Mid-Term Grant Report delivered to the Okanagan Basin Water Board (OBWB) for the Water Conservation and Quality Improvement Grant Program (WCQI)

November 15, 2021

ASSESSING MICROPLASTICS IN OKANAGAN LAKE

A scoping study to evaluate the presence of microplastics in Okanagan Lake and Kelowna's municipal wastewater

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Executive Summary

The evaluation of *Microplastics in Okanagan Lake* project was initiated in the Spring of 2021 with the grant commitment from the Okanagan Basin Water Board (OBWB) to FreshWater Life. The overarching goal of this project is to better understand microplastics in Okanagan Lake and inform potential mitigation solutions. This project was set as a scoping study that may inform future monitoring in addition to looking to quantify and *possibly* qualify the presence of microplastics in Okanagan Lake and Kelowna's municipal wastewater.

The core partners of FreshWater Life, Seven in the Ocean and Copper Sky Productions have been actively working with the City of Kelowna, local educational and research institutions of University of British Columbia Okanagan and Okanagan College (OC), the Okanagan Nation Alliance (ONA), and Fresh Outlook Foundation (collectively the "Partnership"). To date, the Partnership has:

1. Established a freshwater and wastewater sampling protocol in alignment with the project goals.
2. Purchased supplies and equipment (Manta Trawl) to collect water samples and conduct analyses.
3. Tested the surface-water surface sampling equipment and laboratory procedures.
4. Conducted the Okanagan Lake surface water sampling at 5 locations per the grant agreement.
5. Collected both inbound and outbound wastewater samples at the City of Kelowna Wastewater Treatment plant.
6. Collaborated with Okanagan College to develop two capstone projects where students developed analysis protocols for extracting and identifying microplastics from freshwater and wastewater samples.
7. Initiated analysis of samples for microplastics in partnership with Okanagan College.
8. Collected video footage at each of the above steps of the process for the purpose of building the 10-minute video documentary.
9. Secured the domain "https://microplasticsokanagan.com/" and associated social media channels including:
    a. Facebook: https://www.facebook.com/microplasticsokanagan
    b. Twitter: https://twitter.com/MicroplasticOK
    c. Instagram: https://www.instagram.com/microplasticsokanagan/

At the time of preparing this mid-term grant report, there were no definitive results that can be reported. Initial laboratory observations suggest that microplastics were present in both wastewater and in Okanagan Lake surface water samples. Ongoing laboratory analysis continues to quantify and qualify the observed microplastics.

We expect that the Partnership will be able to deliver on the commitments made in the grant application at the conclusion of the grant in Spring 2022.

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1.0 Introduction

Plastics have transformed the world for humanity: from the goods we consume to the utility and protection of foodstuffs, to healthcare and clothing, to transportation and beauty products and beyond. It can be difficult, if not impossible, to live a truly plastic-free lifestyle, and plastics have become a part of our everyday lives. It is likely that the vast majority of people on the planet have had access to or utilize plastic in their daily lives. Both single-use and recycled plastics are in use globally, and industry is producing and people are consuming it much faster than the environment can break it down.

Unfortunately, most plastics end up in landfills or are inadvertently released into the environment where they can sit for hundreds of years or longer before they are broken down; simply put, plastic is accumulating in the environment. While there are variants of plastics, the most pervasive plastics do not magically disappear, they simply break down into smaller and smaller fragments through biological and photodegradation processes. The smallest of the fragments are designated as microplastics (<5mm in diameter) and can be invisible to the human eye, mistaken for organic debris, or even food for aquatic organisms from invertebrates such as zooplankton, to fish and birds. Functionally, some of the plastic we consume and dispose of today will be present and likely will be detectable in the environment for multiple human generations.

The global evidence and pervasiveness of macro and microplastics in all the world's oceans and freshwater systems indicates that the majority are anthropogenic in origin. We expect that plastic use in the Okanagan follows global patterns of use and disposal, and any plastic pollution in the Okanagan environment would be due to the human population living, working, and visiting the Valley. With the bulk of the population in the Okanagan Valley residing on or close to the Okanagan Lake, and the communities of Vernon at the north end (Kelowna, West Kelowna, Peachland, Summerland and Penticton/Naramata at the south) constituting approximately 250,000 residents that at least partially rely on the Okanagan Lake for their daily water use including the release of wastewater, we hypothesized that plastics have been and are possibly being inadvertently discharged into the Okanagan Lake with uncertain consequences in the short term and long term.

The first step in understanding the consequences of plastics in our environment is confirming that it is indeed present, and if so at what concentration.

1.1 Goals and Objectives

The goals of this project were:

1. to determine if microplastics are present and can be detected in Okanagan Lake;
2. if wastewater is a potential source of contamination; and
3. if microplastics are present, determining solutions to mitigating microplastics entering waterways that are achievable and community-oriented.

2.0 Partners and Collaborators

This small scoping study has garnered considerable attention on discussion with various active and potential collaborators and partners. The core partners of FreshWater Life, Seven in the Ocean, and CopperSky Productions have been actively working with collaborators from FreshOutlook Foundation, UBCO and the City of Kelowna to meet the terms of the grant agreement.

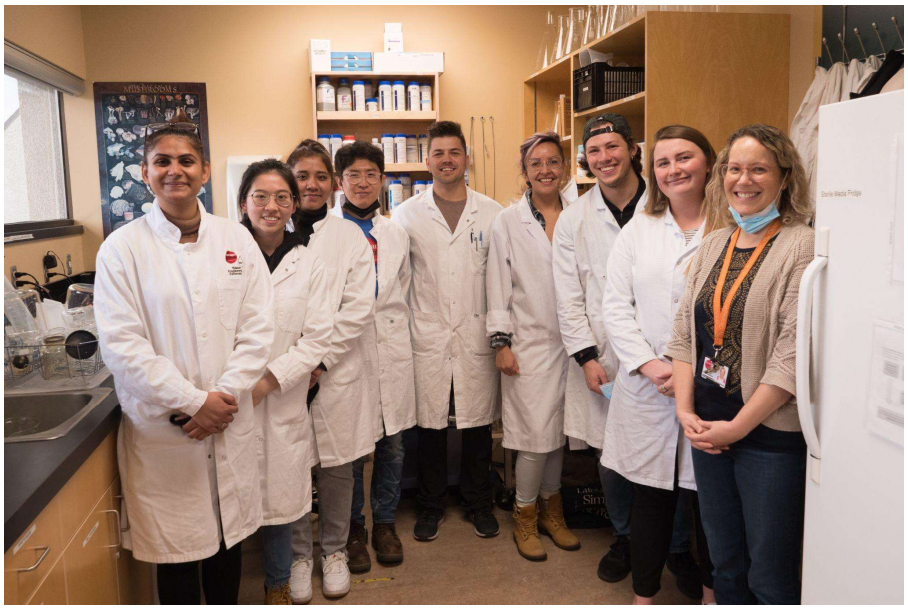
Since inition of the project, we have expanded the Partnership and added additional collaborators that are now involved with the project. The City of Kelowna has been outstanding in their support and commitment to facilitate safe access to wastewater samples despite the challenges that COVID-19 has created with how the samples are both collected and handled.

The Okanagan Nation Alliance (ONA) Fisheries Program was approached about their interest in this project. With ongoing monitoring of fisheries in the Lake, they expressed an interest in the project and offered their rigid-hull inflatable fisheries vessel and crew to conduct the open water manta trawl. Their ongoing involvement in this project is pending the results of the sample analysis.

UBCO was active in the first quarter of this grant cycle, assisting with sampling design, testing the laboratory analyses, and facilitating access to laboratory facilities. However, the graduate student (Ryland Giebelhaus) we were working closely with could not delay his departure for his graduate studies to Alberta and became unavailable for the freshwater sample analysis. Additional new, inbound graduate students at UBCO were offered, however, due to onboarding and training delays, we could not guarantee the analysis of water samples before the end of the grant period. Thus, we pivoted to work with Okanagan College to conduct both the wastewater and freshwater sample analysis.

The Okanagan College Water Engineering Technology (WET) program have been conducting both the wastewater and freshwater sample analysis for microplastic through the Fall Term 2021. There are two groups of four (4) students, divided into the wastewater and freshwater teams, cooperating with the Partnership to process the samples, and concurrently meet their requirements as a capstone project in compliance with their degree requirements.

It is anticipated that these eight (8) students will have completed the sample analyses and will report out on the presence of microplastics in both freshwater and wastewater by mid-December 2021.



Okanagan College WET Capstone Students with their mentor, Erin Radomske (right).

3.0 Okanagan Lake Microplastics Assessment

3.1 Objectives

We have hypothesized that microplastics of anthropogenic origin have been discharged into Okanagan Lake most likely transported mostly through surface water runoff and from plastics released into the lake via wastewater from daily household activity including dishwashing, laundry, and cosmetics used in daily hygiene care, and other sources. Should microplastics be extant in the lake, we endeavoured to determine if they were detectable in surface water in Okanagan Lake, and focused our sampling in areas where they might predictably be detected if present.

3.2 Methods

Okanagan Lake surface water sampling occurred twice over the month of August 2021: August 5 to test gear and sampling protocols and again on August 25, to collect the official samples. On the first sampling trip, both UBCO (Ryland Giebelhaus) and OC (Erin Radomske) were present to assist with the collection. Following the first trip, all samples were brought to UBCO for analysis. Official samples, once collected, were stored at OC until capstone students were identified.

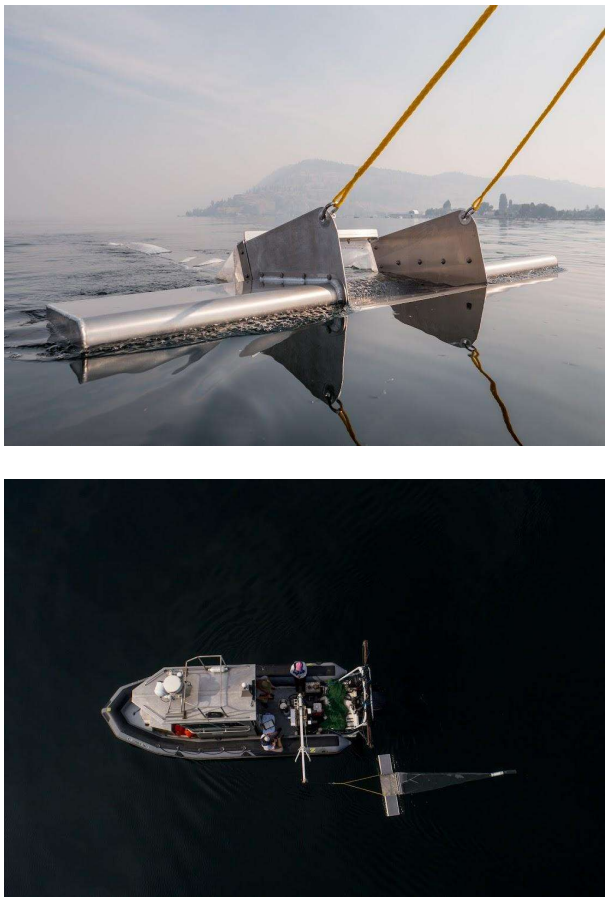


Figure 1. Manta Trawl used to sample surface water on Okanagan Lake, August 2021.

Surface water sampling was completed using a surface manta tow with a 0.335mm mesh net, fitted with a mesh collection bag to collect sample (Figure 1). Prior to deploying, the net was checked that all hardware was fastened and secured. The net was towed next to the research vessel for ~30 minutes, on 1 km long transects, with the vessel travelling at a target rate of ~2 knots. Transect length was confirmed following test sampling vial checks that showed no more than a 50% visible collection of surface debris in the sample vial. ***Each transect sieved ~31,000 litres and reduced the volume of material to fit into 2-3 1L glass mason jars. Total water filtered across all five sample sites equates to roughly 155,000 litres.***

The collection bag contents were rinsed into a stainless steel bucket, and poured into sample jar for later analysis. Each jar was labeled with sample #, time, date, transect #, and location. To prevent bacterial/algae growth, ethanol was added (>10% volume), and jar placed into cooler and stored at ambient temperature for transport to Okanagan College.

Okanagan Lake Freshwater Sampling Points

We identified five sampling transect points (Figure 2), three of which were hypothesized to have likely higher concentration of microplastics based on their likely origin (wastewater, mouth of Mission Creek), or were concentrating due to natural constriction (W.R. Bennett bridge). Two additional samples were collected at the widest points of the lake south and north of the bridge as general reference sampling points.

Specifically, we sampled at:

a) **Central lake at its widest point, north of the bridg**e: North of the bridge on Okanagan Lake there are numerous commercial ventures including the construction of residential properties and the decommissioning of the Tolko sawmill at the base of Knox Mountain.
b) South side of the **William R. Bennett bridge-crossing**: This represents a natural constriction and likely concentration point of any microplastics that may have been moving with the currents.

c) **Downstream of the Kelowna Wastewater Treatment Facility** near the outfall pipe where micropolastics may have been released.
d) **Mouth of Mission Creek**: Mission Creek is the largest freshwater input flowing into Okanagan lake. Additionally, Mission Creek flows through mixed-use recreational land, parks, farms, and residential neighbourhoods.
e) **Central lake at its widest point, south of the bridge**.

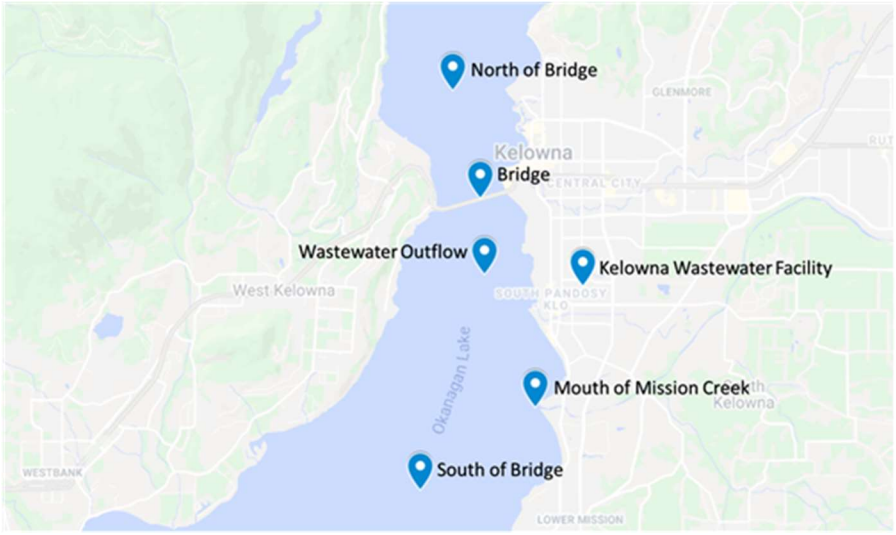


Figure 2. Approximate freshwater sampling locations on Okanagan Lake, and at the Kelowna Wastewater Facility. August/October 2021.

3.3 Progress and Preliminary Results

The freshwater capstone team at Okanagan College has been working to develop sampling and analysis protocols for the detection of microplastics that are specific to Okanagan Lake surface water samples. As of October 29, 2021, the students were in the process of analyzing all samples for microplastics (Figure 3). They are expected to deliver their findings, along with all protocols, by December 15, 2021. The Partnership will review these findings and incorporae these findings into the final report for the Spring 2022 deadline.

Figure 3. Okanagan Lake freshwater samples in Okanagan College prior to analysis, August 2021.

3.4 Anticipated Deliverables by End of Grant Period

By the end of the grant period, The Partnership anticipates delivering the following as part of its grant obligations:

1. A succinct, analysis protocol for the collection of and detection of microplastics in lake water samples.
2. Sample results, including the abundance of microplastics per sample and morphology breakdown (i.e., fibres, fragments, and films).

4.0 City of Kelowna Wastewater Microplastics Assessment

4.1 Objective

The City of Kelowna - with the largest concentration of residents in the valley, and its wastewater treatment facility concentrating a large proportion of the resident population's wastewater – was predicted to represent the area with the highest probability of detecting microplastics. Thus, our sampling focused on influent wastewater at the treatment facility (pre-treatment) and effluent wastewater (post-treatment) before discharge into Okanagan Lake.

4.2 Methods

In cooperation with the City of Kelowna, sampling was timed to correspond with daily high water inputs into the treatment facility. This time period was chosen based on when residents were more likely to be at home and using water for laundry, dishwashing, and using hygiene products that may be washed into the sewer system.

The specific step-by-step sampling and analysis protocols were developed in collaboration with Okanagan College WET capstone students and will be confirmed in December 2021.

4.3 Progress and Preliminary Results

The wastewater capstone team at Okanagan College has developed a sampling and analysis protocol for the detection of microplastics that are specific to Kelowna's WWTF. As of October 29, 2021, the students had received their samples and were in the process of analyzing all samples for microplastics. They will deliver their findings, along with all protocols, by December 2021. The Partnership will review these findings and incorporate them into the final report, Spring 2022.

4.4 Anticipated Deliverables by End of Grant Period

By the end of the grant period, The Partnership anticipates delivering the following as part of its grant obligations:

1. A succinct, sampling technique for the collection of wastewater for microplastics; and an analysis protocol for the detection of microplastics (both abundance and morphologies)
2. Sample results, including the abundance of microplastics per sample and morphology breakdown (i.e., fibres, fragments, and films)

5.0 Communications

5.1 Objectives

The purpose of developing communication materials is to raise awareness about the project and generally, to shed light on the topic of microplastics in the Okanagan. These communication materials that are still in development at the time of this report preparation, intend to connect the community with the larger, global context of plastic pollution in a way that is inclusive, transparent, and that invites inquiry and dialogue (and that does not stoke fear).

5.2 Progress and Preliminary Results

A project website has been established (https://microplasticsokanagan.com/) to house information about the project, the project team, findings, and related research that tie this work to the global issue of microplastics. Similarly, social media channels have been set up on Facebook, Instagram, and Twitter, to engage with the general public once initial results have been received. Finally, video and still photography footage has been captured along the way for use in the upcoming 10-minute documentary film that will summarize this project's story. The still photography has been used on the website and will also be used across social media platforms, in upcoming press releases and newsletters, and in other ways. This effectively stretches the use of visual media across multiple channels and sectors.

5.3 Upcoming Communications

The remaining communications for this project include printed and online infographics, blogs on the project website, social media posting and engagement, in-person presentations with interested parties, and the production of a 10-minute (approximate) documentary film that not only captures the story of this project but also ties it to the global context of plastic pollution. Once results are available, a Press Release will be drafted and shared among the Partnership to send to local media outlets. The Partnership will work in close collaboration with the OBWB and Okanagan WaterWise to sync communications and cross-post for the most effective digital interaction and engagement.

5.3 Anticipated Deliverables by End of Grant Period

By the end of this grant period, The Partnership anticipates delivering the following as part of its grant obligations:

1. an online presence.

2. A complete, 10-minute short documentary
3. Digital and print infographics
4. Additional digital assets including press releases, newsletters, blogs, and social media posts.

6.0 Budget

The project was budgeted at approximately $56,000, with $22,000 committed from the OBWB. To date we have secured approximately $37,000 of in-kind support from UBCO, Okanagan College, the Okanagan Nation Alliance, and FreshWater Life. No additional cash commitments have been identified (Table 2).

The expenses to date have been primarily on project management (Ryan Cope, Seven in the Ocean), supplies (sample collection and laboratory analysis), and equipment (the Manta Trawl, see Sampling Details).

Copper Sky Productions and the Partnership acknowledges the need to secure additional funding - by way of private donors, crowdfunding, or additional grant funds - for the final delivery of its 10-minute documentary film, including the full production budget. The Partnership has developed a fundraising plan and expects that the ensuing press release and ramping up of dialogue on various digital - and in-person - platforms will aid in that effort.

FreshWater Life has contributed approximately $4,800 in salary time for the oversight, administration and serving in the role of Project Director. FreshWater Life through Gregg Howald has absorbed the financial costs for all expenses to date in anticipation of reimbursement on submission of this mid-term report.

Due to the complexity of the project, additional project management and oversight time has been required, and will be into the future, to meet our obligations as outlined with the OBWB agreement.

Table 1. Microplastics in Okanagan Lake project budget, in kind, expenses to date, and budget forecast into Spring 2022. Budget completed as of October 29, 2021.

OBWB Grant Budget Categories	**Budgeted $1000's**	**In-Kind Matching $1000's**	**Expense to Date $1000's**	**Total Forecasted Expenses through 2022 $1000's**
Management	$5	-	$ 2.5	$ 5
Equipment	$5	-	~$ 4 .5	~$ 4.5
Supplies	$3	-	~$ 1	~ $ 3
Printing/Media (Web and Video)	$28.1	-	~$ 0.1	~$ 28
Consultant (Vessel time))	$1	~$5	$0	$ 0
Travel	$55	$0	$0	$ 0.5
Wages	$14	~$ 32	$0	$14

7.0 Future Activities

We anticipate that the Okanagan College WET students will complete and report out on the water sample analyses by mid-December 2021. Inevitably we expect the results of the analyses will catalyze

additional questions about the significance of the results, the limits of the sampling, in addition to making recommendations to overcome the challenges faced in the laboratory analysis.

In the late winter and Spring 2021, the Partnership proposes to:

1. Form a Technical Advisory Group (TAG) that can advise the Partnership on the significance of the results, offer guidance on improving both field sampling and laboratory analysis, and potential future water sampling such as in the water column, sediment layer, and potentially in other lakes in the Okanagan Valley.
2. Based on input from the TAG, finalize protocols for future sampling and analysis.
3. Complete the 10-minute video production.
4. Coordinate with the OBWB and other partners in media outreach and communication with the people of the Okanagan Valley writ large.
5. Initiate communication strategy.

8.0 Acknowledgements

The Project team wishes to thank the following organizations and individuals for their time, commitments, and energies to date:

Okanagan Basin Water Board & the WCQI Grant Program
Okanagan Nation Alliance: Sam Pham, Dave Tom (Vessel Operator)
City of Kelowna: Ed Hoppe, Jen Anderson
Okanagan College: Erin Radomske, Allison O'Neill, David Teasdale, Frank Carey, and WET Capstone Students & Lab Techs:
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Quinn Dartnell
Megahan McCreight
Joshua Sztanko
Tejveer Kaur
Harjit Kaur
Jongsun Park
Shu Ying Sai
Cascade Tong and Isabelle Curyk (Bio/Chem lab tech)
Michelle Toftland (WET lab tech)
UBCO PlantSMART Lab: Dr. Susan Murch, Ryland Giebelhaus
Fresh Outlook Foundation: Joanne De Vries
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Raphael Nowak: **Institute for Underwater Research (IFUR)**