulations	
Community Discharges	Waste Discharge Authorizations (BC Ministry of Environment)
Solids	
Nutrients	
Bacterial Counts	
Effluent	
Kenney Dam	Industry data (e.g. from RT, others), UNBC
Seasonal flow	Industry data (e.g. from RT, others), UNBC
Low flow	Industry data (e.g. from RT, others)
Modelling	UNBC
River temperature	Industry data (e.g. from RT, others), UNBC
Flood control	Industry data (e.g. from RT, others)
Legislative constraints	
Minimum flow standards	
Sediments	UNBC - Fine sediment sources and dynamics; Nechako River Environmental Assessment Report
Hydro generation	Hydro electric generation
Industrial discharge	

DATA CATEGORIES	KNOWN DATA/SUSPECTED DATA SOURCES
Decommissioned mines	BC Ministry of Energy and Mines
Monitoring points	
Reclamation records	
Soil samples	Nechako River Environmental Assessment Report
Geochemistry	
Agricultural runoff	
Utility corridors	
Land clearing	
Herbicide applications	
Forest harvesting rates	
PHYSICAL CHARACTERISTICS OF THE WATERSHED	Geosciences BC; Wateroffice Environment Canada, BC Ministry of Environment, Indian and Northern Affairs Canada
Topology	Seismic data - Integrated Interpretation and First Arrival Tomography of Reflection Surveys in Nechako Basin; Nechako River Environmental Assessment Report
Water Demand	
Surface water	Nechako River Environmental Assessment Report
Groundwater	Nechako River Environmental Assessment Report; Groundwater observation well network
Water balance	
GW-Surface water interaction	Stoney Creek surface water- groundwater interaction study (UNBC)
Groundwater profile	
Hot springs	
Season recharge	
Spring water withdrawals	
Aquifer maps	Private well survey - Vanderhoof, rural
Monitoring wells	Private well survey; Well water testing (e.g. Northern Health, municipal, FLNRO)
Flow trends	Water Quantity and Flow; Takla Stream Monitoring Project
Observation wells	
Aquifer inventory	
Sub surface drill logs	
Land owners	
Geology	
Private well survey	
Well location	
Monitoring Capacity	

DATA CATEGORIES	KNOWN DATA/SUSPECTED DATA SOURCES
River inter-connectivity	Geosciences BC - Soil/Structure data - Mapping the Structure of the Nechako Basin Using Passive Source Seismology
RECREATIONAL WATER USE	
Recreational properties	
Effluent discharge	Waste Discharge Authorizations (BC Ministry of Environment)
Access	Nechako Watershed Health Atlas - Water-based recreation (e.g. boating, canoeing)
Angler fishing data	The Angler's Atlas;
SOCIAL DEMOGRAPHICS	Community Development Institute at UNBC
Community demographics	Nechako Watershed Health Atlas
Population - Loss or growth	Nechako Watershed Health Atlas
Employment	Nechako Watershed Health Atlas
SPECIES AND HABITAT WATER NEEDS	Upper Fraser Fisheries Conservation Alliance
Wildlife	Back yard bird count; feeder counts
Biodiversity	Stand-level biodiversity - Nechako Watershed Health Atlas
Invasive species	Northwest Invasive Plant Council
Pesticide applications	BC Pesticides Group
Aquatic Ecosystems	Frog watch (possible BC Frogwatch program)
Riparian health	Impact of Forestry Activities on Riparian Zones - Nechako Watershed Health Atlas
Habitat profile	Upper Fraser Fisheries Conservation Alliance - Critical Habitat
Fish populations	Fisheries Project Registry; Nechako Fisheries Conservation Program
Species at risk	Species at Risk – Red and Blue Listed Species - Nechako Watershed Health Atlas
Species count	Benthic invertebrate Community Status - Nechako Watershed Health Atlas
Chinook Escapement	Age distribution, sex ratio, size, fecundity, and egg retention of adult Chinook salmon in the Nechako River; Adult Chinook salmon count between September and early October - Nechako Fisheries Conservation Program
Biological spread	
Sturgeon - Salmon	Nechako White Sturgeon; Salmon Escapement
Other species water use	Mountain Caribou Population Status; Moose
Terrestrial Ecosystem	Eco-sections and Protected Areas - Nechako Watershed Health Atlas; EcoCat
Migratory Bird Habitat	Christmas bird counts; Breeding bird surveys; BC Breeding Bird Atlas; Loon Survey

DATA CATEGORIES	KNOWN DATA/SUSPECTED DATA SOURCES
Designated Sensitive River	Fisheries Sensitive Watershed Designation (from FLNRO); Species and habitat specific data (science based)
Legislative tools	
SARA listed species	
Fisheries Sensitive Watershed	UFFCA Anadromous fish; Species and habitat specific data (science based)
TRADITIONAL KNOWLEDGE	UFFCA - Cultural and Spiritual teachings related to management and planning
Traditional practices	EcoTrust - Aboriginal Traditional Knowledge Protocols
Oral History	Interviews with local people, elders, seniors; Oral history from First Nations
First Nation cultural sites	Interviews with local people, elders, seniors; Oral history from First Nations
Linear density	
VALUES	
Governance	Official Community Plans
Inclusiveness of decision making	First Nations, University, NGOs, Citizens
Co-management agreements	Omineca Regional Stewardship Forum
Data sharing agreements	Carrier Sekani First Nations and Province of British Columbia - Collaboration & Social Cultural Initiatives Agreements
Collaborative processes	Chilako River Monitoring and Restoration; Nechako Watershed Roundtable
Legislative tools	
Government oversight	
First Nation perspective of water	Saik'uz stewardship plan; Yinka Dene Uza'hne Surface Water MGMT Plan
Heritage effects and Benefits	BC Ministry of Health; BC MoE; local Health Authorities; Northern Health; Nechako River Environmental Assessment Report
Mental health	Northern Health
Recreation values	
Fish Values	Omineca Watershed Assessment
Industrial	
Economic benefits and impacts	Community Development Institute at UNBC
Socioeconomic impacts	Omineca Watershed Assessment

Needed and New Data Sources

The above table provides a comparison of known and suspected data sources to data categories and data types needed to inform decisions in the Nechako watershed. The information needed for various water related decisions differ by decision and by decision maker. For one decision there may be sufficient data while another decision may lack data. As such the data gaps suggested in the above table and by the findings in this report suggest general types of local data that could inform the decision-making process and do not reference a specific decision or decision context.

Based on the available data at the time of this study, there are several data gaps noted for the Nechako watershed. These include a lack of information on snow pack and other hydrometric parameters. Water quality data is lacking across several measures including bacterial counts and dissolved metals. Moreover, data on surface water to ground water interactions, while being studied, are generally unavailable or more likely do not exist.

Information on transportation corridors and fires were unavailable or unknown to the study team and Data Workshop participants suggesting needed data for various water related decisions. For example, decisions related to development and monitoring decisions (i.e. those affecting water quality) may require data on truck traffic patterns, infrastructure plans, and transportation plans through watershed corridors. Continued work on quantifying the impact of community values on decisions is needed to provide decision makers information on community priorities and expected outcomes. And needed data on the impacts, risk, and management of wildfires is noted in the above table and by Data Workshop participants.

Other data gaps, in addition to those noted in the above table, are described by the Nechako Watershed Strategy[1] and include gaps in land coverage change studies, Geographical Information System (GIS) maps, and baseline groundwater data and observation of groundwater wells.

New Data Sources

Potential sources of new data were identified by Data Workshop participants and are included in Appendix B. New data sources focus on the nine decision types along with general water related decision making in the Nechako watershed. New data addressed the need to measure and quantify impacts to riparian habitats, improve geological data, and the linkages between groundwater and surface water systems. While water licensing and well information is available, participants were not aware of these resources before the Data Workshop, suggesting new sources (or methods of sharing this information) of licensing data would help support local

1 Fraser Basin Council, (2016). "Towards a Healthy Nechako: Nechako Watershed Strategy - Version 1", prepared for the Nechako Watershed Roundtable. Available at http://www.refbc.com/sites/default/files/Nechako%20Watershed%20Strategy-31Oct2016-FINAL.pdf

decision making. Recording First Nation perceptions of the Nechako watershed history was noted along with mining old data sets (e.g. environmental assessment data). Additional gauging stations were recommended for flow and climate data. Decision support tools including online modelling tools and decision support that includes Traditional Knowledge may provide a source of new data. Finally, data was recommended by Data Workshop participants on hydrometric data, air temperature, pesticide/fertilizer use (to measure chemical persistence) and road development.

DISCUSSION AND CONCLUSION

Decision makers in the Nechako watershed have expressed a need for more data about historical benchmarks and ongoing trends related to the health of the Nechako watershed[1] and this study has noted local data available to inform a number of water related decisions. Because watershed managers make decisions within specific localized contexts, their need for information differs across the region. Decisions differ across scales and by decision maker. Further, there are a range of water decisions across the region – including reservoir operation decisions, short-term water supply decisions, and longer-term infrastructure and water licensing decisions. Yet, from a watershed management perspective, improving the access and availability of data for all decision makers in the Nechako watershed will support numerous decision outcomes and help with maintaining and improving the health of the Nechako watershed.

The Nechako Watershed Strategy[2] outlines strategies for improving the health of the watershed, of which two of those strategies are supported by the findings in this report. First, this study was successful in encouraging conversation and an exchange of knowledge between diverse sector representatives. Participants in the Data Workshop worked aggressively to:

1. Identify local data available to inform water related decisions in the Nechako watershed and
2. discuss opportunities and barriers to amalgamating these data.

One participant noted that the "Workshop generated new areas of focus not previously considered (e.g. migratory bird, drinking water, wildfire impact, Wild Salmon Policy)" while another participant noted that the "Province is far more engaged in data collection and management than I previously imagined - this is great news, I now have a glimmer of optimism & hope." In this way, the Data Workshop supported the strategy outlined in the Nechako Watershed Strategy to: *Strengthen Education, Engagement, and Capacity of Decision-Makers, Stakeholders and the Public*.

1 Fraser Basin Council, (2016). "Towards a Healthy Nechako: Nechako Watershed Strategy - Version 1", prepared for the Nechako Watershed Roundtable. Available at http://www.refbc.com/sites/default/files/Nechako%20Watershed%20Strategy-31Oct2016-FINAL.pdf

2 ibid

Second, the findings in this report support a second strategy to: *Strengthen Data, Information and Knowledge*. While incomplete, the data listed in Appendix B provide a multitude of sources for either supplementary investigation or centralized data referencing. The work by UNBC in developing and deploying an online Water Portal for the Nechako watershed could serve as a central collection point for identifying and directing decision makers to data resources collected in this study. In further support of the above strategy this report provides a discussion of the opportunities for amalgamating data discussed in Data Findings and the challenges and difficulties that might exist in amalgamating these data.

Challenges and Opportunities for Amalgamating Data

Identifying local data is challenging and amalgamating these data is further challenging. In this study we noted differences in data format, data preparation, and data storage that would complicate efforts to store these data in a single repository. Legal agreements or memorandum of understandings that direct or control access to data collections would impede attempts to centralize data. Further, agreements that require data to be collected or stored in specific format may disregard subsequent uses of that data. Data collectors or managers may also be unwilling to relinquish control of the data for concerns of quality management, misinterpretation, or privacy (e.g. confidential data vs. public sector data). As well, turn over of data managers in organizations may result in a loss of institutional knowledge in what data is available and how it is managed. Differences in data collection methods (e.g. frequency, quantity, testing methods) may invalidate or prevent future use of previously collected data. Technology issues (e.g. software and hardware requirements) could increase the cost or prevent the use of data. Costs to store and maintain amalgamated data is a significant barrier along with personal resource constraints. Some data sources (e.g. verbal histories, photographic records) require translation or interpretation before they are usable by others than the data holder. As well, the absence of a working history between watershed stakeholders[1] necessitates building trust between data users before data sharing may be possible. Finally, the significant volume of data and the number of individuals (including citizens) and organizations collecting data increases the effort needed to amalgamate and manage data.

In addition to the barriers and challenges to data amalgamation, this study noted several opportunities and directions for amalgamating data. First, the Nechako Watershed Roundtable provides a forum for collaboration and trust building needed to open conversations on data sharing. Data sharing agreements like those developed by the Okanagan Basin Water Board and the Okanagan Water Stewardship Council[2]

1 Also noted in the Nechako watershed strategy - Fraser Basin Council, (2016). "Towards a Healthy Nechako: Nechako Watershed Strategy - Version 1", prepared for the Nechako Watershed Roundtable. Available at http://www.refbc.com/sites/default/files/Nechako%20Watershed%20Strategy-31Oct2016-FINAL.pdf

2 http://www.obwb.ca/fileadmin/docs/091210_wsc.pdf

between local, regional, provincial, and federal agencies provides a model of what is possible. Second, co-monitoring agreements (e.g. government to government) and multi-party collaborations may provide new directions for initiating data sharing programs. Joint funding programs among multiple parties (e.g. water management groups, governments, educational institutions) may increase capacity to collect (e.g. watershed monitoring) and manage large data sets. Other partnerships between local academic institutions and monitoring volunteers may improve data analysis and resource sharing. Changes to the Environmental Assessment process could improve sharing of data collected through process. Alternatively changes to water management and reporting practices for industry and large water users could encourage these users to report and share historically held data.

Additional opportunities for amalgamating local data can be found in new approaches for collecting data. Citizen science programs like Streamkeeper and the Canadian Aquatic Biomonitoring Network (CABIN), and student volunteer and college programs (e.g. graduate research) provide additional avenues for data collection and can be fashioned to support data sharing from the onset. Social media and online technologies provide new possibilities for recording and increasing access to traditional knowledge and First Nation historical records. One participant in the Data Workshop noted that a "Nechako Water Blog" would provide an avenue for sharing watershed stories. Online reference libraries, like the aforementioned UNBC data portal, provide an opportunity to survey watershed stakeholders on available data resources as well as ease the sharing of existing data.

What was heard

"Aha moment was realizing there is a large group of individuals who are working on relatively the same thing with common goals but from different angles."

Concluding remarks

The aim of this study was to investigate local data that could inform water related decision making through an investigation in the Nechako watershed. This report represents an initial examination of local data in the Nechako watershed across a generalized decision context and further investigation is encouraged. The discussion of data in this report identified several data gaps and directions for future investigation including improving the recording of and access to Traditional Knowledge and quantifying watershed values to inform the setting of watershed objectives. This report also provides a reference of material for Nechako watershed stakeholders. Appendix A provides an illustration of the key data types across the watershed, Appendix B provides an extensive listing of data for further examination, and Appendix C provides a complete, un-edited, listing of Data Workshop outcomes that were not summarized in the main body of this report.

The information in this report, while centred on the Nechako watershed, should also

provide useful for other communities across British Columbia. Communities wishing to host their own local data workshop can use the workshop agenda provided in Appendix D. The discussion of amalgamation challenges applies to communities across British Columbia. Communities can draw parallels in the discussion of opportunities and data gaps applied to their community issues. Further, it is anticipated that the categorization of data shown in Data Findings applies to communities across British Columbia as well as the data types shown in the conceptual model prepared for the Nechako watershed.

APPENDIX A

NECHAKO WATERSHED CONCEPTUAL MODEL

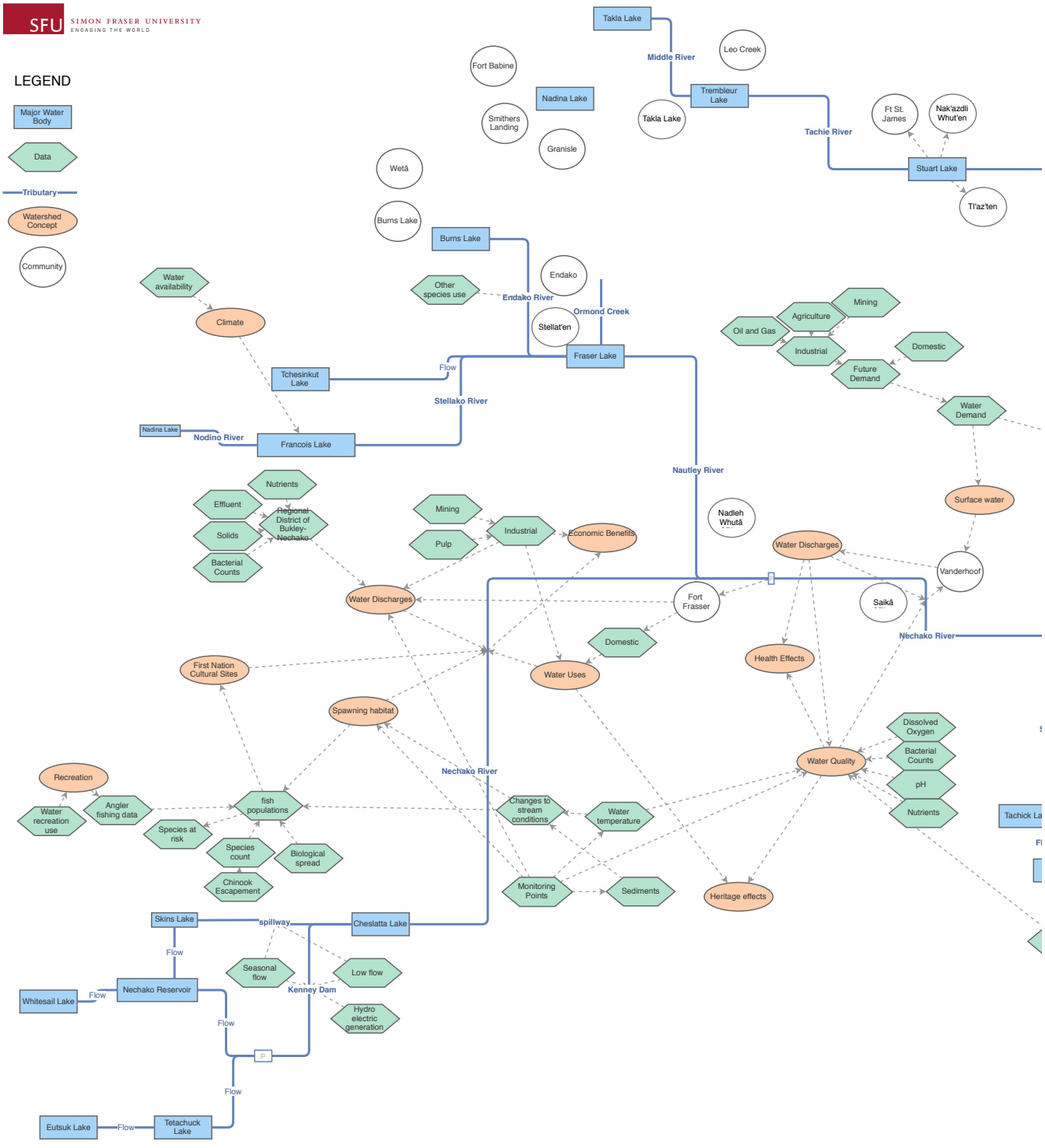
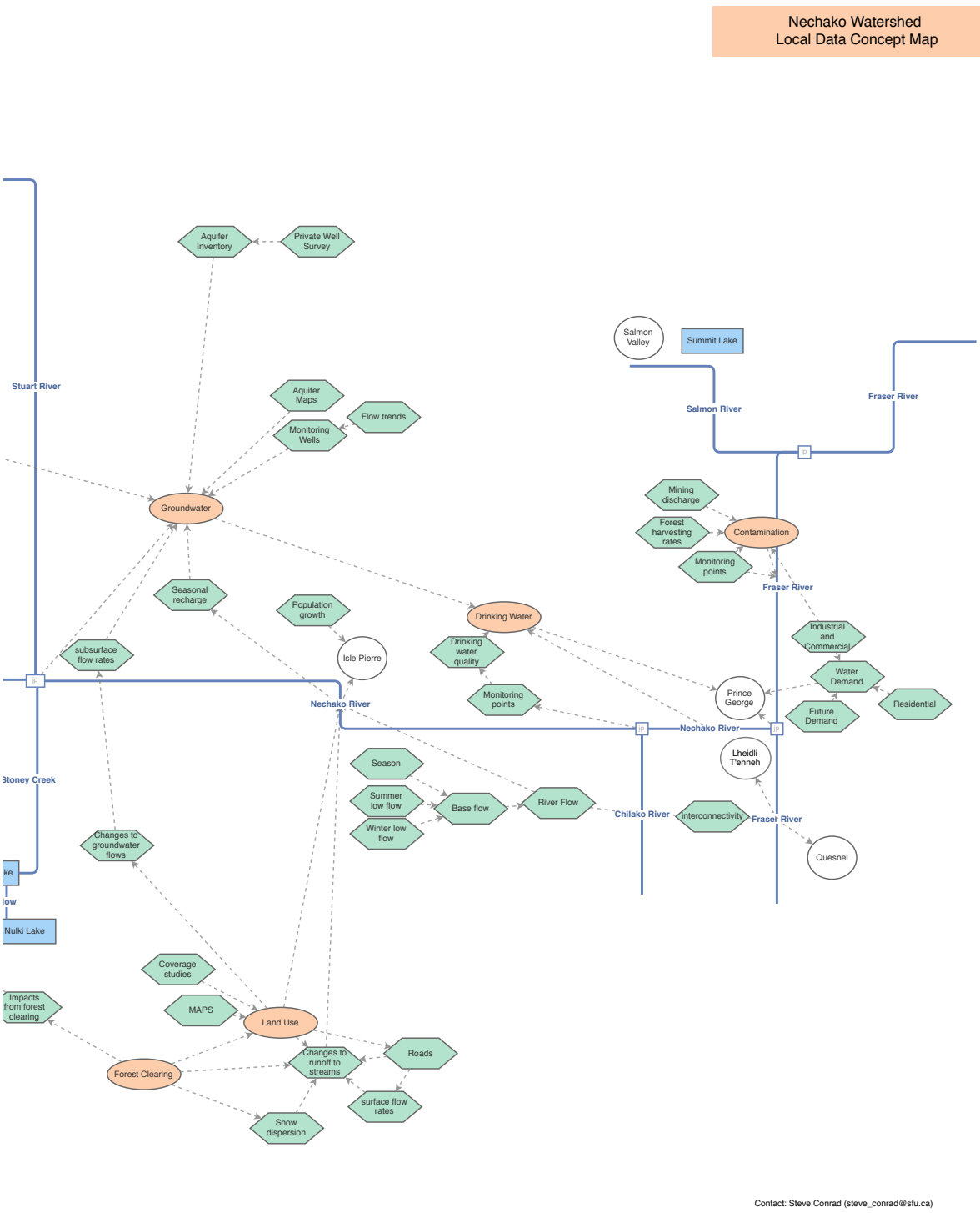


Figure A.1 Original Nechako Watershed Concept Diagram



Contact: Steve Conrad (steve_conrad@sfu.ca)

Figure A.1 Original Nechako Watershed Concept Diagram

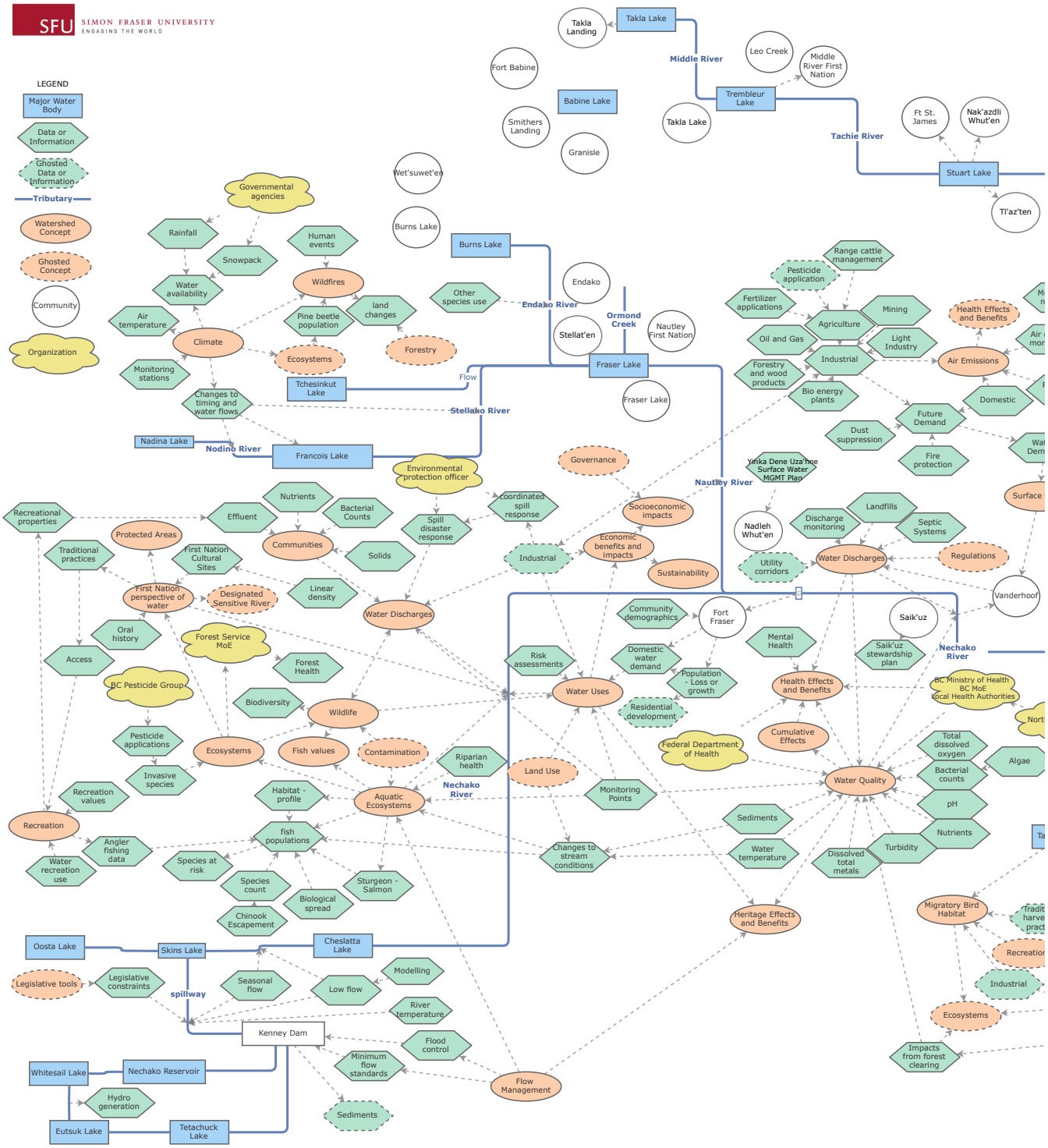
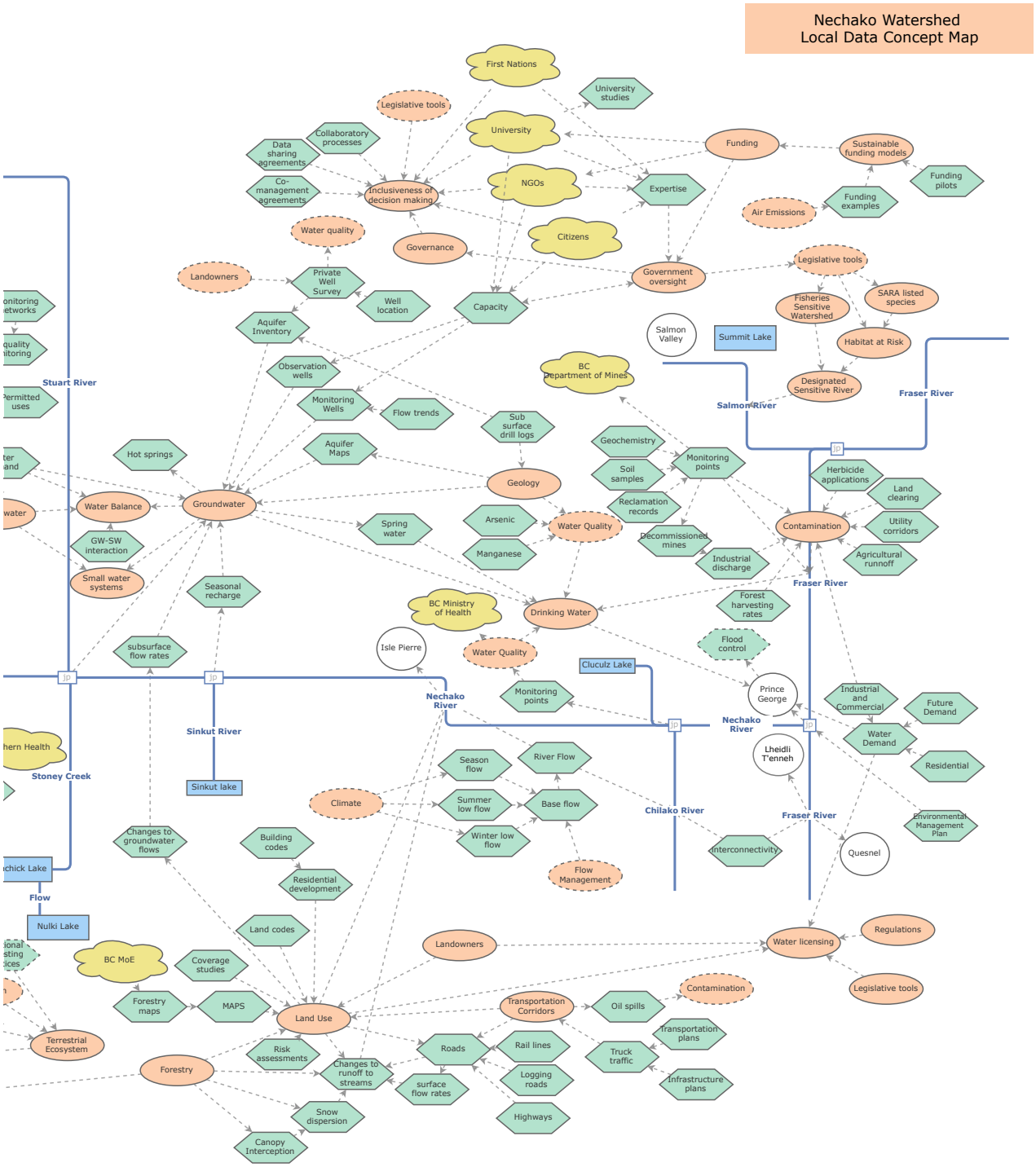


Figure A.2 Revised Nechako Watershed Concept Diagram[1]

1 Available at http://www.sfu.ca/content/dam/sfu/rem/water/SFU-Nechako%20Watershed%20local%20data%20diagram.pdf



Contact: Steve Conrad (steve_conrad@sfu.ca)

Figure A.2 Revised Nechako Watershed Concept Diagram

APPENDIX B
NECHAKO WATERSHED LOCAL DATA LISTS

Known Data

The following lists data/data types identified during the Nechako watershed local data workshop (Data Workshop) preparation and interviews. When known, reference to data sources is provided.

Industrial use

- Canfor Pulp Limited Partnership, others
  - Kraft pulp processing water use
- Agriculture and Mining water use
- Hydro electric generation
- Nechako Watershed Health Atlas[1]
  - Water Quality Impacts from Forestry Activities
  - Fine sediment impacts to water quality – through FLNRO
  - Change in Forest Cover
  - Impact of Forestry Activities on Riparian Zones
  - Resource Roads and Stream Crossings
  - Licensed Water Volume by Sector
  - Forestry
  - Agriculture
  - Mining Activity
- AMEC – Nechako River Environmental Assessment Report[2]
  - Economic Effects
  - Heritage Effects
  - Health Effects

Recreational use

- The Angler's Atlas[3]
  - Angler fishing data
- Nechako Watershed Health Atlas[1]
  - Water-based recreation (e.g. boating, canoeing)

Species & habitat

- Nechako Watershed Health Atlas[1]
  - Fisheries Project Registry
  - Benthic invertebrate Community Status
  - Species at Risk – Red and Blue Listed Species
  - Nechako White Sturgeon
  - Mountain Caribou Population Status
  - Salmon Escapement
  - Moose
  - Stand-level biodiversity
  - Eco-sections and Protected Areas

1 Fraser Basin Council, (2015). Nechako Watershed Health Report. Prepared by the Fraser Basin Council. Available online: http://www.fraserbasin.bc.ca/_Library/Water_BCWF/Nechako-Mar31-2015_FINAL.pdf

2 AMEC, (2015). Blackwater Gold Project: Application for an Environmental Assessment Certificate/ Environmental Impact Statement. Prepared for New Gold Inc by AMEC.

3 https://www.anglersatlas.com

- Northwest Invasive Plant Council[1]
  - Invasive plants
- Nechako Fisheries Conservation Program[2]
  - Annual Water Allocation
  - Age distribution, sex ratio, size, fecundity, and egg retention of adult Chinook salmon in the Nechako River
  - Adult Chinook salmon count between September and early October
  - Activity Reports
    - Remediation measures
    - Fisheries
    - Habitat
    - Stock monitoring
    - Applied research
- Nechako Environmental Enhancement Fund[3]
  - Flow regimes [4]
- AMEC – Nechako River Environmental Assessment Report [5]
  - Wetlands
  - Fish and Fish Habitat
  - Ecosystem Composition
  - Plant Species and Ecosystems at Risk
  - Wildlife

Physical characteristics

- Geosciences BC[6]
  - Regional Drainage Sediment and Water Geochemical Data - Anahim Lake and Nechako River, Central British Columbia
  - Seismic data - Integrated Interpretation and First Arrival Tomography of Reflection Surveys in Nechako Basin
  - Soil/Structure data - Mapping the Structure of the Nechako Basin Using Passive Source Seismology
- Nechako Watershed Health Atlas [7]
  - Water Quantity and Flow
  - Freshwater Temperature - Nechako Fisheries Conservation Program technical Data Review 1988-2002
- UNBC Integrated Watershed Research Group[8]
  - Fine sediment sources and dynamics
  - Changing landscapes profiles[9]
- Wateroffice Environment Canada, BC Ministry of Environment, Indian and Northern Affairs Canada[10]
  - Real-Time Hydrometric Data
- Nechako Fisheries Conservation Program[11]
  - Water temperature
- Department of Fisheries and Oceans
  - Nechako River Physical Data
- BC Ministry of Environment
  - Nechako River Water Quality Assessment Report
  - Water Quality Assessment And Objectives For The Nechako River (1987)- Historic data on:
    - Hydrology
    - Water Uses

1 http://nwipc.org
2 http://www.nfcp.org
3 http://www.neef.ca/reports
4 Boudreau, K. (2005). Nechako watershed council report: Assessment of potential flow regimes for the Nechako watershed. Prepared for the Nechako Enhancement Society & Nechako Watershed Council, 6-20.
5 AMEC, (2015). Blackwater Gold Project: Application for an Environmental Assessment Certificate/ Environmental Impact Statement. Prepared for New Gold Inc by AMEC.
6 http://www.geosciencebc.com
7 http://nwipc.org
8 http://www.unbc.ca/integrated-watershed-research-group
9 see nhg.unbc.ca/datafiles/ChangingLandscapes.pdf
10 https://wateroffice.ec.gc.ca
11 http://www.nfcp.org

    - Water Discharges
    - Water Quality
    - Monitoring Programs
- AMEC – Nechako River Environmental Assessment Report[1]
    - Climate Change
    - Surface Water Flow
    - Surface Water Quality
    - Sediment Quality
    - Groundwater Flow
    - Groundwater Quality
    - Physiography and Topography, Surficial Geology and Soil Cover, and Soil Quality

Demographics

- Nechako Watershed Health Atlas[2]
    - Population numbers
    - Employment and Unemployment
    - Employment by Sector
    - Employment in Prince George

Environmental Change

- Omineca Watershed Assessment[3]
- UNBC/ Natural and anthropogenic factors affecting the Nechako River watershed (Abadzadesahraei, n.d)[4]
- UNBC Integrated Watershed Research Group[5]
    - Water security and climate change
- UNBC
    - Climate Change & Resource Development Scenarios[6]
- Nechako Watershed Health Atlas[7]
    - Climate change

Other Knowledge

- Upper Fraser Fisheries Conservation Alliance[8]
    - Critical Habitat
    - Cultural and Spiritual teachings related to management and planning
- EcoTrust
    - Aboriginal Traditional Knowledge Protocols[9]

Existing data review

The following, unedited, list presents additional local data sources collected during a review known data sources at the Data Workshop. Participants noted several sources of data which are listed below which provide possible, additional, sources of local data.

Table discussion and review of existing data

- Environmental Monitoring System
- Water quality data
- MOE Environmental Protection Division
- Nechako Fisheries Conservation Program (Nechako Environmental Enhancement Fund

1 AMEC, (2015). Blackwater Gold Project: Application for an Environmental Assessment Certificate/ Environmental Impact Statement. Prepared for New Gold Inc by AMEC.
2 Fraser Basin Council, (2015). Nechako Watershed Health Report. Prepared by the Fraser Basin Council. Available online: http://www.fraserbasin.bc.ca/_Library/Water_BCWF/Nechako-Mar31-2015_FINAL.pdf
3 to be released, more information available at https://www.for.gov.bc.ca/ftp/HFP/external/!publish/ClimateChange/Workshops/Prince_George/2015/7-Hydro2-Climate%20Workshop%20-Rex.pdf
4 https://www.mitacs.ca/en/projects/natural-and-anthropogenic-factors-affecting-nechako-river-watershed
5 http://www.unbc.ca/integrated-watershed-research-group
6 Picketts, I.M., Curry, J., Déry, S.J. and Cohen, S.J. (2013). Learning with practitioners: climate change adaptation priorities in a Canadian community. Climatic Change, 118, 321-337.
7 Fraser Basin Council, (2015). Nechako Watershed Health Report. Prepared by the Fraser Basin Council. Available online: http://www.fraserbasin.bc.ca/_Library/Water_BCWF/Nechako-Mar31-2015_FINAL.pdf
8 http://upperfraser.ca
9 http://ecotrust.ca/project/study-traditional-knowledge-and-endangered-species/

program; publish the data; does it monitor the right things?)
- UNBC Water Portal
- ImapBC
- EcoCat
- Omineca Water Tool
- Nulk:-Tachik Watershed Report
- Fire weather data
- Omineca Climate Action Plan
- Omineca Drought Management Plan
- MOE/FLNRO collected data - office based
- Aquarius
- LRDW (Government database)
- Watershed reports (online or locally available)
- Water Management Plans
- FREP Protocol Reports
- Licensing/short-term use data (available online and through water stewardship division)
- Benthic invertebrate study/reports
- Interviews with local people, elders, seniors
- ZAO reports (sometimes not reliable)
- Oral history from First Nations
- Spot measurements of streamflow
- Private well survey
- Water chemistry
- healthspace.ca/nha
- Community Development Institute (at UNBC)
- University theses and dissertations
- Interviews with industry workers
- Need for easy access to government data/ databases
- Wildlife data
- Christmas bird counts
- Breeding bird surveys
- BC Breeding Bird Atlas
- Nocturnal Owl Surveys
- Loon Survey
- Winter Swan Survey
- Frog watch[1]
- Back yard bird count
- Feeder counts
- BC Lake Stewardship Society (water quality data)
- CWS & DU Helicopter waterfowl surveys at ecoprovince scale
- Listing of Upper Fraser Fisheries Conservation Alliance is inaccurate (not Traditional Knowledge)
- Fisheries Sensitive Watershed Designation (FLNRO) - streams already designated in PG area; candidate streams in Middle River & Trembleau Lake
- BC Fish/Forestry interaction study (UBC/ DFO/Prov. BC) for Stuart-Takla Watershed (Name Withheld) includes fish counts etc.
- BC/EC Cabin Data
- Groundwater observation well network
- BC/EC Water Quality
- EC Fraser Basin Watershed Plans (e.g. sediment survey in Fraser Basin - 4 sites in Nechako)
- Species and habitat specific data (science based)
- UFFCA Anadromous fish

1 possible BC Frogwatch program - http://www.env.gov.bc.ca/wld/frogwatch

- Snow survey/water supply (RFC)
- Water survey (hydrometric)
- Industry data (e.g. from RT, Canfor, etc.)
- Environmental Assessment data

New Data requirements

New data identified during workshop

The following, unedited, presents workshop participants' comments on new data requirements following a review of issues, key decisions, and the conceptual model in the Nechako watershed.

New Local Data

- Water Survey of Canada gauging stations
- Water Stewardship gauging stations
- Environment Canada weather stations
- Forest Service (possibly Ministry of Forests, Lands and Natural Resource or Natural Resources Canada) weather stations
- Ministry of Transportation & Infrastructure weather stations
- Rio Tinto flow data
- Snow surveys for river forecasting
- Climate change - FLNRO report
- PCIC data locations
- Groundwater observation wells (FLNRO & MOE)
- Contaminants (Environmental Protection)
- Fisheries data (Environmental Stewardship & DFO)
- Insightmaker.com (online modelling tool)
- Wildlife data
- Groundwater data
- Ecosystems missing - wetlands, tributaries & lower order streams
- Landowners
- Habitat at risk
- What animals and plants are extinct in the area
- Snowpack on headwaters data
- Old data
- Fire protection
- Spill response/disaster management
- Road development/dust mitigation
- Wastewater
- Spring water/hot springs
- Landfill (septic tanks)
- Population loss (change in demand)
- Precipitation
- Sediment discharge
- First Nations perceptions of water/oral history
- Smaller streams (spot flow measurements in 3rd order streams)
- Pesticide/fertilizer use
- Blue-green algae blooms
- Riparian habitat
- Public education
- Need for riparian habitat data gaps analysis?
- Invasive species
- BC Breeding Bird Atlas
- Geologic data/info (esp. for groundwater, ecosystems)
- Natural background conditions (i.e. baseline)
- Linkages between surface and groundwater
- Mine monitoring (what is being monitored? leachate levels from Endako mine)
- PG Air monitoring (transferability of lessons learned? other models? esp. funding models)
- Invasive species inventories – aquatic terrestrial
- Inventory of pesticide use – agricultural and forestry

- Continuous hydrometric stns (stations) on streams of various orders and biogeoclimatic zones
- Lake level changes (continuous data) – water storage – water quality and containment sources – habitat assessments – fisheries control fish habitat
- Riparian health of streams – nutrient pharmacological chemical deposition into lakes from human sources – habitat assessments – more sensitivity of soils – susceptible to erosion – water storage capacity of feeder streams
- Long-term GW temperature cumulative affects analysis of data
- Aquifer health assessments for key aquifer e.g. lower Nechako – groundwater dependent ecosystems
- Unlicensed water use
- Local traditional knowledge
- Qualitative narratives
- Updated old legislature e.g. mining act, e.g. placer mining
- Air temp – stream temp – snowpack in bug kill stands – cat blocks

APPENDIX C
WORKSHOP OUTCOMES LIST

This section presents data collected at the Nechako watershed local data workshop. The lists represent participant views and are presented in un-edited form, organized by common themes, and presented in order of the workshop discussion. A synthesis of themes are listed and discussed in the main body of this summary report.

Nechako watershed issues

The following lists of water related issues influencing key decisions in the Nechako watershed were collected during workshop discussions, interviews, and workshop documentation. Additional issues affecting the Nechako Watershed can be found in Section 3 of Nechako Watershed Strategy[1].

Water Consumption

- Existing data does not reflect real water consumption
- Discrepancies between licences and actual water users
- Increasing demand for agricultural water (Vanderhoof area)
- Increasing demand for water (general)
- Residential wells in Beaverley
- Info for wells on reserves

1 Fraser Basin Council, (2016). "Towards a Healthy Nechako: Nechako Watershed Strategy - Version 1", prepared for the Nechako Watershed Roundtable. Available at http://www.refbc.com/sites/default/files/Nechako%20Watershed%20Strategy-31Oct2016-FINAL.pdf

Water Quality

- Arsenic, Manganese, Uranium
- Cryptosporidium
- Giardia
- Changing water quality in a range of lakes (oligotrophic lakes becoming more autotrophic; cyanobacteria blooms; potential increases in aquatic macrophytes, possibly invasives)
- Limited data on groundwater quality (fewer observation wells)
- Quality of lake water quality (i.e., cyanobacteria algal blooms) – euro trophic lakes in aquatic microphytes (some invasive)
- Industrial development
- Water temp is issue due to reservoir releases

Impacts of Development

- Visual impacts of forestry
- Changes in hydrology due to forestry
- Changes in water quality due to forestry (e.g. nutrient loading, turbidity)
- Degradation from private land development
- Cumulative impacts of storage/reservoirs on flow regimes
- Effects of decreased water quality on health (e.g. cancer rate has risen)
- Rio Tinto (e.g. industrial) water quality concerns

- Agricultural runoff (sediment, fertilizers, phosphorous)
- Runoff from mines
- Logging road development
- Kenney Dam & Nechako River Dam operation (changes to flows and impacts on riparian habitat & human communities)
- Uncertainty about development (e.g. many proposed pipelines, future LNG effects on water quantity/quality from work camps)

Watershed Characteristics

- Highly variable watershed (lake fed, mountain fed, snow fed, etc.)

Pests

- Water doesn't stay in watershed as long due to devastation of forests from pine beetle & impacts from salvage logging
- Implications for changes in peak flows from pine beetle
- Interactions of pine beetle effects with effects of agriculture (cumulative effects)
- Spruce beetle

Concerns about potential effects of climate change

- Water temperature changes
- Significant differences in hydrology already observed compared to 10-20 years ago
- How does climate affect ice jams?
- Impacts on volume and timing of flow
- Increased flood frequency
- Increased drought frequency
- Changing snowpack
- Changes in flow variability (low elevation basins, large vs. small basins, mountain fed vs. lake fed)
- Changes in precipitation
- Concerns about all climate change effects on salmon
- Outdated infrastructure (climate change)

Problem with definitions

- Definitions of "Water quality", "watershed", "critical environmental flow" need to reflect First Nations culture and values

Wildlife & Habitat

- Changes in moose and other wildlife populations that are dependent on healthy aquatic ecosystems
- Impacts to bird migration/feeding areas (e.g. Tachick Lake pelicans)
- Concerns about sturgeon and salmon
- Concerns about increased frequency of algal blooms in lakes with increased temperatures
- Poor fish health in Cunningham Lake
- Sea-lice appearing in Takla Lake
- Oligotrophic lakes becoming more autotrophic
- Potential increases in aquatic macrophytes in lakes (possibly invasives)
- Need to understand fish needs (main stocks = Chinook, Sockeye, White Sturgeon)
- Impact of fine sediments on fish (salmon and sturgeon)

Monitoring & Data

- Water Survey of Canada gauges discontinued for most smaller watersheds (limited network, large basin scale data only)
- Lack of data for small streams with high water demand
- Perception of lots of data but it's for large systems

- Data management and collection is a challenge
- Existing modeling tools rely on Water Survey of Canada data (e.g. Omineca Water Tool), so do a poor job of estimating flows in smaller watersheds with storage (e.g. lakes)
- Lack of baseline data
- Poor data about groundwater levels (long and short term)
- Lack of groundwater quality data (only exists in observation wells and major water supply wells) - GARP = Groundwater at Risk of containing Pathogens
- Limited time-series for surface water data (leads to poor representation of seasonal variability)
- Lack of aquifer mapping for groundwater
- Lack of knowledge about existing licences
- Lack of data about Cryptosporidium and Giardia in surface water or Groundwater Under the Direct Influence (GUDI) of surface water wells
- Need cultural data to support identification of fish of importance to First Nations
- Need to develop Critical Environmental Flow data based on historical information (i.e. not just 10% percentiles as for BC Province)
- Lack of data about fine sediment (amount, quality, composition, source, destination) - important due to effect on smoothing river gravels in key fish habitat
- Need information to support Critical Environmental Flow decisions
- Residential wells (access to info/testing equipment)
- Compliance and monitoring/enforcement (long term) - Quality
- Lack of baseline - Quality
- Who owns data that is collected?
- Who has access to data?
- Lack of data on residential wells (licenses, new developments)

Research

- Lack of knowledge about interactions between groundwater and surface water
- Community & Culture
- Concerns about cultural impacts associated with salmon health and changing fishing seasons
- Data ownership, intellectual & cultural property - approach needs to be defined in a way that respects First Nations values and ownership around traditional knowledge
- Effects of population decline on some communities

Coordination

- Lack of connection between various groups collecting data/info
- Need standardized method of data collection
- Need to increase data platforms of all types and ensure connected
- Need a centralized data repository
- Need a spatially based central portal
- Need to identify who is responsible for a data portal

Politics and Governance

- Lack of government oversight & planning at landscape/watershed level
- Government recognition of issues but lack of action
- Industry afraid of what improved data collection might reveal & negative impacts on profits; in fact they could be the solution

- Too much foreign land purchase (expectations of return on investment without environmental protection)
- Lack of social-environmental accountability
- Poor enforcement
- Poor compliance
- Challenges with government-to-government relationships with First Nations (e.g. agreeing on fishing season regulations)
- Funding & authority of municipal governments not always commensurate with responsibilities
- Governance issues (nation to nation relationship) - impact on Quality

Public Participation

- Need for more public engagement and education

Key Decisions

The following lists of key decisions were collected during workshop discussions and workshop documentation. These represent the viewpoints of the Data Workshop participants and do not represent all key decisions in the Nechako watershed. As well, these key decisions were used to discuss available data and do not represent a specific decision context. A discussion of decision processes in the Nechako watershed can be found in section 4 of Nechako Watershed Strategy (2016).

Development Decisions

- Mining (Blackwater, Mount Milligan)
- Forestry (e.g. upcoming Timber Harvest decision re: Annual Allowable Cut; new CANFOR and BCTS licenses for Takla and Mackenzie = 10 million cubic metres))
- Agriculture
- Infrastructure/roads
- Decisions outside watershed boundaries (e.g. Fraser; shifts in agricultural land use)
- Pipelines/Decisions about proposed pipelines
- Dam/reservoir operations (esp. in association with Rio Tinto; Kenney Dam)
- Kenney Dam water management
- Access
- 170 cms licensed to RT (Kemano Twinning) - increased from 140cms
- Bioenergy (e.g. hay compression plants in Vanderhoof)
- Fisheries plan
- Big industry decisions – what are they going to do?
- Implications for regional & business development impacts on water
- Future decisions about forestry

Environmental Flow Decisions

- Management of flows for fish conservation in the Fraser ("What happens on the Fraser can impact the Nechako")
- How to manage environmental flows

Other Management Decisions

- Recreational use decisions (watershed access)

Governance/Policy/Regulatory Framework Decisions

- Provincial Cumulative Effects Framework
- Socio-economic Effects Management Plans (SEEMPs)

- Lheidli T'enneh Treaty Decision
- Decisions about First Nations rights and title
- Forest Management Plans
- Bill-C38 (Federal)
- Regional Strategic Environmental Assessments
- BC-wide Caribou Management Plan
- Decisions about new forestry licenses (e.g. Takla)
- Surface water and groundwater licenses (incorporating critical environmental flows)
- Water Sustainability Act related decisions around how to deal with fish habitats
- Decisions about implementation of Water Sustainability Act with respect to First Nations inclusion in development of objectives
- Annual DFO fisheries plans
- How will first nations be included (decisions about TEK sharing)
- Review of Navigable Waters Act
- Review of Fisheries Act
- Fisheries decisions
- BC Environmental Monitoring System (will there be enough staff?)
- Changes to Environmental Assessments
- Upcoming BC Provincial election
- Requirement for non-domestic groundwater users to submit information re: water quantity
- How should we manage groundwater?
- Federal E/A commitments
- Social-economic Assessment (e.g. natural gas development - new legislation?)
- Nechako Water Use Plan as basis for developing decision making process
- Potential changes to water use/license approvals
- Business development
- WSA Area Based Regulations
- BC Gov. Sustainable Water strategy (Feb)
- Decision about bio-energy plant & water impacts/regulation
- Changes in government (new decision-making climate)

Climate Change Decisions

- Adaptation planning
- Mitigation planning/strategies
- How to incorporate climate change & uncertainty?
- Design of infrastructure to account for climate change (e.g. dikes)
- How should climate change be incorporated? (e.g. water infrastructure, data/stationarity)?

Capacity Decisions

- Funding opportunities for local groups (Royalties added to resource extraction?)
- Long-term sustainable funding sources for local groups to do work
- Personnel (is the public service big enough? are there enough people working on this in the region?)
- How to improve capacity (staffing, human resources, funding)

Pests

- How to deal with forest infestations?
- What to do about beetle impact on water? ([pine & spruce)

Monitoring Decisions

- Pre- and post- monitoring design
- What do we need to do pre and post monitoring?

Data Decisions

- How to facilitate data access
- Levels of public access to data
- Water Sustainability Act decisions about what data will be generated

Nechako watershed conceptual model review

The following lists Data Workshop participants' un-edited views collected during a review of the Nechako Watershed Conceptual model. A more thorough analysis of changes and data identified on the model is discussed in the main body of this summary report.

What additional components of the watershed came to mind when the concept model was presented?

- First Nations cultural definitions
- Need for critical thresholds & decision tree/ ranking (i.e. sensitivity test on parameters to which have largest effect)
- Water is not a commodity to package and sell
- Basin size
- Poor public awareness/information surrounding Kenney Dam, Rio Tinto and other reservoirs
- How do we map drivers and influences?
- How do we prioritize what new and data and new approach to analysis to inform monitoring science and decisions?
- Need landscape planning

Challenges to amalgamating local data

The following lists workshop participants' un-edited comments on the challenges to amalgamating local data in the Nechako watershed.

- Data format
- Data analysis – statistics package – also making use of existing software (apps)
- Legal agreement and MOV (indirect challenges as prescribed format for data collection/standards – also opportunity – need to consider when look at other data sources
- Quality control of data – Raw data – validated data
- Software issues
- Inconsistency of data measured – time & types?
- How to get private sector data info – public sector data warehouse
- Long-term funding of program and time and resources
- Control issue – Agency might want control of their data
- TRUST
- Information sharing restraint – some don't want to share – sensitive data
- Worries around data security
- Need agency to maintain data full time
- Technical capacity to house the volume of data
- Loss of corporate knowledge
- Historical verbal data
- Too many people collecting data and too many data platforms: Amalgamate and simplify cross communication of platforms.

- Different formats
- Volume of data
- Need to create an agency to maintain the data

Opportunities and ideas for amalgamating local data

The following lists workshop participants' un-edited comments on the opportunities and ideas for amalgamating local data in the Nechako watershed.

Opportunities

- Nechako roundtable (Fraser Basin Council)
- Partnerships combining efforts
- Actively seek out people/organizations with data and make it easy/simple for data to be shared
- Strong data sharing agreements. Data is more likely to be shared and made available
- Awareness//knowledge of existing databases that can be used (include as part of portals)
- Data classification (published quality vs. raw) outline data collection standards
- Ensure provincial databases can accept data from various sources (uploading data)
- Compel industry to share monitoring data – e.g. ALCAN Future conditions of certificates – open data
- Wild salmon policy implementation plan – developed by Fed Gov. collaboration – data collection (large focus)
- Watershed portal(s)
- Collaborative research agreements, i.e., take advantage of student researchers
- Nechako Water Blog

Ideas for amalgamating local data

- First nations programs
- Collaborative programs (co-monitoring agreements) – government to government, e.g. LNG ESL Initiative (CSTC & Prov.) – Geological Survey of Canada – All agencies and stakeholders & FNS (roundtable approach)
- Provincial funding, WSA (linked), other funding (Fed), better resource existing monitoring agencies, groups, etc.
- Citizen science – Streamkeepers and CABIN
- Volunteer programs – school groups – community programs
- Post secondary – college programs – university students thesis
- Partnerships – funding of equipment – monitoring volunteers – data analysis – resource sharing
- Social media internet– "aquanet" – useable and useful apps. – Facebook (e.g. "Nunavut hunting stories")
- Photograph or pictorial collection of the same areas to provide observational trends over time – links to Facebook, apps, social media
- LIDAR data forest cover – remote sensing – satellite – look at land use charges and impacts to water
- Better standardization of data across sectors to help/support accessibility
- High schools – look at trends
- Address ownership of data info – make it accessible – data sharing agreements – protection of information

- Access existing but previously not available data – individual research projects e.g. from industry – through EA process
- Accessing FN traditional knowledge and info (e.g. oral history) e.g. guardian progress
- Survey info collected by other industries/ under given status, reports done, e.g. archaeological impact assessments – Forest Practices Board
- Do a scan/scope what's been successful in other watersheds?
- Mining the historical record, e.g. Hudson's Bay archives

APPENDIX D

WORKSHOP AGENDA

TIME	AGENDA
08:30	**COFFEE/TEA/REFRESHMENTS, REGISTRATION**
09:00	**WELCOME AND REVIEW OF DAYS AGENDA** Opening by Elder Edith Frederick, Lheidli T'enneh Why are we holding this workshop? This is an opportunity for people contribute to data collection Review workshop collaborative rules and guidelines Review of the shared modelling process and why it is being used Review of template for recording your notes and how we will use this information
09:15	**ROUNDTABLE INTRODUCTIONS** Name, organization, and a short statement on how your organization works to prepare and collect data associated with the watershed.
09:45	**TABLE DISCUSSION OF WATERSHED ISSUES AND TYPES OF DECISIONS THAT WOULD IMPACT THE FUTURE OF THE WATERSHED** Appointment spokesperson for the table 5-10 minute thinking and recording Record your thoughts on the template provided (page 1 and 2) Tables will share their perspective on the issues and types of future decisions that would impact the watershed Record new thoughts on the template provided (page 1 and 2)
10:15	**TABLE REPORT OUT ON WATERSHED ISSUES AND FUTURE DECISIONS**
10:30	BREAK
10:45	**INTRODUCTION OF THE CONCEPT MODEL** Review of the scope of watershed for discussion General review of model and its use Record your thoughts on additions/revisions during review using provided template (page 3)
11:00	**ROUNDTABLE REVIEW OF THE CONCEPT MODEL STEP 1** Introduction and overview of process Step 1 - review of components of the watershed - marking concept maps on each table Rotating table discussions (3 rounds of 20 minutes) What water users are missing? What key sources of water are missing? What flows and water stocks are missing? What modifies these flows and stocks?

TIME	AGENDA
12:00	LUNCH
13:00	**TABLE REVIEW OF THE CONCEPT MODEL STEP 2** Data and Actors What data (or types of data) are represented by the model? What actors are needed to address the key decisions identified? Record your thoughts using the template provided (Page 4)
13:30	**INTRODUCTION TO THE EXISTING DATA LISTING**
13:45	**TABLE DISCUSSION AND REVIEW OF EXISTING DATA** 5-10 minute thinking and recording Record your thoughts using the template provided (Page 5) Tables review existing data list and note discrepancies and add known data sources/types Record any additional thoughts using the template provided (Page 5)
14:15	**TABLE REPORT OUT AND GROUP DISCUSSION ON DATA SOURCES** Tables report key observations and note key omissions
14:45	BREAK
15:00	**WORLD CAFÉ DISCUSSION** Introduction, process, roll of question hosts Consider the questions: How might additional data be collected to support decisions making in the Nechako watershed? What are the opportunities for accessing and amalgamating the data discussed during the workshop? What challenges and difficulties might exist in amalgamating the data discussed during the workshop? What new data would support the decisions and issues we identified?
15:10	**TABLE GROUP DISCUSSIONS** Rotating table discussions (4 rounds of 20 minutes) Breaks as needed during discussions
16:30	**GROUP PRESENTATIONS** Groups present table discussions (5 minutes each)
16:45	**FINAL PLENARY DEBRIEF – KEY LESSONS LEARNED AND OVERALL EXERCISE** Given the overall objectives of the workshop What are the implications of the exercise for watershed management in your organization/ region? Record any final thoughts using the provided template (Page 6) Next steps

APPENDIX E
NECHAKO WATERSHED LOCAL DATA WORKSHOP PARTICIPANTS

Honoured Guest

Opening by Elder Edith Frederick, Lheidli T'enneh First Nation

Workshop Facilitators

Steve Conrad Simon Fraser University
Cedar Morton Simon Fraser University

Participants

NAME	ORGANIZATION
Barry Booth	Integrated Water Research Group, University of Northern BC
Celine Davis	BC Ministry of Environment
Theresa Fresco	Fraser Basin Council/Nechako Watershed Roundtable
Arthur Halleran	Nak'azdli First Nation
Darren Haskell	Tl'az'ten First Nation
Kate Hewitt	University of Northern BC /Canadian Water Network
Kirby Johnnie	Carrier Sekani Tribal Council
Phillip Krauskopf	BC Ministry of Forests, Lands and Natural Resource Operations
Lyle Larsen	BC Ministry of Forests, Lands and Natural Resource Operations
Chief Alexander McKinnon	Nak'azdli Whut'en First Nation
Phil Owens	Integrated Water Research Group, University of Northern BC
Wayne Salewski	Nechako Environment and Water Stewardship Society
Dave Tamblyn	Northern Health
Michelle Tung	Upper Fraser Fisheries Conservation Alliance
Jennifer Vigano	BC Ministry of Environment
Madeline Wilson	Cumulative Impacts Research Consortium, University of Northern BC
Jun Yin	BC Ministry of Forests, Lands and Natural Resource Operations

APPENDIX F
INTERVIEW QUESTIONS

The following lists the questions used during the open ended local interviews conducted in preparation of the Nechako local data workshop.

Primary Question:

- What information is available in your community to support water management and water related decisions?

Possible Probing Questions:

- What data are available for population size, growth, and water demand/use?
- Are you aware of water conflicts in your community? If so please describe.
- Do you know of any water quality issues and how are these addressed?
- Does water monitoring occur in your community? What gets monitored?
- Are riparian zones monitored, studied, documented? How would you access this information?
- Are you aware of any community water, groundwater and/or watershed studies?
- Are surface water and/or groundwater mapped digitally?
- In what condition is your community's water supply infrastructure?
- What is the main source of drinking water in your community?
- Are you aware of any water shortages occurring in your community?
- How frequently are ground water extraction points mapped and monitored (e.g. wells)? Do you feel this is adequate? Please discuss...
- Where can you find information about water licenses?
- Are you aware of a community water management plan?
- Who is in charge of water management and conservation in your community?
- Do you have any concerns about riparian ecosystems (including wetlands) and how can you obtain information about these?
- Do First Nations in or near your community access local water supplies?
- Is information about First Nations riparian spiritual/cultural sites available to you? How would you obtain this information?
- Is information about riparian species available to you? How would you obtain this information?

PACIFIC WATER
RESEARCH CENTRE

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