

2017 Annual Report

from the

Integrated Watershed Research Group

at the

University of Northern British Columbia

submitted to

Nechako Environmental Enhancement Fund
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Prepared by Barry Booth, Research Manager,
in conjunction with
Drs Déry, Owens, Parkes and Petticrew

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General Project Introduction

The University of Northern British Columbia (UNBC) houses an Integrated Watershed Research Group (IWRG) comprising: Stephen Déry (Environmental Science Program), Philip Owens (Forest Renewal BC Chair in Landscape Ecology), Ellen Petticrew (Forest Renewal BC Chair in Landscape Ecology), and Margot Parkes (Canada Research Chair in Health, Ecosystems and Society). These researchers have worked collaboratively for several years on integrated watershed-based research with an emphasis on the Fraser River Basin and other northern BC watersheds including the Nechako River Basin (NRB). The researchers view integrated watershed research as linking biophysical, chemical, social, and human-health processes to address important environmental, landscape ecology, and community issues. This group is completing a four-year research program in the NRB comprised of three foci that address specific questions.

1 – Water security and climate change (Déry and students): Is a warming climate leading to more or less surface water availability in the NRB? What is the impact of anthropogenic versus natural influences on the basin's water resources, including streamflow amounts and timing?

2 – Sediment sources and dynamics (Owens, Petticrew and students): Fine-grained sediment has been identified as one of the main concerns within the NRB, and some key questions are: Where is the sediment coming from? If we identify the sources of the sediment, can we implement watershed management strategies to help control these sources and limit their detrimental effects? Given anticipated future changes in climate and land use in the watershed, how will sediment sources respond to these changes?

3 – Tools for integration in watershed management and governance (Parkes and students): How do decision support tools such as watershed report cards, indicator frameworks, and tools to integrate spatially referenced watershed information feed into broader processes of watershed management and governance? How do we build capacity for developing, managing and maintaining decision-support tools that integrate health, ecological and socio-economic parameters to inform watershed management and governance? How do we better understand the relationship between these decision-support tools and ongoing watershed-based science, given their different timelines, orientations and processes?

Timeline

The IWRG at the University of Northern British Columbia was awarded a \$500,000 contract from the BC Ministry of Forests, Lands and Natural Resource Operations via the Nechako Environmental Enhancement Fund (NEEF) in late March of 2014. This contract was backdated to January 6th, 2014 since the IWRG-NEEF discussions regarding the project contract had been under discussion since September 2013, and the initial proposal indicated a January 2014 start date.

The following text in this report represents the work we accomplished in the final year of the project (2017).

Overall Project Management

Research maintenance:

- We continue to collate documents and existing knowledge (published reports, journal articles, books, etc.) pertaining to work in the NRB. These documents will feed directly into Theme 3;
- We continue to refine the IWRG website that features work done under the auspices of this research program/grant (<http://www.unbc.ca/integrated-watershed-research-group/research/nechako-river-basin>).

Presentations, meetings, and extension:

- Presentations, meetings, and outreach with potential project partners:
 - Barry Booth, Research Manager, presented a synopsis of the work that has taken place under the auspices of NEEF over the last 3 years at the Salmon Enhancement Community Workshop, Quesnel, BC, May 19-21, 2017;
 - The IWRG team members presented a summary of their work at a public meeting in Vanderhoof on October 12th, 2017. PDF versions of the slides from the presentation can be found on the IWRG website. In addition to presentations by the principal investigators, two posters were developed for this event. Details can be found in the Theme 1 summary.
- As part of the collective contributions of the IWRG, we also continued our collaborative work with the Nechako Watershed Roundtable (NWR) partners, both from a project and a governance perspective, in ways that complement efforts across all three themes. Our work in this area included the following:
 - Margot Parkes has resumed her position as UNBC's representative on the core committee of the Nechako Watershed Roundtable in January of 2017, Barry is her alternate;
 - Barry remains a member of the Technical Advisory Committee with the Nechako watershed strategy that is being developed by the Fraser Basin Council in conjunction with the Nechako Watershed Roundtable;
 - The IWRG co-hosted the second annual Nechako Watershed Roundtable meeting at UNBC on October 12th, 2017 in Vanderhoof as well as a follow up core committee meeting on the 13th, also in Vanderhoof. Please also see Theme 3 update.

Theme Updates

Theme 1: Water security and climate change (Déry, staff and students)

We have made tangible progress on climate research in the NRB. Our progress so far is summarized below.

Reports published and in press:

- In 2017 we had two publications:

Published papers:

Picketts, I. M., Parkes, M. W. and Déry, S. J., 2017: Climate change and resource development impacts in watersheds: Insights from the Nechako River Basin, Canada, *The Canadian Geographer*, 61(2), 196-211, doi: 10.1111/cag.12327. *Please note that this citation is also included in the Theme 3 update.*

Hernández-Henríquez, M. A., Sharma, A. R., Déry, S. J., 2017: Variability and trends in runoff in the rivers of British Columbia's Coast and Insular Mountains. *Hydrological Processes*, 31:3269–3282. <https://doi.org/10.1002/hyp.11257>

Field work, data collection and analysis:

- The past year also marked the third year of operation for our Tatuk Lake weather station, data collection continues and a website has now been developed to collect and disseminate our data: <http://cirrus.unbc.ca/camnet/Database>. Note however this site is password protected: please contact Stephen directly if you want access to these data;
- We received funds from the UNBC BC Real Estate Foundation Partnering Fund to further the work of Aseem Sharma, PhD student on his work relating to atmospheric rivers;
- Aseem continues to work on his PhD. He successfully defended his proposal in the winter semester (January to April 2017);
- We have developed an algorithm to detect atmospheric rivers landfalling in coastal BC;
- We have collected hydro-meteorological data along the BC coastal region from Environment and Climate Change Canada and BC River Forecast Centre;
- Further, we have collected/downloaded and reanalyzed climate data from various sources;
- We have developed a detailed climatology of atmospheric rivers influencing BC including the Nechako River Basin and assessed their trends and variability;
- We have analyzed impacts of anthropogenic modifications and climate change on Nechako River Basin's streamflow using the observed hydro-meteorological data. Based on our findings, we are preparing a manuscript for possible submission to a suitable journal;
- We continue to support the development of the Nechako watershed data portal by providing, data, maps and sharing ideas with new Master's student Joseph Gothreau.

Research extension and outreach:

- We worked on sharing climatological information on NRB to our fellow IWRG colleagues, local communities and stakeholders, and at an international conference:
 - Stephen conducted a public talk entitled Changing climate, changing landscapes in Northern BC: Perspectives from the ground at the Prince George Exploration Place on March 3, 2017;
 - Aseem presented the findings of the aforementioned paper on the variability and trends in runoff in the rivers of British Columbia's Coast and Insular Mountains at the Canadian Geophysical Union (CGU) Meeting at UBC, Vancouver, BC on May 29, 2017;
 - Stephen, along with the rest of the IWRG team, presented a summary of their work at a public meeting in Vanderhoof on October 12th, 2017;
 - A poster entitled: Rivers in the Sky: contribution of atmospheric rivers to precipitation and streamflow in the Nechako River Basin was presented at the IWRG meeting in Vanderhoof on October 12, 2017 by Dr. Déry and Dr. Islam;
 - A poster entitled: Hydrological Modeling of Nechako River Basin's Flows was presented at the IWRG meeting in Vanderhoof on October 12, 2017 by Dr. Islam and Dr. Déry.

Theme 2: Sediment sources and dynamics (Owens, Petticrew, staff and students)

Reports submitted:

- In 2017, we submitted one paper for publication.

Paper submitted for publication:

Owens, P.N., Gateuille, D., Petticrew, E.L., Booth, B., French, T. Sediment-associated organopollutants, natural organics, metals, and nutrients in the flow-diverted Nechako River, British Columbia, Canada, and its major tributaries: A current study with a synthesis of historical data. Canadian Water Resources Journal (submitted November 2017).

Field work, data collection and analysis:

- We continued to work on research related to sediment sources in the NRB:
 - Dr. David Gateuille, a past Post Doctoral Research Associate, now at Université Savoie Mont Blanc, Chambéry, France, continues his analyses of data collected in 2014-15 as well as results from samples collected during the 2016 field season. He is presently writing a manuscript for submission to a journal in 2018;

- We have submitted a number of suspended sediment samples to University of Manitoba for fallout radionuclide analyses to augment sediment fingerprinting. This work was funded through matched-funding by a UNBC General Research Fund award (~\$10,000);
- We received funds (~\$10,000) in conjunction with Scott Emmons, Senior Lab Instructor, GIS Lab, UNBC, from the UNBC BC Real Estate Foundation Partnering Fund to complete our GIS based work relating to historical changes in land uses throughout the Nechako basin.

Research extension and outreach:

- We worked on sharing sediment related projects in the Nechako to our fellow IWRG colleagues, local communities and stakeholders, and at a national conference:
 - Ellen Petticrew and Phil Owens presented some of the research findings on the sediment work in the Nechako within broader talks on sediment fingerprinting to the New Zealand National Institute of Water and Atmospheric Research (NIWA) in Hamilton, New Zealand in February 2017;
 - Phil presented preliminary results of sediment fingerprinting research at the 14th International Symposium on the Interactions Between Sediments and Water, Taormina, Sicily, Italy, June 17-22 2017;
 - Phil and Ellen spoke with scientists from the federal research organization CSIC in Spain in June 2017 and described research work on the Nechako;
 - Phil and Ellen, along with the rest of the IWRG team, presented a summary of their work at a public meeting in Vanderhoof on October 12th, 2017;
 - We have provided advice about sediment sampling to the Theme 3 to augment the Pacific Streamkeeper work.

Theme 3: Tools for integration in watershed management and governance (Parkes and students)

We continue to develop and trial a spatially referenced watershed portal tool to create a platform to bring together, share and profile existing knowledge and new watershed research. Progress for this theme continued to focus on design and collaborative activities required to develop and test new tools to integrate and share information in the watershed. The development of this theme has been directly informed by the projects described in Theme 1 relating to climate change and resource development in the Nechako and will continue to be informed by the research and results emerging from Theme 2. In addition, we continued to work on watershed governance through our activities with the Nechako Watershed Roundtable.

Due to the collaboration across themes, some activities in Theme 3's overlapped Theme 1, including the collaborative work linked to the publications noted above (Picketts et al. 2017). Joseph Gothreau, a Master's student whose work also straddles Themes 1 and 3 defended his master's thesis proposal: *"Climate change implications for ecosystems and well-being: developing effective geospatial knowledge exchange tools in the Nechako"*

Watershed". Joseph is also providing critical input into the technical development of the watershed portal.

Reports published and in press:

- In 2017, we had one paper accepted for publication.

Published paper:

Picketts, I. M., Parkes, M. W. and Déry, S. J., 2017: Climate change and resource development impacts in watersheds: Insights from the Nechako River Basin, Canada, *The Canadian Geographer*, 61(2), 196-211, doi: 10.1111/cag.12327. Please note that this citation is also included in the Theme 1 update.

- One other publication has progressed that makes a conceptual contribution that is directly influenced by the work with the IWRG and in the Nechako, although not explicitly focused on specific Theme 3 study findings is the following:

Sloan Morgan, V., Parkes, M., Gislason, M., Mitchell-Foster, K., Watershed partners EcoHealth & Watersheds in Northern BC Steering Com; Ecohealth and Watersheds UNBC Research Team. (Revised and Submitted November 2017). Voices from the landscape: Digital storytelling as counter-narrative and collective action for Northern BC watersheds. *Health & Place*. Submission number: JHAP_2017_1049. *Under revision*.

Field work, data collection and analysis, and technical development of portal:

- We continue to refine two spatially referenced watershed portal tools to create a platform to bring together existing knowledge and new watershed research. Development of the watershed portal included the following activities:
 - We continue to maintain and expand our Zotero library of resources relating to the Nechako watershed. This includes regular searching for articles, reports, etc. through Google Scholar and other search tools. This Zotero library is the central storage place for managing items before they are submitted into the portal;
 - We have submitted all preliminary literature to the portal (300+ papers);
 - We have also collected and prepared spatial data to be attributed to each submission; where necessary creating shapefiles that can be added to a repository of shapefiles;
 - We have assigned an attribute of the watershed governance prism to each paper. This is informed by previous work including:
 - Bunch, M. J., et al. (2013). Watershed Management and Public Health: An Exploration of the Intersection of Two Fields as Reported in the Literature from 2000 to 2010. *Environmental Management*, 54(2), 240–254);

- Parkes, M. W., Morrison, K. E., Bunch, M. J., Hallström, L. K., Neudoerffer, R. C., Venema, H. D., & Waltner-Toews, D. (2010). Towards Integrated Governance for Water, Health and Social-Ecological Systems: The Watershed Governance Prism. *Global Environmental Change*, 20, 693–704.
 - A key development has been developing a mechanism for the bulk loading of submissions into the portal. Bulk loading is designed to make it easy and time efficient to load large quantities of data into the portal. As a part of this we have spent considerable effort to prepare submissions from the Nechako Literature Review for bulk uploading including designing forms that will be used within the Portal to submit data. To date we have tested and continue to enhance the functionality of bulk loading;
 - We have also created a Web Map Service (WMS) layer of climate data for the Portal and designed a IWRG theme for the Portal;
 - By the end of 2017 a production version of the IWRG Portal was live and ready for users and data. We began Beta testing the Portal to identify bugs and additional features that are needed;
 - We continue our work with Aseem Sharma and Stephen Déry on ways to present climate data from the Nechako within the Portal, especially in conjunction with the Masters research being conducted by Joseph Gothreau;
 - We continue documenting the process on the development of the portal and we are currently drafting a research article relating to this work. A draft of this article is expected early in 2018.
- Development of partnerships with portal user-groups, for future refinement and applications of the portal:
 - Cheslatta Carrier Nation (CCN).
 - Kate Hewitt, UNBC Masters student, and Mike Robertson (CCN) have selected photographs for the Cheslatta Portal. Kate has also gathered required information for the photographs including identifying each location within Cheslatta Territory;
 - An essential part of this process has been the development of a new “photographs” form for the portal to test usability and functionality;
 - All of aforementioned photos have been submitted to the portal, with information/stories and shapefiles generated for each photograph;
 - Discussions have occurred on methods or approaches for using the portal as part of the Cheslatta Reconciliation process, especially with their collaborative stewardship framework development. This will continue through January 2018.
 - NEWSS and School District (SD) 91.
 - We are continuing our work with NEWSS and SD 91 on how students from this district could work with NEWSS on collecting both ecological data (e.g., riparian health, water quality, etc.). Barry met with SD 91 administration and staff on April 27th to help develop a sampling plan for

the summer of 2017 as well as formulating a strategic plan for Streamkeeper work in the Murray Creek watershed. He returned on May 12th to work with Casey Litton, Vanderhoof science teacher, to select sampling locations for the summer of 2017, and again on Sept 29th with Casey and Wayne Salewski to select locations for Streamkeeper work in 2018. Further, Margot, Barry, and others met with SD 91 staff and administration on October 12th to formalize our working relationship with SD 91, and plans are underway for follow-up in 2018 ;

- We helped coordinate a second set of Pacific Streamkeeper training workshops for schoolteachers in SD 91 (September 25th-29th). We had two, two-day training workshops: one in Vanderhoof and the second in Burns Lake. We had a total of eight participants from SD 91 (four from Vanderhoof, two from Burns Lake, at two from Fraser Lake).
- Barry has explored the potential of collaborative work with the [BC Integrated Laboratory Network \(ILN\)](#) at Thompson Rivers University (TRU). Initial discussions with the principal investigators at the BC ILN will have implications for the work being done by Theme 3 in conjunction with SD 91, and potential further analytical work by Theme 2.

Research extension and outreach:

- The Theme 3 team participated in the launch of the pan-Canadian effort entitled the “[Environment, Community, Health Observatory Network](#)” (aka ECHO project), May 8-11, 2017. Events took place in both Prince George and Vanderhoof. At each event, and particularly in Vanderhoof, the UNBC portal and work with our community partners featured prominently. As part of the ECHO launch the following tasks were undertaken:
 - Scott Emmons, Senior Lab Instructor, UNBC GIS Lab, demonstrated the UNBC portal to the ECHO group. This highlighted the relevance our work in the Nechako in relation to the overall ECHO project;
 - Kate and Joseph Gothreau, UNBC Masters students, developed a poster to highlight the critical elements of the UNBC portal. This poster is also adjustable for other presentations, meetings, conferences, etc. The poster included:
 - preliminary maps of literature distribution (over time) in the Nechako watershed;
 - preliminary maps of literature distribution (using the Watershed governance prism – ecosystems, health, community).
- Joseph met with Serge LaRochelle (Cocagne Sustainable Development Group) and Raissa Marks (New Brunswick Environmental Network) to discuss the Portal and other initiatives of common interest, including potential application

of the portal to watersheds in New Brunswick, as part of the ECHO Network (August 2017);

- Margot and Joseph gave a presentation at the Rural Alberta Innovation & Learning (RAIL) Commons (September 30, 2017). Presentation was titled: *“Environment, Community, Health Observatory (ECHO) Network: Strengthening intersectoral capacity to understand and respond to health impacts of resource development”*;
- Margot, Joseph, and Barry met with members of the Battle River Watershed Alliance in Camrose AB (October 2, 2017) to discuss UNBC Portal related work;
- Joseph presented a poster at the 12th annual UNBC Graduate Conference on his thesis work. The poster title was: Climate change implications for ecosystems and well-being: developing effective geospatial knowledge exchange tools in the Nechako Watershed;
- Margot, along with the rest of the IWRG team, presented a summary of their work at a public meeting in Vanderhoof on October 12th 2017;
- Margot gave two presentations while in Australia and New Zealand in 2017, that both profiled the development and the application of the portal as an integrative tool for health, environmental and community issues in the Nechako. Two presentations include:
 - Parkes, MW. (2017). *Cumulative Impacts of Resource Development and the “Integration Imperative”: Enhancing understanding of environment, community and health impacts, and strengthening intersectoral capacity to respond*. Edith Cowan University School of Science Seminar Series. October 27, 2017. Perth, Australia;
 - Parkes, MW. (2017). *The Integration Imperative & Cumulative Impacts: Understanding and responding to the environment, community and health impacts of changing landscapes and waterways. One Health Aotearoa Symposium*. Dec 13-14, University of Otago, Wellington (Invited Plenary Speaker).

Integration and collaborative work

- We continue discussions related to the development of a community-based monitoring program in the Nechako:
 - Barry travelled with Michelle Tung and an Upper Fraser Fisheries Conservation Alliance (UFFCA) crew, as well Chelton van Geloven (FLNROD) and Guy Scarf (DFO) on October 20th, to the Nithi Weir to observe work being conducted on the Nithi as it pertains potential work on small streams in the Nechako. Discussions are on-going as to how to integrate UFFCA sampling with work being proposed by SD 91;
 - Barry attended a Roundtable on Water Monitoring & Reporting in Vancouver on December 11th, 2017. This roundtable was convened by a coalition of funding agencies to develop a shared vision for water monitoring and reporting

in BC and to identify opportunities to further develop collaborative approaches. As a follow-up to this roundtable, Barry has begun the distillation of water monitoring efforts in the NRB.

- We also continued our collaborative work with the Nechako Watershed Roundtable (NWR) partners, both from a project and a governance perspective, in ways that complement efforts across all three themes. Our work in this area can be found in the “Presentations, meetings, and extension” section on page 3 of this report.