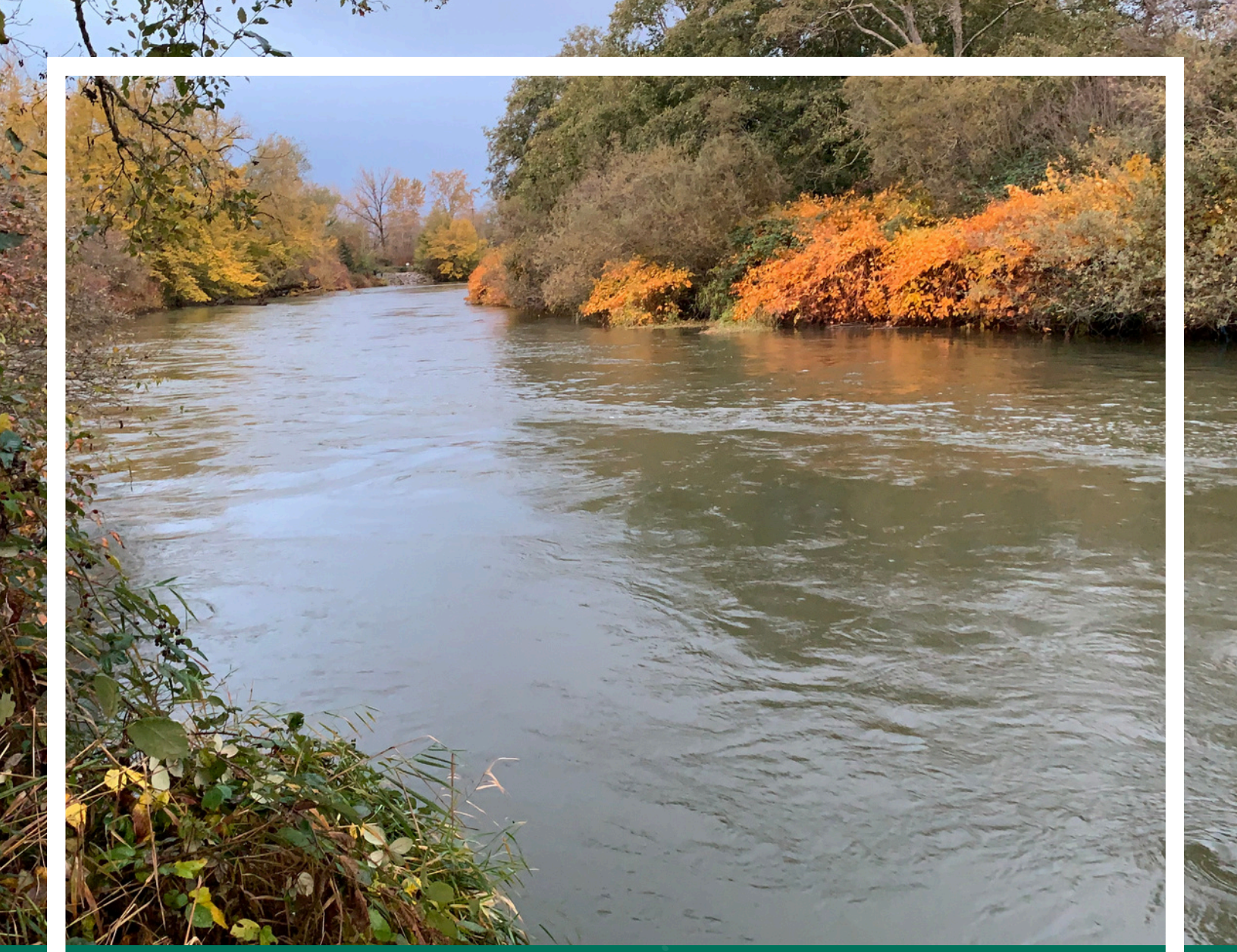

Collaborating for Salmon Resilience: From Crisis to Opportunity – a Cowichan Story

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Cowichan WATERSHED BOARD

Contents

Executive Summary

Catastrophic Fish Kill on the Cowichan River

In July 2023, following a hot dry spring, conditions in the Cowichan River declined to such a point that an estimated 84,000 steelhead juveniles died. Lethal water temperatures and high nutrient levels from a sewage outfall combined with low river flows contributed to massive algae growth that caused extreme diurnal fluctuations in pH and dissolved oxygen that proved fatal to the steelhead and other salmonid species over a 10 km zone.

The Cowichan River has had strong cultural and spiritual significance to the Quw'utsun Mustimuhw (Cowichan people) for millennia, and more recently has been recognized federally and provincially as a Heritage River, supporting both anadromous and resident salmonids and defining the communities in runs through. The significant fish mortality event sent shockwaves through the entire community.

Mobilizing Through Crisis: The Power of Partnerships

The Cowichan Watershed Board (CWB) and its many partners learned a lot over the following year on how to join together people, expertise, and resources in response to this tragic event. The relationships developed before the crisis occurred proved essential in enabling a fast response, facilitating the process of bringing the right people together to form an effective team to work collaboratively towards addressing the challenge.

Following the fish die-off, the CWB secured funding to pull together, in a workshop format, First Nations, senior resource agency and local government staff, subject matter experts, and key people from local ENGOs in order to pool expertise, resources and equipment to plan a path forward.

Developing Response Strategies

In the first workshop, a water quality monitoring plan was developed that described parameters to assess, sample locations, sampling methods (i.e., a mix of continuous monitoring and grab samples), equipment required, and who was available to do the monitoring work. The information providing by this monitoring would provide decision makers with timely data to support decisions needed to avoid a fish mortality event from recurring.

In the second workshop, a response strategy was developed that detailed thresholds for key water-related parameters to indicate when conditions were approaching concerning levels. Important parameters included water temperature, pH, dissolved oxygen and discharge. In addition, four response strategies were developed that could be implemented when thresholds were exceeded. These included three immediate strategies - flow management via the weir at the lake outflow, altering sewage management protocols, and angling closures. The fourth strategy was to identify cold water refugia to support a longer term vision of establishing protection measures to maintain cold water inputs into the river.

Proven Success: Preventing Repeat Mortality in 2024

Rapid sharing of monitoring data, and regular scheduled meetings to make decisions on triggering responses as well as addressing any technical/logistical challenges associated with gathering monitoring data helped us avoid a fish mortality event in 2024, even though similar water quality conditions were experienced.

A third and final post-season workshop was held to discuss what worked well, what could be adjusted, and to plan for 2025.

Key Lessons for Climate-Resilient Watersheds

Many of the lessons learned in this process are likely helpful to many other communities due to the growing challenges of climate change and are described in this report. Key “take-aways” from our experience include:

1. Climate change will impact salmon and salmon habitats in your watershed.

2. We need to be proactive, anticipate what climate impacts will be and how to address them.

3. No one level of government, First Nation, ENGO or academic institution has the resources to deal with these challenges unilaterally. We must forge efficient and effective working partnerships at the watershed level to deal with climate related salmon challenges.

4. Monitoring water and habitat conditions moving forward will be key to identifying problems as they arise and assessing interventions to deal with these problems.

5. Monitoring is not enough. Watershed partners need to identify “levers that can be pulled” where ever possible and collaboratively create response plans

6. Identifying, protecting and enhancing key “refuge habitats” is a recommended response action that is common to most, if not all, watersheds.

7. Good communication is essential – Keep talking!

Background & Context

The Ecological Gift of Salmon

Where does this story begin? Salmon have been returning to the Cowichan River for millennia. For thousands of years, they have provided physical, spiritual and cultural sustenance to Quw'utsun Mustimuhw, and continue to do so for Cowichan Tribes members who live in the valley today. Rather than a resource to be exploited, Cowichan people regard the salmon as relatives, to be honoured and supported as you would your mother or your auntie or your child.

Through the transfer of marine captured nutrients from the ocean to the watershed, salmon have enriched the valley, benefitting all life from the towering Douglas-fir and western redcedar in the riparian zone to the periphyton and benthic aquatic invertebrates that are the foundation of the food web. To this day, it is not uncommon for hundreds of thousands of salmon to end their epic journey from halfway across the pacific to the welcoming waters of the Cowichan.

A River Under Stress

Yet despite its historical significance, ecological importance, and dedicated stewardship from Cowichan Tribes and the broader community, the Cowichan River is no stranger to stress in recent years.

Freshwater inputs into the lake, which used to come like clockwork each summer, have dropped by almost a third in the last twenty years due to climate change. The steady flow of fresh water had supported a delicate balance, essential for the survival of numerous aquatic species, including the iconic salmon and trout. Lower water levels affect fish in multiple ways, disrupting the complex relationship between them and their habitat.

The negative effects of less freshwater coming into the Cowichan have been magnified by the simultaneous rise in water temperatures, also associated with climate change. As the summers grow hotter, the lake and river's waters become warmer. Salmon and trout, species that thrive in cool, oxygen-rich environments, find themselves struggling to survive in these new conditions. Elevated temperatures not only stress the fish but also exacerbate the growth of harmful algae, which further degrades the habitat. These changes combine to alter the water chemistry, changing the acidity of the water, creating additional stressors.

As the effects of climate change continue to accelerate, this worrisome scenario has been playing itself out in countless rivers and streams across British Columbia. For the past several years the health of salmon in the Cowichan River and countless other salmon bearing river systems in BC has been at risk, balancing delicately on the knife edge separating a sustainable productive aquatic ecosystem – and something that looks much different, something that the people of this place have never experienced, something that, until very recently, was unimaginable.

A Watershed Moment: The 2023 Fish Kill

In mid-July 2023, recreational swimmers in the Cowichan River noticed something different in the river – something alarming. Dead and moribund juvenile salmon and trout began to appear in the swimming holes in the upper river. Emails were sent, phone calls were made and "first responders" from Cowichan Tribes, senior resource management agencies, and the stewardship community converged on the river. Relationships that had been formed over the years through the work of the Cowichan Stewardship Roundtable and the Cowichan Watershed Board were heavily relied upon to help gather information and piece together a picture of what was happening – and the news was not good.

Over 10 kilometers of river – approximately 20% of the mainstem Cowichan - was a death zone. Estimates of salmonid mortality were pegged at 84,000 steelhead juveniles as well as significant numbers of Coho juveniles and adult and juvenile trout. This totally unprecedented event, on a federal and provincially designated "Heritage River" that defines the community it runs through,

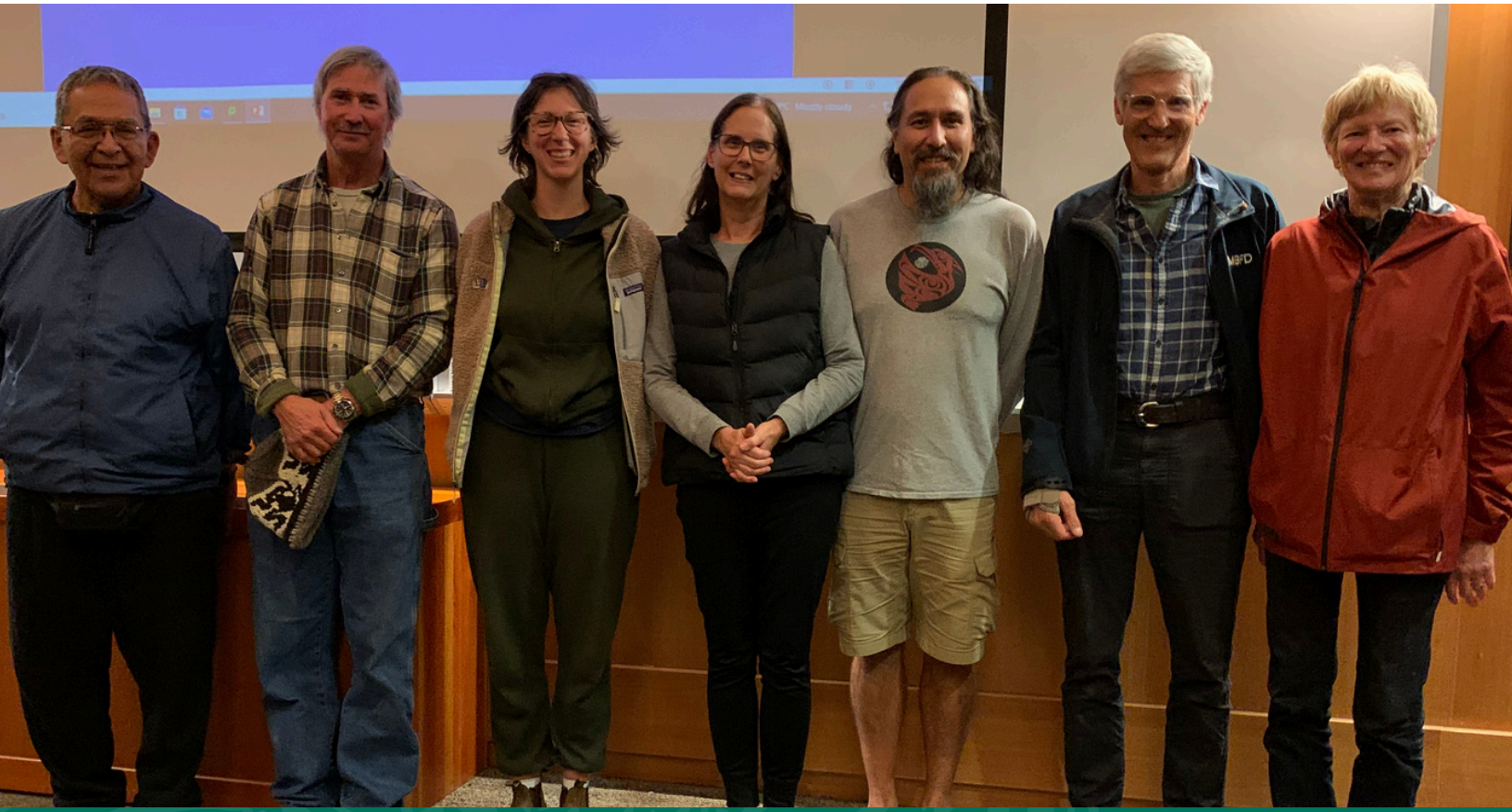
was a jarring and tragic wake up call. An undeniable indication that the world is changing in ways we could not have imagined a few decades ago and, if we are going to continue to enjoy and rely upon a world with salmon in it, of the need to change and adapt our approach to stewarding our salmon and the rivers that support them.

A Story of Resilience and Collaboration

This report tells a story, a story of how the Cowichan community came together to share our grief, our concern, but perhaps more importantly, our knowledge, our passion, our resources and our commitment to salmon in order to collectively address the challenges we are facing that were made very clear to us through the events of those days in July of 2023.

We hope that this is a story that can be helpful to other communities in other watersheds that share the same challenges we do. It is a story that isn't over but a story that holds promise for a brighter future for salmon in British Columbia. We hope that by documenting our actions, and the resulting outcomes, we can provide others with something that provides a sense of hope in challenging times but, more importantly, some ideas or approaches that might assist others in their efforts to ensure a robust and sustainable future for salmon populations in their watersheds.

This is a story of how people can work together across cultural and organizational barriers, of how strong western science can intersect with local and traditional knowledge, of how individuals can make a difference. This is a story about salmon and, perhaps most of all, about resilience.



Just the Facts

Cowichan Watershed

- 940 Km2 total area.
- Cowichan River is 47 km long and Cowichan Lake is the second largest lake on Vancouver Island with a surface area of 62 km2, and a perimeter of 109 km.
- Home to 70,000 people including almost 6,000 Quw'utsun Mustimuhw.

Cowichan Salmon escapement (10 year averages)

- Cowichan Chinook (adults and Jacks): 22,000
- Cowichan Chum: 150,000

Cowichan Salmon escapement (5 year averages)

- Coho: 21,000

July 2023 Fish Mortality Event

- 10 km of river affected.
- 84,000 "0+" steelhead mortality estimated (2024 swim up fry).
- Unknown numbers of dead juvenile coho and trout adults also lost.

Recorded Water Quality Parameters

- Temperature Extremes: 25.5 C
- Diurnal Dissolved Oxygen fluctuations: 8 - 14.6 ppm
- Diurnal pH fluctuations: 7.3 - 9.5

Active partners in Monitoring Response Effort

- Cowichan Tribes
- Fisheries and Oceans Canada
- Ministry of Water Land and Resource Stewardship
- Ministry of Environment
- Cowichan Valley Regional District
- Town of Lake Cowichan
- British Columbia Conservation Foundation
- Cowichan Lake and River Stewardship Society
- Somenos Marsh Wildlife Society
- Friends of Cowichan River
- Dr. Ken Ashley (Special Advisor)
- Cowichan Watershed Board

The ‘Cowichan Cookbook’

An Approach to Drought Response

The following sections outline the approach that was taken in the Cowichan Valley to address the drought induced fish mortality event experienced in 2023. They tell a story that begins before the crisis occurred and include the actions taken in response. For each step along this journey we’ve included generic suggestions or advice as well as specific actions taken in the Cowichan example that speak to the suggested points. It’s hoped that other communities can “see themselves” in many of these scenarios and that the difficult lessons learned in the Cowichan will assist you in your work to protect and support salmon in your watersheds as we collectively address the challenges associated with global climate change.

Getting ready for the unexpected

Every river has its own story to tell about where the water is coming from, where it is going, and what it encounters along the way. Every river is also unique in terms of how people have influenced its health in the past and into the present. Coming together as a community, to understand the story that the river has to tell is important. Establishing those relationships helps guide us along the path to solutions once challenges occur.

1. Establish partnerships before you have a problem.

- It's important to be able to respond quickly. This means knowing ahead of time who can help solve the problem as well as having the relationships already built so everyone already knows each other.

- Finding a way for "salmon people" from all organizations in the community to meet on a regular basis to build these relationships is a very important first step. Then, if and when a specific challenge occurs, the community already knows who to bring together to work towards finding solutions.

- These relationships can be built in informal ways where people gather to share inventory and research results, new programs, community event updates – just to name a few ideas. Invitations can be widespread and inclusive, bringing together First Nations, federal and provincial government experts, local government staff, representatives from local non-government stewardship organizations, and interested community members.

- This requires some sort of leadership, where a group takes on the responsibility to set a schedule and agenda for these regular gatherings.

Here's how we did it:

- In around 2003, the Cowichan Stewardship Roundtable (CSRT) was established following a serious drought that threatened salmon populations. Since that time, local residents, First Nations representatives, industry, government and stewardship groups have met monthly to share updates on their work, learn from presentations on important projects, and pool expertise and resources when new challenges arise. Participants have helped with relocating spawning chinook when river flows were too low, assisted with a remediation project to reduce fine river sediment from burying salmon eggs, and more recently working with Cowichan Tribes to organize the Quw'utsun Sta'lo Skweyul (Cowichan River Day) bringing together the community to celebrate the river.

- A second outcome following the drought concerns that started in 2003, was the establishment of the Cowichan Watershed Board (CWB) in 2010. The CWB is a local governance entity focused on promoting water sustainability in the Cowichan-Koksilah watershed. It is co-chaired by the Chief of Cowichan Tribes and Chair of the Cowichan Valley Regional District, and the membership works together to advance watershed health, while working together along the path to reconciliation. The Board guides staff and Working Groups consisting of representatives from over 20 stewardship organizations and governments, to work together to improve fish populations, water quality and flows, estuarine health, riparian ecosystems, wise water use, and community understanding of our interconnectedness with our environment. It is through these connections that the CWB immediately knew who to bring together following when the fish kill occurred. The relationships had already been built.

2. Understand what makes your river unique.

- Every river has a different story about where it originates, what influences its water quantity and quality, and how people have changed it. Understanding this story is important when trying to figure out where a problem is coming from, what data is needed, and what options are feasible within a response plan.

- Figure out what data has been collected and reports have been written that relate to the problem.

- Find out from Indigenous Knowledge Keepers and Elders what the river was like during the millennia prior to settlement.

- Find out what long-time settler residents know that also provides clues on what the river was like decades ago when it was healthier.

- Understand how existing infrastructure might be impacting the river. Understanding if and how forestry, agriculture, industry, residential development, and all associated infrastructure may be impacting the river is important.

Here's how we did it:

- When the fish kill happened, we had to do a quick inventory of which factors affecting river health we could control, and when the time came, build a response strategy around. One positive was that there is a weir at the beginning of the river that was used to manage summer flows to ensure fish habitat was maintained while enough water was available for the local pulp mill. This gave us the opportunity to further adjust flows if needed.

- A second positive factor is that Cowichan River Provincial Park protects a large area of riparian forest along the river, including the lower reaches of important cold-water inputs. This provides a good starting point for long term planning around how we can make sure cold-water refugia remain functional during warm summer months.

- On the negative end of the spectrum, there are two sewage outfalls, one feeding nutrients into the upper river downstream of the lake, and the second further downstream towards the estuary. In addition, long term water quality sampling shows nutrients entering the river in other areas, possibly because of old and failing septic fields and fertilizer use.

- Other pressures affecting water quality and fish health were being monitored, including some contaminants of emerging concern from sunscreen from a very active river tubing use, and tire compounds.

3. Understand what information is already available and what it means before you have a problem.

- Often, there is a large amount of data and many reports from the past that can offer important clues around river health. Understanding who knows what is key to avoiding problems.
- However, water quality reports can be complex and not easily understood by non-experts. Making sure the right conversations are happening between the right people is key!

Here's how we did it:

- Water quality objectives and attainment sampling has been in place for the Cowichan River for many decades. Past reports have stated that high nutrient levels were contributing to conditions that could result in fish mortality. More recently, upon a closer look, provincial fish inventory data show there were likely fish mortality events in more years than just 2023. Somehow the information has existed to let us know that a fish kill might happen, but we missed it, even though we have a strong river stewardship community! We now know what to watch for though we wish we had looked at the data closer, especially once the impacts of climate change started becoming more obvious.

Getting started once there is a problem

Once the problem has occurred, it's time to get busy, time for the community to come together, share knowledge and expertise, pool resources, and figure out the path forward. This requires some sort of leadership to keep things moving since everyone is generally very busy.

1. Figure out who is in a position to lead

- Within the community partnerships that exist, there may be one partner who is better positioned to provide some sort of leadership to get the process started. While they may not have the expertise required to solve the problem alone, they may have the resources and be in a good position to identify and bring together the people who can solve the problem.

- While most of the funding to fix the problem may already exist in the budgets of the various partners, there may still be some gaps. If so, finding funding to fill any gaps may be a good job for the leadership role to take on.

Here's how we did it:

- The staff of the Cowichan Watershed Board was immediately directed by the Board to 'solve this problem'. While it was a daunting task, the staff was able to quickly identify the first few steps to get the ball rolling. We already knew and had relationships with most of the people and organizations that could solve the problem, we knew the names of the experts from outside the community that we would want to pull in, and we had a general approach in mind. A collaborative approach of 'meeting to make a plan together" before jumping into action was adopted and 2 workshops were organized in quick time. One to develop a monitoring plan followed by another to develop a response plan.

"There are very few communities that find a way to pull together for the good of their river like the Cowichan Valley."

- **Ken Ashley**, B.Sc, M.Sc, M.A.Sc., Ph.D, BCLSS director, recently retired Director of Rivers Institute, BCIT)

2. Building the right team – no one organization can likely shoulder the entire burden

- Solving complex problems requires a lot of different people with a lot of different areas of expertise and different resources (i.e., equipment and funding). This often involves different people from different government agencies (First Nations, federal, provincial and local governments), local NGOs who are often the 'boots on the ground', as well as academia who are well-connected to the latest western science:
    - First Nations can provide essential rights-based leadership, local and traditional knowledge, skilled field workers, and an important sense of place. However, they have a much broader mandate than the resource management agencies and staff and resources often stretched very thinly.
    - Senior resource management agencies have huge mandates and geographic areas of responsibility. They are much more likely to be able to help with guidance, equipment, or boots on the ground if they see opportunities to effectively partner – leveraging their contribution.
    - Local governments and academic institutions can often provide resources and knowledge but often have to be "invited to the party" and encouraged to do so.
    - Watershed-based environmental non-government organizations (ENGOs) are often strong in the "boots on the ground department" but traditionally lack equipment, support, and guidance.
    - By working across organizational boundaries, with contributions from all, equipment, transportation, human resources, and expertise can be pooled allowing for a much more coordinated and robust program than if each entity attempts to implement monitoring or response actions independently.

Here's how we did it:

- Working toward solving the problem of the fish kill required pulling together around 25 people from multiple agencies, non-government organizations, and academia. We brought together fisheries biologists, water quality experts, public works staff from the local government, and communications experts.

- We could also see a role for other community members who may not have technical expertise but still could help by being part of a solution. Many NGOs had well established communication networks that became an important way to reach the broader community. Many residents wanted updates on what was being done and on the health of the river. Weekly updates were created and circulated through these groups. We also asked community members to report on any dead fish they saw throughout the warm summer months. Everyone in the community had a role.

- While most people knew each other, the work required bringing new expertise to the table and new relationships were built over the coming months. These new relationships were formed with organizations and subject matter experts that, traditionally, had not been involved in salmon, water, or watershed centric conversations in the Cowichan Valley (e.g., sewage plant operators, academics with specific areas of expertise).

- Some organizations became team members in their own way. One very unique outcome of the fish kill was the creation of the '84,000 Fish Project' started by local NGOs. Built around the idea that many people were grieving due to climate change impacts to the river's health, people throughout the community participated over the following year in an art project where 84,000 fish were rubbed with crayons onto a continuous roll of paper. This was then, with ceremony, displayed at the Quw'utsun Sta'lo Skweyl (Cowichan River Day), and then at the local art gallery.

"Everyone needs to put 100% on the table and then let the work take its path"

- **Tim Kulchyski,** Cowichan Tribes Member, Fisheries Biologist, Lulumexun (Lands and Governance) Cowichan Tribes

3. Getting the Funding/Pooling Resources:

- Having leadership and the right team is probably not enough. Resources from third party funders from outside the watershed may be needed and are much more likely to be available if the proponent(s) can demonstrate a unified partnership approach.

Here's how we did it:

- Once we had a rough idea of what the community needed to do, and had ideas of who should be on the team, we needed to rough out a budget to get funding to organize the workshops and fund some of the field work.

- Significant resources were obtained from both the Pacific Salmon Foundation (PSF) and the Habitat Conservation Trust Fund (HCTF). None of the work documented in this report would have been possible without those contributions from funders who respected and endorsed the strong partnership approach demonstrated by the project proponents.

- Over time, as plans developed and were endorsed through a collaborative process, equipment and financial resources were pooled by a number of organizations (e.g., Cowichan Tribes, PSF, HCTF, British Columbia Salmon Restoration and Innovation Fund, Department of Fisheries and Oceans (DFO), BC Ministry of Water, Land and Resource Stewardship (WLRS), BC Ministry of Environment (MOE), Cowichan Valley regional District (CVRD), and CWB).

- In a few short months, the people and funding were in place such that real planning could happen.

Creating the Monitoring Plan

Now that the right team has been pulled together, how can this expertise be applied to help solve the problem? Creating the right monitoring and response plans is an important next step. Pooling knowledge, equipment, and people's time is key for a successful strategy.

"The Cowichan River likely has the most effective monitoring program in Canada in terms of providing the information needed to make decisions in a timely manner"

- Ken Ashley, B.Sc, M.Sc, M.A.Sc., Ph.D, BCLSS director,
recently retired Director of Rivers Institute, BCIT

1. Keep your monitoring plans simple and focused.

- It's great to collect data but if you are working towards addressing specific challenges in your watershed, the monitoring plan needs to isolate the concerns and identify the key parameters that need to be tracked in order to provide an early warning system.
- Rely on subject matter experts from academia, First Nations, resource management agencies and ENGO's. Folks who understand the challenges and are already doing the work are invaluable resources in terms of identifying what's essential – versus what's "nice to do".
- Resources are always limiting. There are never enough boots on the ground, equipment or money. Therefore it's important to focus the resources you do have on what matters most!

Here's how we did it:

- During workshop #1, the partners shared information on who was already doing what monitoring where and when, and what data and reporting already existed. Regular information was being collected on water quality, fish abundance and health, benthic invertebrates, and algae (Appendix 1)
- In the next step, the partners designed the ideal water quality sampling program (continuous monitoring and grab samples) to support decisions around responses.
- Subject matter experts were quick to identify three relatively simple parameters that could be tracked and would provide us with advanced warning that another fish kill event was possible. In our case these were water temperature, dissolved oxygen and pH – all relatively simple to monitor through meters or continuous sampling probes.
- We explored what parameters were already being measured, and discussed which needed to be added and which could be dropped. We also refined water sampling locations.

- We figured out who had what equipment and who was available to collect field data, and who could analyze the data. We identified some gaps and then worked to fill them after the workshop (Appendix 2).

- We identified how we could work together, pooling our time and resources. A few examples include:

    - DFO and WLRS collaborated on resourcing, installing and maintaining continuous monitoring stations;

    - MOE, WLRS, CVRD, CWB and local area volunteers collaborated in implementing grab sampling program;

    - The Town of Lake Cowichan, CWB, Cowichan Tribes, CVRD, DFO, WLRS and Dr. Ken Ashley support weekly "situation room" meetings; and

    - CWB, Cowichan Tribes and the BC Conservation Foundation (BCCF) collaborated on thermal refugia field survey work.

Creating the Response Strategy

Now that there is a monitoring plan, it's time to develop a simple and focused response strategy. The best response plan uses tools that are easy to implement, ecologically sound, cost effective – and are expected to work!

1. Agree up front on what monitoring information will "trigger" responses and what those responses will be.

- Thresholds that trigger in-season action, and that are based on monitoring data, need to be clear. As the data comes in, it needs to be quickly compared against thresholds that identify when to be cautious versus when to respond. When the caution alarm goes off, then a decision-making team needs to start getting ready to respond. For example, if dissolved oxygen falls below X, then emergency oxygen infrastructure will be installed in these three locations. If these decisions are made in advance, planning, preparation and implementation will be much smoother.

- Figuring out how to work across organizational boundaries to identify a suite of actions that can be taken in response to worsening conditions is key. A well-designed monitoring program can help indicate when conditions are reaching a crisis point and when there is a need for intervention.

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- help indicate when conditions are reaching a crisis point and when there is a need for intervention.

2. Make sure it is clear who is part of the decision-making team for determining what "response lever" is pulled when.

- There needs to be a smaller team who participates in the decision making around when to implement these responses. A strategy needs to be in place to outline how the monitoring data is shared, when to meet, and how to get ready when conditions begin to deteriorate.

- The response strategy should be focused on actions that can actually be taken by organizations represented in the team and individuals responsible for implementation should be clearly identified and understood by all.

- The heavy lifting involved in reaching consensus on what interventions are feasible, affordable, and supported by all should be done in advance – not in season!

- An effective strategy also requires that there is clear direction on where to store and access information and how to communicate important information to the right people. Figuring out how to share information in a timely manner is key to fast response times.

- All partners should be sensitive to the limitations or differing perspectives at the planning table (e.g., potential conflict of interest, cultural sensitivities, concerns with "officially induced error" etc.). It should be clearly understood who has the authority to make which decision. In some cases, those who have the authority to make a decision or implement an intervention action may not have the resources to do so. Planning in advance and sharing resources may be essential to attaining common goals.

Here's how we did it:

- In Workshop #2, the same group who developed the monitoring plan met to develop a response strategy (Appendix 3). The strategy described four potential actions based on thresholds being reached from monitoring data, and establishing a short list of the key people who need to be part of the decision-making team (Appendix 4). All responsible organizations agreed to the triggers, the actions, and their respective roles up front.

- Over a four-month period (May to September), a smaller team reviewed continuous monitoring data on a weekly basis and convened regularly when conditions dictated (Appendix 5). Important information reviewed included weather, river flows, water temperature, dissolved oxygen, pH, fish health observations, and actions taken by the Town of Lake Cowichan in response to current water conditions.

pH (upper river):

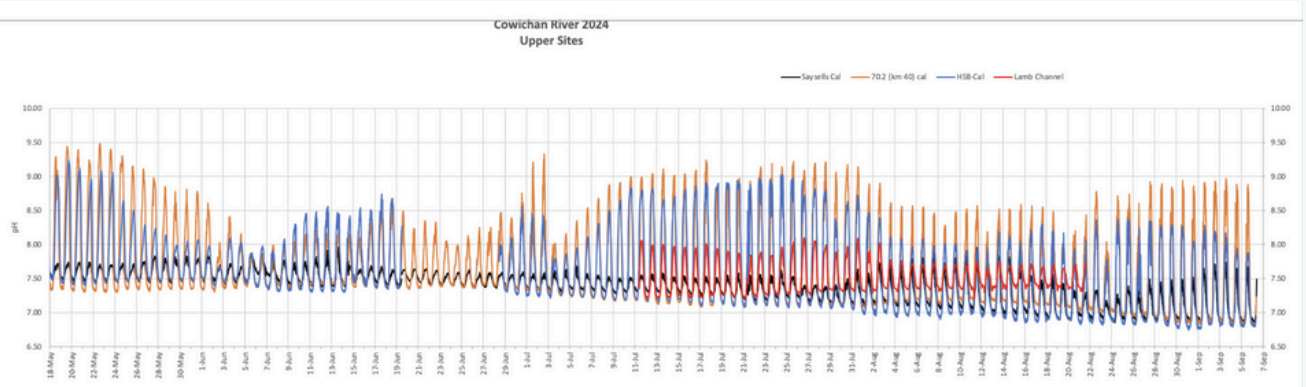


Figure 1. Example of continuous data monitoring results for pH from May to September 2024

- Once the Caution Zone was reached, meeting frequency became weekly, and plans were put in place to look for dead or stressed fish.

- The response actions ranged from changing weir management (water release) protocols to changing wastewater management practices to altering fishing regulations to conducting field work to document and monitor cold water refugia (Appendix 6).

- Responsibilities for these actions rested with a number of organizations: WLRS, Cowichan Tribes, Town of Lake Cowichan, Cowichan Watershed Board, BC Conservation Foundation. and the Cowichan Weir operational Team (Domtar, WLRS, Cowichan Tribes, DFO).

- Unfortunately, there was a gap in terms of the value of grab sample data for making fast decisions. Due to lab delays and problems with errors in the data, grab sample information was not available to help with response planning. While useful for assessing long term trends, it could not be used to guide decision-making.

Transferring a good plan into action

It's one thing to come up with a plan – it's another to make it happen! As documented throughout the planning process, the key to navigating this difficult step is adopting a truly collaborative approach. A few significant considerations that worked for us in the Cowichan and should work in other watersheds facing similar challenges include:

1. Keep talking, and be flexible and respectful – Things might not always go as planned!

- Ongoing regular communication throughout the season is essential. Things change, individuals get sick or pulled away, equipment breaks down, weather interferes with schedules, life happens! It's important for partners to meet regularly and be prepared to accommodate unplanned occurrences – keeping focused on gathering the information needed to trigger a response plan if need be.

- Drought response requires this ongoing communication between partners to assess the results of actions taken and continue to evaluate the need for further intervention.

- A broad and flexible communications strategy should be in place to explain the actions being taken and the rationale behind them to the general public. Unprecedented actions may be necessary that affect many people who are not involved in the decision-making (or are even aware of the crisis).

Here's how we did it:

- Weekly Monday morning "situation room meetings" were held by the decision-making team to review the data gathered the previous Friday and make decisions on whether or not adjustments to responses were required A small group of decision makers from Cowichan Tribes, local government and senior federal and provincial resources management agencies met weekly first thing Monday morning to review data and make decisions.

- BI-weekly technical meetings were held with key monitoring team members to tweak technical programming and deal with equipment and/or personnel needs in order to keep good data flowing to inform in-season decision making.

- Monitoring results and actions taken were reported weekly to all workshop participants and to the public with requests to look for and report any dead or stressed fish. The CWB and its partners provided weekly updates to the general public through open board meetings, newsletters and other tools (Appendix 7).

Maintaining momentum and moving forward….

Drought response is not a "one and done" exercise. In 2024 the Cowichan partners avoided a repeat of the 2023 fish mortality event. What about next year - or 10 years from now? Climate change impacts on rivers and salmon are only expected to get worse. What's the long-term plan?

1. Keep the partners together. Drought response tables are an essential piece of the puzzle.

- Climate change adaptation is a big job. It requires a collaborative approach bringing in partners with a range of authority and responsibilities.
- Creating and maintaining an ongoing watershed scale drought management table is not a "nice to do", it's a must do.
- Ensuring continuity year to year will strengthen relationships, improve efficiency, and effectiveness and result in better and more timely outcomes.

"Fish kills can be cryptic and not always in your face; all monitoring was important. This year was a win but it is tenuous — we have to keep at it and are well set up to do that."

- Jennifer Moss, Resource Restoration Biologist,
Fisheries and Oceans Canada

Here's how we did it:

- After successfully implementing agreed upon monitoring and response plans in 2024, the Cowichan partners met in December to debrief, discuss what worked and didn't, identify gaps and plan for 2025 (including resourcing the gaps) (Appendix 8).
- The team will meet again in April of 2025 in preparation for the field program roll out.
- Maintaining continuity has allowed the Cowichan partners to build and strengthen relationships, build on shared experience and provide collective onboarding and mentoring for new participants.

“This was a wake-up call. We avoided another fish kill this year - although it could have happened without this work. It’s a privilege to be part of this effort and I look forward to next year.”

- Ellery Jackson-Renz, Environmental Services Technician, Cowichan Valley Regional District

2. Share the load. Drought response is not free.

- Effective monitoring – and implementation of required responses to drought conditions requires resources – both human and financial.
- Advance planning will assist all partners to budget for this work moving forward.
- The mandate and responsibilities for managing water, rivers, watershed values, salmon, drought, and community wellbeing are spread between all levels of government and First Nations and supported by empowered communities, industry and academia. Pooling resources enables well-resourced programming that would otherwise not be possible.

Here’s how we did it:

- All partners involved in the 2024 Cowichan response initiative provided resources (staff time, equipment, cash, training, etc.)
- At the December debrief a gap analysis was costed and by the end of the meeting all gaps that had been identified were addressed by the participating partners. Incremental costs were shared between several partners, enabling an enhanced monitoring plan that would be “out of reach” for any one organization or agency.
- Grant applications for this work are attractive to funders as a result of the robust engagement of First Nations, all levels of government, ENGOs and academics. A stable inclusive drought management table is seen as an attractive option for many funders, much more so than any of the individual partners.

3. Both short (responsive) and long (proactive) term planning is required.

- Climate change impacts are expected to get worse.
- "Dodging a bullet" one year does not provide assurance of similar success the following year.
- Both long- and short-term response planning is necessary.
- Short term actions may not be effective or sustainable over the long term.
- Long term interventions are likely to take time – either to plan and resource major infrastructure initiatives or to implement "governance" solutions involving longer term planning initiatives.
- Both are necessary and neither can be ignored!

Here's how we did it:

- In the short term, the Cowichan team has identified and is implementing a suite of response actions. It is recognized that these are stop gap emergency measures and that a long-term plan/intervention is needed.
- Work to implement 5 such measures is currently at different stages:
    - A new Cowichan weir which will provide over 42 million cubic meters of additional water storage, providing adequate e-flows through the summer.
    - A cold-water siphon extending upstream from the weir which will allow for cooling of the river.
    - A "whole of watershed" plan that will look at changing the way we use our water and our land to ensure a more sustainable future.
    - New wastewater treatment infrastructure for the Town of Lake Cowichan that will significantly reduce nutrient inputs into the upper river
    - A new outfall for the Joint Utilities Board wastewater treatment facility that will move the outfall out of the river into the marine environment.

Lessons Learned from the Cowichan Experience

The 2023 Cowichan fish mortality event, the actions that followed it, and how this story might relate to your watershed are documented in this report and the attached appendices. The challenges and struggles that we are experiencing here in the Cowichan Watershed are being replicated all across British Columbia as we continue to see the accelerating impacts of climate change on our watersheds and our salmon.

The following are a few key "lessons learned" that might be applicable to your watershed as all First Nations, agency personnel and salmon stewards in BC grapple with how to better prepare for an uncertain future.

1. Climate change will impact salmon and salmon habitats in your watershed.

- Climate change is real and it's here. We can't expect conditions in our watersheds to be "as they always have been."
- As our watersheds change we must change how we manage land and water in order to protect our salmon
- We need to be flexible in our approach to salmon stewardship, adapting our work to address these new challenges in an iterative way, directly informed by Indigenous and local knowledge and strong western science.

2. We need to be proactive, anticipate what climate impacts will be and how to address them.

- In coastal watersheds increased winter flooding and summer drought are likely and should be anticipated. Prolonged drought and the impacts of wildfire are already being experienced in the interior and will likely increase
- "Status Quo" salmon and salmon habitat management practices are not likely to be successful in the future. We must collectively expect the unexpected, gather the information and have the conversations necessary to plot a different course towards a more sustainable salmon future.

3. No one Level of government, First Nation, ENGO or academic institution has the resources to deal with these challenges unilaterally. We must forge efficient and

effective working partnerships at the watershed level to deal with climate related salmon challenges.

- This is key. Unless First Nations, senior government, local government, ENGOs and academic institutions find a way to work together on watershed scale monitoring and response actions, we are likely to fail to respond adequately to climate change impacts on salmon.
- Strengthening and empowering whatever collaborative models exist in your watershed, or beginning this often difficult yet always rewarding work, is a great first step in "enhancing watershed readiness" to deal with climate impacts on salmon.
- There are simply not enough of us who are committed to a positive future for salmon to not be working together and failure to find a mechanism that allows us to do so will severely hamper the heavy lifting required to this important work.

"This is the first proactive, collaborative, successful effort to deal with these issues that I've seen in the last 40 years."

- Ken Ashley, B.Sc, M.Sc, M.A.Sc., Ph.D, BCLSS director,
recently retired Director of Rivers Institute, BCIT

4. Monitoring water and habitat conditions moving forward will be key to identifying problems as they arise and assessing interventions to deal with these problems.

- If you don't look, you won't know…
- A collaborative approach to designing and resourcing a monitoring plan that will provide the right information to trigger responses to worsening conditions is a cornerstone of salmon resiliency.
- This is where partnerships pay off. If the cost of equipment and field time is shared between a variety of partners, a monitoring program can be much more fulsome and benefit from the input and advice from a variety of different perspectives.

5. Monitoring is not enough. Watershed partners need to identify "levers that can be pulled" where ever possible and collaboratively create response plans.

- No one wants to “monitor as salmon die.”

- Collaboratively developing and empowering a response plan using Indigenous & local knowledge as well as strong western science is an essential task. This is not just technical work. Decision makers from First Nations and all levels of government need to commit to implementing these response plans.

- In the Cowichan example, First Nations biologists, wastewater treatment engineers and local government technicians who had not previously worked together were all part of a strong team working with a common purpose and a mandate from their elected officials to contribute to a collaborative decision-making process and implement any decisions made.

6. Identifying, protecting and enhancing key “refuge habitats” is a recommended response action that is common to most, if not all, watersheds.

- Work needs to be done to identify habitat features that provide refuge in extreme drought and flood conditions.

- These features should be mapped and provided increased protection and, if feasible, their value to salmon be increased through restorative interventions.

- As our summers become hotter and summer river temperatures increase, cold water refugia will be key to ensuring salmon sustainability.

7. Good communication is essential – Keep talking!

- Things can change rapidly when implementing complex monitoring programs in the real world. Scheduling regular opportunities to touch base, discuss challenges and respond collaboratively to unforeseen events is an essential component of this work.

- There is incredible value in keeping the broader community engaged and informed as to “how things are going” for salmon – and to actively celebrate whatever successes come our way!

- It’s also important to celebrate whatever successes come our way and remind our communities what a privilege it is to live in a watershed that supports Pacific salmon – and how fragile that privilege is!

In Conclusion

The increasing impacts of climate change on Pacific Salmon in British Columbia require a collaborative watershed scale response.

This report tells the story of our experiences over the last couple years in the Cowichan Watershed. We have every expectation that the challenges we are currently facing will increase in scope and scale, and that we will have to continue to evolve and adapt in order to ensure a sustainable future for Cowichan Salmon – and we have every confidence that our collaborative approach will enable us to do so.

We hope that by telling our story we have provided some ideas and perspectives that will assist other communities to work together for the benefit of salmon stocks across BC.

"When something (like this fish kill) comes up we feel helpless. Meeting like this ... brings greater collective knowledge and better capacity to respond. I feel way better. It's no longer just a sense of loss. We are collectively moving somewhere. We are all able to sit and talk this issue through. It's the right approach and one that is often not taken."

- **Tim Kulchyski,** Cowichan Tribes Member, Fisheries Biologist, Lulumexun (Lands and Governance) Cowichan Tribes

Acknowledgements

While doing this work, several partnerships were strengthened or established that will support continued and coordinated work aimed to protect and restore the health of the Cowichan River well into the future.

The partners included representatives from:

- Cowichan Tribes
- Fisheries and Oceans Canada
- Ministry of Water Land and Resource Stewardship
- Ministry of Environment
- Cowichan Valley Regional District
- Town of Lake Cowichan
- British Columbia Conservation Foundation
- Cowichan Lake and River Stewardship Society
- Somenos Marsh Wildlife Society
- Friends of Cowichan River
- Dr. Ken Ashley (Special Advisor)
- Cowichan Watershed Board

This project was completed on the unceded Coast Salish Territory. Larry George and Philomena Williams welcomed the partners onto Quw'utsun territory to do this work. Tim Kulchyski provided knowledge about the river and the fish it supports that further strengthened the outcomes of this project.

Funding was provided by the Pacific Salmon Foundation and is acknowledged with appreciation.

All photos by Cowichan Watershed Board staff, volunteers and monitoring partners. Group photo on page 1 by Graham Twomey.

Appendix 1: Workshop 1 Notes – Monitoring Plan Development

Cowichan Watershed Water Monitoring and Fish Response Workshop:
Towards a clear plan for detecting and responding to risks to juvenile fish
Workshop 1 – Meeting Notes (Final Draft)
March 12, 2024

Summary of Actions (to be completed prior to April 17th meeting):

1. Mike: to circulate the memo prepared by Nathan Medinski to all workshop participants
2. All: Prepare surplus equipment inventory
    a. Rosie has surplus she will inventory
    b. DFO likely has 3 pH monitors to lend
    c. Tim will see what CT can offer
3. All: Use surplus year-end funds to purchase equipment
    a. Kevin and Cheri to connect regarding equipment needs and pricing
4. Mike to report back to participants ASAP on HCTF funding to enable partners to see where they can help with shortfalls
5. Heather/Rosie: Calculate cost per sample site for sampling following WQ objectives
6. Heather/Tom (in consultation): In a 'straw dog' format, propose for consideration trigger points – what WQ parameter levels trigger action?
7. All: prepare to bring forward action options to consider as a collective group
8. All: consider what messaging we need out in the community. Are there education/training questions?

Workshop Objectives:

a. Develop a common understanding of current water quality sampling and other relevant monitoring regimes in the Cowichan River;
b. Explore together the design of an ideal water quality sampling regime that tracks what we know about key impacts;
c. Apply collective knowledge to assess current water quality monitoring gaps and develop strategies to fill them;
d. Design, clarify and invite participation in a technical process for detecting and responding to lethal water quality conditions; and
e. Time permitting, brainstorm an initial list of possible response strategies for further deliberation future session.

Welcome - Larry George, Lulumexon Director, Cowichan Tribes
Larry welcomed the group, expressing appreciation for everyone's willingness to work together toward solutions to help fish populations survive another possible drought year.

Background Information and Potential Pathway Ahead – Tom Rutherford, Cowichan Watershed Board
Tom provided an overview as to why the workshop was planned. In 2023, there was a significant fish mortality event caused by some combination of low flows due to drought conditions, high temperatures, high nutrient inputs from the Town of Lake Cowichan (TOLC) sewage treatment and associated algae growth and decomposition contributing to huge fluctuations in pH and dissolved oxygen, creating lethal conditions for fish. This is a big problem requiring the participation of a wide range of expertise and resources and is beyond the scope of what a single partner working alone can resolve. However, the partners gathered at this workshop can combine expertise and resources to make a difference.

This workshop intends to develop an early warning system to inform the stewardship community when river conditions are approaching lethal conditions. In a second workshop in about a month, we will address how we can respond when river conditions decline.

Current Monitoring Regime – Heather Pritchard, Cowichan Watershed Board
Heather provided an overview as to what water quality monitoring plans are already in place for the Cowichan River in 2024. Specifics may adjust after today's workshop as gaps and synergies are identified.

- BC Environment, in partnership with CWB, will be conducting water quality monitoring at 7 or 8 sites once/week for 5 weeks during low flows (August) and again after first flush (~mid-October). Parameters from water quality objectives approved by the province in 2011 will be followed. In addition, orthophosphate will be assessed.
- BC Fisheries established 3 sites in 2023 for continuous monitoring of temperature, dissolved oxygen, and pH. One site is above the sewage outfall, the second is at 70.2 Mile Trestle, the third at Horseshoe Bend. At a minimum, these sites will be monitored in 2024. Grab samples were also taken at each site, assessing many of the parameters established in the water quality objectives.
- The CVRD also has long term water quality monitoring sites. There are 5 located along Cowichan River and they are sampled 3 times/year, at spring, summer low flows, and fall first flush. The parameters align with the water quality objectives and include additional coliforms, nutrients and metals.
- Specific toxins are being assessed by several partners:
    - 6PPD-Q (tire compound) is being assessed by BCCF, DFO, CT, CLRSS;
    - UV Filters are being assessed by BCCF and CLRSS

Comments from participants:

- Sampling of contaminants of emerging concern is important.
- Environment and Climate Change Canada have a 20-year data set.
- Nature Trust and Cowichan Tribes conduct sampling in estuary; there is one site on the main stem and at Quamichan; requires proprietary software to access data.

What Would an Ideal Monitoring Plan Look Like? Mike McCullough, BC Fisheries (WLRS)

Mike provided an overview of some shortfalls in current monitoring followed by suggested improvements to address fish health. Shortfalls included:

- Permittees of sewage treatment plants are also required to regularly sample water quality. This includes the TOLC and the Municipality of North Cowichan (for the JUB outfall). However, agreements are out of date and do not meet the requirements in current water quality objectives.
- Sampling to date has been episodic monitoring. While this is useful for assessing long-term change, it isn't enough for assessing fish health when there are immediate issues.
- In 2023, after the fish mortality event, BC Fisheries quickly put monitoring in place that was helpful for understanding what may have happened; but it was initiated mid-season whereas we now need an early warning system so we can identify potential stressors and mitigate (e.g., change flows).

A monitoring strategy needs to include:

- Flow levels (critical for assessing dilution and overall quality of fish habitat);
- Parameters in the water quality objectives, plus others as recommended today (e.g., un-ionized ammonia);
- Expand continuous monitoring sites to middle and lower reaches (e.g., Vimy);
- Monitor earlier in the season and regularly (e.g., every 2 weeks); and
- Include biomonitoring:
    - Adult fish: increase snorkle surveys from 1 to 2 per year
    - Juvenile fish: 10 established electrofishing sites assess rainbow trout spawner abundance
    - CABIN sites to assess overall stream health via invertebrate populations (sites along river have been established in past)
    - Algae: using periphyton plates, chlorophyll a, algae species composition
- Ensure data is entered into EMS is important to ensure accessibility

Points brought up in follow-up discussion include:

- Grab samples taken at the same time each day do not capture diurnal changes; continuous loggers are better for some parameters. Are there other parameters besides DO, temperature and pH that require continuous monitoring probes? Probes can be expensive and are difficult to maintain
- A technical memo written about the fish kill with recommendations was written by Nathan Medinski and will be made available to the group
- ALS is under contract to the province to assess water samples and enter data into EMS; turn

- around is usually about 2-3 weeks; MOE QAQC takes longer and depends on budget
- BC Fisheries 2023 data showed that DO was supersaturated (up to 200%); DO and pH fluctuated broadly diurnally; orthophosphate was 10-15 micrograms where we would expect to find 1-2 micrograms; usually orthophosphate is limited constraining algal growth - however this is not the case in the Cowichan River.
- Fish population estimates: last creel survey is old (due to high cost); snorkel surveys are used as they are an inexpensive surrogate, and are useful for calibrating snorkel surveys.
- More snorkel surveys would be beneficial, and earlier (mid-May to also catch resident fish).
- Important to align/update authorizations for TOLC and JUB with water quality objectives.
- There's a gap in terms of how information is analyzed and communicated.

Straw Dog Monitoring Plan – group brainstorm:

What:

- Provincial WQ objectives for Cowichan River: include Dissolved oxygen (top to bottom)/ pH / Phosphorus / Chlorophyll A, water temperature, nitrogen (all forms)
- Contaminants of emerging concern
- JUB's impacts and lower river condition
- Algae populations throughout system
- Invertebrates
- Fish monitoring (including health), esp. middle river
    - Who is looking for dead fish? In 2023 it was reported by a member of the public versus caught through monitoring
    - Lethal sampling of healthy fish
- Lake temperature monitoring (affects river temps)
- Option: assess nutrients hourly over one sunny day to look at impacts on pH or algal growth
- Groundwater/cold water inflow monitoring because:
    - Can change the condition of downstream water through dilution
    - Mixing of cold, clean groundwater and high pH river water at refugia locations - where do things become toxic?
    - We need to protect it – cold water refugia resulting from groundwater inflows were the only places that fish survived in that 10 km stretch

Where:

- Is there a gap at JUB (lower river); nutrient source at sewage outflow?
- We need to know more about non-point sources (i.e., not just sewage outfalls)
- Small creeks: small groundwater fed creeks keep Cowichan alive (e.g., Exeter creek); development in these areas can dry up those creeks

Ken's Presentation: Key Lessons and Priorities

The Cowichan River is a mixed runoff hydrograph, influenced by inputs from the lake and run-off in the form of rain and some snow. Different sections of the river perform different functions. The river is 47 kms long. The 1st km is influenced by the lake; followed by a section with tight canopy

canopy producing shade; then it opens and more sunlight reaches river. Here we see more algae as well as more oxygen and carbon produced. These areas should be our focus for monitoring. Climate change and nutrient inputs from effluent are problems affecting river health.

Six to 7 sampling sites should be evenly distributed along the river (~ 7 km apart), with one above and below each sewage outfall. Nutrient cycling within algae community can cause problems when nutrient inputs are high; there is a cycle where phosphorus is taken up to support algae growth and then released during decomposition; the cycle continuously repeats.

Fish growth happens in 4 months (June to September); otherwise, they are mostly hanging out. The important sampling time is from the beginning of June to September; the most important timing window is July and August. Ideally, begin sampling in late May to early June on a monthly basis, then switch to every 2 weeks July August, and depending on September conditions, monitor water quality once or twice monthly.

The most important parameters to sample are nutrients, general ions, total phosphorus, orthophosphate, dissolved phosphorus, all the nitrogens, particularly un-ionized ammonia, as higher temperatures and pH affect toxicity. Continuous monitoring of DO, temp, pH is also important.

If funding permits, other useful parameters are:

- Periphyton, 2 sets, (June1-July15) - (July15-Sep1)
- CABIN (benthic invertebrates)
- Algae
- Fish surveys

Ken has written a “Protocol for Sampling Nutrients in Rivers”

Within the process of developing a monitoring program, it is important to address who collects what, who analyzes/interprets results, and who reports out. Identify who the partners are and define roles. Communicating out the results well is important for getting support from government.

Good news is that Ken’s thinks the issues in the Cowichan River are fixable. Important considerations are to not let flows get down to 4.5 cms all through July and August. Based on the information he looked at on nutrient inflows and river discharges, Ken determined that the river can handle effluent if flows are 10 cms. A short-term solution for when flows are lower than 10 cms is to manage nutrient inputs.

There are 3 priorities for this coming year:

1. Manage river flows and temperature via the weir. Do not let flows get low in July and August.
    a. Also, protect cold water refugia, protect inflowing creeks (riparian areas and runoff). This is especially important where developments are being built.

2. Reduce impacts of nutrients when flows reduce. Nutrient levels (ammonia and phosphorus) must not reach levels measured in 2023. Alum or chlorofluoride can be added to bind with phosphorus to reduce algal growth (this is already done at JUB).

a. In 2023 phosphorus was over 5000 units below outfall versus undetectable elsewhere in the river. We should never see free phosphorus in the water. If it's not absorbed, the system is grossly overloaded;
b. Ammonia was 35,000 units and could kill fish on its own;
c. pH> 8 harms fish, such major daily fluctuations also harm fish.

3. Consider surface aerator in wastewater treatment plant (to reduce amplitude of DO swings).

In summary, the combination of high temps (18-25 degrees), low flows and increased nutrients caused algal bloom which, along with bacteria, produce oxygen in the daytime and respire significant CO2 at night producing huge swings in DO and pH. When NH4+ is produced, fish aren't impacted; however, when NH3 is produced, it causes internal shocking and this change is precipitated by the change in pH. At night when algae (and bacteria) are respiring, oxygen is taken away, reversing pH and DO levels. These huge fluctuations and elevated pH levels are harmful to fish.

For the long term, raising the weir is key. Plans include roughing in of a cold water siphon from the lake. Budgets don't allow for constructing this now, but the option to do it later will be available. Okanagan Falls had an identical problem as Lake Cowichan (2500 versus 3000 people) and went to a state-of-the-art plant (it removes everything including pharma; can raise trout in the effluent). They paid $10 million which equals the amount TOLC has for a new plant.

In terms of establishing a monitoring plan for 2024, if funding is inadequate:

- Sample in July and August and reduce or eliminate early sampling, that is, in May;
- Drop sites where there have never been issues;
- Ensure sites where issues were last year are sampled in 2024 as this is where any issues will likely occur again;
- Don't compromise on what you are monitoring (this part is inexpensive); and
- Ensure continuous monitoring of pH, DO, temp occurs at places where mortality was observed last year.

Jessica summarized preliminary thoughts based on Ken's presentation:

- MOE sites: every 2 weeks at 7 sites - (as per water quality objectives); and
- BC Fisheries sites: Continuous sampling of DO, pH, temperature monitoring at approximately 4 sites, plus grab samples at these sites following water quality objectives.

Summary of preliminary actions:

- Fiscal year end equipment purchase
  - Inventory who has what - where are there gaps? Who has excess and can share? (MOE has 'expired' equipment that still works great but is not being used. Rosie can provide a list of what MOE has.)

- Add an earlier snorkel survey day
  - May or June was suggested
- Identify the process for deciding on who decides what lever to pull in what situation

Breakout sessions:

WQ Team: One group discussed what a monitoring plan for 2024 would look like. This is presented in a separate table (to be circulated prior to Workshop #2).

The strategy included these actions:

- Create budget estimate: determine cost per sample site and multiply out by number of samples and number of sample sites
- Work with TOLC (and MNC?) to increase number and timing of samples to levels above permitted requirements to help partners proactively identify problems
- Ensure monitoring plan includes back-up sensors in case of equipment malfunctions
- Monitoring has to be up and running no later than June 1st
- Consider establishing a real time monitoring site at Skutz falls where there is power and wifi

Some barriers were noted:

- Costs of additional sampling. BC Fisheries is waiting for response from HCTF which will inform our path forward;
- Who is looking that data and watching for triggers?; and
- Volunteer capacity for CWB/MOE attainment sampling now that we are looking at additional sites.

Data Collection and Analysis Team:

Data collection:

a. Continuous data loggers:

- we need to decide on schedule for data collection
- training is required, especially on how to maintain and calibrate equipment; who can do this?
- Set up and security will be important for this expensive equipment; do we need locks? how do we ensure access?

b. Grab samples:

- Can these can be taken by the CWB volunteers or are they at capacity?
- Are these sites needed or is MOE/CWB attainment sampling sites enough (if started earlier)?

Analysis:

a. Continuous data:

- Need to identify triggers, and who decides what triggers are and what thresholds are? How can we ensure timeliness?

b. Grab samples:

- Analysis done by ALS and reported to MOE (in roughly 2 or 3 weeks)
- Work with CT to ensure sampling around and below JUB helps build data set (i.e., is consistent

)Communication:

- If triggers are hit, how is that information communicated? Who needs to know? Who will pull levers? (TBD at next meeting)

Bottleneck:

- Finding the dedicated capacity for analysis or is it a bottleneck?

Wrap-up:

Triggers will be an important part of the next conversation. Ken has established a system of triggers in a paper. These include:

- Caution as pH reaches 8.5
- Phosphorus: pay attention over 5ug/l; at 7.5 - 10 ug/l, expect algal mat
- Watch ammonia, pH and temp together
- Management trigger example: At Hope, when water reached 20 degrees, catch and release for sturgeon was stopped due to stress on fish

Analysis does not need to be complicated:

- Check the triggers EVERY time that data comes in, especially in July and August. Look for warning signs. It is not complicated and doesn't require expertise to do (like a traffic light - green/yellow/red).
- When yellow zone reached, look for dead or stressed fish

Brainstorm on short term (2024) responses:

Responses will be the main focus of the follow-up workshop. To begin the process, a quick brainstorm came up with these ideas:

Short Term:

- Cover sewage ponds to create shade and decrease heating (Ken to discuss with TOLC)
- Add alum to effluent (Ken to discuss with TOLC)
- Pay attention to development activities that interfere with groundwater/small stream inputs to cold water refugia
- Coast Guard levers – which ones will help?
    - Is in-river recreation during low flow high temperature events an issue that requires limiting?
- Restrict angers to fishing during cooler weather (outside spawning season)
- Educate the community through articles in the newspaper re: the cold-water inputs between the highways, groundwater protection; conservation letters to gov't
- Any training requirements?

Long-term responses:

- Cold water release already designed to be 'roughed in' as part of the weir, so weir construction will make it easier to add it later when there is money.
- Superior sewage treatment design - clean water coming out of new facility
- Weir - process underway. Future rain is uncertain but priority has shifted from optimizing for fish habitat protection.
- River Corridor - riparian protection but larger. Keeping it cool. Can we push the gov't to have more park? Last park addition was 2002. Land acquisition.

Attendees for Workshop #1:

Larry George (for welcome) – Cowichan Tribes
Kevin Pellett - DFO
Karalea Filipovic (Cantera) - DFO
Ellery Jackson-Renz - CVRD
Mike McCullough - BC Fisheries, WLRS
Ken Ashley
Kristine Sandhu - CWB (TOLC)
Liam Janke - UVic student
Haley Tomlin - BCCF
Jay White
Dave DePape - CLRSS
Marissa Waddell - PSF
Rosie Barlak - MOE
Tim Kulchyski - CT
Gretchen Hartley - KWG
Rodger Hunter - KWG
Cheri Ayers - Consultant
Phaedra Douglass - SMWS/CWB
Jill Thompson - CWB
Heather Pritchard - CWB
Danni Paydli - CWB
Tom Rutherford - CWB
Joe Saysell

Appendix 2: Monitoring Plan

Method	Sites	Parameters	May	June	July	Aug	Sept+
Grab samples	Up to 11	From MOE WQ objectives: E. coli, chlorophyll a, total phosphorus, ammonia, DO, temperature, turbidity, non-filterable residue, copper, lead, zinc Other: orthophosphate, pH, conductivity	Bi-weekly	Bi-weekly	Bi-weekly	Weekly for 5 weeks	Bi-weekly until fall flush
Continuous sampling	6 to 8 sites	Temperature Dissolved oxygen pH	Yes	Yes	Yes	Yes	Yes
CABIN Benthic sampling	Up to 6 sites	As per CABIN guidelines at established sites				Yes	
Periphyton sampling	Grab sample sites			Sample 1: June to July 15th	Sample 2: July 15th to Aug 15th		
Fish - snorkel surveys	Throughout system		May or June	May or June	July 25	Yes, if mortality evident	
Fish - smolt trap	70.2 Mile trestle	Coho	Install in spring				
Fish - health	Along 2023 10km kill stretch				If fish mortality discovered	If fish mortality discovered	

Appendix 3: Workshop 2 Notes – Response Plan Development

Cowichan Watershed Seasonal Monitoring and Fish Response Workshop #2: Developing a clear plan for detecting and responding to risks to juvenile fish
April 17, 2024

Workshop Objectives:
a. Share and develop a clear understanding of the proposed monitoring plan for this summer, including confirming a smaller group of representatives who can work together to refine technical details as needed;
b. Discuss and refine a proposed near and longer term response strategy, including key thresholds to trigger in-season action;
c. Develop a common understanding of the in-season actions likely to be taken this summer by those responsible for different components of the strategy;
d. Clarify communications and information sharing related to monitoring and response; and
e. Time permitting, begin to consider what longer-term response planning and capacity building could look like.

Anticipated Outcomes include:

1. Approval in principle for the monitoring plan, with a dedicated team identified to continue refinements as needed
2. Refined overall response strategy for addressing underlying issues affecting juvenile rearing
3. Improved understanding of the specific actions those responsible are likely to take in-season
4. Clear understanding of the communications and information sharing this summer

Welcome - Larry George, Lulumexon Director, Cowichan Tribes
Larry welcomed the group and set the stage for the workshop and identified the importance of this work to Cowichan Tribes. Larry expressed his appreciation for everyone's hard work and willingness to work together on this important issue. He explained that 'lulumexan' means 'guardians' and that this is the role of all of us on protecting the river and fish.

Cowichan River Monitoring Plan (draft)
Heather Pritchard described the proposed monitoring plan as developed in the previous workshop as well as some of the remaining gaps and new opportunities that arose from discussions within the monitoring partners since workshop #1.

For **continuous monitoring**, the partners came up with equipment for 6-8 sites, including the 3 sites from 2023, a 4th at Sandy Pool, plus a site above and below JUB. There is equipment for 2 additional

sites with location to be determined.

For **grab samples**, 11 sites were selected, fairly equally spaced throughout the system:

- MOE parameters + orthophosphate, pH, conductivity. The timeframe has expanded to include bi-weekly sampling in May, June, July, and September until fall flush. CVRD has offered staffing to support this work
- Cabin benthic sampling (6 sites)
- Periphyton sampling (needs more discussion) - could sample at continuous monitoring locations dependent on outcomes, funding, etc.

Fish surveys include:

- Snorkel surveys for July 25th (as usual), an earlier spring count, and additional counts if dead fish are reported
- Fry and smolt (coho) downstream trapping surveys are ready to go

Discussion:

- WLRS is looking after periphyton sampling and it will occur at grab sample sites
- Additional water quality monitoring occurs (under permit) above and below Jub (3x/yr)
- CVRD has a hydrometric station by Jenny Place on Riverbottom Road that measures flows and temperature
- Lethal sampling of live fish is still being considered and Kevin is following up with DFO vet; BCCF can store fish and can do gill biopsies and RNA on live fish to help identify environmental stressors
- There was the question if gas saturation can be added as a water quality parameter?
- There was discussion around having other watersheds considered for continuous monitoring; adjacent watersheds (Chemainus/Koksilah) could be in-basin controls to support understanding of the Cowichan watersheds; after confirming priority sites in the Cowichan system, the same protocol could be applied in the adjacent watersheds; it is unknown if there have been fish kill events in these other watersheds, however, on August 18, 2023 around 60 dead coho were observed within an hour in Somenos.

Towards a Coordinated Response Strategy

A straw dog response strategy, primarily developed by Ken Ashley, was presented, discussed and adjusted with input from the partners. Tom and Ken introduced the proposed strategy. Key messages:

- A typical emergency management system has a list of triggers that are closely monitored and a selection of response. For example, in wildfire management, concern arises when conditions hit any of when 30 degrees, 30 km/hr wind, 30% relative humidity. As concern grows, team meetings switch from weekly to daily.
- There are 4 major levers to pull depending on water quality, flows and fish survey results: i) sewage treatment; ii) flow and temperature management; iii) river use management; and iv) habitat protection.

- Effectively applying these levers requires paying ‘emergency’ lab rates to ensure quick turn around.
- A new approach is needed, with ‘all hands on deck’ for up to 3 months.
- There is also the need to develop a long-term plan/policy (e.g., fishing, ocean-use, development & groundwater, land use planning, etc.) to avoid annual emergency response.

Response Strategy

Response Strategy	In season objectives	Caution/Triggers	2024 Response Actions
1. Sewage Treatment	Reduce/curtail P and NH3 discharges in June, July + Aug	**Caution** - reduce NH3 and P release into river when river flows reach 8 m3/s in June; **Trigger** - curtail NH3 and P release into river when river flows reach 6 m3/s in July and Aug	Install alum injection system Dilute and/or store effluent using 3rd large lagoon
2. Cowichan flows and temperature management	Manage river storage and discharge in May and June to allow > 6 m3/s in July and Aug	N/A	Maintain July flow > 6 cms Maintain Aug flow > 6 cms
3. River use management	Reduce angling/ recreational river use impacts on fish/fish habitat	Flows: **Caution** - flow < 6.0 m3/s **Trigger** flow < 4.5 m3/s Temperature: **Caution** – river temp > 20 C **Trigger** – river temp > 22 C	Proactively prepare Directors Order for angling closure Close angling in July-Aug if flows < 4.5 cms and water temp > 22 C
4. Habitat Protection	Protect cold water refugia		Collate/map current knowledge on cold water refugia Educate water users to reduce water use in June-Sept.

Strategy #1 – Sewage treatment (Jas Sandhu and Ken Ashley)

The TOLC shares the concern of this group and is preparing to take action to reduce future nutrient impacts. Ken Ashley has prepared a report for TOLC that provides solutions for 2024 and beyond. In summary, for 2024 the TOLC will be implementing actions as appropriate that include adding alum, upgrading aerators and/or utilizing the 3rd unused pond for storage or dilution.

Current sewage treatment:
In summer, lagoon #1 receives 10 l/s of effluent. Next the effluent enters lagoon #2 where there are 6 aerators. It sits there for 25/26 days. Organic materials decompose (proteins turn into ammonia and nitrates). Effluent is then chlorinated and dechlorinated before being released into the river. A 3rd lagoon (50 m3) is unused at this time.

Sewage treatment options for 2024:

- Option #1: Place curtain across lagoon #2 to create a small pond. Add alum to small pond and let sit for 2 days to remove phosphorus (adding alum injection can reduce phosphorus by 80% bringing levels to as low as to 2 micrograms (dissolved phosphorus) per liter, as opposed to 10 micrograms in 2023).
- Effluent then stays in the larger portion of lagoon #2 for 26 days where ammonia naturally converts to nitrate. Enhanced denitrification can reduce ammonia by 100% in summer.
- Option #2: Dilute effluent in pond 3 prior to release into river.
- Option #3: Store effluent in lagoon #3 for 60 days (maximum holding capacity) and discharge as flows increase (this is a standard practice in cold climates where rivers freeze), ammonia would naturally convert to nitrate after 26 to 60 days of storage. If flows got down below 8cms, this storage solution should be implemented.

Note: Options can be mixed and matched. For example, 5 l/s could be released to the river while the remaining 5 l/s is stored in pond 3, extending the length of time effluent could be stored should 60 days not be enough.

Discussion:

- Once alum is applied, phosphorus binds with it and then goes to landfill as sludge. Little sludge is produced; the last time it was cleaned out was 1972.
- The long-term solution will be a new sewage treatment plant as discussed in workshop #1 (see workshop #1 notes)
- Emergency measures are in place for JUB. Water quality monitoring occurs above and below the outfall. The outfall releases 7-8K cubic meters/day (it is 7-8 times the size of Lake Cowichan). Emergency measures include adjusting the alum system (permit allows alum for July/Aug; if fall low flows, BC Ministry approval required to continue alum into Sept/Oct). Ammonia tends not to be a problem in summer as aeration systems effectively supports nitrification. High NH3 can occur when air temperature is low as nitrification is less efficient.

- Fish kills were observed late last summer below JUB indicating it would be good to do extra monitoring there as well.
- Orthophosphate levels need to be kept below 5 micrograms/liter, though they reached as high as 10 in 2023.

Summary points:

- A working group is needed to monitor water quality results and flows.
- Additional continuous water quality monitoring stations at JUB is a good idea.
- Real time information is required to effectively use levers.

Information sharing:

- Establish a Monitoring Team and Response Team
- Hold weekly meetings June to end of August; more frequent if problem appear
- Report out to group on continuous pH, DO and temperature data, as well as flows, phosphorus and ammonia; report on lake levels if pumping required

Strategy #2 – Flows and temperature management (Kevin Pellet)

The river is currently 'on control' with flows reduced to 17 cms to store water in lake; rule curve for now is 25 cms.

The rule curve requires (to provide optimal fish habitat):

- April 1st - at least 25 cms)
- May 1st - 15 cms
- June 15th for duration of summer to fall rains - 7cms
- Pumping is required at 4.5 cms

For 2024, to prevent adverse conditions for fish by providing optimal flows for effluent dilution) we want to maintain 100% storage within limits in early season to ensure min flows of 6 to 7 cms in July/Aug. These adjustments require discussion in real time:

- April - 15-17cms
- May 1st - 7- 15 cms
- July 1st for duration of summer - 6 - 7 cms
- Sept - 4.5 to 7 cms

- Long-term plan is to build weir and ensure design includes ability to easily retrofit hypolimnetic siphon for temperature management

Discussion:

- It was mentioned that 7 cms was a value agreed to by Cowichan Tribes in the past and that it would be preferrable to not drop to the 6 cms; below 7cms may make survival more difficult for smolts, however, it may reduce risk of a fish kill event

- It was mentioned eggs and fry do better with high spring flows as they can hide in grasses; in lower flows, they are in the main channel and more vulnerable to predators; this may impact their survival; however, there is much uncertainty reinforcing the idea of having weekly calls to review triggers
- Spring chinook, which are very low in numbers now, would do better with higher spring flows; it is possible to do a pulse to bring fish in as flows are reduced
- It was discussed if flows could be kept higher in lower reaches by concentrating remaining flow into one channel; however, this has been tried in the past and was not successful – to some extent because these systems are complicated and always changing
- Lake levels must also be monitored in dry weather; there is a minimum level after which any pumping would affect water available to the residents of the TOLC
- If TOLC treats effluent and effectively to reduce nutrient levels, there is less risk in terms of pH in letting flows fall to 4.5 cms; however, any resulting higher water temperatures on their own could kill the fish

Information sharing (same as Strategy #1):

- Establish a Monitoring Team and Response Team
- Hold weekly meetings June to end of August; more frequent if problem appear
- Report out to group on continuous pH, DO and temperature data, as well as flows, phosphorus and ammonia; report on lake levels if pumping required

<u>Strategy #4 – Habitat protection – Tim Kulchyski</u>

- Cold water refugia are important habitats especially in situations like last summer
- There is a lot of pressure on these small cold water creeks from development
    - Stanley Creek is one example where during the fish kill, chinook fry were found at the cold creek water while none were found in the river
- There are only a few big cold water inputs - Gold, Bear, Fairchild, and Holt creeks (8-10 degree water in august) but influence on the main channel is less than hoped.
- Cowichan Tribes is measuring cold water refugia for trout and salmon using aerial drone thermal imaging and field measurements – these habitats are very small, but they might be important for sustaining trout and salmon over the summer when flows are low and temperatures are high

Discussion:

- There are a lot of small streams under pressure from development below Hill 60 outside the TOLC
- Even the best available drones were not good enough to detect all of these small cold-water habitats; in colder regions in Canada where rivers freeze, you can find these areas easily by seeing which parts of the river remain unfrozen in winter, but in the coast region this won't work – doing field surveys is probably the best
    - However, some equipment can do thermal mapping down to 1/10th of a degree

    - Jennifer (DFO) has capacity to do thermal mapping
- People who saw dead fish last summer didn't know who to report it to – this was a problem affecting speed of responsiveness
- There are a few tools that can be applied to protect cold water refugia:
    - Many available tools only work for Crown land, e.g., wildlife habitat features, wildlife management areas, fisheries sensitive watersheds, wildlife habitat areas
    - Other tools include development permit areas for ecologically sensitive areas, limits to water license applications
    - PMFLA review will be finalized after the Watershed Security Strategy is finalized (soon) and may include new tools
    - Impacts from recreational tubers would be under federal jurisdiction and difficult to regulate
- The sunscreen study, after 6 years, determined there is no obvious concern however bioaccumulation at low concentrations has not been thoroughly addressed
- The Tube Shack has and will continue to hand out fish-friendly sun screen

Summary of 2024 actions:

- Organize a mapping workshop to identify & document (map) cold water refugia and critical riparian areas, especially those facing developmental pressures
- Share with CVRD, MNC and WLRS
- Explore drone based thermal mapping options
- Based on results, deploy existing cold water monitoring equipment
    - place tidbits (BCCF has lots) at cold water locations; conduct swim and place data loggers at cold spots
    - Jamieson will provide quote to do work, map sites, etc. (roughly 2 weeks work)
    - Team includes Tim, Jennifer, and Jameson; Keith is recipient of technical results produced by other 3
- Develop longer-term support for looking into municipal and provincial regulatory processes to drive habitat protection (CWB role)

Information sharing:

- We need signage and communications that tell people who to contact if/when they see dead fish
- Share information with local governments so they can create Development Permit Areas for these sensitive ecosystems
- Share information with WLRS to inform water license application process

Meeting Close

Tim closed the meeting by sharing his reflections:

What resonates from this process is that there is a tiny handful of us that are out there doing this work, and when something comes up. Meeting like this today brings greater collective knowledge

and better capacity to respond. This will help us actually move forward instead of just having a knee-jerk response. I think it is great. I feel way better. It's not just that it's this huge loss but we are collectively moving somewhere. We are all able to sit and talk this issue through - you can't say that with all issues.

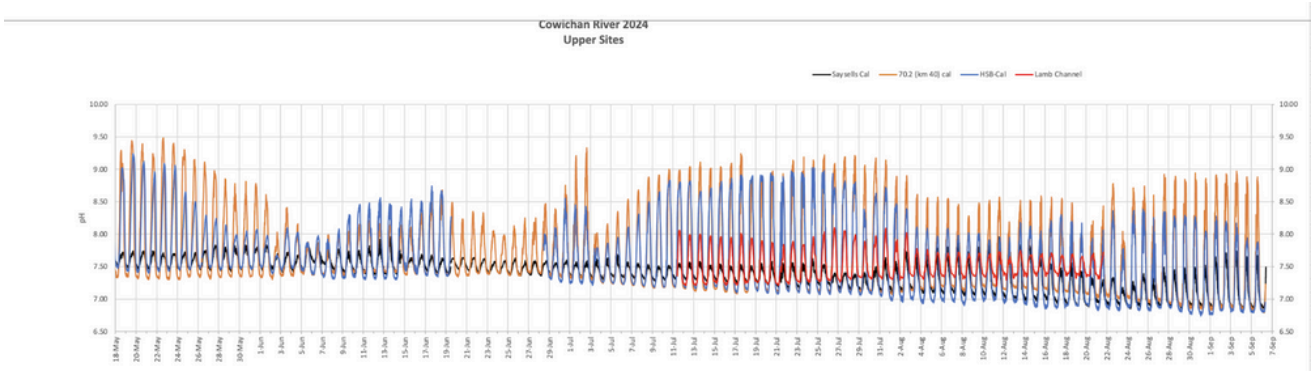
Appendix 4: Response Plan

Categories	Right Now	In Season	Long Term	Caution/Triggers
ToLC Sewage Treatment	Repair/replace all surface aerators, install alum injection system	Reduce/curtail P and NH3 discharges in June, July + Aug	Modern Okanagan BNR WWPT	Caution - reduce NH3 and P @ 8 m3/s in June Trigger - curtail NH3 and P @ 6 m3/s in July+Aug
Cowichan Flows and Temperature Management	Monitor Cowichan Lake level and river flows	Manage storage/discharges in May + June to allow 6 m3/s in July + Aug	Refire weir siphon pipe size with modelling, build weir, and include hypolimnetic siphon for temperature manangement	Maintain July flow > 6 m3/s Maintain Aug flow > 6 m3/2
River Use Management	Prepare Directors order for Angling closure	Close angling in July-Aug if flows < 4/5 m3/s and water temp > 22C		Caution - flows < 6 m3/s Trigger flows < 4.5 m3/s Caution - temp > 20 C Trigger temp > 22C
Habitat Protection	Identify cold water refugia and critical riparian areas facing developmental pressures	Water use restrictions in June-Sept	Enact WMAs on cold water refugia and critical riparian zones, enhanced riparian protection, convert houses on riparian septic systems to sewer collection	
Monitoring	Ongoing	Twice monthly in July and Aug, WWTP outfall weekly in July and Aug	TBA	As per Cowichan River monitoring plan

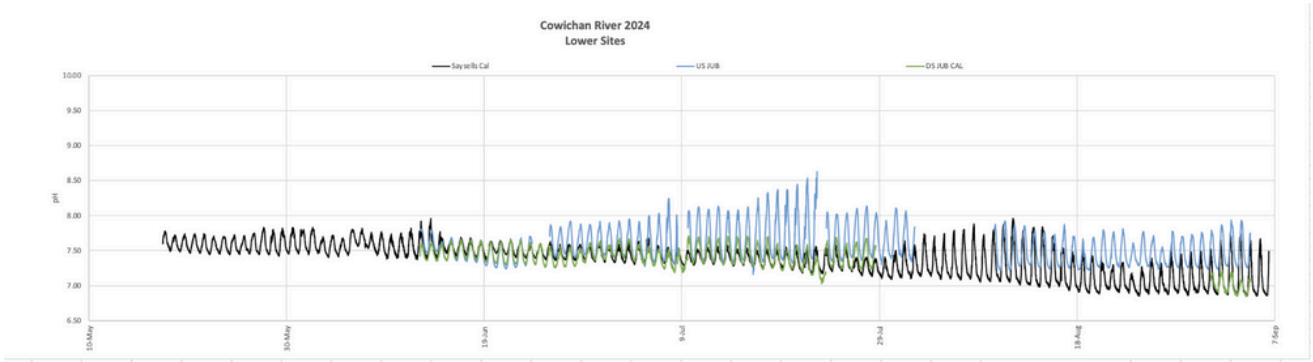
Appendix 5: 2024 Continuous Monitoring Results

Continuous Monitoring Results (May to September 2024)

pH (upper river):

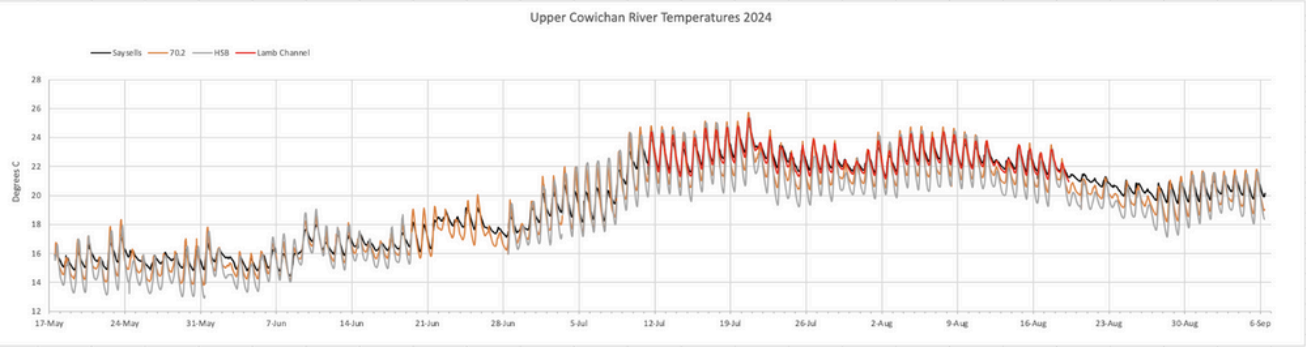


pH (lower river): Results are incomplete due to equipment tampering.

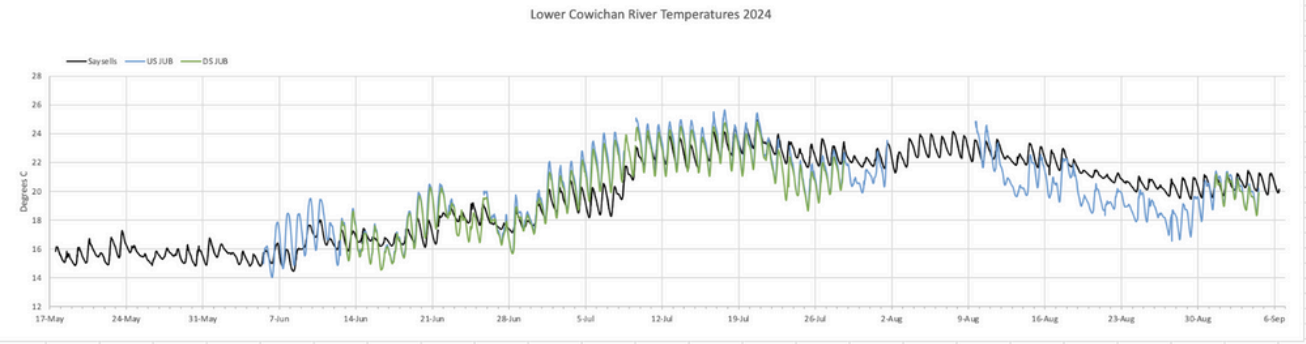


Note: JUB-Joint Utility Board sewage outfall. U/S-upstream. D/S-downstream. HSB-Horseshoe Bend. 70.2-70.2 Mile Trestle. Lamb – Lamb Creek side channel
Diurnal pH fluctuations result from algal respiration. The Saysell Site is located in the upper river above the Town of Lake Cowichan sewage outfall and represents preferred range in pH diurnal fluctuations. Wide diurnal fluctuations indicate excessive algal growth which is harmful and can be lethal to fish populations.

Temperature (upper river):

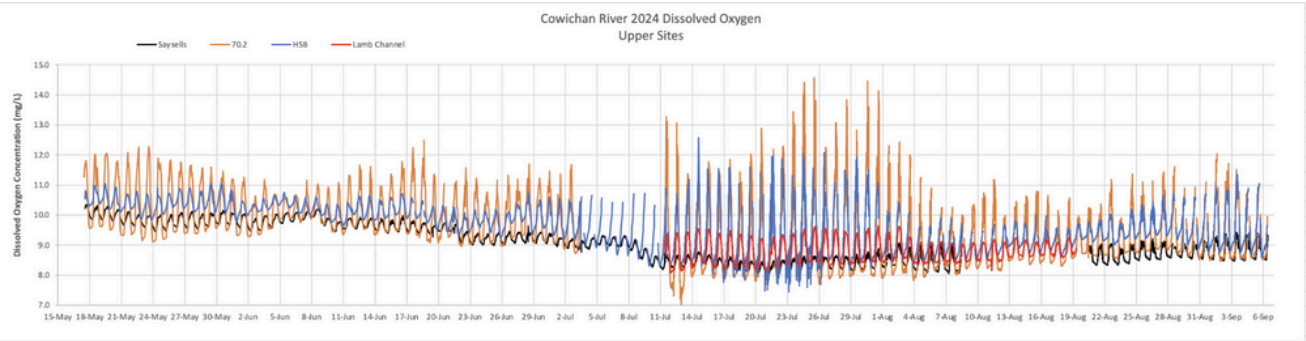


Temperature (lower river): Results are incomplete due to equipment tampering

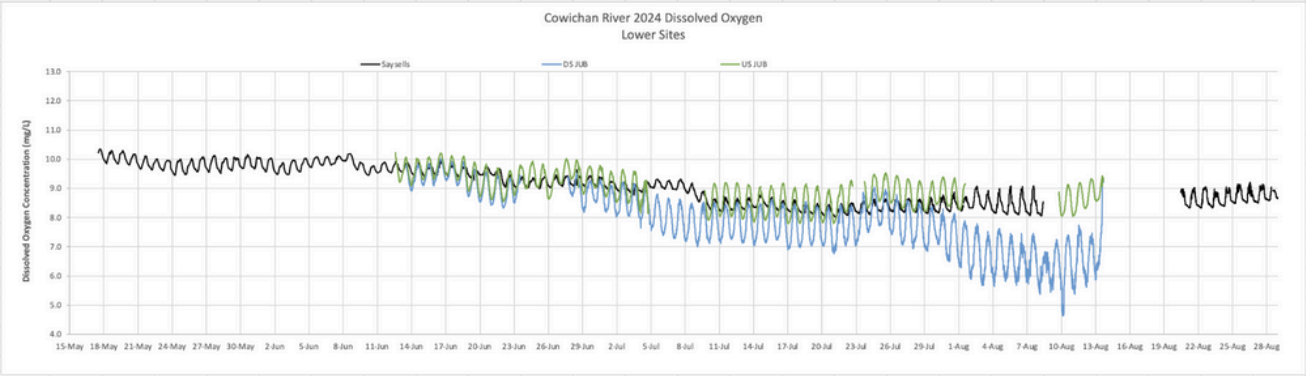


Note: Water temperatures above 16o C are stressful to salmon and trout. Temperatures above 20o C are extremely stressful and temperatures approaching 24o C can be lethal. Note: Data from Saysell's site from upper river added for comparison.

Dissolved Oxygen (upper river):



Dissolved oxygen (lower river): Results are incomplete due to equipment tampering.



Note: Diurnal DO fluctuations result from algal respiration. The Saysell Site is located in the upper river above the sewage outfall and represents preferred range in DO diurnal fluctuations. Wide diurnal fluctuations indicate excessive algal growth which can be stressful and in extreme cases lethal to fish populations.

Appendix 6: 2024 Cold Water Refugia Mapping/Monitoring Report

Prepared for:
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December 20, 2024

BRITISH COLUMBIA CONSERVATION FOUNDATION

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1.0 Introduction

The Cowichan River originates at Cowichan Lake and flows east for approximately 46 km before reaching tidal waters at Cowichan Bay. The river supports populations of Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), and chum salmon (*O. keta*), as well as rainbow (*O. mykiss*) and coastal cutthroat trout (*O. clarkii clarkii*). Like many salmon populations in British Columbia, these stocks have become a growing concern, particularly regarding rising summer river temperatures.

Climate change is expected to increase the frequency and severity of extreme weather events in British Columbia (Smith et al., 2016). In the Cowichan Valley, this is predicted to result in warmer, drier summers with reduced snowpacks (Cowichan Valley Reginal District, 2017). These changes are likely to significantly impact freshwater systems by reducing summer flows and increasing water temperatures, which would affect the suitability and availability of rearing habitat for salmonids.

Temperature is a key factor that strongly influences the distribution and abundance of species in freshwater systems (Issak et al., 2009). Cold-water adapted species, including salmonids, are especially vulnerable to warmer water conditions as elevated temperatures can lead to heat stress, affecting physiological processes and behaviour, and in extreme cases can result in mortality. The optimal temperature range for rainbow trout is between 9°C and 18°C, with the temperature range for Pacific salmon being typically lower (Ministry of Environment, 2001). Furthermore, increased water temperatures can promote diseases and favour non-native species such as brown trout (*Salmo trutta*), which are present in the Cowichan River (Robert & Machung, 2015).

2.0 Purpose

An unexpected fish kill occurred in the Cowichan River in summer 2023. The die-off was most likely caused by excessive nutrients from the Lake Cowichan sewage outfall, combined with low river flows and high temperatures, which resulted in a large algal bloom. The timing of the effluent release during low mid-summer flows exacerbated the hyper-eutrophication event by reducing dilution capacity. Following the event, large diurnal swings in pH and dissolved oxygen were observed, and nearly 10 kilometers of the river downstream from the outfall were found to be completely void of juvenile salmonids. The province estimated that 84,000 steelhead fry were killed in total (M. McCulloch, Fisheries Specialist, WLRS, pers. comm., 2023).

Given the trend toward warmer and drier summers, there is a high likelihood that large fish-kill events could become more frequent. Monitoring temperatures and identifying areas of

influence for cold-water refugia, such as tributaries and groundwater springs along the Cowichan River, is crucial for understanding potential fish refuge areas during periods of high summer temperatures. This data will help assess the relative importance of each cold-water input and inform future habitat protection and restoration strategies.

Between June and October 2024, the British Columbia Conservation Foundation's Aquatic Research and Restoration Centre (ARRC) and Cowichan Tribes deployed temperature loggers at cold-water inputs along the Cowichan River. Multiple loggers were installed at three major sites to estimate the extent of their cold-water influence by capturing temperatures above, below, and at the cold-water sources.

3.0 Methods

3.1 Temperature Logger Deployment

Between June 27 and July 5, 2024, ARRC and Cowichan Tribes staff installed 20 temperature loggers at 14 cold-water inputs, including groundwater upwelling springs and tributaries along the Cowichan River (Table 1). A combination of HOBO® TidbiT® v2 (model UTBI-001) and Bluetooth-enabled HOBO® MX TidbiT® 400 (model MX 2203) temperature loggers were used. At each site, one logger was installed directly in the cold-water source to collect hourly temperature data throughout the study period. Field crews conducted scheduled site visits on July 30 and August 1, 2024, to check and download the loggers. Temperature loggers were removed between October 1 and 3, 2024.

Site locations were selected based on previously identified cold-water refuge zones, drawing on local knowledge (Stenhouse, 2015). Sites spanned much of the river between Lake Cowichan and the City of Duncan, covering approximately 36.5 km. A 14 ft raft (Aire 143D) was used to access sites between Lake Cowichan and Skutz Falls, while the lower sites were accessed by vehicle and foot. Cinderblocks and rebar were used to secure the loggers in place, ensuring they remained fully submerged, while cables were attached to foreshore vegetation to minimize theft and aid in retrieval. Loggers were hidden from public view as much as possible, and photos and GPS coordinates were recorded for each site.

At Holt Creek, Rip Rap, and Wrixons Run, two additional loggers were installed in the mainstem of the Cowichan River, both upstream and downstream of the cold-water inputs, to estimate the zone of cold-water influence. The downstream locations were selected based on the anticipated range of cold-water impact, which was estimated by field staff using physical touch and thermometers during installation. Additional site information and maps can be found in the appendix.

Table 1. Site summaries for the 2024 temperature logger sites.

Site	~ Downstream distance from lake (km)*	Coordinates	Install Date	Removal Date	# Loggers installed
Stanley Creek	2.0	48.828814, -124.041383	Jun 27	Oct 1	1
Willow Run	3.5	48.827792, -124.027497	Jun 27	Oct 3	1
Spring pool	6.0	48.817972, -124.010792	Jul 5	Oct 3	1
Rip Rap	6.5	48.816492, -124.009589	Jul 4	Oct 3	3
Wrixons Run	8.0	48.809678, -124.004289	Jun 27	Oct 3	3
Upper Three Firs	11	48.789961, -123.991817	Aug 1	Oct 3	1
Three Firs	11.5	48.787994, -123.988708	Jul 4	Oct 3	1
Bear Creek	15	48.778164, -123.955500	Jul 4	Oct 3	1
Skutz Falls	15.5	48.783564, -123.954972	Jul 4	Oct 3	1
Mayo Creek	20	48.777881, -123.919303	Jun 28	Oct 1	1
Stoltz Pool Slough	23.5	48.769292, -123.898539	Jun 28	Oct 1	1
Sahtlam Lodge	25	48.765722, -123.886781	Jun 28	Oct 1	1
Holt Creek	33.5	48.761344, -123.801872	Jun 28	Oct 1	3
Inwood Creek	38.5	48.777592, -123.760156	Jun 28	Oct 1	1

*Distances estimated in Google Earth™

3.2 Snorkel Surveys

Snorkel surveys were conducted over two days to assess fish utilization of cold-water refuge areas. The first survey, on August 28, 2024, was part of the Ministry of Water, Land and Resource Stewardship's (WRLS) annual brown trout enumeration. Surveys were conducted from the Greendale Trestle in Lake Cowichan to Skutz Falls (~15 km). Three WRLS staff surveyed the upper section to the 70.2 Mile Trestle, while a crew of two (one ARRC and one WRLS) surveyed the section downstream. Together, these efforts covered the nine upper cold-water monitoring sites. A second snorkel survey was conducted by ARRC staff on September 17, 2024, covering sections from Stoltz Pool to Sahtlam Lodge, as well as a spot-swim at Holt Creek.

During the second survey, loggers were checked, and Bluetooth-enabled units were downloaded. During this process, the downstream logger at Holt Creek was found removed from the river and left on the bank. It was inspected for damage, downloaded, and placed back in its original location in the river. Data from this logger indicated that it had been removed since August 18, so this data was excluded from the analysis.

4.0 Results

4.1 Cold-Water Inputs

Between July 6 and September 30, 2024, peak temperatures in the Cowichan River reached 25.4°C and did not drop below 18°C in the upper river. Mean temperatures at all cold-water input sites, except for Three Firs, were significantly lower throughout the study period (Table 2).

For these cold-water sites, mean temperatures ranged from 10°C to 16.7°C, compared to the 21.4°C average found in the mainstem below the weir in Lake Cowichan. Wrixsons Run recorded the coldest mean temperature of 10°C, along with the lowest minimum temperature of 7.2°C on September 30, 2024. While the cold-water inputs remained cooler than the Cowichan River mainstem (Figures 1-5), they also fluctuated in response to changing air temperatures (Figure 6).

The highest temperature in the mainstem Cowichan River was recorded at Three Firs and the Holt Creek upstream logger at 17:00 on July 20, 2024 (25.4 °C). Overall, mean mainstem river temperatures showed a 1.9°C difference between the upper Government of Canada (GOC) hydrometric station in Lake Cowichan (below the weir) and the lower station near Duncan, indicating that the river cools as it flows downstream from the reservoir. Temperatures recorded in the Cowichan River above Holt Creek, located roughly midway between these stations, supported this trend, with a mean temperature falling between the two (Table 2).

Discharge in the Cowichan River is controlled by the Cowichan Lake outlet weir and remained between 6 and 12 cubic meters per second (m^3/s) throughout the study period (Figure 7).

Table 2. Summary data for temperatures recorded in cold-water inputs and the mainstem Cowichan River from July 6 to September 30, 2024. The "Lake Cowichan" and "Near Duncan" data was obtained from GOC real-time hydrometric data stations (Station IDs 08HA002 and 08HA011, respectively).

Cold-Water Inputs			
	Mean	Max	Min
Stanley Creek	12.1	14.2	9.5
Willow Run	13.3	16.1	9.4
Spring Pool Rip	15.5	21.7	9.8
Rap Spring	11.4	14.9	8.0
Wrixons Run	10.0	13.4	7.2
Creek Upper	13.8	16.8	12.8
Three Firs Three	20.5	25.4	16.1
Firs Bear Creek	14.7	18.4	8.9
Skutz Falls Mayo	13.0	15.7	8.8
Creek Stoltz Pool	16.2	21.0	10.6
slough Sahtlam	16.7	18.8	13.0
Lodge Holt Creek	12.8	14.8	9.2
Inwood Creek	15.9	20.2	9.1
	16.6	21.4	9.7
Mainstem Cowichan River			
Lake Cowichan (GOC)	21.4	24.7	18.0
Above Holt Creek	20.2	25.4	14.2
Near Duncan (GOC)	19.5	22.1	14.2

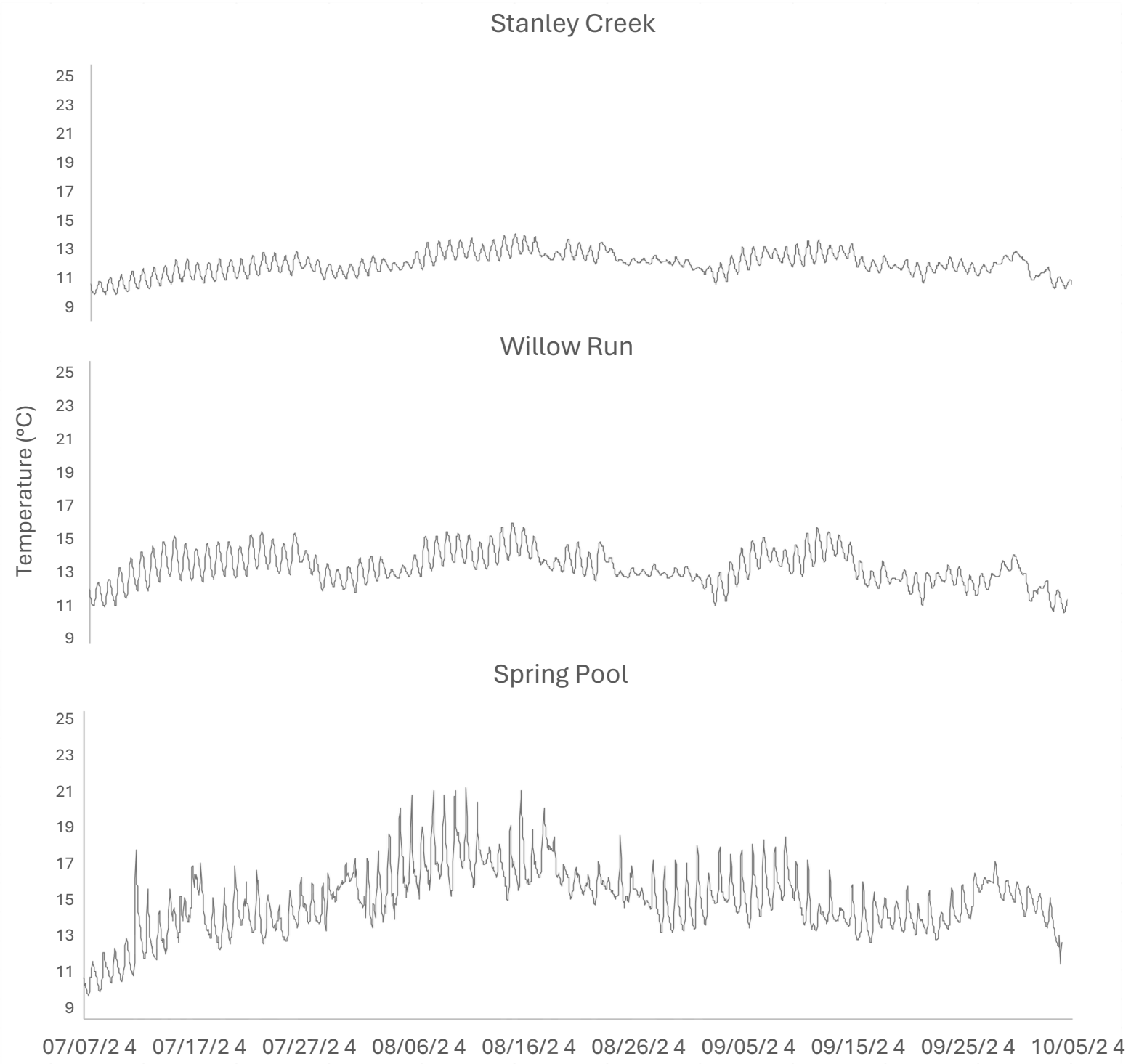

Figure 1. Recorded water temperature obtained from temperature loggers installed at the Stanley Creek, Willow Run, and Spring Pool sites between July and October 2024.

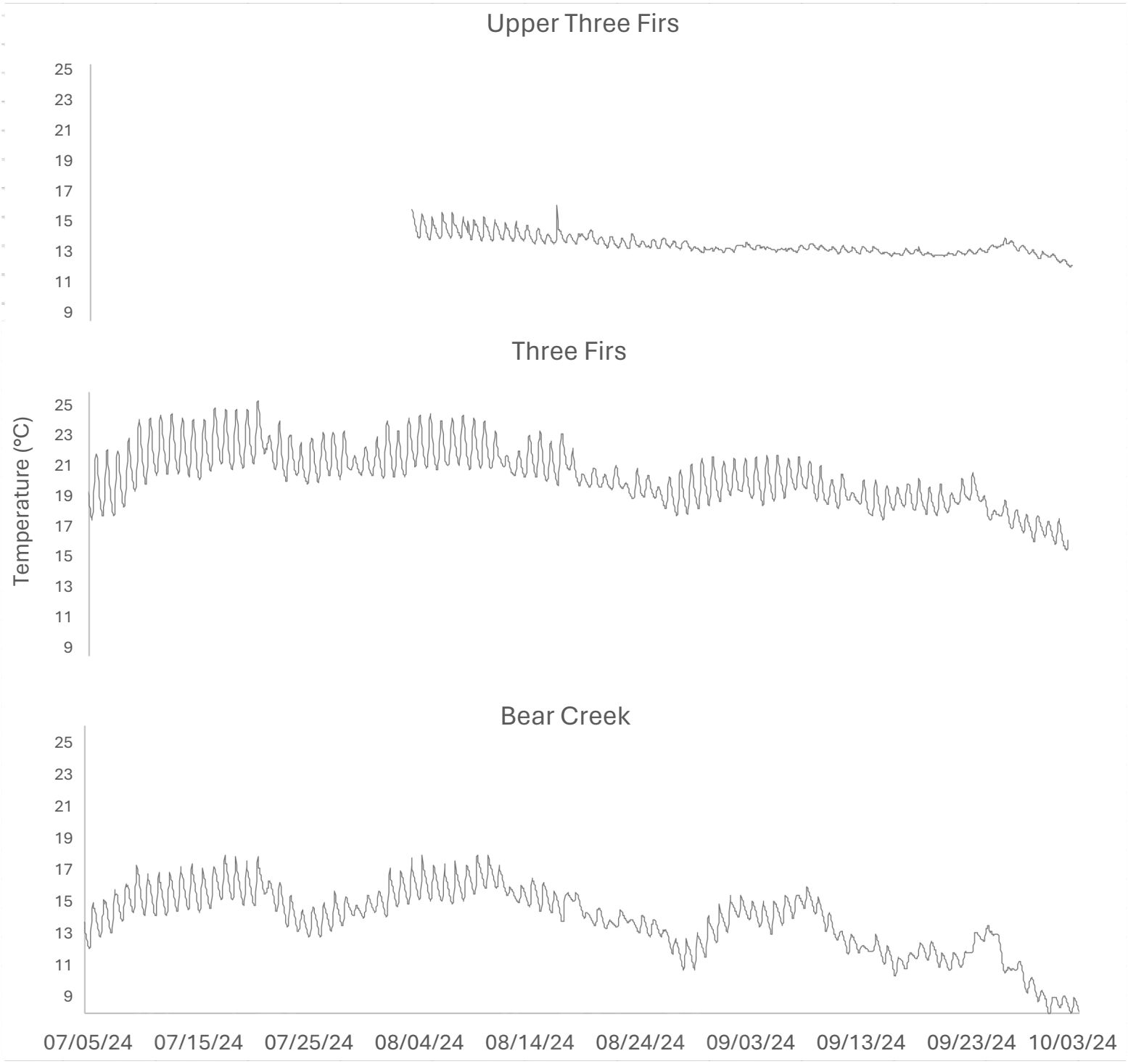

Figure 2. Recorded water temperature obtained from temperature loggers installed at the Upper Three Firs, Three Firs, and Bear Creek sites between July and October 2024. The temperature logger at Upper Three Firs was installed midway through the study period on August 1, 2024.

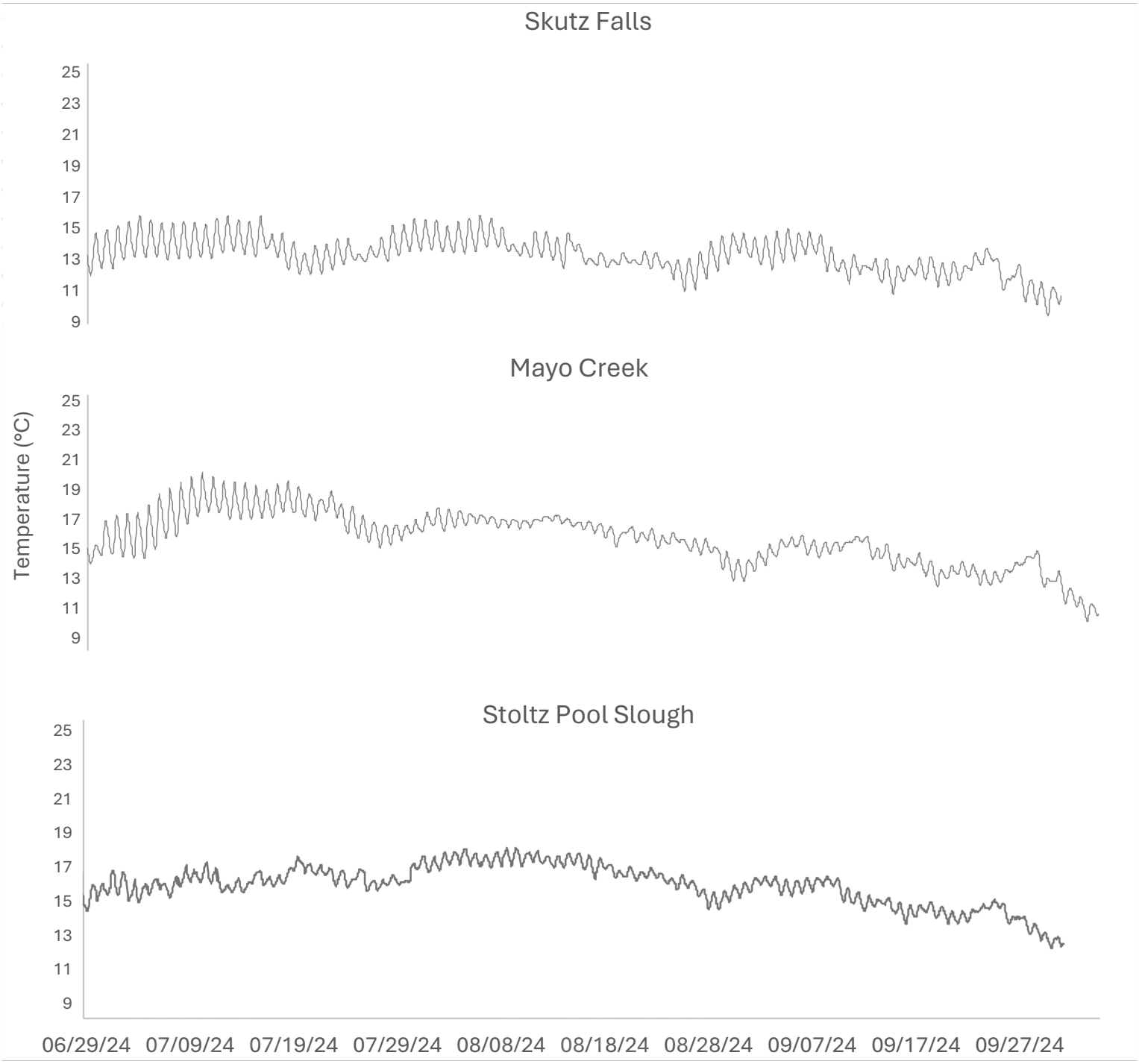

Figure 3. Recorded water temperature obtained from temperature loggers installed at the Skutz Falls, Mayo Creek, and Stoltz Pool Slough sites between July and September 2024.

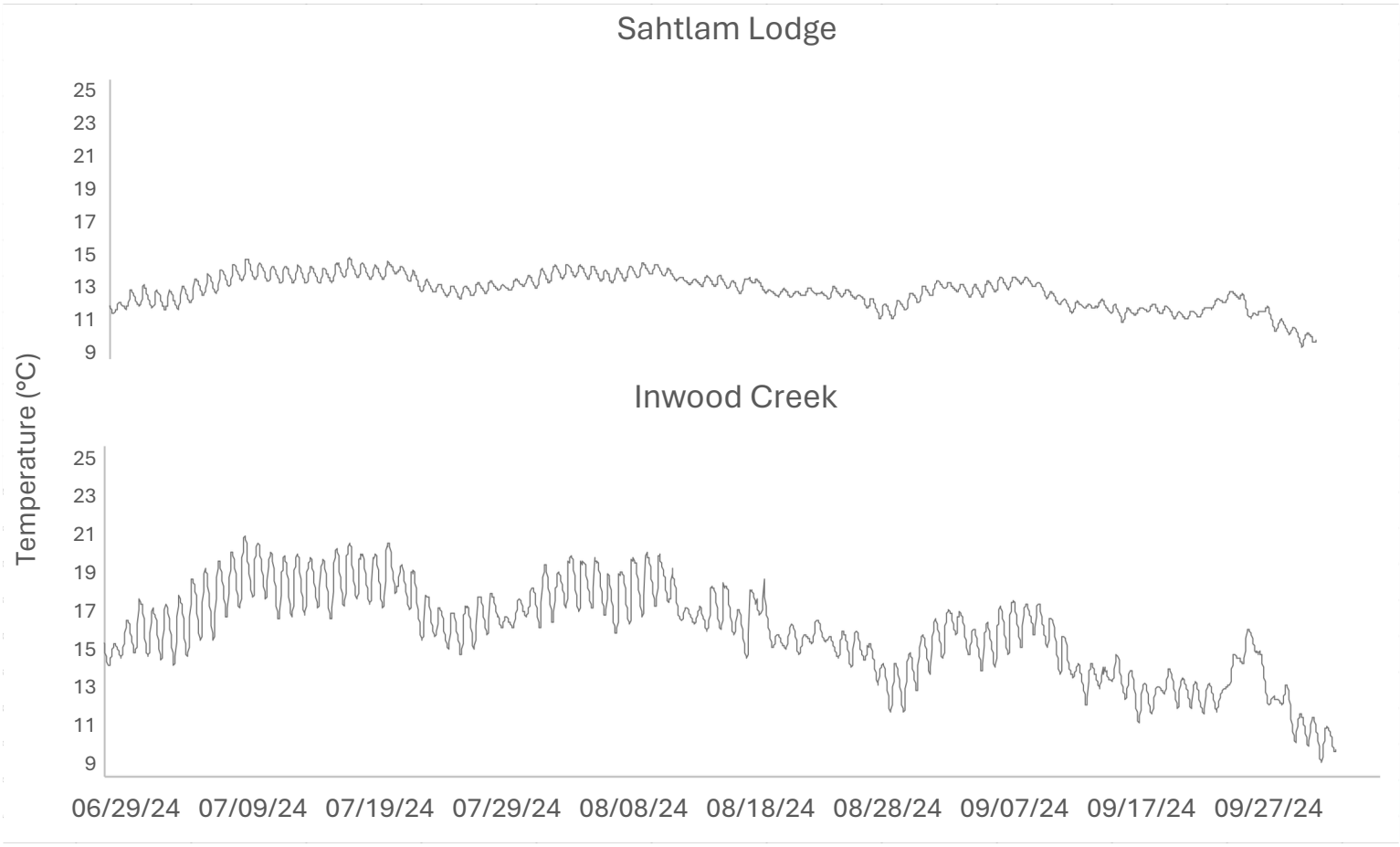

Figure 4. Water temperature obtained from temperature loggers installed at the Sahtlam Lodge and Inwood Creek sites between July and September 2024.

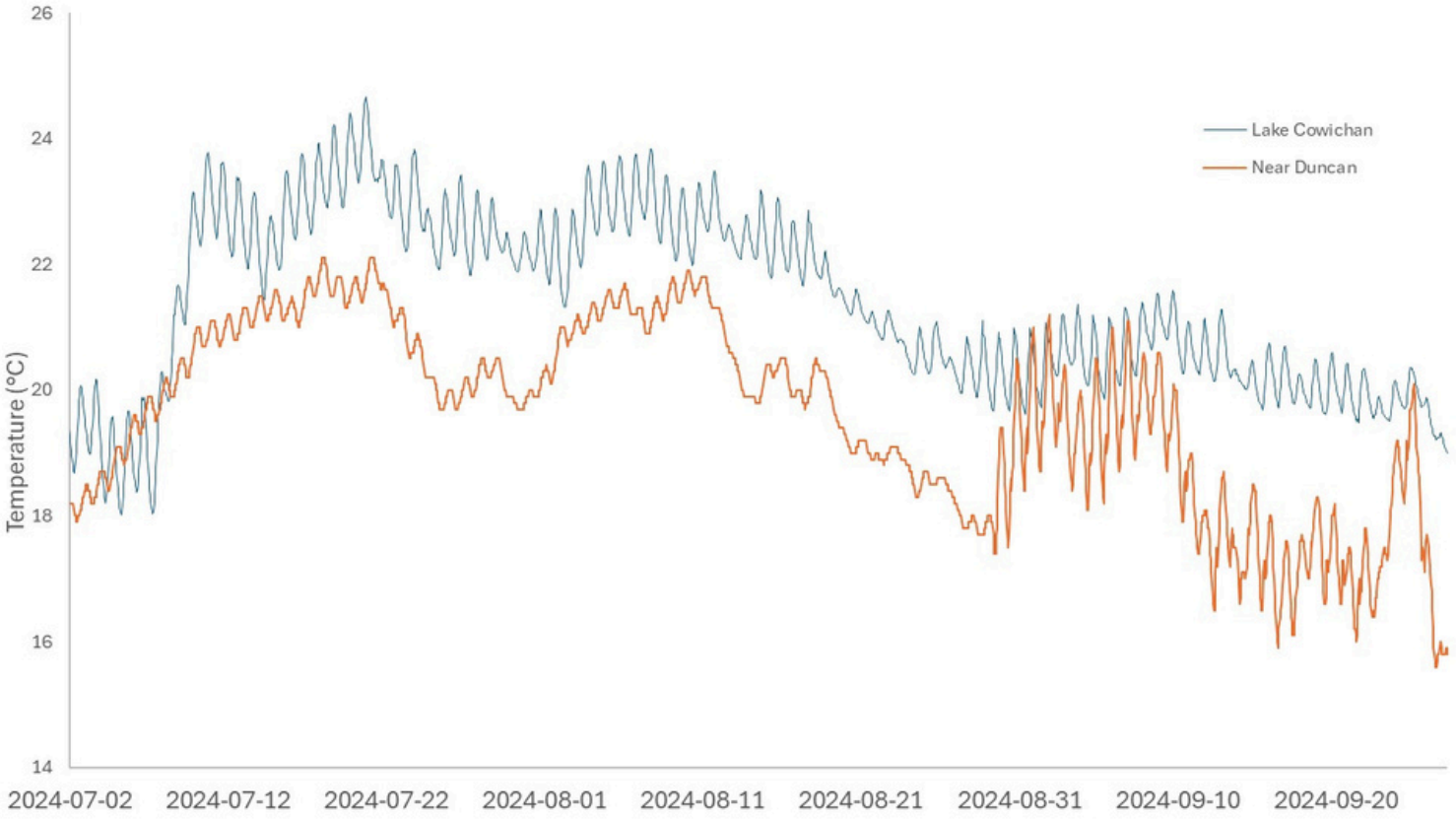

Figure 5. Water temperature for Cowichan River between July and October 2024, obtained from the Lake Cowichan and Near Duncan GOC real-time hydrometric data stations (Station IDs 08HA002 and 08HA011, respectively).

Figure 6. Recorded air temperature for Lake Cowichan between July and October 2024, obtained from the Lake Cowichan Dam GOC station.

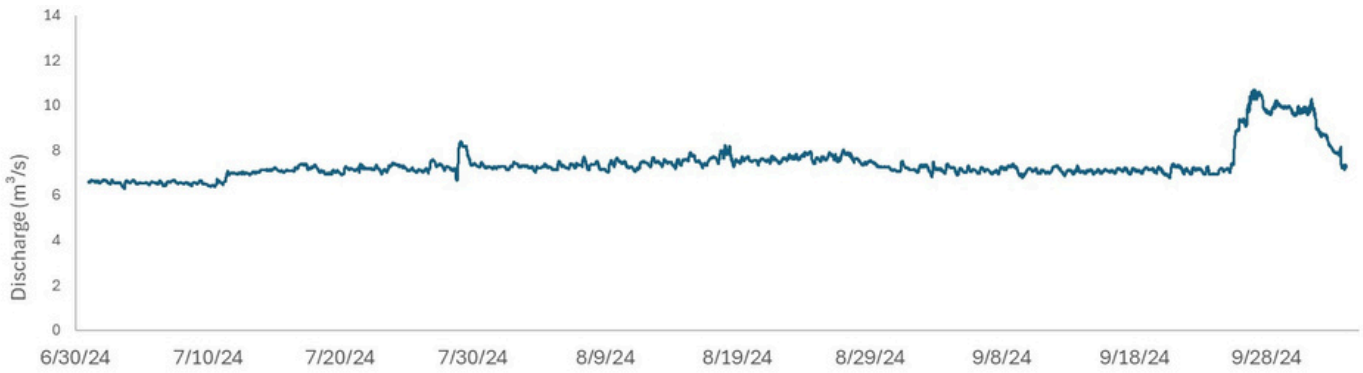

Figure 7. Recorded discharge for the Cowichan River between July and October 2024, obtained from the GOC real-time hydrometric data station in Lake Cowichan (Station ID 08HA002).

4.2 Multi-Logger Sites

Holt Creek

Holt Creek recorded a mean temperature of 15.9°C from June 28 to October 1, 2024, compared to 20.1°C in the mainstem, approximately 30 meters upstream of the confluence (Figure 8). The results suggest that Holt Creek has a significant zone of influence, with mean and maximum temperatures of 0.3°C and 0.2°C lower, respectively, approximately 54 meters downstream of the confluence compared to the mainstem above it. These estimates are based on data from July 28 to August 18, 2024, as the downstream logger was tampered with and removed from the river on August 18.

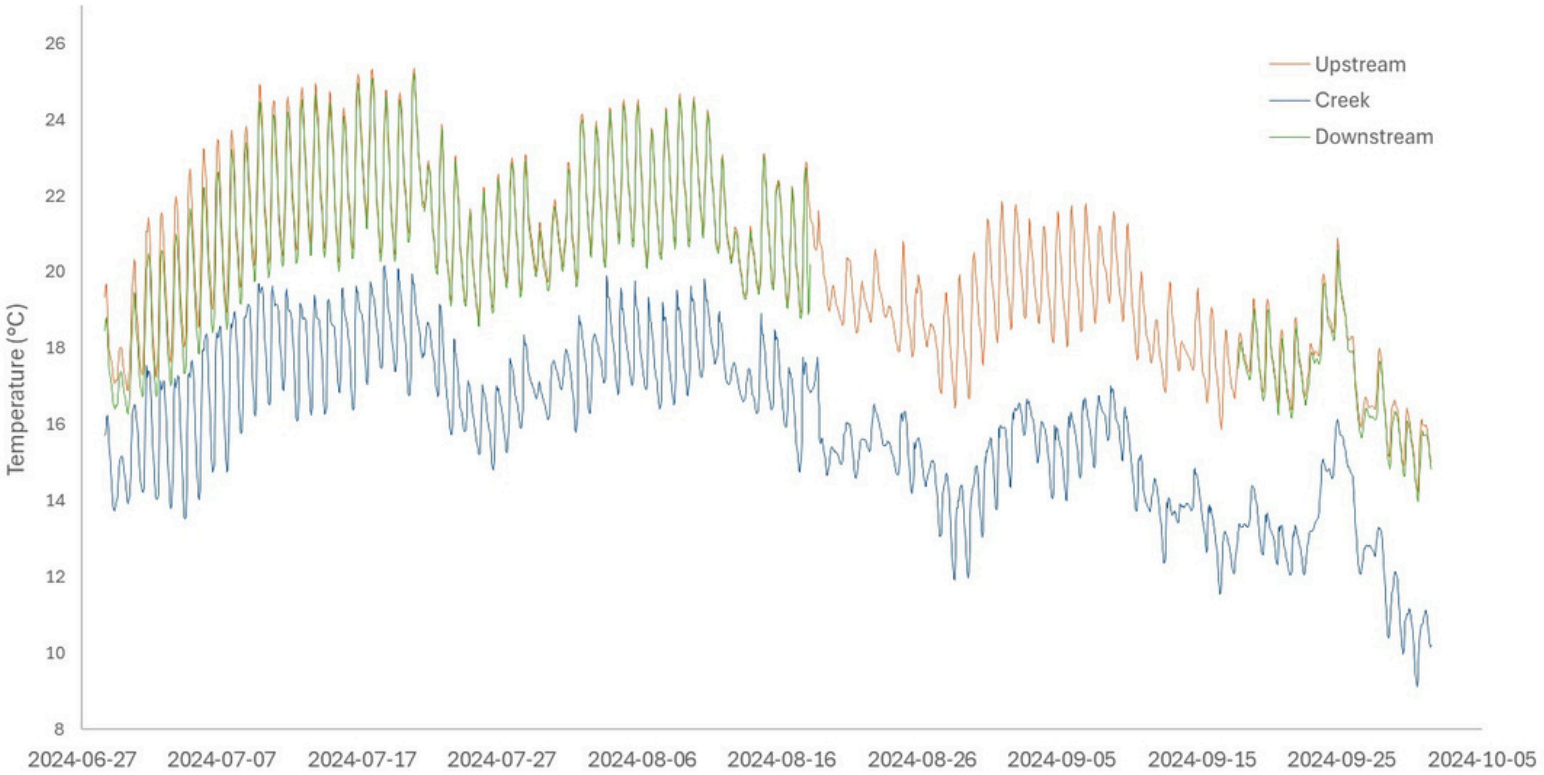

Figure 8. Temperature data from three temperature loggers deployed at the Holt Creek site between June 28 and October 1, 2024. The "Upstream" and "Downstream" data were from loggers installed within the Cowichan River mainstem above and below the Holt Creek confluence, while the "Creek" data was directly from Holt Creek. The downstream data between August 18 and September 17, 2024, has been removed as the logger was tampered with and removed from the river during this time.

Rip Rap Spring

The logger installed at Rip Rap Spring recorded a mean temperature of 11.4°C from July 4 to October 3, 2024, compared to 20.3°C in the mainstem, approximately 46 meters upstream of the spring (Figure 9). The results suggest a significant zone of cold-water influence at this site as the logger positioned approximately 30 meters downstream of the spring recorded mean and maximum temperatures of 0.4°C and 0.7°C lower, than those in the mainstem above the spring.

An abrupt temperature spike at the cold-water spring on August 1, 2024, was likely caused by a slight adjustment of the logger during a scheduled download. Despite the small change in logger position, the noticeable temperature shift highlights the small area of input for cold-water at this location.

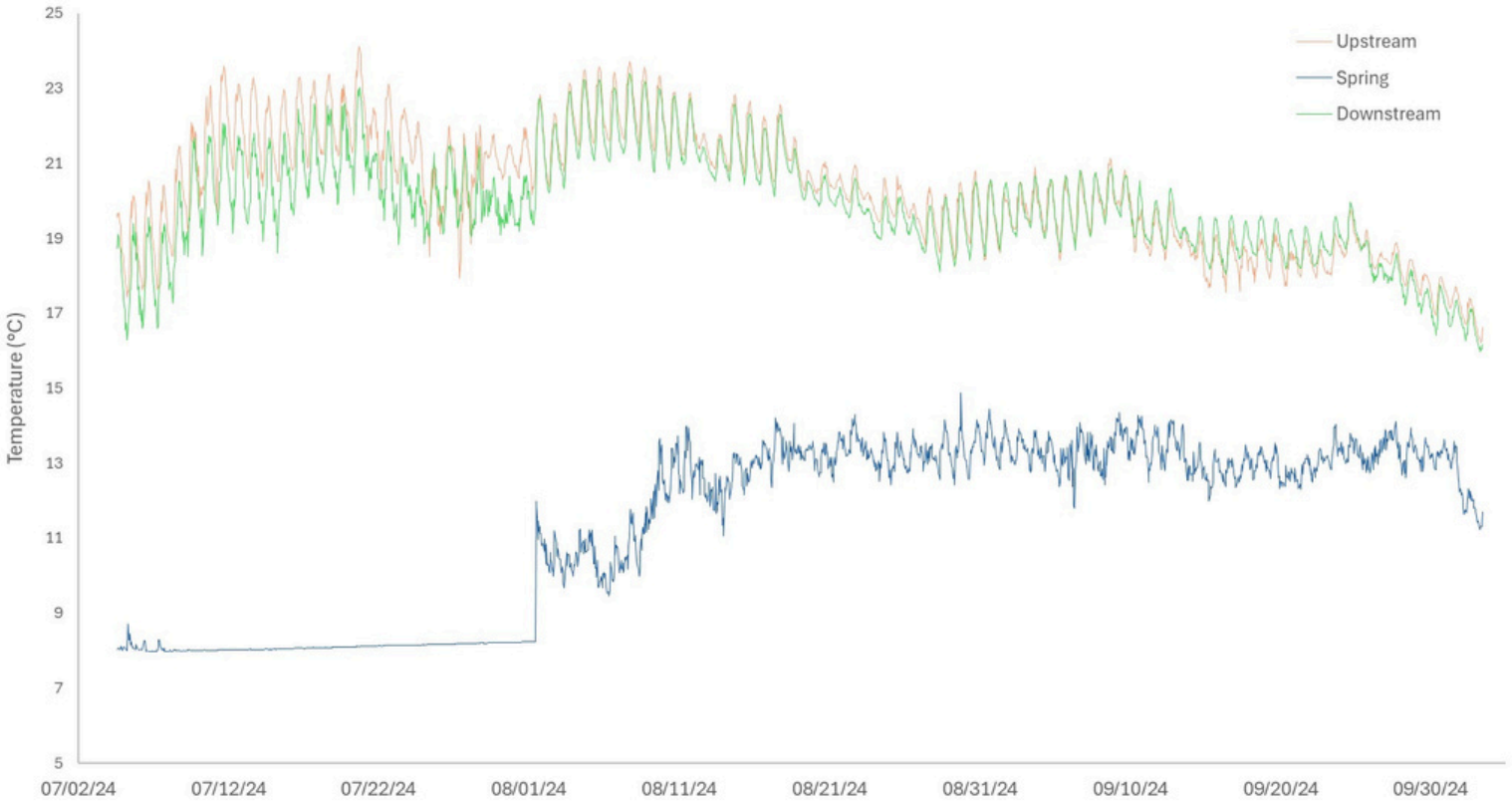

Figure 9. Temperature data from three temperature logger locations at Rip Rap Spring site between July 4 and Oct 3, 2024. The "Upstream" and "Downstream" data were from loggers installed within the Cowichan River mainstem above and below the cold-water spring, while the "Spring" data was directly from the location the spring entered the river.

Wrixons Run

Fairservice Creek at the Wrixons Run site recorded a mean temperature of 10°C from June 27 to October 3, 2024, compared to 21.2°C in the mainstem, as observed at the GOC hydrometric station in Lake Cowichan. The mean temperature of the mainstem, approximately 64 meters downstream of Fairservice Creek, was 2°C and 0.3°C lower than the temperatures recorded at the GOC hydrometric stations in Lake Cowichan and near Duncan, respectively. This variation suggests that the cold-water input from Fairservice Creek influences this zone. The mean temperature in the mainstem, approximately 10 meters upstream of the Fairservice Creek confluence, was found to be 2.3°C cooler than downstream (Figure 10). This temperature drop is suspected to be due to cold water from the creek moving upstream due to the local back eddy or seeping through the narrow bank separating the creek from the mainstem. The cooler temperatures observed at the upstream location, which occurred abruptly following a scheduled logger download on August 1, 2024, suggest that the logger's position may have been altered during the download. Additionally, the mean temperature at the downstream

logger was 0.5°C cooler than at the upstream logger before the August 1 download, further supporting the presence of cold-water influence at this location.

Figure 10. Temperature data from the three temperature logger locations at Wrixons Run between June 27 and October 3, 2024. The "Upstream" and "Downstream" data were from loggers installed within the Cowichan River mainstem above and below Fairservice Creek, while the "Creek" data was collected directly from Fairservice Creek.

4.3 Snorkel Surveys

On August 28, 2024, WRLS staff observed 140 brown trout holding at Wrixons Run, 2 at Spring Pool, 12 at Rip Rap, and a mix of approximately 70 rainbow and brown trout in the Three Firs Pool. No adults were observed at Bear Creek, but several were seen upstream of Skutz Falls. While no other study sites were noted, aggregations of trout were observed in other locally known holding zones, such as Kenzies, Big Bend Pool, and Breakfast Hole. Survey notes indicated that fish were generally found near obvious cold-water inputs and appeared more spread out than in previous years (J. Damborg, Fisheries Biologist, WLRS, pers. comm., October 7, 2024; M McCulloch, Fisheries Specialist, WLRS, pers. comm., October 10, 2024).

On September 17, 2024, ARRC staff observed 6 rainbow trout, 2 brown trout, and 8 coho salmon in Stoltz Pool, as well as 12 rainbow trout, 6 brown trout, 20 coho salmon, and 15 Chinook salmon between Stoltz Pool and Sahtlam Lodge. Small schools of juvenile rainbow trout and coho salmon were observed near the Holt Creek confluence, while a mix of 11 adult rainbow trout, 1 brown trout, and 10 coho salmon were seen in a large pool approximately 150 meters downstream of the confluence.

5.0 Discussion

Cowichan River 2024 mainstem temperatures reached above 25°C and remained above 18°C in the upper river throughout the summer period. Indicating that cold-water refuge areas are critical for the health of juvenile and adult salmonids rearing in the river. Summer snorkel surveys confirmed this, with individuals typically observed holding near cold-water inputs. Predictions of warmer and drier summers on Vancouver Island, coupled with events like the 2023 fish kill, underscore the urgent need to study and protect these vital habitats.

In this study, 13 of the 14 sites demonstrated the capacity to contribute cold water to the Cowichan River mainstem. Data from sites with three temperature loggers (Holt Creek, Wrixsons Run, and Rip Rap Spring) indicated areas large enough to provide cold-water refugia for resident schools of fish. While the scope of this study was limited, these findings suggest that further research with more data points would improve our understanding of the extent and quality of these refuge areas. Investigating additional sites could also provide valuable insights into their impact on water temperatures and the potential for finding additional refuge zones.

Further in-depth studies are recommended to assess the significance and characteristics of each site, as well as to inform effective management strategies. The importance of this habitat during peak summer temperatures is clear, even with the limited data collected during this study. Given the recent declines in salmon populations across the Pacific Northwest and growing concerns about summer fish kills in the Cowichan River, protecting these easily identifiable cold-water refuge zones should be a top priority.

6.0 Acknowledgements

The project was conducted in partnership with ARRC, Cowichan Tribes, and the Cowichan Watershed Board (CWB). In-kind support, including project planning, local expertise, field staff, and equipment (e.g., temperature loggers), were provided by Cowichan Tribes, WRLS, DFO, and CWB. The Cowichan River lies within the traditional unceded territory of Cowichan Tribes, and it was through their partnership and local knowledge that the project moved forward. Project funding was provided by CWB.

7.0 References

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Cold Water Refugia Report: Appendix A – Site Descriptions

Stanley Creek Stanley Creek is a medium-sized creek that enters the Cowichan River ~2 km downstream of the Cowichan Lake weir. One logger was installed on the right bank ~3 m downstream of Greendale Road (photo 1). The logger was attached to a square cinder block to weigh it down and secured to the bank with a cable.

Willow Run
This site contains a small unnamed stream originating from the slopes locally known as hill 60 and enters the Cowichan River at ~3.5 km downstream of the Cowichan Lake weir. One logger was secured to a cinder block and placed in the center of the flow ~5 m upstream of where it enters the Cowichan River. A light gauge cable was used to secure the logger to a tree on the bank.

Spring Pool
This cold-water upwelling site is located on the Cowichan River left bank ~6 km downstream of the Cowichan Lake weir. Here, cold groundwater, originating from a small upland creek, seeps into the river along a small rocky beach. A 6°C difference between the upwelling area and mainstem was observed during installation, with a ~40 m by 1 m area influenced in the shallows along the river's edge.

One logger was attached to a short piece of rebar and hammered into the riverbed along the bank at the lowest end of the cold-water influence (~20 m downstream of the rock beach). A light gauge cable was used to secure the logger to a tree on the bank.

Rip Rap
At this site, a cold-water spring seeps into the right bank of the Cowichan River, ~25 m upstream of a Rip Rap armored section and ~6.5 km downstream of the Cowichan Lake weir. The main cold-water input is in a shallow glide just upstream of a large pool. Three loggers were installed at this site: one at the spring source, one ~46 m upstream, and one ~30 m downstream. All loggers were secured to the bank with light gage cable with either a cinder block or rebar used to hold them in place on the river bottom.

Wrixons Run
This site contains a large tributary, locally known as Fairservice Creek, flowing out of a beaver pond and into the right bank of the Cowichan River ~8 km downstream of the Cowichan Lake weir. This site is believed to be the most significant cold-water input on the river. Three loggers

were installed at this site: one in the creek ~10 m above where it enters the Cowichan River, one in the mainstem ~10 m upstream of the confluence, and one in the mainstem ~64 m downstream of the confluence. The in-creek logger was secured with rebar and a cable and the two mainstem loggers were attached to cinderblocks cabled to the bank.

Upper Three Firs

One logger was installed at this site midway through the study on August 1, 2024, as an additional data point. Here a small back channel on the right bank of the Cowichan River contains a cold-water spring. This is ~500 m above the reach locally known as Three Firs and ~11 km downstream of the Cowichan Lake weir. The logger was secured near the river bottom with rebar.

Three Firs

This site consists of a deep pool on the right bank of the Cowichan River along a steep rock wall ~11.5 km downstream of the Cowichan Lake weir. One logger was installed and attached to three short pieces of rebar to weigh it down to the bottom of the pool. The other end of the cable was secured to a tree on the right bank to keep the logger from drifting away. Multiple small cold-water springs were found seeping along the rock wall into the pool.

Bear Creek

This large tributary enters the Cowichan River on the right bank ~15 km downstream of the Cowichan Lake weir. One logger was installed directly in the creek ~30 m upstream of the confluence. The logger was attached to a cinderblock and hidden under an overhanging fallen tree on the right bank of the creek.

Skutz Falls

At this site, a small stream enters the Cowichan River on the left bank beside the concrete fishway ~15.5 km downstream of the Cowichan Lake weir. One logger was installed directly in the creek just upstream of where it flows out onto bedrock and into the Cowichan River. The logger was hidden by tall grass and cabled to a nearby willow to reduce the risk of tampering and/or theft at this popular park.

Mayo Creek

Mayo Creek is a large tributary that enters the left bank of the Cowichan River along Marie Canyon ~20 km downstream of the Cowichan Lake weir. One logger was installed directly in the creek ~30 m upstream of the bridge on Riverbottom Road. Cable and rebar were used to secure the logger in place under an overhanging root.

Stoltz Pool Slough

A large slough fed by a cold-water creek and network of swamp wetlands enters the Cowichan River's right bank across from the Stoltz Provincial Park, ~23.5 km downstream of the Cowichan Lake weir. Directly beside the slough is a large deep pool that regularly holds fish and is a popular spot for anglers. One logger was installed in a short section of creek connecting the slough to the upstream wetland ~45 m upstream of there the slough enters the mainstem. The logger was secured in place with a piece of rebar driven into the streambed in a spot hidden from view under overhanging shrubs and willows.

Sahtlam Lodge

A small stream enters the Cowichan River's right bank ~25 km downstream of the Cowichan Lake weir. One logger was installed directly in the creek ~35 m upstream of the confluence, directly below a large concrete culvert under the Cowichan Valley Trail. The logger was cabled and hidden under a log and attached to a cinderblock to keep it in place.

Holt Creek

This large tributary enters the right bank of the Cowichan River ~33.5 km downstream of the Cowichan Lake weir. Three loggers were installed at this site: one directly in the creek, one in the mainstem ~30 m upstream of the confluence, and one in the mainstem ~54 m downstream. Each logger was attached to three pieces of rebar to weigh them down and cabled to trees on the bank.

Inwood Creek

Inwood Creek is a large tributary that enters the Cowichan River left bank at ~38.5 km downstream of the Cowichan Lake weir. One logger was installed directly in the creek ~50 m downstream of the bridge on Gibbons Road. Rebar and cable were used to secure the logger in place.

Cold Water Refugia Report: Appendix B - Site Maps

Map 1. Google Earth imagery for the upper sites from Stanley Creek to Skutz Falls.

Map 2. Google Earth imagery for the lower sites from Skutz Falls to Inwood Creek.

Appendix C - Project Photos

Photo 1. Field crew measuring the distance between the lower temperature logger and the Holt Creek confluence.

Photo 2. Willow Run temperature logger location approximately 10 m upstream of the creek's confluence with the Cowichan River. Photo taken looking towards the Cowichan River.

Photo 3. A HOBO® TidbiT® v2 temperature logger cabled to a cinderblock before placed in the Cowichan River above Fairservice Creek.

Photo 4. Looking upstream at the Fairservice Creek confluence with the Cowichan River.

Photo 5. Beer Creek temperature logger location. Logger attached to the cinderblock visible in the lower right under the fallen tree. Photo taken looking towards the Cowichan River.

Photo 6. Bluetooth-enabled HOBO® MX TidbiT® 400 temperature logger secured to a piece of rebar prior to placement in Mayo Creek.

Photo 7. Field crews used a 14 ft raft to access upper sites.

Photo 8. Field crew checking a temperature logger above Holt Creek during a snorkel survey.

Photo 9. Field crew conducting a snorkel survey at Stoltz Pool.

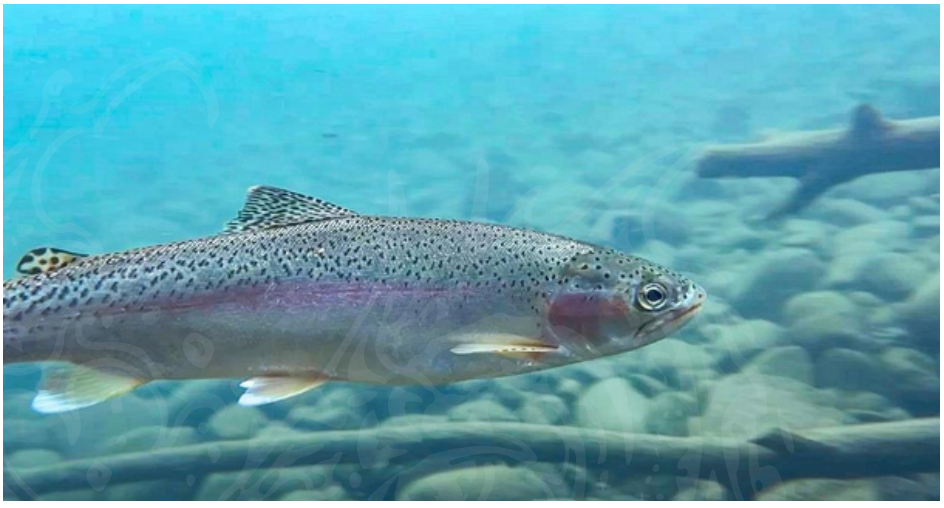


Photo 10. A rainbow trout observed at Stoltz Pool during snorkel survey.

Photo 11. Field crew retrieving a temperature logger from a small creek at the Sahtlam Lodge site.

Appendix 7: Example – Weekly Monitoring Update

Cowichan River
Water Quality Update – September 6, 2024

The following information summarizes water quality results for the upper and lower sections of the Cowichan River beginning May 2024. A rigorous monitoring program was put in place as part of a multi-partner plan to avoid another fish mortality event as observed in the summer of 2023. Partners include Cowichan Tribes, BC Fisheries, DFO, CVRD, Town of Lake Cowichan, Municipality of North Cowichan, and the Cowichan Watershed Board. Water quality results are used by the partners to make decisions on required responses to protect fish health and their habitat.

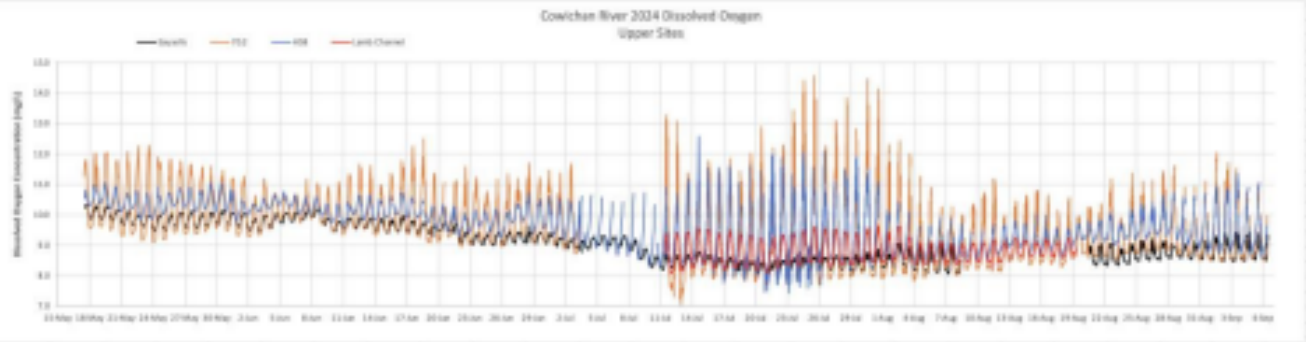
Continuous monitoring equipment has been installed at various locations in each of the upper and lower sections of the river to assess daily fluctuations in water temperature, pH, and dissolved oxygen. Grab samples are collected every 2 weeks at several sites along the river to assess various parameters including nutrient levels and E. coli.

1. Highlights for the week

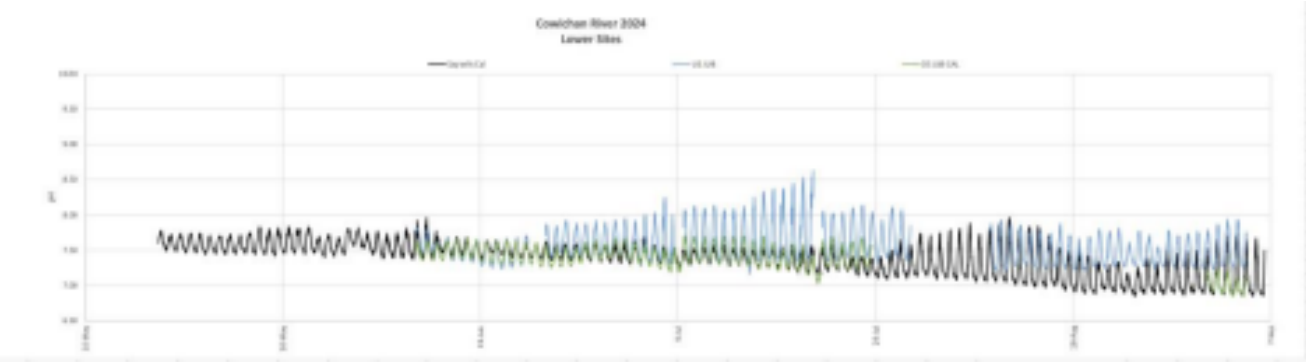
- Water quality (pH, temperature and dissolved oxygen) has shown **some decline** over the last week though is significantly improved over conditions encountered in mid July
- Flows remain at 7 cms, significantly higher than the 4.5 cms in 2023
- In the upper river, **pH has increased slightly again** reaching daytime highs around 9 at the 70.2 Mile Trestle, while night time lows decline below 7 or lower (preferred conditions are diurnal ranges of 7.25 to 7.5); results for the lower river have also increased slightly, with some daytime values approaching 8
- Diurnal swings in dissolved oxygen levels have widened slightly again over the last week in the upper river (diurnal fluctuations have decreased to between 8.5 and 13mg/L); data on DO levels in the lower river are incomplete due to equipment tampering
- Upper river **water temperatures continue to decline** though are still reaching 22oC on occasion which is still considered stressful for fish; lower river water temperature results are incomplete due to equipment tampering however indicate temperatures continue to trend down toward safer levels for fish
- **No fish mortality** has been reported; counting fence has been installed in lower river

2. Continuous Monitoring:

pH (upper river):



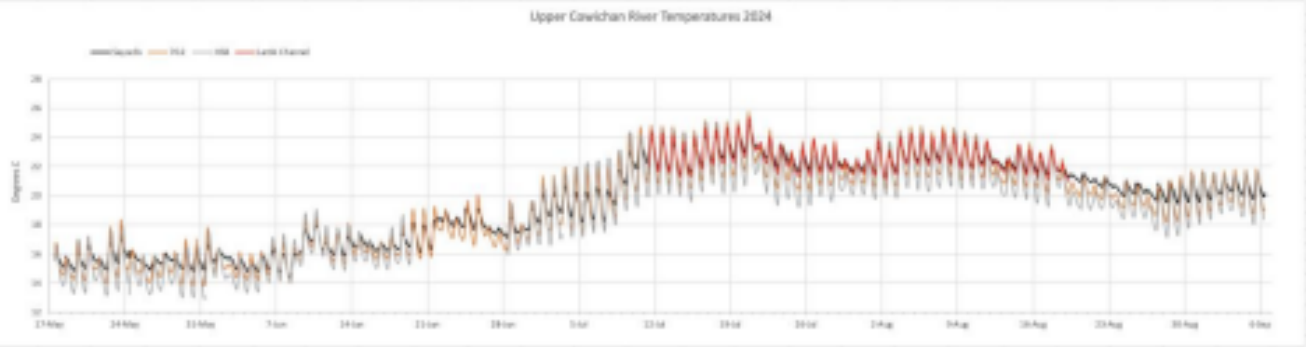
pH (lower river): Results are incomplete due to equipment tampering.



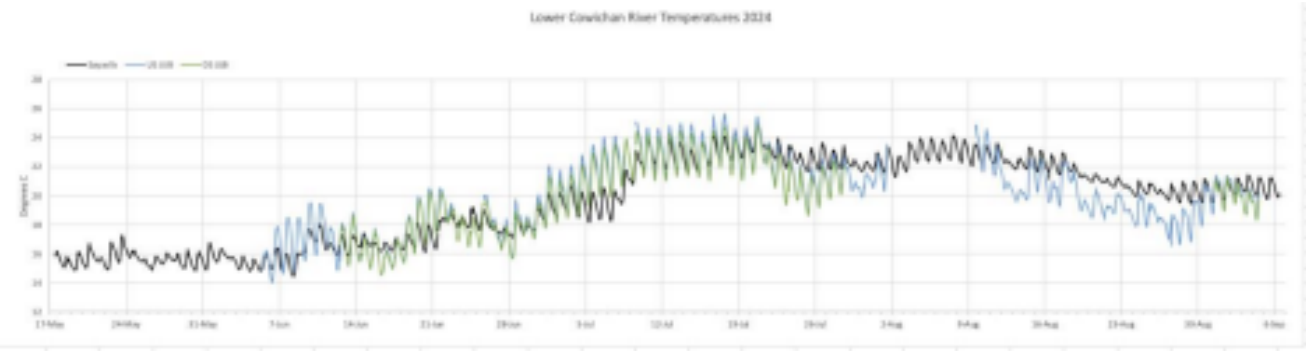
Note: JUB-Joint Utility Board sewage outfall. U/S-upstream. D/S-downstream. HSB-Horseshoe Bend. 70.2-70.2 Mile Trestle. Lamb – Lamb Creek side channel.

Diurnal pH fluctuations result from algal respiration. The Saysell Site is located in the upper river above the Town of Lake Cowichan sewage outfall and represents preferred range in pH diurnal fluctuations. Wide diurnal fluctuations indicate excessive algal growth which is harmful and can be lethal to fish populations.

Temperature (upper river):

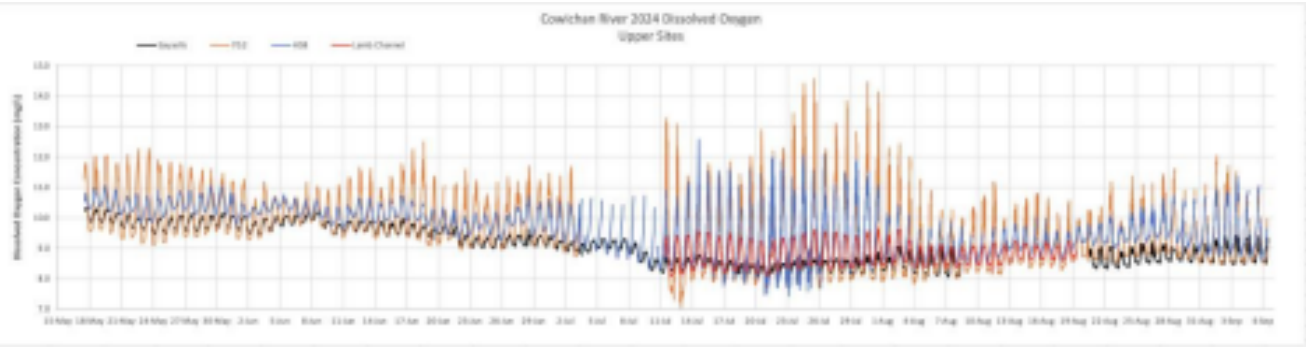


Temperature (lower river): Results are incomplete due to equipment tampering

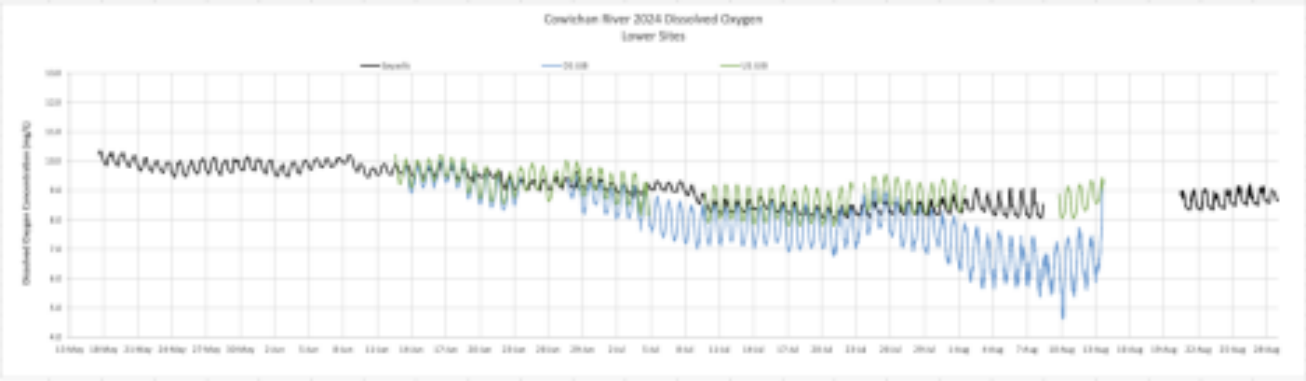


Note: Water temperatures above 16o C are stressful to salmon and trout. Temperatures above 20o C are extremely stressful and temperatures approaching 24o C can be lethal. Note: Data from Saysell's site from upper river added for comparison.

Dissolved Oxygen (upper river):



Dissolved oxygen (lower river): Results are incomplete due to equipment tampering.



Note: Diurnal DO fluctuations result from algal respiration. The Saysell Site is located in the upper river above the sewage outfall and represents preferred range in DO diurnal fluctuations. Wide diurnal fluctuations indicate excessive algal growth which can be stressful and in extreme cases lethal to fish populations.

2. Fish Health:

- No reported observations of fish mortality in upper or lower sections.

Note: Observations of dead fish are to be reported to:

- RAPP: 1-877-952-RAPP (7277)
- DFO: 1-800-465-4336
- CWB: admin@cowichanwatershedboard.com

Appendix 8: Workshop 3 Notes – Lessons Learned/Looking Forward

Cowichan Watershed Seasonal Monitoring and Fish Mortality Response Workshop #3 Reviewing Outcomes and Lessons learned from 2024 monitoring program Development of monitoring design for 2025

Notes:
Dec. 5, 2024, 10 am – 4:00 pm; coffee at 9:30 am
The HUB at Cowichan Station, 2375 Koksilah Rd, Duncan, BC

Workshop Purpose and Objectives:
The purpose of the workshop was to bring together community leaders, technical experts (reflecting
both Indigenous and scientific knowledge) and stewards involved in planning and implementation of the 2024 Cowichan Watershed monitoring program in order to review the outcomes of that work and plan for 2025.

Specific objectives of this workshop were to:

- Review outcomes and "lessons learned" from 2024 monitoring program and come to consensus on what worked and what didn't. What information collected (if any) might not be essential moving forward and what information is lacking in order to support short- and long-term decision making.
- Discuss and refine a proposed monitoring design for 2025 c/w a short and longer term response strategy, including key thresholds to trigger in-season action;
- Identify any resourcing gaps that need to be addressed in order to implement the preferred
- 2025 monitoring program and collectively work towards creating a plan to address them.
- Clarify communications and information sharing related to 2025 monitoring and response.

Anticipated Outcomes include:

1. Approval in principle for the 2025 monitoring plan, with a dedicated team identified to continue refinements as needed
2. Identification of resourcing gaps associated with the 2025 monitoring plan and creation of a plan to address them
3. Clear understanding of communications and information sharing strategies

Attendees:
Tim Kulchyski, Heather Pritchard, Tom Rutherford, Danielle Paydli, Jeff Moore (morning), Karalea

Filipovic, Vahab Pourfaraj, Ken Ashley, Kristine Sandhu, Jas Sandhu, Ellery Jackson-Renz, Jennifer Moss (Sibbald), Jeramy Damborg, Jay White, Jamieson Atkinson, Cheri Ayers (afternoon), Frieda (the dog)

Meeting Opening, Purpose and Objectives
Territorial Welcome (Cowichan Tribes) — Tim Kulchyski
"Put 100% on the table and then let the work take its path" Tim
CWB Welcome — Danni
Overview of Agenda and Objectives – Heather and Tom
Quick Roundtable Introductions
Two "reporters" identified to share their thoughts at end of workshop:
— Jennifer Moss (Sibbald) and Ellery Jackson-Renz

2024 Cowichan River Monitoring Plan
Review Karalea – Continuous monitoring
See slides for content (https://cowichanwatershedboard.ca/wpcontent/uploads/2025/01/Fish-Kill-Workshop-3-DFO-Dec-5-2024.pdf)

Discussion:

- Bluetooth would help with data transfer from continuous monitoring probe to tablet/laptop.
- It would be interesting to compare pH from continuous monitoring with grab samples.
- There were issues around equipment tampering at lower river sites.
- Spot swims were done on occasion at 3 Firs and Horseshoe Bend. There was algae on rocks and healthy RT fry observed. No mortality was noted.
- It would be good to understand algae better – species and which are good/bad.
- Q: Why aren't the readings high right after the effluent outflow?
    - A: Phosphorus travels a certain distance before it gets tied up in algae leading to the chain of events that results in harmful water quality impacts.
- Follow up Q: so just below the source it is not as bad as some distance away; takes some distance before it affects algae - so why didn't we see the same dynamic with downstream monitoring below JUB?
    - A: b/c monitoring station too close to the outflow.
- Q: This year, pH was still high despite higher flows, less effluent discharge, addition of alum, etc. Were we on the edge of another fish kill in 2024?
    - A: We were nervous at the end of July as temperatures increased; but the 2023 fish kill was a combination of many things (low flows, temp, etc - perfect storm). In 2024, we took out some of those factors (e.g., kept flows higher), which made the difference. b. The data indicates that the Cowichan River was close to another fish kill in 2021, 2022 and likely would have occurred in 2024 had we not implemented the changes in our response plan.
- There were questions raised about the JUB outfall and high algal growth below it. Why is it so dense? Why doesn't it impact pH and DO, or does it and we're mot capturing it? John Charlie Sr. has property right there — always keeping that on Cowichan radar. Chinook gets stuck in there.

- It was agreed it would be good to have a better understanding on algae – types and possible impacts. The province (Rosie) has some data and it will be shared at some point.

Jeramy - Fish Surveys – swims and juvenile transects

- See slides for content (https://cowichanwatershedboard.ca/wpcontent/uploads/2025/01/Fish-Kill-Workshop-3-BC-Fisheries-Dec-5-2024.pdf)

Discussion:

- Good conditions for snorkel surveys and counts were near long term averages, though lower numbers of par due to 2023 fish kill; lower habitats affected by fish kill were not 'reseeded' in 2024 and numbers were lower
- Electrofishing results showed a huge loss in 1+ steelhead juveniles especially around 3 Firs
- At 3 Firs site, pH changed in a matter of a few meters (e.g., 8.5 near the edges and lots of algae versus 7.5 in the thalweg and little algae)— not seeing fry where seeing algae (8.5), seeing them where the algae isn't at (7.5)

Perspectives from the field – Jeramy, Ellery & Karalea

- Saysell's is a good control location; all sites worked, i.e., were accessible and no concerns/problems
- Downloading of data was a bit of a problem creating a time lag between getting results and sharing them to initiate responses; e.g., any alarming data downloaded on a Friday afternoon wouldn't be responded to until Monday morning; solution: uploading from loggers via Bluetooth to phones would be more efficient
- Tampering with loggers at lower sites was a problem; one logger showed errors/shut down/etc. but found spots in Rotary where they are less likely to be tampered with…for next year. Chlorophyll a blocks routinely tampered with
- Cowichan Tribes has loggers collecting dust at BCCF but they are expensive to run and need satellite or cell service
- Ideally, there would be more YSI's like Jenn had at lamb's Creek, but expensive; $6-7000 for pH, DO, temp sensors plus $6-7000 for real time (total around $20k)
- Is there a way we can invest money in that type of equipment and ensure it's safe?
    - (1) yes, Skutz falls (secure building with power/potential internet if someone pays).
    - decent location for capturing lower water quality.
    - piece of mind for $20K piece of equipment
    - (2) lower river — CTs counting fence has a building, internet, etc. but wouldn't catch effects from JUB.
    - Cowichan Marine crew can help
- Challenge - accessing 500m downstream from JUB (lots of people not comfortable with river crossing); Ellery reached out to Clay/Dave but couldn't get easy access. Thanks to John Charlie for letting them access from his property.

Reflections on 2024 program and response – Ken

- See slides for content https://cowichanwatershedboard.ca/wp-content/uploads/2025/01/FishKill-workshop-3-Ken-Ashley_Dec-5-2024.pdf)
- Q: do we see any result from the decision for keeping water for summer by lowering rates in the spring?
  - A: the amount of different that 3-5 cms makes in the spring (15-20cms) is very different than in the summer (4-7cms).
  - Would take years of data collection to quantify any impacts to habitat from reducing spring flows
- A: always a difficult decision but this year it was really a sense of, if we don't do it, fish certainly will die again.

Workshop Results:

- What, if any, aspects of 2024 program are not priorities moving forward and/or need not be repeated?

Continuous Monitoring

Parameter	Keep?	Comments
Temp	Yes	achievable and essential
DO	Yes	achievable and essential
pH	Yes	achievable and essential
Sites	**Keep?**	**Comments**
Above Outfall (Saysell's)	Yes	
70.2 Mile Trestle	Yes	can we choose either 70.2 or Horseshoe Bend? DFO will have less resources next year?
Horseshoe Bend	No	Wouldn't need it if we put one in at Skutz falls. Need $80/month for internet connectivity (DFO can't do this). Bottlenecks (BCCF) can cover it.
Lamb Channel	No	7K needed to budget to do this (ie. solar, etc.) Key reason is because it is a real time station but not ideal location. Priority is 70.2…that said Skutz is a close second.
Skutz Falls	Yes, **NEW**	Has the bells and whistles to allow for real time data transfer
JUB u/s	Yes	Stay in same or maybe at the fence?
JUB d/s	Yes	Stay the same
Further downstream	Yes, **NEW**	Just above the bifurcation (deepest part of pool - above log jam, up from the corner there is a concrete block would be a good place to put it. May be able to use Horseshoe Bend loggers.

New Locations:

- Add position at Skutz falls and take away Horseshoe Bend and Lamb Channel as that should provide us will “real time” capabilities, be easier to maintain and give the info needed for the upper river.
- Add another further downstream site (see comments)

What gear could be used:

- Could use the loggers freed up by Horseshoe Bend for the new location in Lower River.
- CTs have 3 hobo mx3501 (pH and temp) and 10 hobo tidbits mx2203s — Cheri has access to additional (2 continuous monitoring pH probes)
- Bottlenecks project (BCCF) can cover wifi/ connectivity at Skutz
- BC Fisheries also has some extra pH probes (backups)

Gear needs:

- Have updated pH units but not updated DO ones (5 units at $2200 each=$15k); 1 to 3 of the DO’s will be covered by BC Fisheries, DFO (Karalea’s and Jenn’s departments may have funds to contribute)
- Skutz needs real time (hook into power or solar set up); better for cable due to safety but more expensive ($3500); note: buried conduit is already in place
- Temperature is all good; nothing else needed
- Backups for everything except the pH probes
- All equipment is Bluetooth
- Make sure there are spares available

People needs:

- **S**omeone needs to walk by upstream and downstream stations; one person can do all six sites in one day
    - DFO, BC and BCCF likely have capacity

Start time:

- Start as early as possible. April 1st??

Grab Samples

Parameter	Keep?	Comments
pH	No	
C-dissolved org.	No	
Chlorophyll a	Yes	
Ammonia	Yes	Could add sensor to loggers - Jenn could get quote; add to Skutz Level of sensitivity so important to know
nitrate/nitrite	Yes	
nitrate	Yes	
N-total organic	Yes	
N- total kiedal	Yes	
P-orthophosphate	Yes	
P-total	Yes	
TSS (non filtrate residdue)	No	
Turbidity	No	
Metals total	No	
Metals- dissolved	No	
E-coli	Yes	
Sites	**Keep?**	**Comments**
Weir	No	7 sites doable in a day
above outfall	Yes	
below outfall	Yes	
70.2 mile; horseshoe bend	No – SKUTZ instead (new site)	
Stoltz	No	
Sandy Pools	No	
Vimy	No	
Allenby Rd bridge	No	
Rotary Park	Yes	
500 m below JUB	Yes	
1km below JUB	Yes	this and site above and below Quamichan

Funding:

- Jer has submitted proposal to HCTF to do this work: same parameters, sites, lab costs, and staffing

Timing:

- Assess once/month may to September (consider April if very low flows)
- Assess every 2 weeks in July and August

People power:

- the 7 sites are doable in 1 day
- BC Fisheries (Jer) could likely do (assuming HCTF proposal approved), though funding only covers 1/month in July/August so may need minor additional funding
- Note: CVRD: DWWP will be doing sampling (3x/yr)

Fish/**Invertebrates**/algae

Activity	Keep?	Comments
Swim - July u/l - August u/l	- Yes - Yes	Upper river; all in the bag (BC) Lower river; not planned for by BC Fisheries
Steelhead Fry Transect Electro-fishing	Yes	WLRS
Opportunistic swims		e.g. when on site when water quality conditions are declining
Cold water	Yes, for select sites; strategy est. after results are analyzed; est. tech group once results are available to determine next steps.	If we get resources we could concentrate on 3 sites identified by experts
Cabin	low priority	- Jamieson will share his data for comparison - not yet analyzed for 2024; good data for upper river - from UV filter work - samples not analyzed and waiting (earlier)
Periphyton	WQ work - Yes	- adjust site locations to address vandalism - some locations roughly as wq.

Other notes:

- Cold water: in addition to looking at protection, work with Jenn's group and explore restoration opportunities.
- E.g.: riparian restoration, shading/protection zone; large woody debris /low-tech restoration; increasing in storage opportunities in that area

- Tim looking for a contact process for people who look for and observe dead fish; could put 'RAPP contact' signs at popular places in kill zone.
- Swims in lower river would require additional funding though may not be important

Next steps:

- **V**irtual launch meeting in March (mid-end); schedule around when Jeramy knows what he will have available.

End of Day Reflections:

- Jenn: Fish kills can be cryptic and not always in your face; all monitoring was important; 7cms is really important; this year was still a win but it is tenuous — have to keep at it and we are well set up to do it.
- Ellery: Agrees that having this conversation today was a good wake-up call – we avoided a fish kill though it could have happened without this work. Flow management, and effluent management are critical. It's a privilege to all work together and look forward to next year.
- Ken: This is the first proactive, collaborative, successful effort to deal with these issues that he's seen in the last 40 years.