

2020 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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in conjunction with
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General Project Introduction

The Integrated Watershed Research Group (IWRG) of the University of Northern British Columbia (UNBC) was initiated in response to the growing recognition of the environmental, socio-economic and health implications of watershed dynamics. This led to an application to the Nechako Environmental Enhancement Fund (NEEF) for an initial phase of research (Phase 1: 2014-2017), which was supported by matched funds from other sources. Our experience with Phase 1 has reinforced our awareness of the demand for watershed research, monitoring and evaluation frameworks that integrate a range of relevant information, knowledge and perspectives to better understand and respond to interrelated issues in the Nechako River Basin (NRB), and contribute to enhanced decision-making at the basin scale.

Informed by the insights and outcomes from Phase 1 research, we secured a further ~ \$1 million worth of funding to explore important issues regarding the NRB over the course of five years (Phase 2: 2018-2022). The Nechako Environmental Enhancement Fund Society (NEEFS) approved a second ~\$500,000 grant from NEEF through the NEEF Management Committee, with the other half of the research investment coming in the form of matching funds from other sources.

Dr. Stephen Déry, NSERC/Rio Tinto Industrial Research Chair, Forest Renewal BC Chairs in Landscape Ecology Dr. Philip Owens and Dr. Ellen Petticrew and Dr Margot Parkes will use the funds to further examine issues ranging from water security in a changing climate, riverine fine sediment sources and developing tools to help inform integrated understanding and decision-making in the watershed. In addition to conducting research, the group will use the funds to retain the services of a project manager, train research associates as well as undergraduate and graduate students. The results of the research will be made available through public workshops as well as academic conference presentations, posters and publications.

Timeline

The IWRG at UNBC applied for a second phase of funding from the NEEFS in October of 2017. This second phase of funding was approved on November 22nd, 2017 and the final funding agreement was signed on March 15th, 2018, thereby allowing the team to continue its second phase of research in the NRB without interruption. We are currently at the end of our third year of this second phase of work and continue to make significant progress. The report that follows is synopsis of the work that was completed in 2020.

COVID-19 has had significant implications for work during this time period. COVID-19 has led to the cancelation and/or significant modification of outreach events and meetings and has delayed and/or modified field work. Despite these effects, we are continuing to partake in outreach events and meetings, as well as executing our research in accordance with the recommendations that have been brought forth by the Province and by UNBC Risk and Safety.

Overall Project Management

Presentations, meetings, and extension:

- Stephen has been attending Rio Tinto's Virtual Water Engagement Initiative (WEI) meetings and as well as the WEI Technical Working Group meetings.
- As part of the collective contributions of the IWRG, we have 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 remains as co-chair of the Core Committee of the NWR;
- Several members of the IWRG team¹ attended the virtual Nechako Watershed Roundtable Spring Technical Meeting on April 22nd, 2020

Research maintenance:

- Field work and data collection continue within each theme, and as a result, each theme continues to train Highly Qualified Personnel (HQP);
- Ongoing efforts to enhance our work by seeking external funding continues (see each theme for details);
- 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 update the IWRG website to profile work done under the auspices of this research program/grant, including:
 - Publications and Presentations page: <https://www2.unbc.ca/integrated-watershed-research-group/iwrg-publications-and-presentations>
 - Videos made available of IWRG presentations e.g. 2019 NRESi presentation.

Theme Updates

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

We continue our work on climate research in the NRB. Our progress so far is summarized below.

Field work, data collection and analysis:

We continue to work on research related to climate change and resource development in the NRB. This has included:

- Exploring the relationship between climate, forest fire events, mountain pine beetle infestations and runoff in the Stellako and Nautley watersheds. These results are contained in a manuscript that has been published in a special issue of the journal *Hydrological Processes*;
- We have created a database of shapefiles for the sub-basins of the Nechako that have historical flow records, with delineated boundaries from the Water Survey of Canada, Rio Tinto and others that have been internally created from Digital Elevation Models (DEM's) of the region. This database of shapefiles will make working with hydrologic and climatic data easier and more accessible to a wide range of UNBC students working in the NRB;
- We have visited the weather station at Tatuk Lake, downloaded accumulated data and performed annual maintenance to ensure data collection over the year;
- Following a pilot project in 2019, we deployed 26 stream temperature loggers throughout the NRB. Site visits and deployment was in collaboration with First Nations communities including Cheslatta Carrier, Stellat'en, Nak'azdli Whut'en and Tl'azt'en First Nations;
- We are working on an updated database for the Cariboo Alpine Mesonet (CamNet) weather station network. The project will take an open-source approach by using an open-source relational database platform (i.e., PostgreSQL). A paper describing the updated datasets is currently in preparation.

¹ Team members attending: Barry Booth, Stephen Déry, Megan LeBron, Margot Parkes, Megan Usipuik

Reports published, in press, and in preparation:

- In 2020 we published one paper.

Vore, M. E., Déry, S. J., Hou, Y., and Wei, A., 2020: Climatic influences on forest fire and mountain pine beetle outbreaks and resulting runoff effects in large watersheds in British Columbia, Canada, *Hydrological Processes*, 34(24),4560-4575, doi: <https://doi.org/10.1002/hyp.13908>.

Outreach, knowledge exchange and extension:

- Stephen gave a presentation at the True North Business Forum on January 28th;
- Stephen was interviewed:
 - on CBC Radio's Daybreak North Radio on February 13th about the heavy snowpacks in the Stuart and Upper Fraser and the potential implications to the spring freshet in northern BC;
 - was interviewed by the Omineca Express (May 1st) on a similar topic as the above interview.
- Stephen gave a presentation to the Kitimat Public Advisory Committee on September 8th to provide the group a progress update on research being undertaken.
- Stephen's team demonstrated various aspects of climate data collection and the overall research project to students from the SD 91 Koh-Learning program on October 23rd.

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

Field work, data collection and analysis:

We continued to work on research related to sediment sources and sediment quality in the Nechako Watershed:

- Laboratory analysis of source and sediment samples collected in September 2018 was completed in May 2020 by Nick Reiffarth at UNBC. These samples are composed of three to five samples from eight transects, and five resuspended sediment samples, all from the Murray Creek watershed. They were analysed for compound-specific stable isotopes (CSSIs) of very long chain fatty acids (VLCFAs). Currently these data are being analysed to determine if subsequent samples will need to be collected in summer/fall 2021. This statistical analysis aims to understand if there are significant differences between the various vegetation types from the sites sampled and thus, the effectiveness of using VLCFAs in this type of landscape to tracer sediment;
- Kristen Kieta, PhD student, is continuing sampling to investigate the effects of the 2018 Shovel Lake wildfire on sediment and pollutant transport using polycyclic aromatic hydrocarbons (PAHs), and other physical properties of soils and sediment in 2020. Time-integrated samplers were deployed at the same six sites as 2019, which include three tributaries: Tatsutnai, Ormond, and Nine Mile Creeks, and three mainstem sites: Nechako River at Dog Creek, at Highway 27, and at Vanderhoof. At each site, two time-integrated samplers were deployed on April 23 and were emptied and redeployed every two weeks until late fall;
- Kristen also added four additional sampling sites in 2020 for a wider scale fingerprinting project to build on the work of Dr. David Gateuille (Post-doctoral researcher 2014-2015). New sites include: Murray, Stoney and Smith Creeks and an additional site on the Nechako River at Fort Fraser. These samples are being prepared for geochemical and particle size analysis;

- Given that the spring flow peak for the Nechako River is driven by low elevation melt, which would include most of the burned area of interest, grab samples were also collected on April 23rd, during the rising limb of the freshet;
- We completed analysis of all wildfire related samples for magnetic susceptibility at UNBC and sent samples to SGS/AXYS labs for analysis of PAHs. All wildfire samples (2018-present) were prepared for colour analysis and shipped to the University of Manitoba;
- Results from PAH analysis have been received for all samples from 2018-2020 and are being statistically analysed and written into a manuscript;
- Kristen was awarded a prestigious Alexander Graham Bell - Canada Graduate Scholarship from Natural Sciences and Engineering Research Council of Canada (NSERC) for the next 3 years for her PhD on the NEEF project in the Nechako watershed;
- Kristen also received a UNBC Research Project Award in October 2020 (value \$2777) for additional analytical work.

Outreach, knowledge exchange and extension:

- Kristen gave a presentation at the Western Division of the Canadian Association of Geographers, 14th March 2020, Prince George, BC.

Presentation title: Determining sources of sediment in response to land cover change in the Nechako River Basin.

- Kristen presented to students from the SD 91 Koh-Learning program on October 23rd about monitoring for sediment in the NRB and why it is important;
- Kristen gave a guest lecture on work completed by Dr. Gateuille and her on-going work in the NRB to UNBC's Environmental Science 111 class.

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

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

The spatially referenced watershed portal tool continues to be a focus for Theme 3: We are developing and expanding this as a key tool for integration in watershed management and governance and creating a platform to bring together existing knowledge and new watershed research. Our ongoing development of the portal is responsive to the needs of our partners for sharing information and linking this to decision-making needs. Development of the watershed portal can be summarized as follows:

- We are maintaining and expanding our Zotero library of material relating to the Nechako watershed. This includes regular searching for articles, reports, etc. through Google Scholar and other search tools. This library is the central storage place for managing items before they are submitted into the portal. We continue to add 'grey' literature (e.g., professional reports, books) to the Zotero.
- We continue to refine watershed portal tools to create a platform to bring together existing knowledge and new watershed research. Development of the watershed portal included:
 - additions and improvements to the Geopaparazzi Loader;
 - additions to the layout and inclusion of sub-forms in Geopaparazzi and the Portal Loader;
 - bulk loading testing and improvements to loading from external datasets into the portal;

- integration of an area-based statistics tool for Portal layers (Building an Overlay of Spatial Statistics - BOSS);
 - creating custom email (email responses as forms are submitted) templates for individual forms;
 - initiating a schema mapping tool for spatial data loaded into the Portal;
 - Developing new forms specific to documenting workshops, and grey literature and reports.
- We have dedicated additional efforts to improve portal functionality of the connection between the portal and the Geopaparazzi app for entering data into the portal. This work has included:
- developing forms for data entry into the portal using the Geopaparazzi app;
 - writing instructions for how Geopaparazzi can interface with the portal. This was then used to host a hands-on activity as part of the Environment Community Health Observatory (ECHO) Annual Meeting June 10-12, 2020 (held online due to COVID-19). Several members of the IWRG team² participated in this meeting, with the Nechako-focused work informing and being informed by the work of the national ECHO collaboration;
 - hosting an online workshop with Koh-Learning team members and UNBC teacher candidates about how to use Geopaparazzi to connect to the portal, May 21, 2020;
 - hosting a second online workshop with Koh-learning teachers about how to use Geopaparazzi to collect data and connect to the portal, September 22nd, 2020;
 - trialing Geopaparazzi in the field as a tool for data collection on an Android tablet that could be utilised for citizen science, community and school-based monitoring;
 - Held meetings with SD91 teachers to discuss options for using Geopaparazzi in the field for comparing historical pictures and current conditions.

The development of partnerships with portal user-groups, for future refinement and applications of the portal is a key aspect of the work. Below is a summary of the development of these partnerships:

- We are continuing our work with School District (SD) 91 and Nechako Environment and Water Stewardship Society (NEWSS) on how students from this district could work with UNBC and NEWSS on collecting and sharing ecological data (e.g., riparian health, water quality, etc.). Examples of how this has progressed are as follows:
- at the “Koh-learning in our Watersheds” winter meeting on February 26th, 2020 at North Nechako Secondary School, IWRG team members profiled how the portal can be used to by students and teachers to document and profile their work;
 - we are working to identify ways that the portal tool can be used in conjunction with other environmental monitoring tools in ways that support the work of Ella Parker, UNBC Master’s student, as she develops her thesis on school-based monitoring and water resources decision making;
 - we are exploring ways in which the portal will be able to support the work Dr. Brent Murray at UNBC. Dr. Murray who, along with Barry Booth, Research Manager, and a student from SD 91, are engaged in a pilot project to explore how environmental DNA can be used to detect juvenile salmon in the tributaries of the Nechako Watershed.
- Nechako Watershed Roundtable (NWR)
- Discussions are continuing with the NWR as to how the UNBC portal may be able to be adapted and refined for use by the roundtable. We are examining how the portal will enable

² Team members attending: Barry Booth, Megan Lebron, Ella Parker, Margot Parkes.

the NWR to share videos and other materials about the NRB. We are also exploring way that the portal may be able to be used to support the NWR strategic planning processes in 2021.

➤ ECHO

- the portal and geo-paparazzi were showcased at the Annual Meeting of the Environment Health Community Observatory (ECHO) Network in June 2020. The ECHO network is interested in potentially using the portal as a tool for integrating and displaying information relevant to resource extraction and health.

- 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 in the fall of 2021.

Outreach, knowledge exchange and extension:

- Margot, Scott and Ella provided a presentation on the portal at the UNBC Research Week Conference on 6th March 2020 at UNBC in Prince George.

Presentation title: The Nechako Watershed Portal: An integrative, geospatial tool to bridge governance, knowledge exchange, and information-sharing needs, and foster co-benefits for health, ecosystems and equity.

- Ella arranged visits to the NALS lab and to Dr. Brent Murray's eDNA lab for students from the SD 91 Koh-Learning program on October 23rd;
- Margot, Barry, and staff and students from SD 91 were part of the plenary session of the [C2C Conference](#) on October 23rd, 2020 where they discussed the IWRG partnership, and tools such as the UNBC portal as enhancing a supportive, collaborative basis from which to develop the Koh-Learning in our Watersheds program;
- We are developing a YouTube Video Series to profile and support training for various portal user-groups, including UNBC. A series of instructional videos is being developed to inform new and existing users about how to interact with the portal's features. During the course of 2021, these videos will be released on YouTube and publicly available from the [IWRG website](#). A total of 5 videos have been developed to date and more are planned.