DISTRICT OF TOFINO

Report to Council

Meeting Date	23/08/2022	
To	Mayor & Council	**File No: C&C-02**
From	Infrastructure and Public Works	

Water System Overview

RECOMMENDATION

THAT the August 23, 2022 "Water System Overview" report be received for information and discussion.

CAO'S COMMENTS

I concur with the recommendation of the Director of Infrastructure and Public Works.

EXECUTIVE SUMMARY

This comprehensive report provides a broad overview of Tofino's water system. The report is based on work undertaken by staff based on operational inputs, previous water reports, and data collected and analyzed by District of Tofino staff. The Water System Overview report will support the development of a Request for Proposals (RFP) focused on the creation of an overall water strategy, water master plan, asset management considerations, and a review of Development Cost Charges. Funding for these initiatives is allocated in the 2022-2026 Financial Plan.

2021-2023 STRATEGIC PLAN

STRATEGIC PLAN GOAL:

Sustainable Infrastructure.

STRATEGIC PRIORITY:

Plan for and manage the costs and risks of Tofino's aging infrastructure, using comprehensive asset management planning as the foundation for this work.

FINANCIAL IMPACTS

There are no imminent financial impacts related to this report that have not already been accounted for in the 2022-2026 Financial Plan.

Future financial impacts should be expected that the through the development and implementation of the various water related policies, plans, and bylaws. Staff will highlight any significant financial impacts through future budget processes.

BACKGROUND

The genesis of this report is rooted in the need for a fulsome understanding of Tofino's water system prior to embarking on the development of long-term foundational water system plans and bylaws.

Overall, the District needs a plan for its water system that prioritizes investment and upgrades, in the most effective, prudent, and affordable manner. The proposed water master plan intends to provide a well-supported strategy for water infrastructure management for the next several decades in order to sustainably manage this critical resource and make intelligent plans for affordable and appropriate service delivery of Tofino's water supply.

The analysis provides a deeper understanding of the current capacity of the town's water supply in order to help progress risk mitigation strategies, even before completion of the overall plan. This will ensure future consultants can move quickly and smoothly through their analyses allowing the District to accelerate the completion of asset management plans, capital replacement plans, updated operating and maintenance plans, management strategies, land development considerations, and climate and resilience plans to ensure adequate, affordable and value-for-money water system levels of service.

System Overview

Tofino currently obtains all its water from four rain-fed creeks on Meares Island. These sources are directed to two seabed pipelines that route water to Tofino's two water treatment and pumping facilities at Bay Street and at Sharp Road's Ahkmahksis Water Treatment Plant. These plants treat rainwater and store it in large tanks or reservoirs, located south of Maltby Road (Stump Dump), at District Lot 117 (DL117) off Industrial Way, and atop Barrs Mountain in the town centre. Rainwater is also stored on Meares Island in dammed reservoirs at Sharp Creek and Ahkmahksis (also called "Ginnard") Creek, and via a steel tank at Close Creek. The No.1 Creek source water does not have any dedicated storage.

As the town has grown, the water system has been expanded to deliver adequate water services to business, residents, and visitors. As both the town and daytime visitation continue to grow and change, various concerns have been raised by staff, Council, and the public as to the overall capacity of the current water system, which remains undefined. Future development may be limited by several factors in our community, so a better understanding of the current status of one factor – water usage vs demand - and considerations for future development will help the town plan appropriately.

Water Supply and Demand

The most pressing concern is the water availability during the weeks of summer tourism peak, which coincides with the driest part of the year. Understanding water usage and availability during summer peak tourism/dry season can help ensure we have the right mitigations in place for this brief, albeit important part of the calendar year.

Rainfall patterns change each year, and the uncertainty of future rainfall in a changing climate may also reduce or change the supply of water from Meares Island. Ongoing and important analysis/planning is required to better understand the capabilities and limitations of our current system and what system improvements are necessary to maintain adequate future levels of service.

This report reviews the latest water system and usage information, using 2021 as a baseline year, with the historically largest number of service connections/users on the system and one of the driest summers in over a decade. This information is presented in this report to inform the next set of investigation and planning, while still providing a series of supportable actions that can be progressed now.

Issues and Analysis

On an annual basis, Tofino has an excess of water; on a monthly basis there are water shortage concerns during the busy, dry summer months. To make an effective long term management plan for both infrastructure and services, Tofino needs to better understand the capabilities and limitations of the current infrastructure, source flows and usage patterns, as well as the potential benefits and risks of different management strategies. This report summarizes the review of the current system usage and source water patterns and pertinent considerations and actions.

The water system issues are broken down in the following list of questions, which are explored in more detail later in the report:

- What is the state of Tofino's water assets?
- How does Tofino currently use its water?
- How much water does Tofino have available, most importantly during the summer dry/peak tourism period?
- What are the most important actions to reduce water availability risks and to ensure adequate services in the future?
- What are the recommended next steps?

Staff continue to review the District's water system and pertinent information about water usage patterns, source water supply patterns and other relevant management aspects of the town's water supply. This most recent review was completed as part of Staff's commitment to progress both the water system asset management and capital investment plans, as well as a more holistic and comprehensive management plan, that refreshes the town's understanding and planning related to management, conservation, planning and risk mitigation.

DISCUSSION

2021 Baseline

The 2021 water usage patterns have been assessed alongside updated Meares Island creek flow assessments, which provide the latest estimate of summer drought creek supply performance alongside the peak summer usage information. These patterns help us baseline the current supply flows and demand for 2021, which indicate that Tofino used less water than was supplied by the four creeks, even in the 2021 drought year.

District staff forecast future demand using a 2% average water demand increase per year with an estimated decline in creek flows to determine when average day demands would outstrip available supply. Under these conditions, staff expect that the District daily peak season water demands may equal drought source flows (ie. summer drought water inputs equal outputs) as early as 2026-27 and would surpass average (ie. non-drought) summer creek flows by approximately 2032. Surpassing these flows would mean that the District would shift to reliance on stored water to keep up with daily demand, which would eventually eliminate available storage unless additional rains arrived or demands fell sufficiently. Staff note that the significant volume of potable water required demand to support industrial fish processing during summer peak season accelerates exceedance of those threshold limits by about 5 years. It remains clear that higher rates of demand and more severe droughts would also accelerate these timelines.

In order to reduce risks of water shortages and storage concerns (fire flow) during summer months, the District has regularly employed water restrictions to reduce daily community water use and allows the system to be replenished by available source supplies. In 2021, Stage 3 water restrictions on 22 August reduced daily demands by approximately 7%, which buffered the District from risks of drawing down reservoirs too quickly.

Stage 3 and Stage 4 restrictions will be more frequent and for longer duration in the future, unless demand increases are slowed by improvements in water efficiency, reduced waste, and better conservation practices. Stage 4 restrictions prohibit all uses except for drinking and personal hygiene uses, which is difficult to sustain for long periods, and would place undesirable and significant risks on the community (human health, quality of life, convenience, as well as business and economic performance). When looking ahead at the years where demand continues to approach or surpass summer supply, the potential for longer-duration Stage 4 increases.

Forecasting 2032 usage patterns based on the 2021 baseline demand/supply scenarios in July and August helps illustrate potential water usage and reservoir drawdown timelines. Staff show that these conditions would draw down reservoir volumes to less than 50% of total capacity without restrictions. Staff estimate that employing Stage 4 restrictions could reduce daily demand by near 20% and recover reservoir levels to above 90% if Stage 4 was in effect for approximately 3 weeks.

Reducing these types of risks and implications of long duration Stage restrictions will require re-thinking our town's water use intensity in our community and our ability to stretch available resources further. Without demand mitigation measures in place, costly infrastructure upgrades will be required sooner. Practical and affordable options exist to both reduce demands and increase supply that could prove much more economic and easier to deploy than large capital programs. These measures include rainwater harvesting, leak reduction programs, new local standards in water-efficiency for development, retrofits, as well as updated renewed conservation programs, incentives, and regulations – all of which aim to increase supply, reduce demand, and ensure water is allocated to the appropriate priority uses in times of scarcity. Modern and proven water efficient appliances, rainwater capture for non-potable uses, and other operational and waste-elimination programs could realistically deliver major reductions to daily usage. Staff estimate that aggressive deployment of these measures could potentially remove

the risks of summer water shortages for much more than a decade of continued growth at current rates. Water-wise development would have to commence in the next several few years using alongside intelligent retrofit programs to reduce demand intensity to the required levels.

It should also be highlighted and cannot be overstressed – that the water risks in Tofino are seasonal and normally last for 8-12 weeks each summer, which impacts the business case for large capital investment programs to increase water supply that would otherwise be redundant for the majority of the year. Staff suggest that prudent demand-side management programs and investment will provide the planning room and years of savings necessary to bring infrastructure investments online. Staff assess that water-wise programming for both technical and management solutions (including the replacement of non-potable water uses with rainwater) – could all but eliminate the water scarcity issues for the next 10 years or more - even under the current water demand trends (ie. 2% increase per year).

Tofino's Water Assets

For the most part, Tofino's assets continue to perform well and largely as expected. A greater level of understanding is required to define the detailed condition of some key assets, so that appropriate plans (and budgets) can be prepared. Additional analysis by trained municipal water engineers is required to quantify any remaining condition (ie. seabed pipeline alignment/joints/couplings), associated risks, remaining life, replacement, and renewal options (ie. we do not always have to replace with the same system/configuration). Several key water assets will be costly to replace or upgrade, so long planning timelines are required to ensure adequate preparations and savings are in place.

A system-view of assets will provide a holistic and detailed picture to enable the District to finalize renewal and upgrade plans, capital replacement plans and operations/maintenance plans. Condition assessments are required for each of the major asset groups in the water system, including storage, treatment, distribution, controls/monitoring, fleet, and equipment. Condition assessments are required for several important asset groups, including watermain sections, Bay Street facility, Ahkmahksis Facility, Seabed Pipelines, Sharp and Ahkmahksis damns, No.1 Creek piping system, Close Creek Tank, Bay Street Contact tank, DL117 structure, Stump Dump geotechnical and structural, and others.

Current Water Usage Trends

Staff baselined the 2021 water usage patterns, using daily water transfer data, billing, and meter information to breakdown annual and summer peak trends. Water usage in Tofino unsurprisingly follows tourism trends throughout the year, with maximums normally in July and August, and

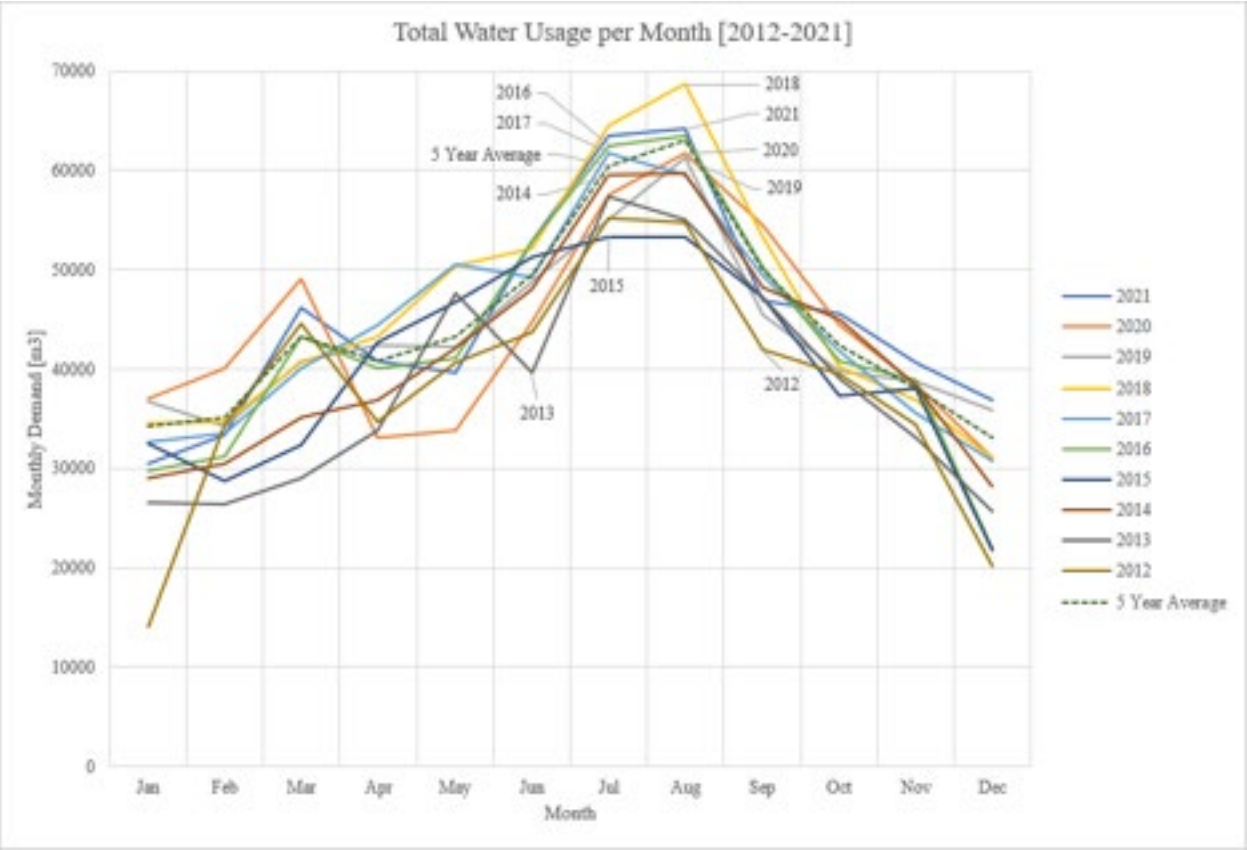

Figure 1. Monthly Water Usage (2012-2021)

other peaks during March, May, September, and December holiday periods. The lowest monthly average water usage occurs in November, January, and February.

The annual water demand graphic shows summer peak maximum usage in 2018, followed by 2021. Closer analysis of the 2018 water use shows several leaks and higher than normal usage[1] that suggest anomalous patterns. Staff assess that 2021 remains the best representative of a current baseline year, which includes the largest number of services and connections on the system. To date 2021 provides the best data and closest representative of the current state of Tofino's water usage patterns. In 2021 July and August[2] water usage was ~16% more than 2012. The table below summarizes the baseline values for water usage that can be used for future comparisons.

Table 1. 2021 Baseline Water Usage Levels (rounded)

2021 Water Usage Baseline	Value
Annual Water Usage	540,000 m^3
Average Monthly Usage	45,000 m^3
July/Aug Monthly Average Usage	64,000 m^3

[1] A closer review of the 2018 consumption patterns suggests that 2018 Q3 suffered from several very high water usage across a number of new and older water accounts, which point to a possible set of impactful water leaks during this time.

[2] Note: both July and August were similarly high when compared to historic levels. Only July water usage was subject to water usage impacts related to the heat wave.

July/Aug Average Daily Usage (volume)	2125 m^3
July/Aug Daily Usage (flow)	24.6 l/s

The figure below outlines the water used by user-type, based on billing accounts and breakdowns monthly water usage for different user categories. From this graph, residential water use is shown to be the single largest water user type, followed by dedicated tourist accommodations (which includes campgrounds). Commercial processing represents the fish-processing plants in the District. Non-revenue water is unbilled water, which includes public facilities, District facilities, leaks, firefighting, water flushing (part of normal treatment operations) and other forms of unregulated/unauthorized water usage.

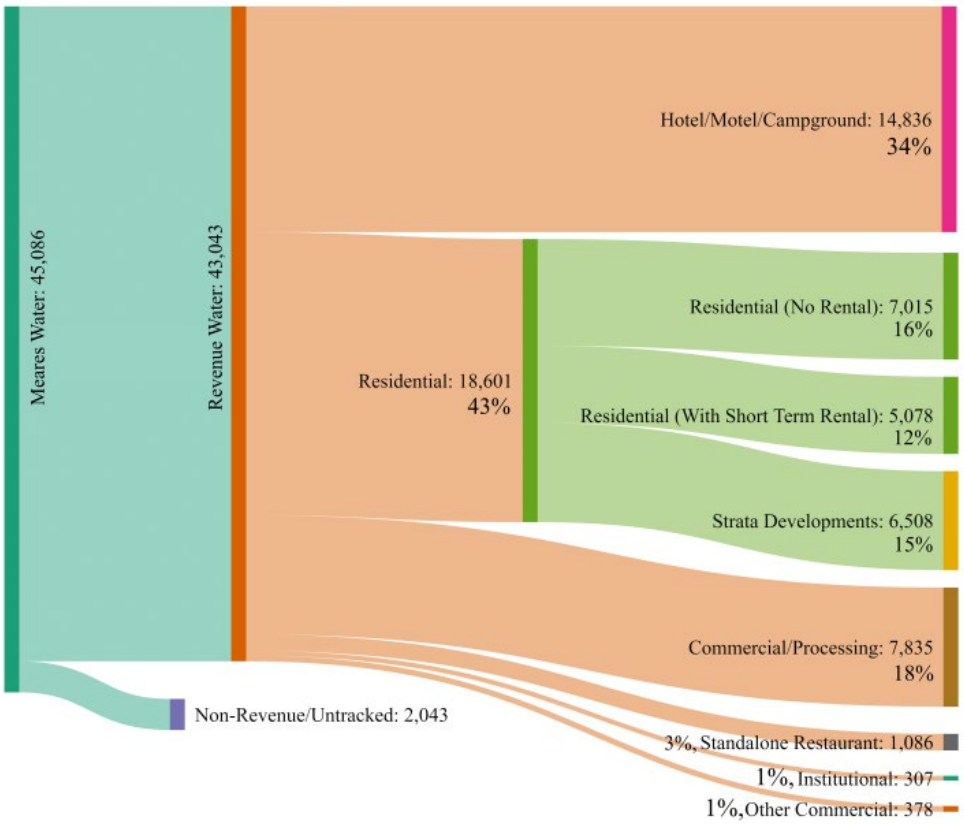

Figure 2. 2021 Monthly Average Water Demand by User Type.

In July and August, a greater proportion of the town's water is used by tourist accommodations. Fish processing operations at the largest facilities were not in operation during the July/August 2021 period. A higher proportion of non-revenue water was noted in July/August 2021, due to high-frequency water treatment plant flushes, high usage at public facilities and large leaks identified (and then fixed) on private property.

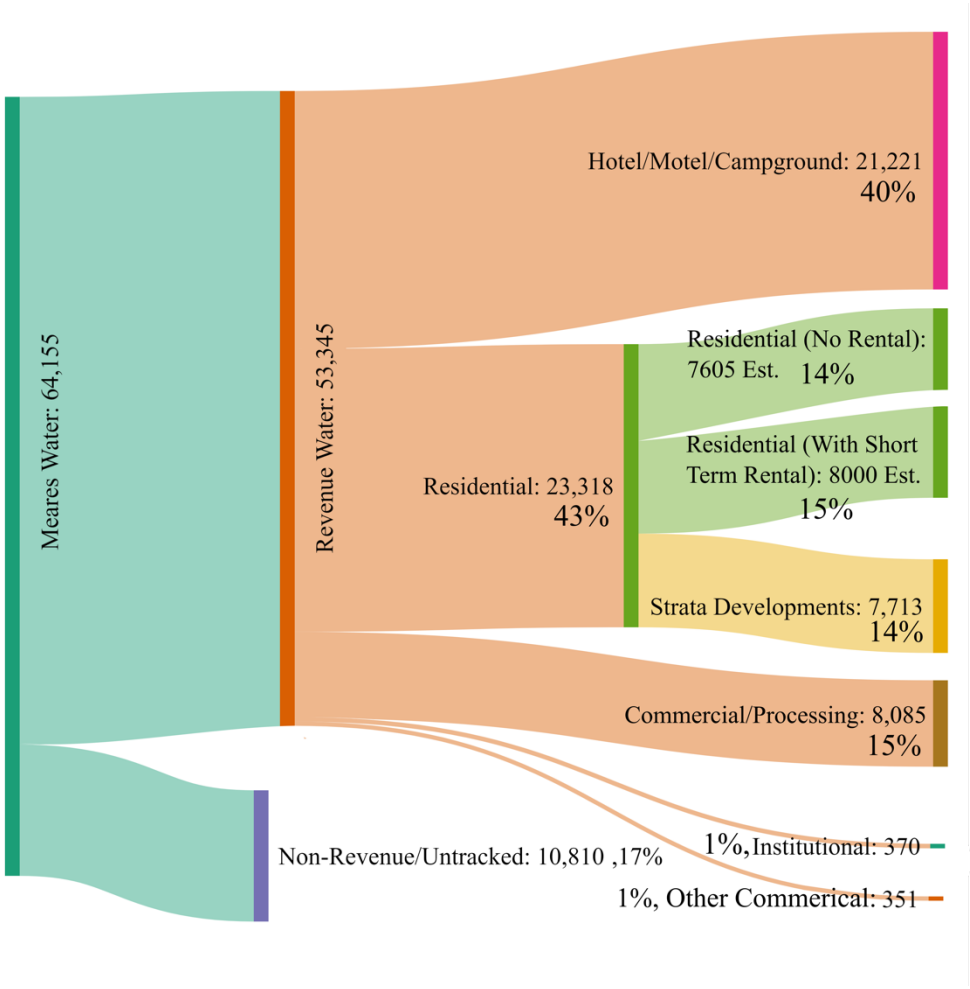

Figure 3. 2021 July and August Average Monthly Water Demand by User Type.

The top 10 users in the District use approximately 25% of the town's water on an annual basis. Of these users, the highest individual accounts are from resorts and fish processing facilities. The breakdown of the annual and 3rd quarter (ie. Jun-Sep) is highlighted below. These larger institutions use a high proportion of town water, each with a unique mix of operations with different occupancy levels, restaurants, pools, fishing, surf rentals etc.

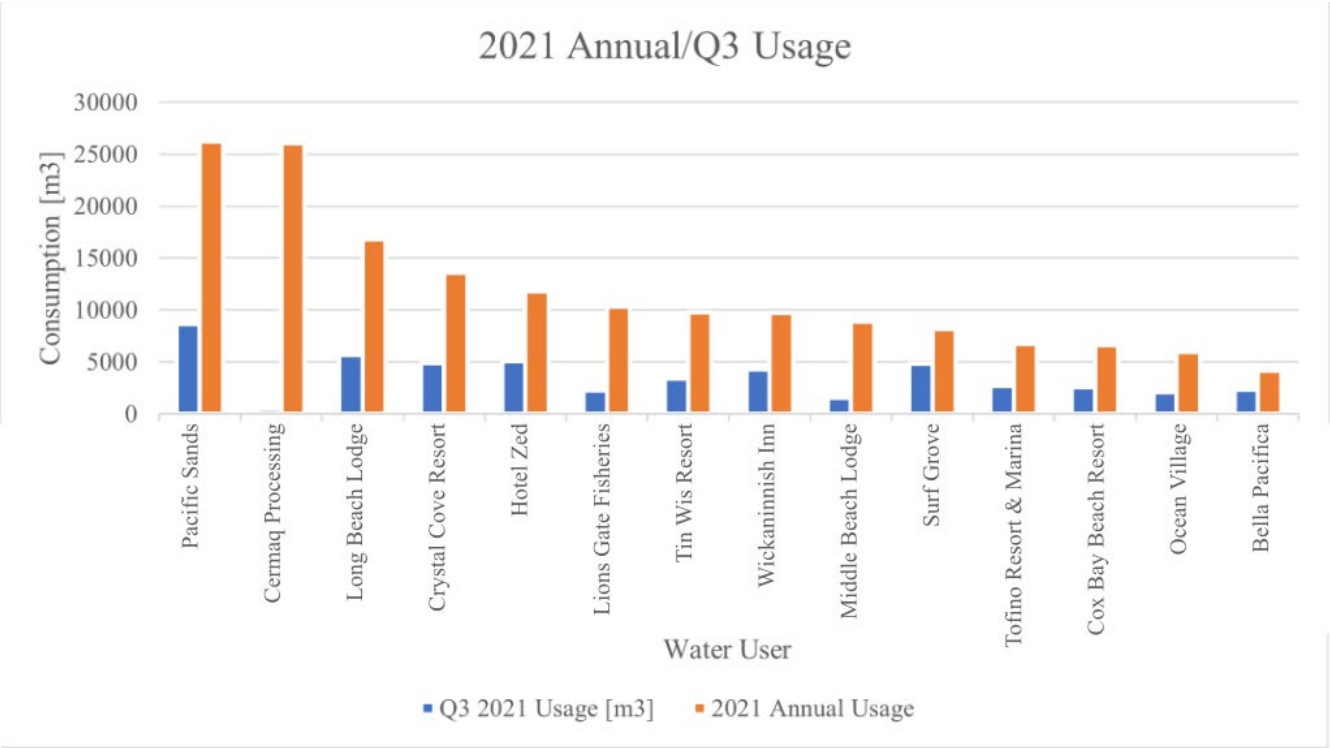

Figure 4. Top Water Users (2021 - Annual and 3rd Quarter Demands).

These users are high water consumers in the District, but several may still demonstrate better per-capita or per-activity water intensities than others. Ideally, all users would be using the least possible water to provide the required services. Their performance, best-practice, ideas, and operations should be continually discussed/examined to share in areas for improvement in both efficiency and overall demand. Working in partnership with these players will be critical to realize any meaningful future changes/savings, taking advantage of the motivation and improvements already made in previous rounds of conservation efforts and commitments.

It's important to note that the fish processing water usage was lower than normal in Q3 2021, due to the largest plant halting their processing operations. This year (2022), the plant is operating with an estimated per day (processing) usage of about 270m^3 per day (3-4 times/week) in July and August.

Climate and Precipitation (Water Source)

Tofino Rainfall Patterns

A closer look at Tofino's rainfall can be assessed from Tofino airport rain gauges over the past 60 years. This data shows that annual rainfall in Tofino has averaged 3180mm per year[3]. The last 10-year rainfall is about 6% below the 60-year average, suggesting that it is more likely in recent years that annual rainfall will be less than 3000mm. Provincial rainfall trends suggest a slightly different trend. The 100-year BC trends[4] suggest that rain is increasing by 10% over the last

[3] Tofino receives almost 5 times the annual rainfall in Victoria and almost 12 times the rainfall in Kamloops.

[4] Available at: https://www.env.gov.bc.ca/soe/indicators/climate-change/precip.html - :~:text=Province-wide annual average precipitation,the Northern Boreal Mountains ecoprovince.

century in the Vancouver Island and BC coastal region (while noting that patterns in different locations may vary).

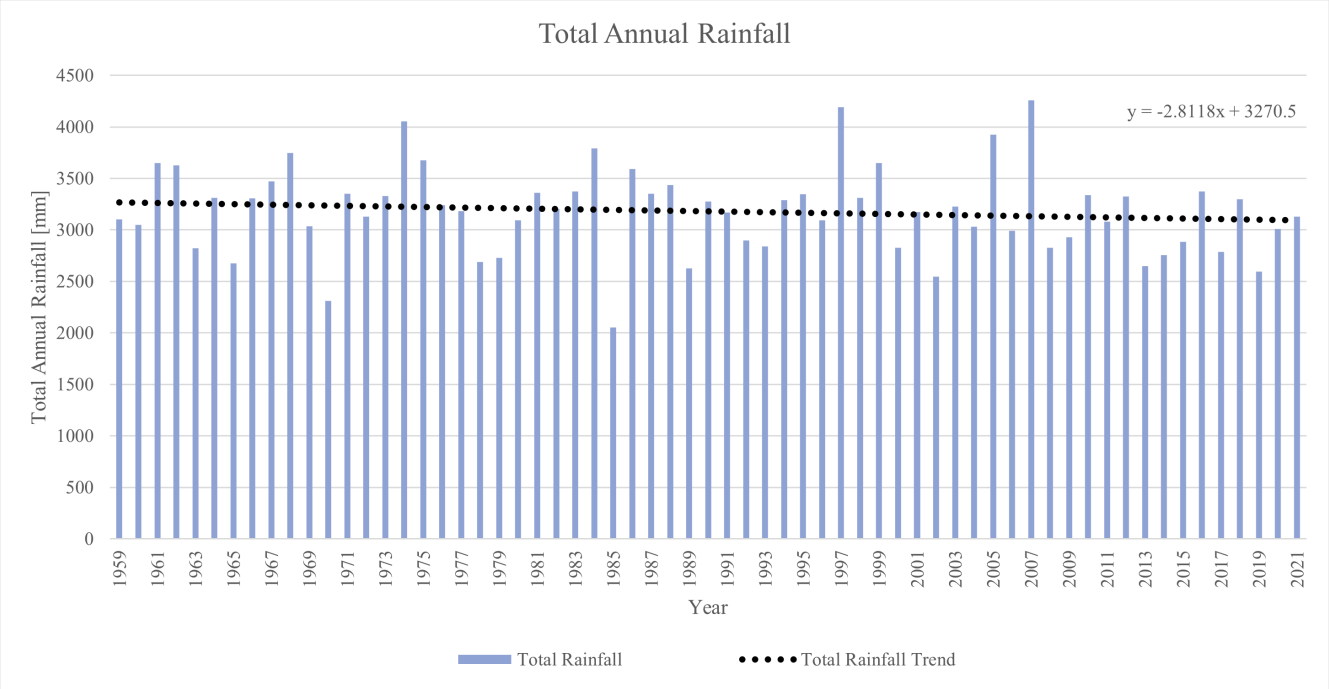

Figure 5. Annual Rainfall 1959 - 2021

Overall, patterns remain consistent on average without any indications of big changes for Tofino. Climate change impacts may emerge with a different and even abrupt change of rainfall patterns in the coming years. Rainfall and precipitation at our source water (Meare's Island) location and in Tofino should be monitored/tracked more closely to ensure accurate data is available to system planners/operators, as they could vary significantly from both historic and regional readings.

The graphic below outlines accumulated rainfall patterns in Tofino from April to September, which shows the variations in rainfall preceding and during the drier season. Some years may deliver 800mm of accumulated rainfall between April and the end of August, while in dryer years, may only accumulate 300-400mm. Note: 2022 is currently tracking with well above average rainfall for the April – July period (solid blue tracking line).

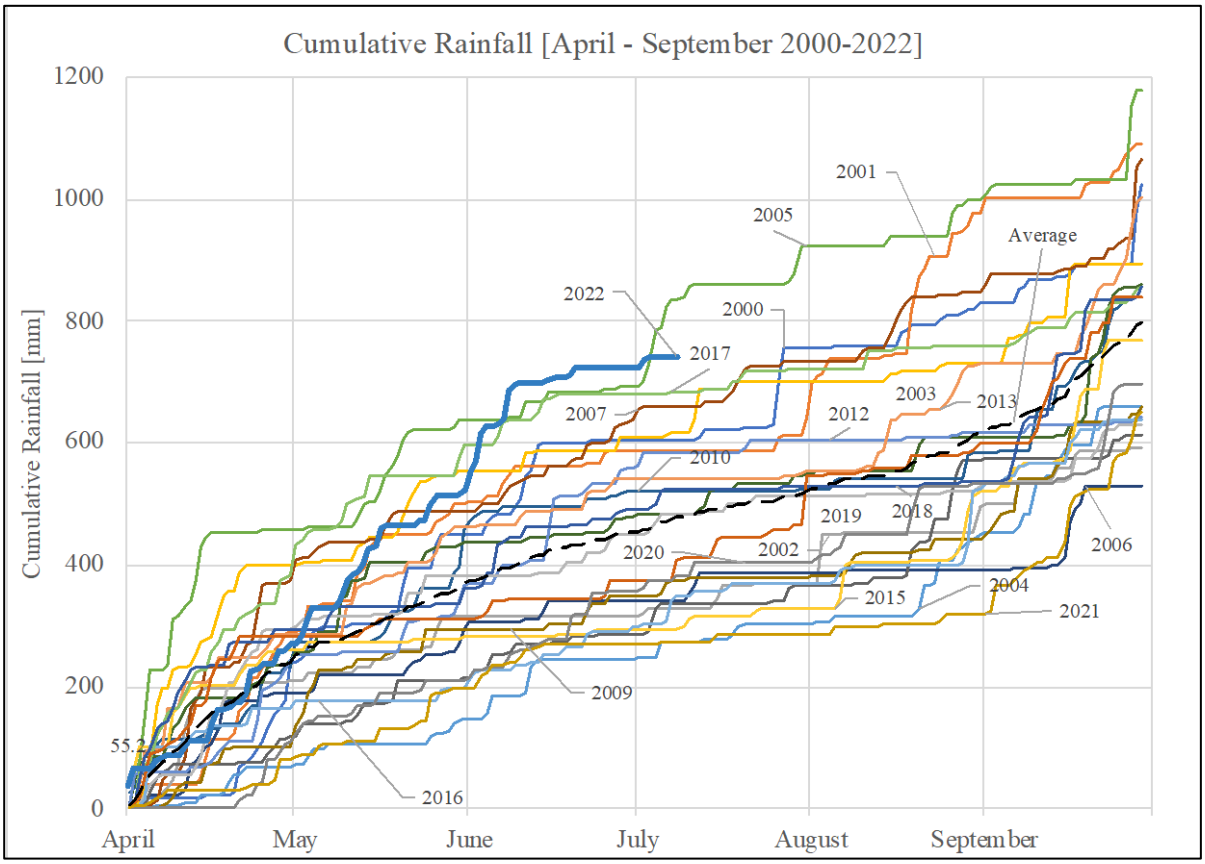

Figure 6. Cumulative Rainfall from April - September 2002-2022

The accumulation graphic shows the driest summer spells (flat curve segments), notable in 2006 and 2021. Rainfall patterns in 2006 were well below average, with only 3 periods of rain between the end of May and September. Even though 2004 and 2021 were drier overall until the end of August, they benefitted from several minor rain events throughout July and August and then significant rains returning in September. The main difference in 2006 being a total dry spell for longer, late in the summer, with no rains for much of August and September. Note: In 2006, during the last major drought year, only 3 creeks supplied water to the town, as opposed to todays 4. In addition, the Ahkmahksis treatment plant and stump dump reservoir had not yet been built. The combination drought, lack of supply, and lack of storage led to the town going into Stage 4 water restrictions and trucking in water from Kennedy Lake." The combined effect of less source water and reduced overall storage exacerbated the water scarcity, even though daily usage rates were lower.

Tofino Rainfall vs Usage Patterns

Peak season water usage and lowest rainfall (source water replenishment) normally coincide for July and Aug each year. Tofino's water availability risks are only present during the summer peak period. The challenge for the District will be to have adequate plans to meet water needs during this period of highest demand and lowest rainfall.

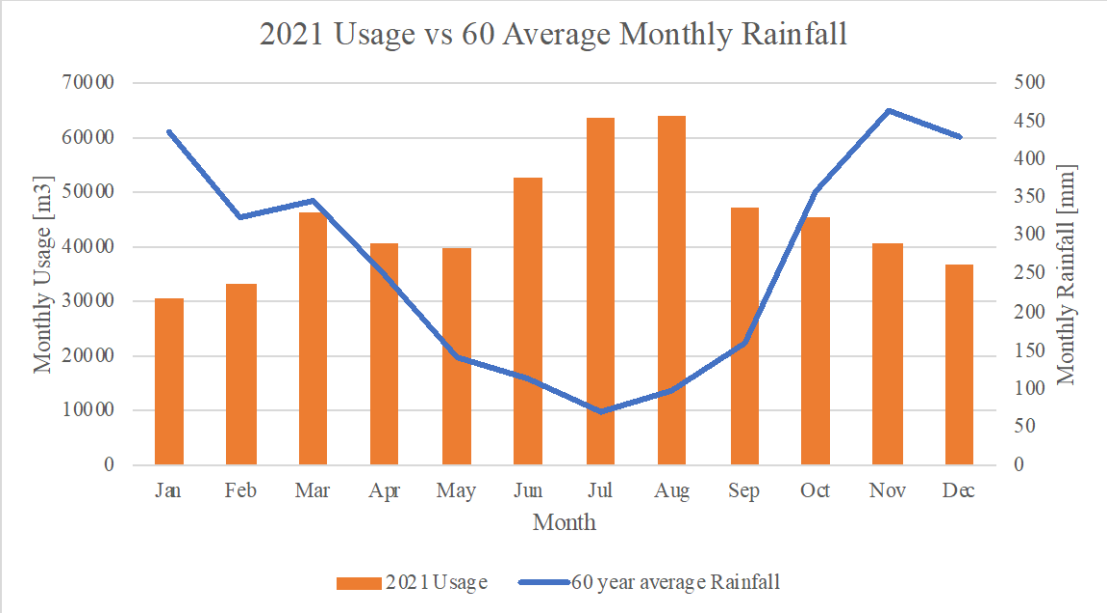

Figure 7. 2021 Water Usage vs Average Monthly Rainfall

For most of the year, Tofino has excess water, and normally suffers shortages during the dry July-Aug periods, with some potential to extend into September. The challenges of water scarcity are isolated to this period, which adds complexity to any investment business case for infrastructure and water-source investments, as improvements could be redundant for the remainder of the year. As rainfall becomes scarcer and as business, visitor and resident demands increase, the risks of water availability may not be met by restrictions alone, as it is today.

2021 Rainfall vs Usage Patterns

During the summer peak in 2021, the water transferred from Meares Island (logged daily) is illustrated below, which shows water sent to the Tofino storage reservoirs and tanks from the two treatment facilities. The graph shows the daily water used across the whole two-month period (blue columns), and the rainfall (scale on right hand side) during the same time (red lines).

Dashed orange line represents the measured creek flows (28.5 litres/second – assumed as steady), and the daily treatment capacity in yellow (dashed line).

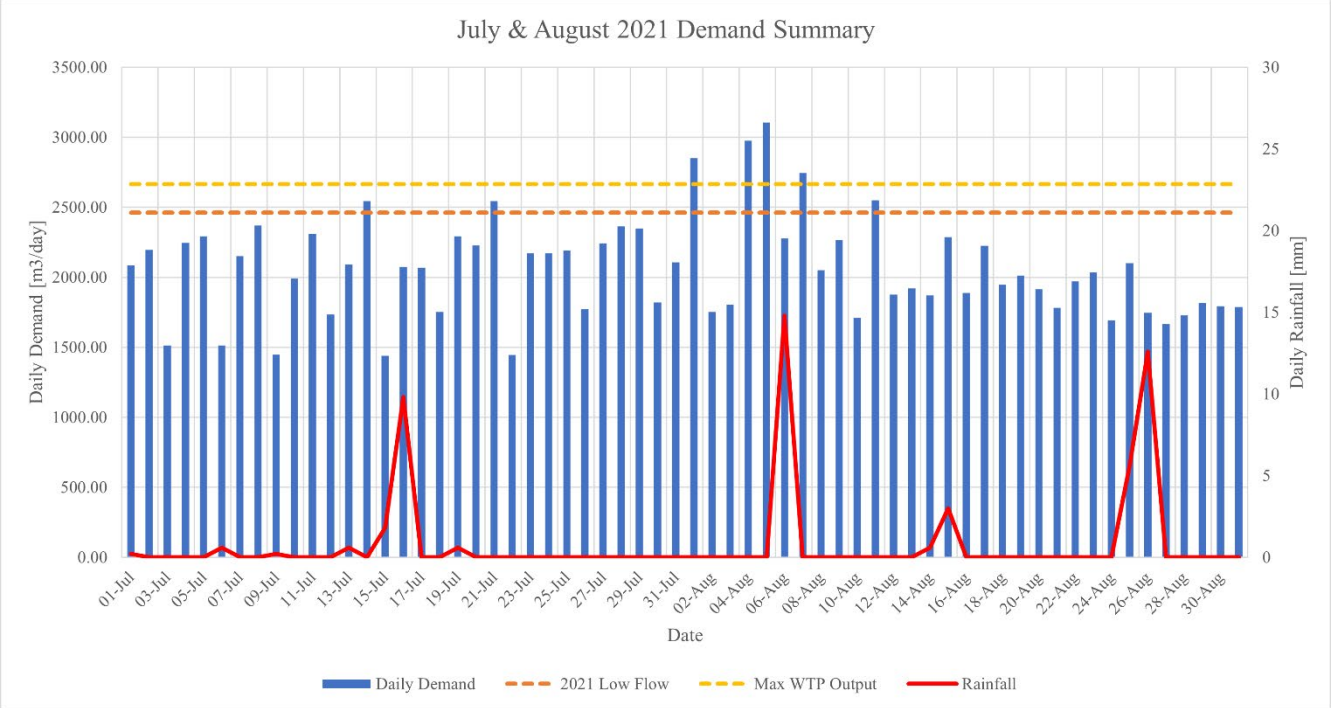

Figure 8. 2021 Summer Demand, Source Flow and Rainfall Summary

The accumulated rainfall for this period was approximately 40mm. Daily maximum demand occurred in the first week of August (at and following the holiday of Aug 2nd, 2021), noting that water production normally follows the periods of highest demand by one or two days (system delays once water is drawn down in the storage system). On average, you can see that daily demand is slightly below overall creek production (dashed orange line). In the summer drought conditions, remaining well below the orange line is best. On only two occasions did the water use exceed the maximum replenishment rate of the treatment facilities. Water restrictions came into effect at the end of August; with reduced usage below 2000m³/day for that period. Note that the water usage reduced after the Stage 3 restrictions came into effect on the 22 August 2021.

Meares Island Creek Supply / Source Water

Tofino has measured creek flows to assess dry season source water volumes from the four sources on Meares Island. The best available data collected since 2013 shows that on average in the summer, creek flow is approximately 33.4 litres per second of supply water to the reservoirs and tanks. In the 2021 drought year, this was reduced by 15% to 28.5 litres per second, which is shown on the above graphs. Daily demand continues to be below the average daily supply, which means that even with some bigger atypical demand days, the system supplies allow us to continually top up or replenish our reservoirs with the creek flows.

The Northwest Hydraulic consultant data (*NHC Tofino 2021, Low Flow Monitoring Summer Drought, Aug 27, 2021*) shows that creek flows for Sharp Creek and No.1 Creek in 2021 were within

2-4% of their average flows (averages from readings taken between 2013 to 2021), whereas the Close and Ahkmahksis creeks were 25-30% below average yields in 2021. This data suggests that Close and Ahkmahksis may be more susceptible to drought conditions than the other two creeks. It is unclear what factors (ie. upstream catchment performance, fog harvesting, in-ground storage capacity etc.) effect creek performance and overall water availability and is worth considering and examining in more detail.

Supply and Demand Scenarios

Future water use demands have been estimated at the current rate of increase[5] (2%), which were originally assessed against steady-state creek flows; the average summer flows from 2013-2021 and the 2021 low flows (baseline drought). Creek flows were estimated using both 2021 Low Flow (which we will call a 10-year Low) and the average summer creek flows observed since 2013 (called average low flow, in the graph). We are not certain if creeks will maintain flows near the averages we've measured since 2013, or if we will see a trend of decline / increase in the coming years. Obviously, the summer low flows are directly related to late spring (storage) and summer (supply) rainfall.

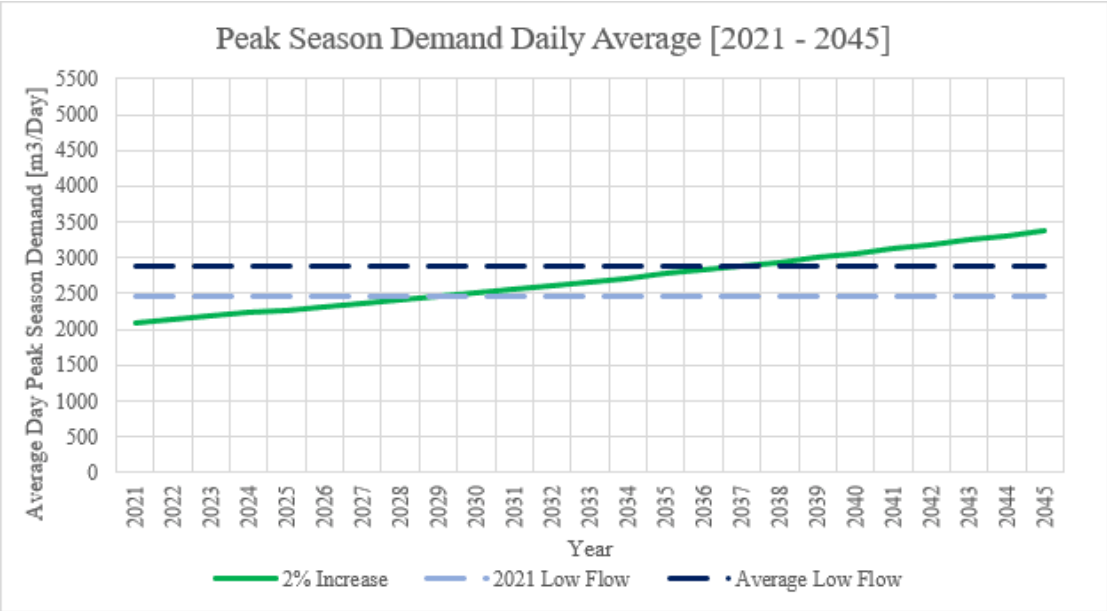

Figure 9. Projected Current Water Demand Increase of 2% per year with Constant Creek Flows.

The current trends in water demand increases (ie. business as usual) graphic shows that the water usage trends will equal the drought low flow source supply by 2029. This would be true if we continued a 2% per year water usage increase and did not suffer worse droughts than 2021. The same projections show that our demands would outstrip our supplies by about 2037, if conditions were similar to recent years.

We cannot accurately predict how water usage will change in the coming years, if demand will increase at a faster rate when compared to the previous 10 years, or if creeks will lose productivity, either sharply or gracefully. For planning purposes, it is useful to consider higher

[5] Comparing average peak season daily demand from 2012-2021 shows a trend of approximately 2% increase per year.

demand rate increases and lower flow rates for supply. If precipitation patterns change significantly, we could see abrupt decline or changes to our summer rainfall / source flows. These types of scenarios are explored below.

We then assessed several demand and supply scenarios below, using demand increases between 2 and 5% and a declining source water rate of 1% per year, which may be a reasonable estimation for summer rainfall / creek flow trends (although with some uncertainty).

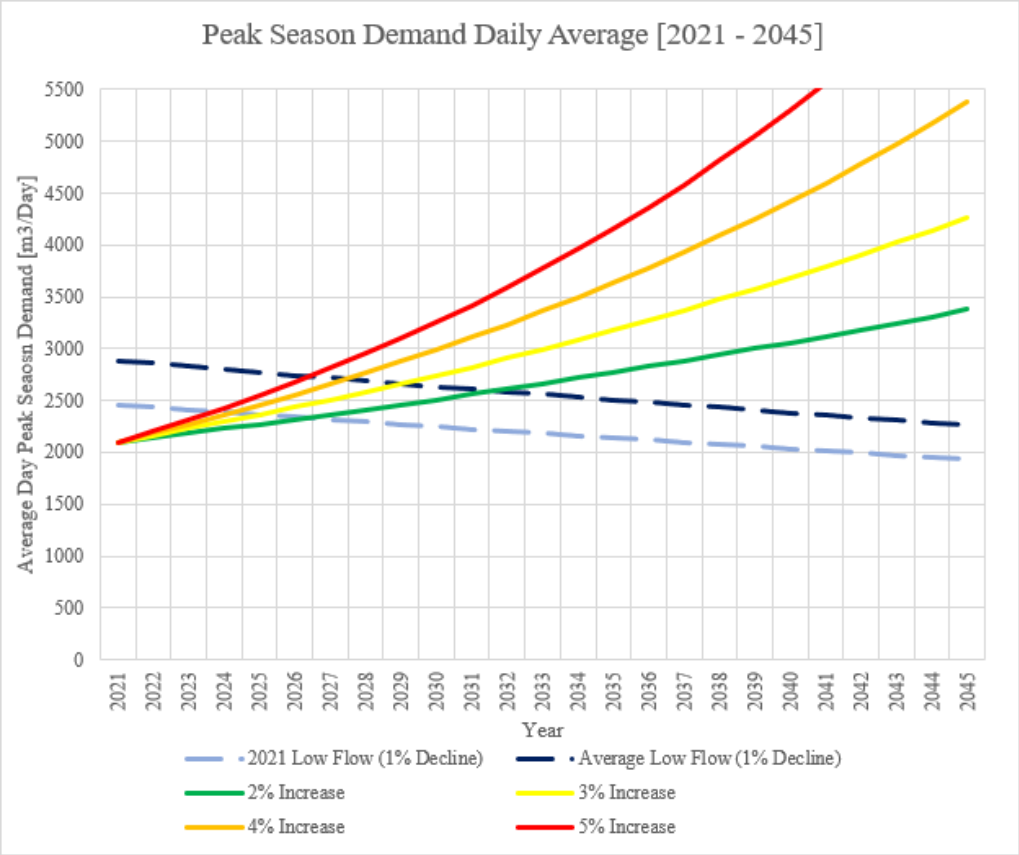

Figure 10. Demand Increase Scenarios with Declining Creek Flows (1%).

With a 2% demand increase (ie. current trend) and declining flows (of 1%), demands would equal low flow (drought) supplies by 2026 and average source flows by 2032. Accelerated demand increases (2-5%) shift these targets to earlier times (at intersections of demand and supply curves). This combination of demand increase and creek flow decline (1%) represents staff "Baseline" scenario (2021), which is used for all comparisons below.

In order to provide context around the impacts from large water users staff have highlighted the difference between the Q3 2021 and 2022 fish processing water usage. Note: 300 m^3/day is 14% of the average daily demand during the 2021 summer peak season.

The graphic and table below shows the effect of fish processing on the daily usage volumes (dashed lines) corresponding to the different demand rates. Under current trends of 2% increase

Figure 11. Additional Demand Scenarios with CERMAQ processing (dashed lines).

per year, Tofino is already at drought capacity (intersection between dashed blue and green lines) and is forecasted to use more than average daily supplies (dark blue dashed) by 2027, which is 5 years in advance of the above 2021 baseline scenario. Finding ways to minimize fish processing use of treated potable water during the driest summer months is already essential for the town's water management.

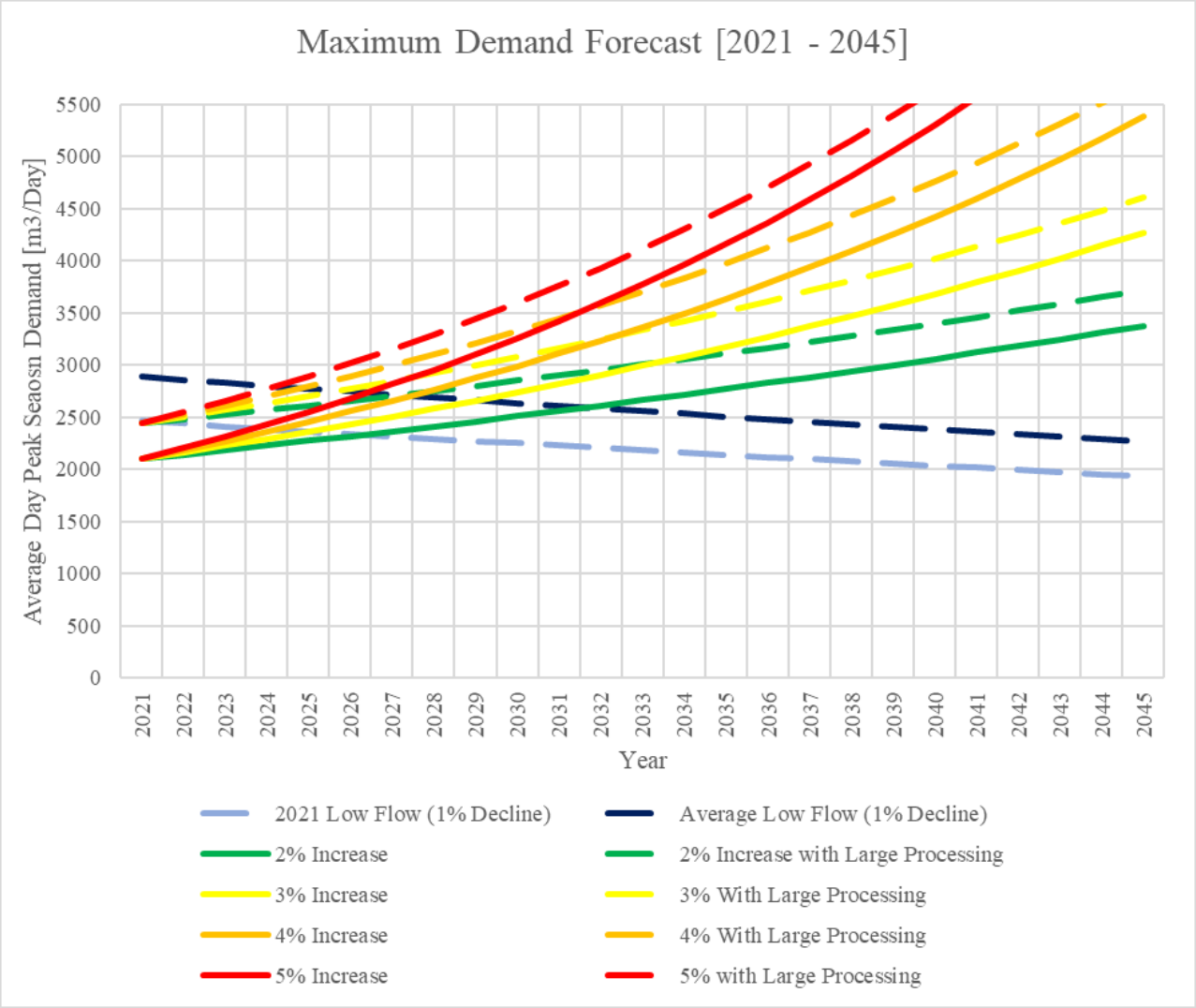

Table 2. Summary of Water Supply vs Demand Considerations

Scenario	Current Conditions – Parameter / Milestone	Added Pressures / Commentary
Current status	Average peak season water **demand is LESS than supply** for the lowest observed creek supply flows (2021).	
2% Increases per year	Projected demand will equal drought low flows by 2029.	We will reach this target 3 years earlier if creek flows decline by 1% a year.
	Projected demand will equal average creek flows by 2037.	We will reach this target 5 years earlier (2032) if creek flows decline by 1% per year.
Large plant Peak Season Processing	Average water demand with fish processing is **EQUAL** to the lowest observed creek flows. (ie. we are NOW at drought capacity with large scale fish processing in the summer).	Under a high growth, declining flow andthe large plant scenario demands would equal avg flows by 2024.
		The addition of large scale fish processing during summer peaks advances 2% growth / 1% flow decline milestones by ~5 years.

Storage

At 100% full, District reservoirs currently hold enough water for 14[6] days of average summer use (2021, daily average of 2100 m^3) without supply flows. Obviously, if supply exceeds demand, we can stay full, if treatment throughput is adequate. If supplies fail to keep up, and we rely on storage rather than rainfall, and different interventions are required to avoid running out of water.

We assess that the Sharp and Ahkmahksis reservoirs have reduced capacity (from their original design) due to sediment transportation over the years. We also know that we would never practically be able to use every drop in the tanks, due to practical cleanliness and loss of suction / transfer issues[7]. The actual volume of our current storage should be measured soonest to better understand our real-world capacity.

<u>2021 'Look Back' – Restriction Timings</u>

In 2021, Stage 3 restrictions were implemented on the 22nd of August 2021. At that time, the District was observing high daily usage demand and an uncertain forecast of rainfall. Stage 3 restrictions were implemented to reduce risks of further decreases of creek flows if rainfall failed to materialize. In 2021, supplies still exceeded demands (on average), so storage/reservoirs remained topped up. Looking back, it is perhaps easy to suggest that Stage 3 restrictions could have been avoided due to available storage volume. The challenge when determining restriction

[6] Days of Storage = Total Usable Storage Volume [m3] / Daily Average Demand [m3/Day]. 14 Days=29,400 m3/2100m3/day

[7] For our calculations we estimate that 20% of total dammed reservoirs has been lost due to sediment transfer and we would be unable to access water at the bottom 10% of all reservoirs due to debris / suction issues.

timings in real-life is that the future uncertainty is so great (source water flows, rainfall, and daily demands – are all uncertain and potentially much worse than before). Its should also be noted that storage serves two purposes (in-town storage), potable water supply, and fire flow pressure; drawing down in-town storage impacts fire-fighting capabilities and therefore remains prudent to approach cautiously in case supply dries up at times of high demand. More accurate information as to the expected flows, rainfall and actual storage volume will increase the clarity required and could reduce any overly cautious application of restrictions.

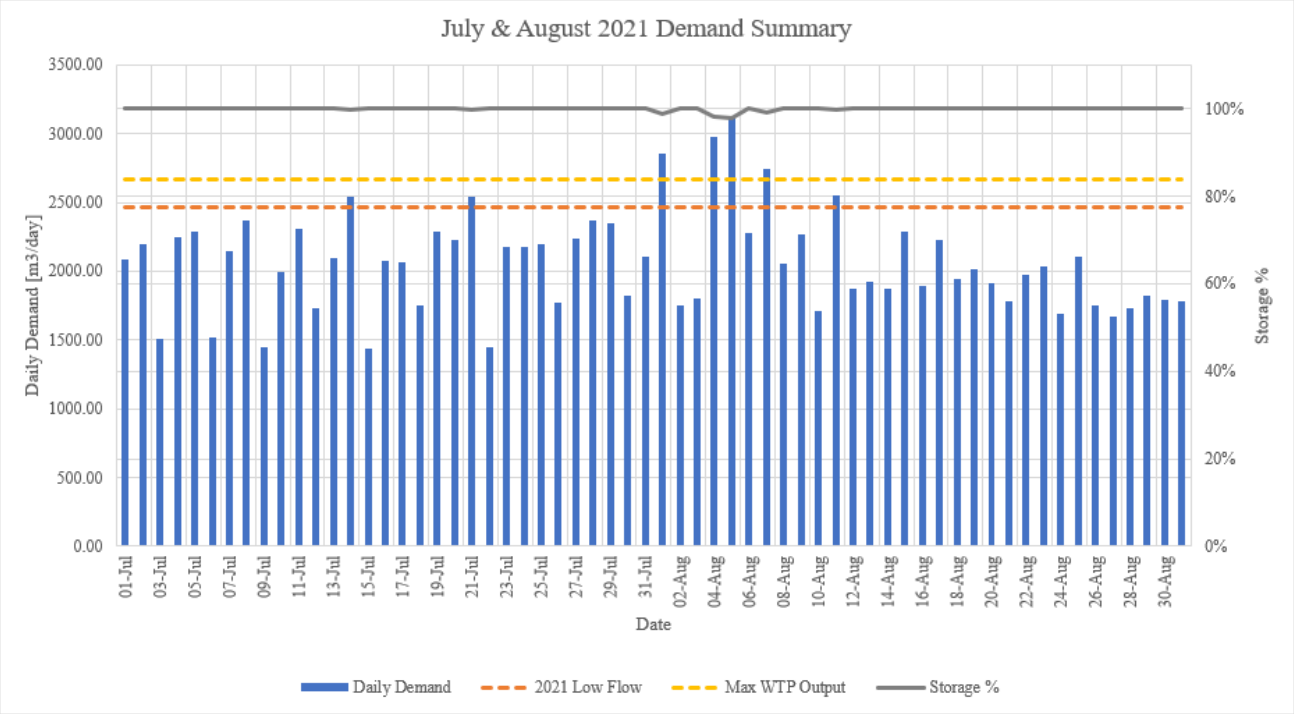

Figure 12. 2021 Supply Demand History with Storage Levels.

2032 Summer Scenario Example (no restrictions)

Looking ahead to July and August 2032 shows us the type of demand and supply patterns we expect, based on the assumptions thus far. If storage was full at the end of June, we may expect to draw down on daily storage due to the demands exceeding supplies (projecting out the 2021 daily supply/demand baseline). If no restrictions were in place, reservoir drawdown would be significant over the two-month period, due to the difference in supply/demand each day. At the end August in this scenario, storage would be below 50% of total volume. Under these conditions/assumptions, this would equate to 45 days[8] of water remaining for the District. As both daily demand and rainfall are uncertain, service providers would have to take precautions to avoid running out of water. In actual terms, the situation in 2032 could potentially be very different from what is modelled here.

[8] Days of storage estimated using the net draw on the system, under average peak season demand and low flow estimates; assuming available storage is reduced by 20% at Sharp/Ahkmahksis reservoirs and we lose suction at approximately 10% for all storage infrastructure.

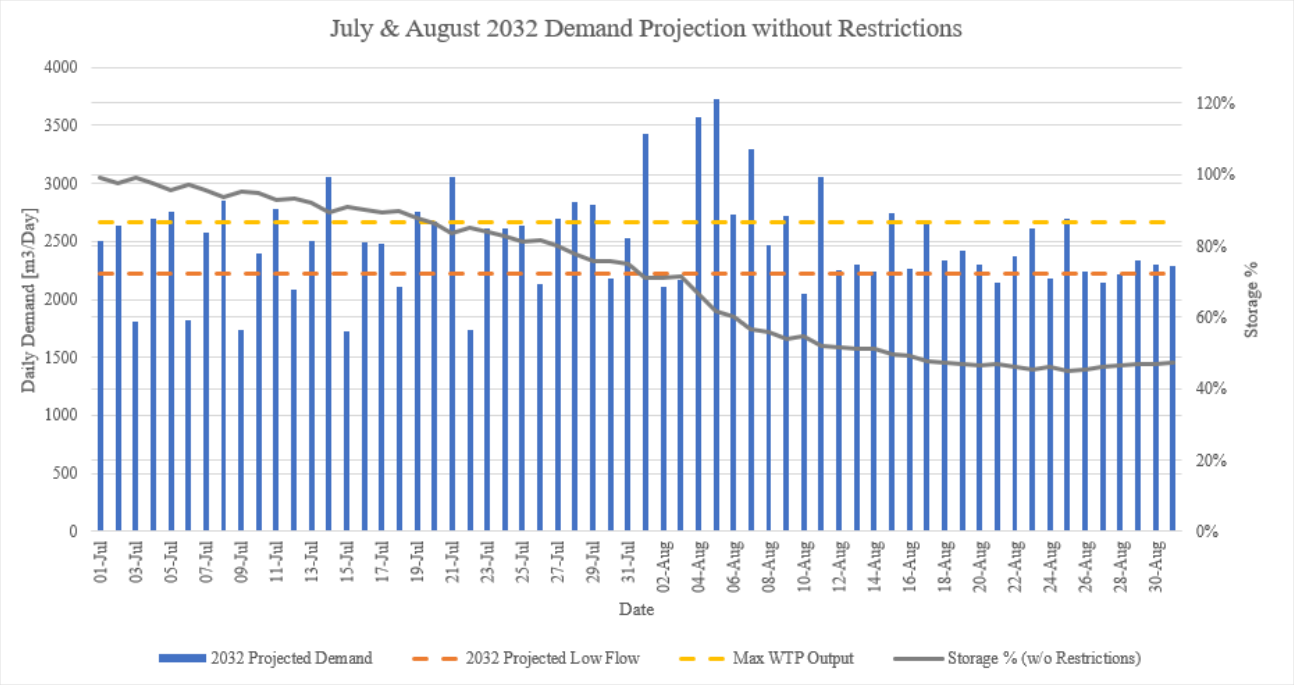

Figure 13. 2032 Supply/Demand/Storage Volume - Forecast Model.

2032 Projections with Water Restrictions

The below graph shows the impact of Stage 3 restrictions at the July 1st outset, continuing all through the period. The red line shows the onset of Stage 4 restrictions to account for high daily demands near the first week of August. The effect of Stage 3 and 4 restrictions clearly demonstrate the recovery of the storage volume. That said, more than 2 months at Stage 3 restrictions and more than 3 weeks[9] of Stage 4 restrictions are likely not palatable from a social or economic perspective. More work must be done to avoid such scenarios.

[9] The model/system recovers to 100% volume after approximately 3 weeks of Stage 4, starting on the 1st of August

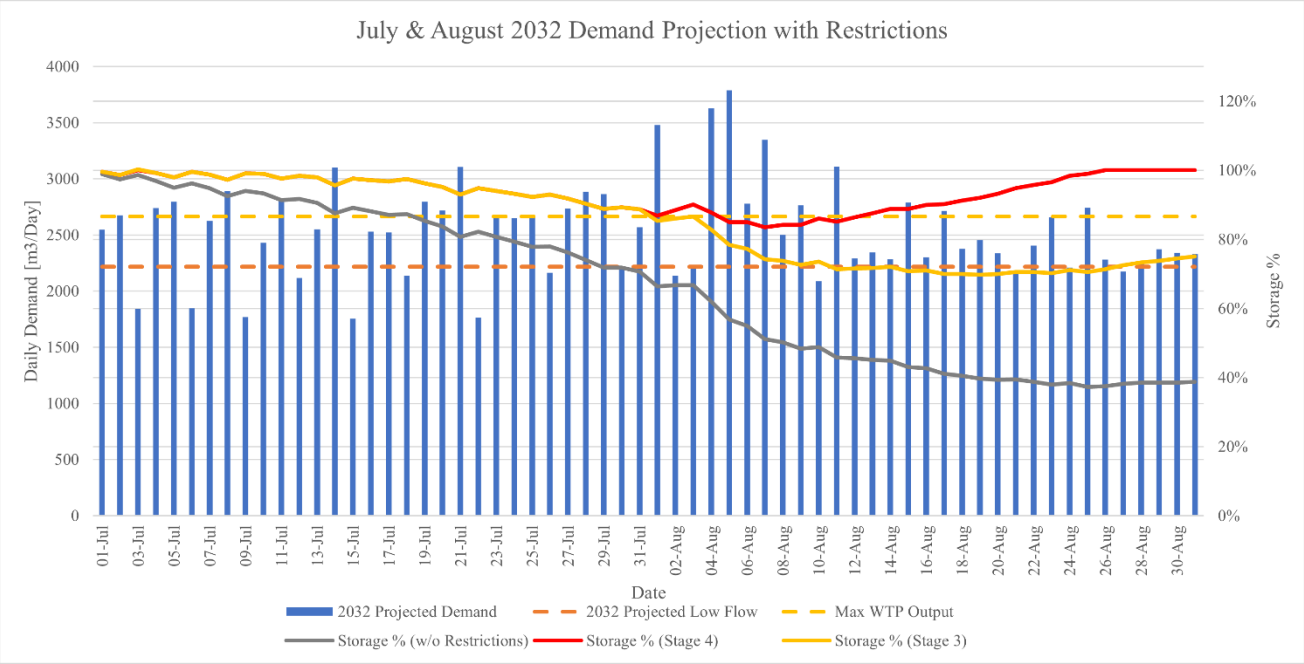

Figure 14. 2032 Supply/Demand/Storage Volume Projections with Water Restrictions.

Stage Implementation Triggers

Establishing standard "triggers" for stage implementation and even emergency interventions may be helpful in future years to manage risks and clearly communicate status/impact. Historically, implementation of Stage 3 and even Stage 4 restrictions have been based on a combination of factors, such as rainfall forecast, creek flows (visual), reservoir levels (visual), treatment plant performance, system integrity/performance, current daily demand trends and historical outlook. The opportunity exists to codify the decision process and its inputs required to implement stage restrictions. This would rely on agreement with Council on what remaining reservoir volumes should not be surpassed without restrictions in place. Is the District comfortable dipping below 40% remaining water without rain in the forecast? These questions and scenarios will need to be explored further to plan for future restriction triggers.

2032 Summer Scenario with Waterwise Performance / Standards in Place

Water use intensity could look very different after 10 years of aggressive improvements. We know that it is possible for rainfall capture in Tofino to replace all household non-potable uses, which is 55%[10] of daily use. Similar improvements could be made for business and resorts, which have large roof areas and potential to capture more water than needed for laundry, toilet, cleaning, and other uses. Efficient appliances may be 15-75% more water-savvy[11] than their older predecessors, which may also aggregate to appreciable savings.

[10] Available at: www.mcgill.ca/waterislife/waterathome/how-much-are-we-using/

[11] Dishwashers, laundry, reduced water usage habits and efficient toilets – and can save up to 75% when compared to older units. (https://www.epa.gov/watersense/residential-toilets)

If meaningful uptake of these measures was realized in the next several years, 2032 daily water use could be at least 20% better. The below graphic illustrates the effect of 20% daily water

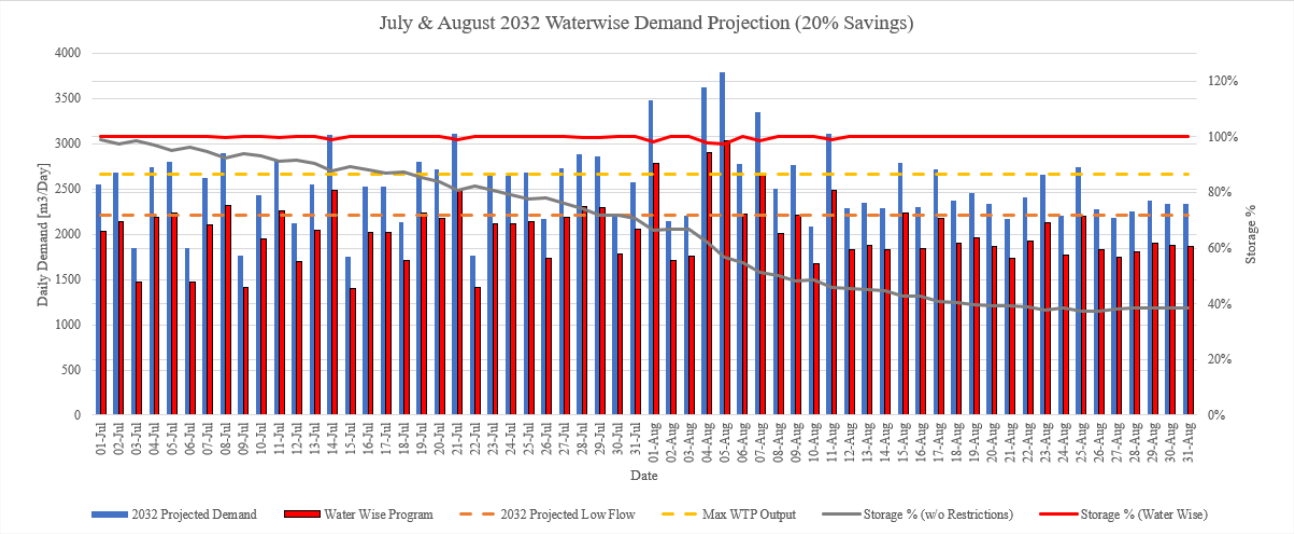

Figure 15. 2032 Projections with 20% Water Savings in Place (without restrictions)

savings (red daily usage columns) and clearly shows supply exceeding demand and the resultant reservoir storage is maintained without need for restrictions (red solid line).

Risk Mitigation

Historically, the District has relied on water restrictions and conservation efforts to reduce water demand during summer dry season. Over the past decades, Tofino has introduced new water sources and treatment capability to keep up with community demand. The additional pressures of increased daily demand and summer drought suggest that a refresh or even overhaul of some of these programs may be required in the coming years to ensure there's enough water to support daily community needs.

There are a number of interventions available to the District (both current and new) that could extend the timelines highlighted in the above scenarios, which provide important years for planning and financial savings to invest in future water system improvements. No matter what scenario plays out, Tofino should invest in BOTH supply and demand side management programs. The cheapest cubic meter of water is the one never used. The increasing price of infrastructure compels the District to first eliminate waste in the water system and find creative ways to stretch the available water resources.

We know that the current patterns of water usage are ripe for improvement, and if overcome, would reduce our water demand intensity, and stretch current supplies. The issues to be addressed include:

1. The allocation of potable water for non-potable uses.
2. Wasting water through poor practice.
3. Wasting water through faulty infrastructure and leaks (both private and public).
4. Treating all potable water uses as equal in importance; not having a manner to allocate to highest priority uses during times of shortage.

5. Losing water to run-off during periods of scarcity.
6. Using water inefficiently through old and/or inefficient appliances and equipment.

Each day, our total water demands are shaped by these burdens above. The right set of policy, program and infrastructure initiatives would improve these different issues and reduce our daily demand, which would make room for growth in our community, if that's desired.

The following mitigation measures should be assessed for reducing daily demand and improving supply and should be the source of additional planning with suitably qualified water professionals. Several of these programs may be integrated into fewer initiatives that reduce the level of effort and time required to capture their value/benefits. Staff note the highest priority items which should be progressed starting in 2022/23.

Table 3. Water Risk Mitigation Measures (High – recommended for action in 0-1 year. Medium 1-2; Low 2-3)

Management Category	Program	Description	Priority
Programs and Policies	Updated Water Restrictions	Renewed water restriction plans, education, and communications programs.	HIGH
	Regulated Water Allocation Priorities	Assessment of water-use permits or equivalent legislation to regulate the types of water usage allowed during periods of risk/shortage.	MED
	Fish Processing Operational Restrictions	Progress discussions with industrial fish processors to explore all options to remove summer operations.	HIGH
	Water Rate Updates	Updated water rates to reflect value of water, especially in Q3.	HIGH
	Updated Conservation Program	Revised and updated conservation program and resources to connect and inspire action in community and with decision makers. Includes dedicated (new) staff, communication and education program.	HIGH
	Waterwise Rewards Program	Creation of a self-funded program and standards to shift fees and revenue to rebates to help community fund water use reduction and rainwater capture improvements (also delivers stormwater reduction benefits).	HIGH
	Watershed Management Program	New governance structure, agreements, and adequate protections to reduce risks to watershed (MNA).	MED
	Emergency Water Plan	Action and plan required to immediately respond to all relevant water emergencies - including temporary loss	HIGH

		of supply, fire, contamination and shortages. Includes trucked water plan.	
	Waterwise – New Development Program	New standards for development to vastly reduce water intensity of new development AND retrofits.	HIGH
	Water Loss Detection / Repair Program	Appropriate leak detection and repair program, including calibration, testing and/or replacement of inaccurate meters.	HIGH
	Long Term Water Supply Plan	Commencement of discussion re: long term water source with neighbouring communities (can be done as part of Master Plan).	LOW/MED
	Water Master Plan	Completion of the required water infrastructure and plans/strategies.	HIGH
Infrastructure and Technology	Optimized Reservoir Volumes	Removal of debris from Sharp and Ahkmahksis reservoirs to increase available storage volume.	MED
	Real-Time Metering and Monitoring	Real time water use monitoring, level and flow sensors for Meares and Tofino assets.	HIGH
	Water Appliance Efficiency Standards	New standards for toilets, dishwashers, laundry and other appliances (residential and commercial)	MED
	Sea water Fire Fighting Systems	Examination and plan for seawater fight suppression water for coastal building fires.	LOW
	Storage Expansion Assessment and Plan	Assessment and plan for future expansion priority and options for Meares Island and Tofino water storage.	LOW

Koers Water Model - Extended Time Water Model Analysis

The 2022 Water Model - Extended Time Water Model Analysis identifies risks to the supply stage following a large fire or extended drought conditions. Future water restrictions (stages) must include provision of the implementation and communication of immediate progression to Stage 4 following a large fire. The report suggests increasing the capacities of the Ahkmahksis Water Treatment Plant and the submarine pipeline from Ginnard Creek will help improve the recovery of the District's potable water reservoirs during high summer demands. The report further recommends that the District undertake more extensive monitoring of summertime creek flows should be undertaken so that future summertime low flows can be estimated with a higher degree of confidence.

District staff are now actively using the Koers water modeling process for all significant development applications to ensure that the required pressure and flows can be maintained.

COMMUNITY ENGAGEMENT & COMMUNICATION

The development of a water master plan will involve significant public consultation and meaningful discussions with the Tla-o-qui-aht and Ahousaht First Nations.

NEXT STEPS

This report quantifies the current status of the Tofino water system and the future planning and risk considerations related to supply and demand imbalances.

Further, the report highlights the risks associated with summer demands outstripping supplies, especially in drought years and identifies the benefit of water restrictions and importantly, the transformational potential for water reduction programs to reduce demand and the duration/frequency of severe restrictions.

Significant water savings could remove or delay expensive capital investments that would otherwise be required to expand source water. Much work is left to measure, track and improve the performance of our creek flows, reservoirs, users, and operations more accurately.

Subsequent to the presentation of the report staff will undertake the following actions in 2022:

1. Share this report with Tla-o-qui-aht and Ahousaht First Nations to fully understand all perspectives and potential insights. The engagement process will help inform future operational and capital actions.
2. Present the report to community stakeholders such as the Tofino-Long Beach Chamber of Commerce.
3. Initiate a Water Master Plan project including a 20-year strategy, a review of water Development Cost Charges, and development of related asset management considerations. This process would also include significant public consultation.
4. Develop an action plan based on the high priority actions identified in Table 4 (above). Completing the various tasks identified in the action plan will depend on the availability of sufficient human and financial resources.

Respectfully submitted,

Fraser Work, 2020-2022 District of Tofino Director Infrastructure and Public Works (Consultant)

For
Aaron Rodgers Director of Infrastructure and Public Works

Appendices: