Final Report

Craig Bay Water Study Group

2021 - 2022

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Executive Summary

There have been numerous studies, reviews and investigations concerning the use and cost of the water service for Craig Bay Estates over the past fifteen years. Most of these efforts tended to examine single aspects of the water utilization issue, such as what changes are needed regarding landscaping practices, or irrigation practices, or homeowners water consumption.

While only four of our five strata groups are connected to our main water supply line, with the Onyx being served by a separate supply line, we felt it was important for us to include all five strata groups in this Study Group. Gains made in any part of Craig Bay regarding water conservation efforts would be beneficial to all members of our community, so having all groups included from the outset seemed to make a lot of sense.

In our approach this time, we recognized the importance of examining all three aspects of this issue – since each area is inter-related to the other two areas. In order to truly improve our water-use practices, we need to identify and implement a set of integrated Best Practices for Landscape Management, Best Practices for Irrigation Management and Best Practices for Homeowner Water Conservation Management. Working on one without working on the other will only yield a partial solution.

Our initial mandate was primarily focused on developing a strategy for approaching the City of Parksville to look for ways to revise their current billing structure for water services in order to reduce our annual cost for water. In the early stages of this study, we concluded that before we could consider any approach to the City, we would need to be able to clearly demonstrate that we were applying a set of best practices throughout Craig Bay to reduce our overall water consumption and contribute to water conservation, without creating problems for our residents. Then, and only then, would we be positioned to make any special requests from the City. While the City is concerned about water conservation, they are probably not very interested in generating less revenue from the supply of water to Craig Bay. So, we must be responsible and find ways to lower our costs by reducing our overall consumption.

As the importance of this shift in approach became clearer to us, we were able to focus our attention on those areas that are within our own control, to help reduce our consumption and ultimately our costs for water.

This report of our analyses and deliberations over the past eighteen months contains:

- A summary of the history of past studies and their corresponding recommendations for changes;
- A detailed yet simple explanation of the complexity of our water supply system and our irrigation system;
- A detailed review of our Pond System and its primary functions;
- Details of the geological conditions of our landscape and the limitations this poses to our landscaping and irrigation initiatives;
- A summary of the 2021 Residents' Survey that clarified the expectations of our homeowners regarding landscaping and irrigation;
- An integrated set of Best Practices for all three aspects – landscaping, irrigation and homeowner water conservation; and
- A set of Recommendations for Action that will enable us to become more efficient in how we use water here in Craig Bay Estates, without compromising our effectiveness at retaining the beauty of our community.

We believe that we have collected almost all of the relevant information that was reasonably available on this topic, so that it is preserved in one comprehensive report for future reference.

Through our study, we concluded that:

- Some of our past, well-intentioned initiatives, such as reducing watering cycles, were creating problems – not actually solving them.
- Trying to establish similar irrigation practices for all four strata was not an effective way to proceed.
- Each individual Irrigation Manager must have the freedom to decide what's best for each of the areas within their own strata because of the many unique variables and conditions that must be considered.
- Our past efforts to "tweak the system" have resulted in solid improvements at lowering our consumption rate over the past 3-4 years and we have probably now squeezed as much as possible out of efforts to trim back on our normal consumption and costs.
- It appears that the most constructive way for us to further reduce our water consumption and our costs will come from these four initiatives:
    1) Ensure that all four Irrigation Managers reach an annual agreement for the date when irrigation begins in the spring and the date when we cease irrigation in the fall. Every week less of irrigation makes a major contribution to reducing or preventing the amount of time in which we pay the highest cost rate for water.
    2) Consider investigating and investing in irrigation equipment improvements to keep our system running as effectively and efficiently as possible, and thus avoid the need for a complete system overhaul or replacement in the future.
    3) Implement the integrated set of Best Practices for Landscaping Management, Irrigation Management and Household Water Conservation Management.
    4) Initiate a concerted effort to inform all members of our community about changes they can make to contribute to better water conservation practices in their own homes.

  The implementation of these four initiatives is within our own control and will help us to further reduce our overall cost for water through wise water conservation efforts.

Once this report has been reviewed and accepted by all five Strata Councils and the CLC, then a decision must be made about whether or not to approach the City of Parksville to consider modifying its current billing practices for large residential customers, such as Craig Bay Estates.

We sincerely hope that our work has produced a useful tool for further improving our collective water conservation efforts.

The Craig Bay Water Study Group (October 25th 2022)

[NOTE: This report was presented to a joint meeting of all five Strata Councils and the CLC on Feb. 2nd 2023. At that meeting, it was pointed out that there was some incorrect information contained on pages 16-18. of the Final Report of Oct. 25th 2022. The identified error was corrected and an Addendum was sent to each Strata Council in early March of 2023. That is why this version of the report has an amended footnote date of March 9th 2023. This version of the report has the corrected version of pages 16-18, so it is the most up-to-date version of the Final Report.]

Section 1: Mandate and Membership of the Water Study Group

This study was undertaken as a follow-up to the 2019 analysis of the practices and costs of supplying water to the four strata of Arbutus Grove, Meadow Beach, Seaside Village and Shorehaven within Craig Bay Estates. That study was initiated by Seaside Village Strata Council. In the final report for this study, Recommendation # 8 stated:

> "Establish a small executive group of knowledgeable residents from Craig Bay to investigate options and ways to approach the City of Parksville for changes in the way we are billed that will help to bring our overall water consumption down, along with the corresponding costs for water supply from the City."

The Craig Bay Water Study Group is the response to this recommendation.

Purpose of the Craig Bay Water Study Group:

- Develop a plan for approaching the City of Parksville to present the case for our whole community – all five Strata Councils and all of our homeowners.
- Identify realistic and viable options that could contribute to reducing our collective annual costs for water supply.
- Include specific internal actions that our strata groups can implement, as well as actions that the City could seriously consider, to create a more equitable pricing model for Craig Bay.
- Identify those services that Craig Bay homeowners provide, which create a significant benefit for the City, such as the annual maintenance of the retention pond system to handle ground water run-off from other parts of the City, maintenance of the walking trails around Craig Bay, etc.
- Secure the endorsement of all five Strata Councils in the approach to be used in negotiations with the City – to ensure a unified voice.
- Establish a constructive working relationship with City officials as we undertake our negotiation process.
- Provide regular update reports to all Strata Councils as the study moves forward – so that there are "no surprises" as our negotiations move forward.

Membership of the Craig Bay Water Study Group:

Although the original Terms of Reference suggested that there be members from each of the four strata groups drawing water from the main meter and exclude the Onyx, because of their independent water supply system, it was agreed that we would be better served if all five Strata Councils had appointees to the group. In addition, we sought out four long-term members of the community who had subject matter expertise in our ponds, irrigation and water systems and who have also provided exceptional service on prior studies and reviews.

The strata appointees were:

Arbutus Grove – Peter Hall
Meadow Beach – John Blackburn
Seaside Village – Jim McKinlay
Shorehaven – Bill Dunlop, who was replaced by Dawn Stewart
The Onyx – Susan Milne

The Subject Matter Experts were:

Chris Chilton
Wally Chinn
Bob Faulkner and
Dave Montgomery

The Study Group began its work in mid-March 2021 and due to the Covid-19 situation at that time, virtual meetings were held until late July when we were finally able to meet in person.

While we had initially anticipated that we would be able to complete our work in time for presentations to each Strata Council prior to their 2021 Annual General Meetings, we soon discovered that we needed to broaden our mandate in order to compile all of the relevant material produced over the past 15-20 years on this subject and be able to put forward a comprehensive set of recommendations that would move us strategically into the future, without having to revisit the whole issue every couple of years.

We quickly came to the conclusion that, in order to ever consider approaching the City of Parksville for any consideration of modifying their current billing practices, which might reduce our overall cost for water, we needed to be sure that we had our own house in order. This would include providing solid evidence that we were doing everything possible to lower our overall water consumption through the use of "Best Practices" throughout Craig Bay.

Past initiatives seemed to be focused on ways to reduce water consumption by either:

- Reviewing and revising our irrigation practices, or
- Reviewing and revising our landscape practices, or
- Encouraging residents to use less water in their daily practices.

We recognized early on that <u>all three</u> of these aspects are intricately inter-woven and need to be examined in an inter-dependent holistic way, not in independent ways. This resulted in a much larger initiative than was previously considered.

It became quite clear that in order to find effective ways to reduce our overall cost for water, we needed to focus on ensuring that we were regularly utilizing "best practice procedures" in all three of these areas: landscape management, irrigation management and household water conservation management. That way, whether or not the City was willing to consider modifying their current billing practices, we still had a degree of control over our own destiny, by lowering our overall water consumption and subsequently, our overall cost for water.

Section 2: Key Components of our Review

During the eighteen months of our study, a series of initiatives were carried out. These included:

- A thorough review of previous documents and studies was conducted on this topic.
- Walking tours were conducted for all four strata, accompanied by the respective Irrigation Manager for each strata to become familiarized with the complexity of the systems and any specific issues or concerns that existed.
- Weekly readings of the main meter at Langara and Gabriola were taken and recorded from April until October, with monthly readings recorded during the winter period when the irrigation system was not operational. This information enabled us to complete comparative assessments from previous years to better understand our annual consumption patterns.
- A Residents' Survey was developed and distributed in June of 2021 to determine what the expectations were of our residents with regards to our irrigation and landscape management practices. A summary of the results of this survey is presented later in this report.
- An Interim Report was prepared and presented to each Strata Council in October of 2021, to provide an update of our progress to date and our plans for completing this assignment. This was done to ensure that Councils were prepared for any questions or concerns that might be raised at Annual General Meetings scheduled for November.
- To ensure we were working with the best information available, special input sessions were held with the Irrigation Managers from each strata, as well as Landscape Committee representatives from each strata. These sessions were extremely helpful in the development of Best Practices for both landscape management and irrigation management.
- A technical input session was provided by a representative from Iritex Pumps and Irrigation in Errington regarding our current system as well as new technological developments in this field for us to consider as we continue to manage our existing system.
- A technical input session was provided by a local Master Gardener on the pros and cons of mulching practices, since there were many various opinions on this topic. This was helpful in developing a Best Practice on this topic.
- Over the course of our study, individual members of the Study Group undertook a series of three experiments to validate the effectiveness of our current irrigation practices, to assess the impact of the various sprinkler heads in use throughout Craig Bay and to calculate the potential impact on water conservation if a set of simple changes in homeowner practices was implemented.

Our intent was to try and compile a comprehensive information base so that sound Best Management Practices could be put forward, as well as a set of solid Recommendations for Action, that would result in reducing our overall water consumption each year and therefore lower our annual costs for water. This initiative was intended to pull all of the relevant information together in *one final comprehensive report*.

Section 3: An Integrated Study Framework

Many of the past initiatives to examine and improve our water consumption practices appeared to be conducted as independent initiatives.

- Each Landscape Committee was concerned about what types of plants were being introduced, where they were being planted and how they were being maintained.
- Each Irrigation Manager was concerned about the efficiency and effectiveness of the operation of their own current irrigation system and how it could be improved.
- Sound information on water conservation practices was shared with homeowners in the hopes of lowering personal water consumption to help reduce costs.

One of the problems that can occur in this type of independent analysis is that a solution in one area can sometimes create a problem in another area. These three components are all inter-related and as such, must be analyzed in an integrated manner – a holistic system analysis.

Since the entire water system that serves Arbutus Grove, Meadow Beach, Seaside Village and Shorehaven flows through one meter and one service distribution system, our household water supply cannot be separated from our irrigation water supply. To change this and set these up as two independent systems, our whole water supply system would have to be redesigned and rebuilt, which would be an extremely complex and costly undertaking.

The primary purpose of any irrigation system is to ensure that the designed landscape – lawns, trees, shrubs and gardens – receive sufficient water to ensure proper growth, when our natural rainfall proves insufficient. So, irrigation efforts must support landscaping efforts.

The original design and layout of Craig Bay Estates was carried out over a series of years and as each section was developed, the water supply system was adapted to serve the new properties being developed. The primary intent was to create a very beautifully landscaped and well maintained community setting. As such, efforts to plant trees, shrubs, lawns and gardens created incremental growth. Each section had its own beauty and each had its own needs for irrigation. When the final work was completed, the four individual Strata Councils assumed control over a variety of conditions and circumstances that have resulted in a very expensive water cost for all residents.

In subsequent years, as we tried to lower our cost for water, we tended to focus on only one or more parts of the entire system. In this study, we recognized that we needed to start by having every Strata Council included in the study, having each Landscape Committee included in the study and each Irrigation Manager included in the study. We also needed to ensure that we explored all three of the primary components of our community's water consumption activities:

- Our landscaping practices,
- Our irrigation practices, and
- Our household water consumption practices.

This diagram outlines the interconnectedness of this type of holistic assessment.

Due to the overlapping aspects, a change in one area will have a corresponding impact on another area – either positive or negative. It also clearly demonstrates the importance of generating Best Practices that can support and enhance all three components without any unexpected negative consequences between components.

To achieve this integrated approach, we needed to look at each component individually as well as explore the impact one component would have on another, as we developed an integrated set of Best Practices.

Section 4: A Vision for Maintaining the Beauty of the Craig Bay Landscape

Any group that holds responsibility for the long-term care of a community needs to have a clear picture of what they are trying to accomplish – their "desired future state". In strategic planning projects, this is referred to as a strong Vision Statement. Our study group drafted this statement as a description of what we believe we are trying to achieve as a community.

Vision For Craig Bay

Our vision is to achieve a sustainable balance between the beautiful landscape characteristics that contribute to the value of our Craig Bay properties, while also ensuring that we utilize best practices in:

- *Landscape design and maintenance, and*
- *Irrigation systems that contribute to wise water conservation practices.*

By diligently applying these practices, we can ensure that the beauty of our landscape is retained, while also ensuring a reasonable cost for water services for all residents.

Section 5: Scale and Scope of Our Irrigation System

The water and irrigation system within Craig Bay Estates was installed in stages, as each strata were constructed. It was never designed as a whole system – but was pieced together section by section. All of the water that supplies Arbutus Grove, Meadow Beach, Seaside Village and Shorehaven as well as the Beach Club Precinct (the Beach Club, the pool and the cottages) is drawn from one main service line that flows through one common meter located at the corner of Langara and Gabriola.

Each of the four Strata Councils are billed for their portion of the total water bill on a pro-rated basis, based upon the number of residential units in each strata. The Onyx has its own separate water supply line and is metered and billed independently.

The water used for household consumption and the water used for irrigation all flows through the same supply lines and is not segregated. So, the consumption level in any one house has an impact on all residents and the irrigation practices in any one of the four strata also has an impact on all of the strata. Water is considered part of the "community lands" and is covered under our monthly strata fees.

Appendix # 1, on Page 45 provides a detailed description of our Craig Bay Water Supply System. It outlines many of the issues we have to cope with as a result of how the system was initially built and it also explains why we are limited in what we can and cannot do as we focus on reducing our overall water consumption and subsequently our overall cost for water.

As this report explains, our annual costs for water in the winter period (Oct. 1st – March 31st) are very consistent from year-to-year. Any variation seems to be due to occupancy levels over the winter, as some residents tend to take extended holidays. Our annual costs for water in the summer period (April 1st – September 30th) can vary significantly from one year to the next, because of the level of rainfall we receive and the corresponding volume of irrigation that is needed to retain the beauty of our landscaped areas. The purpose of irrigating is to protect, develop and preserve our landscaped areas by providing needed water when Mother Nature does not do so adequately. In a typical summer season, approximately 70-75% of our water cost is for irrigation purposes. Our household consumption in the summer again is very consistent, and is related to occupancy levels. During 2020- 2022, as a result of limited travel due to Covid-19, our household consumption levels were higher than past years because of significantly higher occupancy rates throughout Craig Bay.

Craig Bay Estates covers an area of 43 hectares, which is 106 acres (one hectare = 2.47 acres). That's a lot of land to irrigate. Our irrigation system is very complex and the two diagrams in Appendix # 1 (on pages 46 and 48) help to explain it in a simplified way. The sheer volume of equipment needed to monitor and control the system is much larger than many residents realize.

This chart lays it out clearly:

Strata	Number of Irrigation Zones	Number of Sprinklers
Arbutus Grove	6	1,617
Meadow Beach *(Includes the Beach Club Complex)*	5	808
Seaside Village	18	5,725
Shorehaven	1	290
Total	**30**	**8,440**

The number of sprinklers is an approximate number only, as sprinklers are added from year-to-year in some yards and gardens. Also, some become covered up with grass and are no longer operational or visible – so it is almost impossible to get an accurate number. What is important is for residents to understand that our irrigation system is extremely large and complex, which is a real challenge when it comes to managing it in the most efficient and effective way.

There are several different types of sprinkler heads within any one zone – some are pop-up sprinklers for lawn areas, some are directional spray sprinklers in garden bed areas and some are fairly large 360-degree rotor sprinklers to water large open areas.

In the past there has been some criticism of Craig Bay for its water consumption levels. It is important for us to put this into proper perspective.

The City of Parksville calculates water consumption on volume – the number of cubic meters (m3) consumed within a billing cycle. One cubic meter (m3) is equal to 1,000 litres of water. In a recent comparison of four large multi-family residential units within Parksville, the annual water consumption per household (household use plus irrigation) varied between 183.6 m3/year to 193.5m3/year. Our consumption within Craig Bay was 189.6 m3 / year, which means our typical annual consumption rates are within the normal range for other large multi-family units within the city.

Section 6: City of Parksville Billing Practice

The City of Parksville calculates water utility rates based on two billing cycles:

- Winter Period – October 1st – March 31st and
- Summer Period – April 1st – September 30th.

Each billing includes the “cost for water consumed”, as well as a “basic infrastructure fee”, a “treatment plant reserve fee” and a “sewer rate”. Of these four items, the cost of water and

the sewer rate are set on a sliding scale that increases as total water consumption increases. The other two items are set at a fixed rate.

The 2021-2022 rate structure shows that there are 5 stages in the cost for water consumption:

- 0 – 60 m3 costs $0.7026 per m3
- 61 – 120 m3 costs $1.4050 per m3
- 121 – 160 m3 costs $2.3418 per m3
- 161 – 400 m3 costs $3.5128 per m3 and
- 401 m3 and over costs $1.9669 per m3

The sewer rate fee is calculated on the basis of water consumption during the winter period, when irrigation systems are not operational. This same amount is also applied for the summer period, since water being used for irrigation soaks into the soil and does not enter the sewer system, which must then be treated.

There is one water/ sewer bill for the four strata in Craig Bay that are all on the same supply line. The City's Finance Department then splits this bill up into four – one for each strata. This bill is prorated, based on the number of residential units in each strata, as follows:

- Arbutus Grove 87 homes = 21.97%
- Meadow Beach 60 homes = 15.15%
- Seaside Village 229 homes = 57.83%
- Shorehaven 20 homes = 5.05%

Water used for the Beach Club Complex is included in the overall bill and is equally shared by each strata. Since the Onyx is on its own meter and billing system, their portion of the cost for water and sewer for the Beach Club Complex is not separated out. Several years ago, their portion of this cost was calculated. The Onyx currently covers the costs for two street lights in front of their building along Cape Cod Drive. It was determined that their coverage of this common cost for street lighting was approximately equal to their cost for common water use at the Beach Club, so it was agreed that these two items offset each other.

As noted in Section 5, on page 11, our typical consumption level for the typical residence in Craig Bay is 189.6 m3 per household each year. Based on the City's cost structure, that means that we will hit the third and fourth cost levels during the summer billing cycle every year. ***We reach the highest rate level in the same time period when we are using the most water.*** Since 70-75% of our water costs in the summer are the result of irrigation, that means that our best method for reducing our costs is to manage our irrigation practices in such a way that we can reduce our overall irrigation water consumption.

That means that we can effectively reduce our overall cost for water only by applying:

- Best Practices for Landscape Management,
- Best Practices for Irrigation Management, and
- Best Practices for Household Water Conservation Management.

The balance of this report is focused on how we can best achieve this goal.

Section 7: Craig Bay Water Consumption

2019 Irrigation Study

In 2019, Seaside Village undertook an extensive study and invited the Irrigation Managers of all four strata groups to participate. From this study, modifications were made to the watering cycles, agreements were made to eliminate irrigation in some areas that were irrelevant (e.g., the narrow strip along the north side of Saltspring Place, adjacent to the Heritage Lands which are not irrigated at all), and to try and coordinate the practices from one strata to the next. As a result of these initiatives, we effectively produced significant reductions in water consumption from the summer of 2018 to the summer of 2019, as follows:

- There was a significant "water consumption creep" when we examined the summer water consumption levels for the previous five years:
  - Apr. – Sept. 2014 89,000 m3
  - Apr. – Sept. 2015 69,300 m3 (Stage 4 Water Restrictions in place)
  - Apr. – Sept. 2016 90,500 m3
  - Apr. – Sept. 2017 90,000 m3
  - Apr. – Sept. 2018 103,832 m3

- This is what triggered this 2019 study.
- As a result of modifications to the current watering cycles for large rotors, restricting watering to some of the large common areas such as the berm area by the Three Bridges and the strip along the Heritage Lands on Saltspring Place and continued vigilance at maintenance and repairs, we were able to drop the 2019 summer consumption down to 90,341 m3.
- These simple actions did not have any serious negative impact on our landscaping and yielded a reduction of about 13% in summer consumption - and all of this reduction occurred at the end of our billing cycle when we were paying the highest rate / m3, which resulted in a corresponding cost savings of about $116.20 per residence.
- This study proved that there were no significant leaks in our overall system, as some residents continually claim, and it also verified that any efforts to reduce summer consumption costs will yield the greatest cost savings for residents because we are at the fourth stage of the rate scale for most of the summer period.

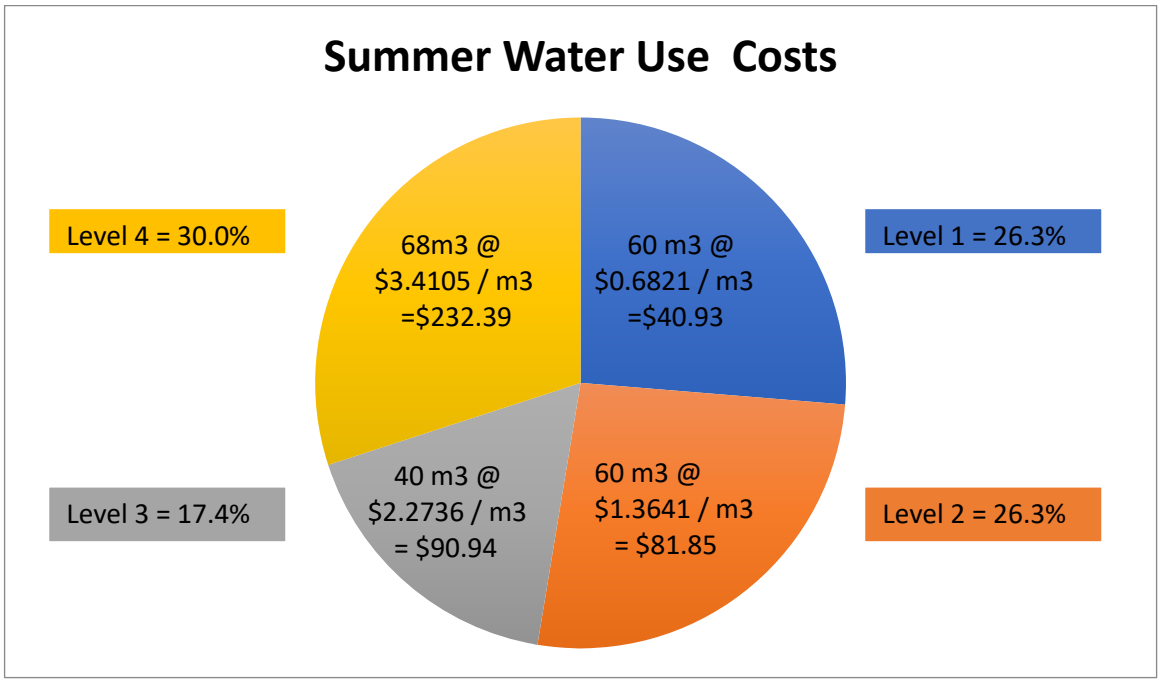
As noted on Page 12 of this report, the City of Parksville's price scale is based on overall consumption. These rates increase significantly as total consumption increases.

- Level 1 cost ($0.6821 / m3) is increased for Level 2 by 49.99 % to $1.3641 / m3
- Level 2 cost ($1.,3641 / m3) is increased for Level 3 by 40% to $2.2736 / m3
- Level 3 cost ($2.2735 / m3) is increased for Level 4 by 33% to $3.4105 / m3

[NOTE: These were the rates for 2018-19 when this study was completed. 2021-22 rates are higher.]

Our annual consumption has never exceeded the fourth level (161 – 400 m3), so our highest cost each year always coincides with the peak of the summer when our irrigation system is in full operation. In the 2019 study report, the chart below explains the impact that this has on our annual cost of water.

2019 Consumption / Rate Proportions



For each household:

- **the first 60 m3 (26.3% of total) costs $40.93**
- **the next 60 m3 (26.3% of total) costs $81.85**
- **the next 40 m3 (17.4% of total) costs $90.94 and**
- **the remaining 68 m3 (30.0% of total) costs $232.39**

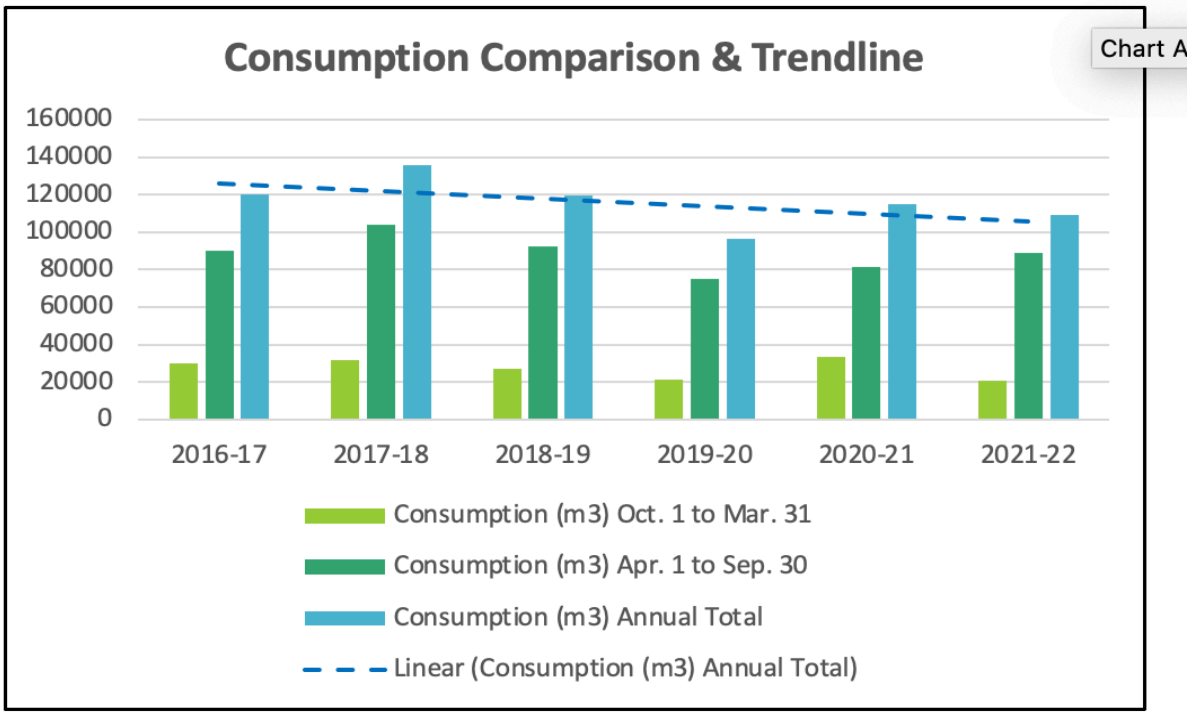
As this chart demonstrates, our final 68 m3 of consumption (during high summer irrigation periods) costs almost six times the cost of the first 60 m3 and almost three times the cost of the second 60 m3.

[NOTE: These rates are for 2019. Current rates are a bit higher as noted on Page 12.]

Last Six Years

Based on meter readings taken over the past six years, we have been able to compare our water consumption for both the winter periods (Oct. 1 – Mar. 31) and summer periods (Apr. 1 – Sept 1), plus our total annual consumption.

Fiscal Year	Consumption (m3)		
	Oct. 1 to Mar. 31	Apr. 1 to Sep. 30	Annual Total
2016-17	30284	90071	120355
2017-18	31736	103847	135583
2018-19	27233	92348	119581
2019-20	21223	75068	96291
2020-21	33275	81592	114867
2021-22	20578	88825	109403



As the Consumption Table shows, our total consumption peaked in 2017-18 and in 2018-19. This created some concerns, so in 2019, Seaside Village Strata Council initiated a study to determine the cause of these increases in consumption and develop some recommendations

for reducing our overall consumption. The summary of the findings of this study were outlined on pages 13 – 14.

If we look at the annual winter consumption patterns, we can see a spike in 2020-21. This was during the Covid-10 period when travel was severely limited, so our winter occupancy rate here in Craig Bay was much higher than normal.

The bar graph clearly shows that through better monitoring of our consumption patterns and through improved irrigation management practices, the trend line over this 6-year period is moving in a downward trajectory. The 2020-21 levels were higher due to higher occupancy due to Covid-19 conditions as well as a hot summer period. Our increased summer consumption in 2021-22 was due to our extremely dry summer and fall, plus the extended heat spell we experienced. We started our irrigation systems about one month later this year than usual, to try and reduce consumption, but this gain was soon lost because of the very dry summer. We received less than 10% of our normal rainfall over this period as compared with other years. In fact, this year was so dry that Stage 4 Water Restrictions had to be imposed in late September – and this has never occurred before during the fall season.

Analysis of Water Consumption – 2022

We know that the greatest influence on our annual water costs is the volume of water used for irrigation purposes in the summer. In order to quantify the impact of this consumption, we evaluated the winter and summer consumption pattern based on 2022 meter readings.

Basics Around Water Consumption in 2022:

- Total consumption for the four strata: October 1st, 2021 through March 31st, 2022 was **20,578 m^3** (Defined as "winter consumption" and relates only to household use.)
- Total consumption for the four strata: April 1st, 2022 through September 30th, 2022 (**183 days**) was **88,825 m^3** (Defined as "summer consumption" and includes both household and irrigation uses.)
- Because of several "incidental extra summer uses", such as car washing, power washing of patios, driveways and walkways, as well as for house painting preparation, an estimated volume of these other summertime uses must be added to the assumed consumed volume under "household use". Also included are hand watering of plants and individual drip irrigation off of hose bibs, which a few residents have installed. As a result, we estimate that there is a 2% differential between annual summer household consumption and annual winter household consumption. This is supported by data from a detailed 2014 study.
- Applying the 2% differential for "incidental extra summer use", the revised summer household or non-irrigation use is 20,578 x 1.02 = 20,990 m^3.

- Therefore, the net irrigation consumption for the four strata is 88,825 m^3 – 20,998 m^3 = 67,835 m^3 or **76.4%** of the total "summer consumption".

- Within the four strata, there are **396 households**. Therefore, the total "summer consumption" **per household** is 88,825 divided by 396 = **224.3 m^3**, and the net "irrigation consumption" per household during that summer period is 67,835 / 396 = **171.3 m^3** per household.

- The irrigation season for 2022 ran from approximately June 7th – September 30th, which equates to **115 days** of operation.

Based on these calculations, ***it can be seen that our irrigation consumption is running at 76.4% of our total summer water consumption***. This explains why our annual water consumption in Craig Bay is higher than other households in Parksville, as noted in the chart on Page 13.

Analysis of the Cost of Water for 2022 (April 1st through Sept. 30th):

- **Total cost per household** for **224.3 m^3** (City prorates billing on a per household basis):
  - Base Rate = $ 91.96
  - 60 m^3 @ $0.7026 (Tier 1) = $ 42.16
  - 60 m^3 @ $1.4050 (Tier 2) = $ 84.30
  - 40 m^3 @ $2.3418 (Tier 3) = $ 93.67
  - 64.3 m^3 @ $3.5128 (Tier 4) = $225.87
  - **TOTAL** Summer Water Cost = **$537.96** for 224.3 m^3 per household

- Seasonal Irrigation cost per household for 171.3 m^3 = $537.96 x 76.4% = **$411.00**

- Average daily irrigation cost per household through 115 days = $411.00 / 115 = **$3.57**

- Average weekly irrigation cost for all four strata = $3.57 x 7 x 396 = **$9,896**

- Using 2022 as an example, the daily combined domestic and irrigation water cost for the four strata, during the "summer" season, shifted the four strata to the highest per cubic metre rate (Tier 4) somewhere around the **fourth** week of August. It is estimated that the irrigation systems ran for approximately 40 days at the Tier 4 level. This yielded a daily irrigation cost, while operating at the highest water cost rate level, of approximately **$2,000 per day** across the four strata, or approximately **$5.05 per day per household.** The longer the irrigation systems are required to operate each year, as dictated by weather conditions, the impact of operating more and more within the Stage 4 rate can add significant costs to the community's water bill. As an interesting comparison, without any irrigation system demand at any time within the Craig Bay community, the total volume of household and other incidental water use consumptions alone would not be sufficient to move the seasonal billing out of the Stage 1 rate.

NOTE: Following the presentation of the Final Report to the five Strata Councils and the CLC on Feb. 2nd 2023, a further review of available summer water consumption data was conducted.

Based on this information, we can say with confidence that our typical summer consumption for irrigation purposes runs between 70 – 75% of our total summer consumption. This varies from year to year, based on rainfall levels.

Conclusion: Any action that can be taken that reduces water consumption to delay reaching the Tier 4 rate and/or reducing the amount of time operating at that level can have significant impact on reducing overall water costs. In past years, we generally begin irrigating at the beginning of May each year and continue irrigating until the end of September or even into early October. We are recommending that we should hold off starting to irrigate until the beginning of June and cease irrigation at the end of August each year.

In a typical year, we have a fairly wet spring and a warm fall. So, a 3-4-week delay in our start-up is not likely to create any harm to our lawns and shrubs in the spring and an earlier shut-down of 3-4 weeks won't create any harm either in the fall, because the plants start to head into their dormant period.

For 2022, the Irrigation Managers delayed the start-up of our irrigation system until early June, which resulted in some significant reductions in water consumption and cost for the month of May. However, the unusually hot and dry period in September and October of 2022 prevented the Irrigation Managers from shutting down the irrigation system in early September, as planned. Irrigation continued until the end of September, when Level 4 Water Restrictions were imposed. ***Implementing this type of shortened irrigation period is totally dependent on the cooperation of Mother Nature and the amount of rainfall we receive.***

If we implement this type of change there are several points to note:

1) The decision on start-up and shut down dates must be made each year by the four Irrigation Managers, based upon current weather conditions.
2) Their annual decision may mean that we can save as much as eight weeks of irrigation in a year – but it could be less than that if we encounter an unusually dry period in any year.
3) Reducing irrigation in this way will have an impact on garden areas, so residents may need to water their own garden areas in May and September, if needed, since the irrigation system will not be operated.

Implementing this recommended change in our irrigation practices could yield annual water cost reductions across Craig Bay of anywhere from $57,708 (for a 6-week reduction) to $76,944 (for an 8-week reduction) based on our consumption and cost analysis for 2022.

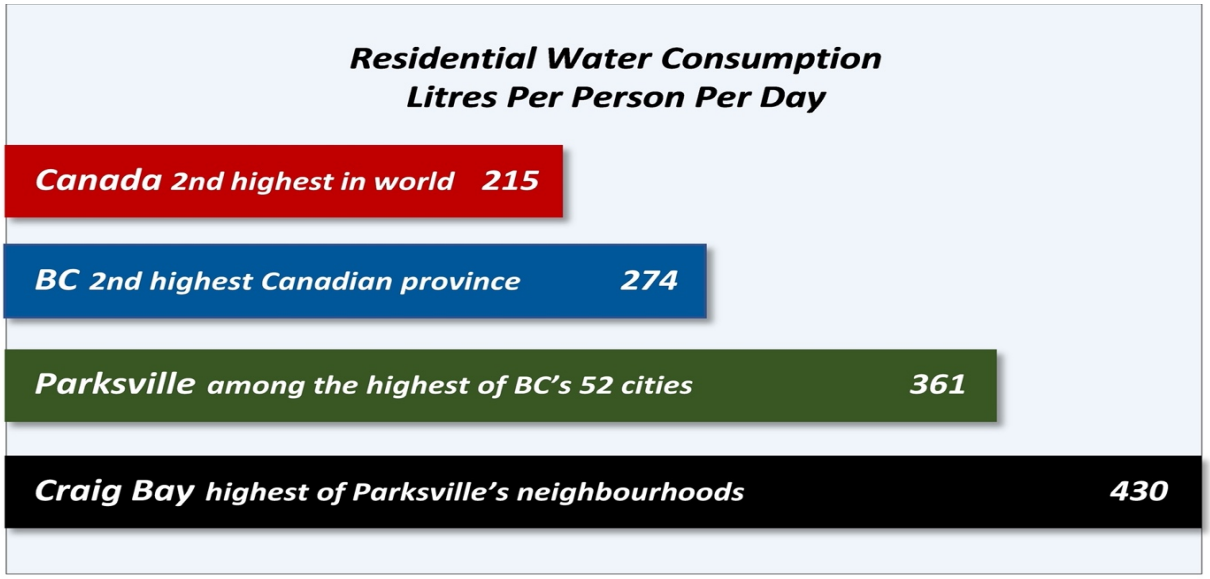
This adaptation to our irrigation practices needs to be given serious consideration. It becomes quite clear very quickly that our best strategy for lowering our overall consumption and cost is directly linked to our summer irrigation practices. And, as was stated back in Section 3 on page 8, this is directly linked to what our landscaping practices dictate. So, a fully integrated set of Best Practices for Landscape Management and for Irrigation Management are critical. At the same time, any improvements in Best Practices in Homeowner Water Conservation Management will only further enhance our efforts to lower consumption.

Comparing Craig Bay to Other Locations

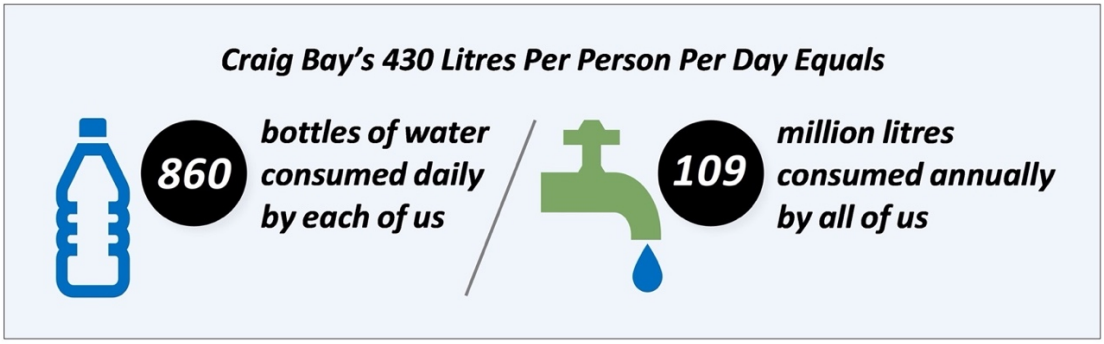
An analysis of our water consumption compared to other locales was carried out in 2017. These data were updated in October of 2022. The charts below provide a good overview.

Craig Bay's water consumption significantly exceeds the Canadian, British Columbian and Parksville averages.

It is important to note that our Craig Bay consumption includes our household consumption as well as our common property irrigation system, which accounts for a significant portion of our residential water use per person per day in comparison to other communities and neighbourhoods. After all, we have a total area of 106 acres in Craig Bay that our irrigation system covers.



- *Figures for Canada and BC from 2019 and estimated for Parksville from 2021.*
- *Figure for Craig Bay based on 2022 consumption by the four strata of AG, MH, SSV & Shorehaven with a population of 697. The Onyx is counted and billed separately.*



- *Based on the 2022 consumption by the four strata.*
- *Water bottle is common .5 litre.*

Section 8: Past Initiatives to Reduce Water Consumption

There have been numerous initiatives launched within Craig Bay over the past twenty years to find ways to lower our water consumption and our overall water bill. Some of these were concentrated on only one aspect – such as irrigation practices. Some were also undertaken by individual strata councils, rather than a complete initiative involving all four strata groups. There have been many recommendations put forward for implementation. History shows that these have not always been implemented or been continued over an extended period of time.

Here is a summary of past efforts at water conservation that were completed within Craig Bay.

Craig Bay Estates Water Conservation

"Craig Bay Estates has 396 ground-level residences built from 1995 - 2007. From May to September each year, 1,000 + trees, 1,200 garden beds, and turfed yards and open spaces are watered by the community's irrigation system. The system, haphazardly built in tandem with the development, has been the necessary focus of conservation efforts.

As soon as Craig Bay was completed by Intracorp, residents established a Water Usage and Conservation Committee. The Committee, composed of experienced retirees, made significant upgrades to the irrigation systems as well as to the community's major amenities. These improvements prepared Craig Bay for the introduction of a tiered water rate structure by the City of Parksville in 2009. The new rates resulted in a 17.5% drop in Parksville's annual water usage. Craig Bay achieved a 29% reduction.

More recently, Craig Bay's four ground level strata made further conservation gains from strong oversight, better watering practices, and no-lawn landscaping. These efforts are ongoing to ensure the community seizes all practical opportunities to lower water usage.

In all, Craig Bay has made the following improvements over the last dozen years.

Irrigation:

1. Installed 28 Solar-Sync moisture detectors to maintain appropriate moisture levels and prevent unnecessary watering.
2. Installed 23 flow meters to track consumption, so problems can be expediently identified and fixed.
3. Regular, on-the-ground monitoring to ensure speedy repair of leaks, defective sprinkler heads and aberrant spray distribution.
4. Replacement of sprinkler heads with water-saving MP Rotator and mister heads.
5. Shortened watering cycles for large rotors.
6. Shut down of redundant heads to achieve better uniformity.
7. Shut down of heads on lawns heavily shaded and / or with sufficient groundwater.
8. Converted strip side lawns into stone walkways.
9. Reviewed the system and practices with the RDN's Team WaterSmart.

Domestic:

1. Installed low-flow toilets and shower heads in Craig Bay's Beach Club and four guest cottages.
2. Installed low-flow toilets in many homes.
3. Carried out an education campaign to encourage reduced home consumption."

Modified Landscaping Options

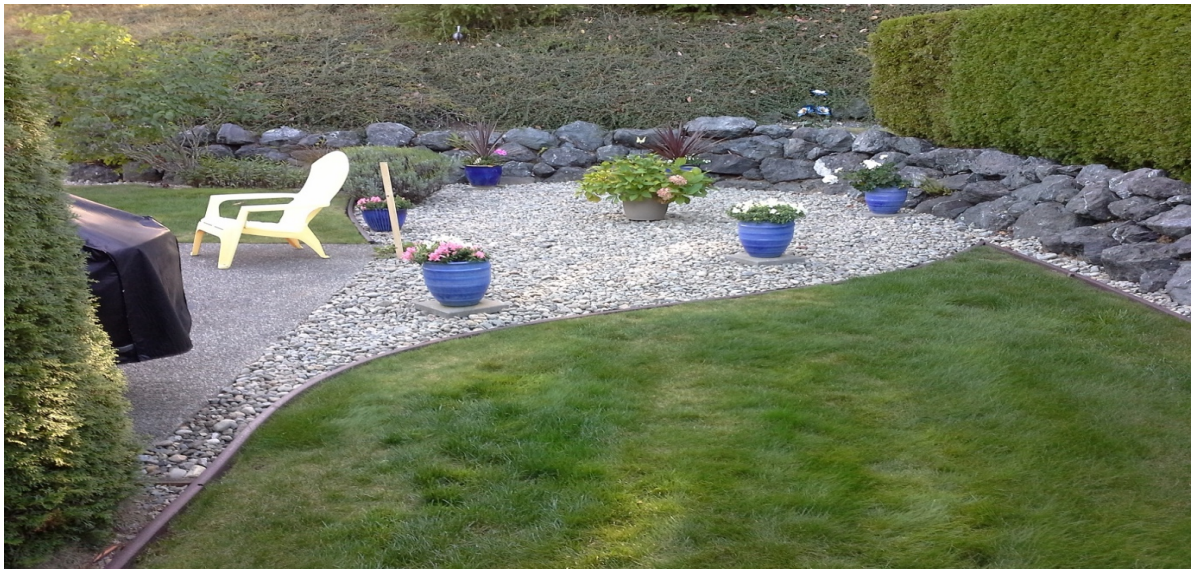
In Craig Bay, we have numerous situations where there is a significant amount of ground water run-off, leaving sections of lawns saturated at all times. There are also numerous cases where the ground is perpetually dry and grass won't grow. We also have some areas where the mature trees provide too much shade which limits lawn growth. These are prime areas where alternative landscaping should be introduced to resolve the issue and also to reduce the amount of irrigation needed.

Some residents are concerned about suggestions to convert landscape areas to xeriscape or rock scaped areas. They do not want an "Arizona look" here in Craig Bay. During our walk-about in Arbutus Grove, we saw some good examples of using xeriscaping practices to overcome problems of lawn sections that were either perpetually dry or perpetually wet.

Arbutus Grove Walk-About:

We looked at Landscape modifications which improved two conditions.

1. Very dry dead lawn areas.
2. Very wet soggy lawn areas.
3. A total of about 10 locations were improved. Each location capped between 3 to 5 spray heads.



This area was very dry and the lawn was always brown. Capped 4 spray heads.

This area was very wet and soggy. Capped spray heads. Water saved: Approx. 9,200 litres per improved area.

In the past, the Wednesday Morning Project Group (WMPG) has assisted with the conversion of these areas, to reduce the overall cost for this type of project. Some residents commented in the Residents' Survey that was conducted in 2021 that they were prepared to do some cost sharing in order to have these spots properly remediated and resolve their problem.

These examples show that by using selective techniques in localized problem areas we can both find a good resolution to an annual problem as well as reduce the overall need for irrigation in those areas. There is no suggestion that we contemplate wholesale examples of xeriscaping within Craig Bay.

Section 9: Operating Our Irrigation System

The operation and maintenance of our complex irrigation system is primarily carried out by a blend of several dedicated volunteers with assistance from contractors in three of the five strata. In Arbutus Grove, Meadow Beach and Seaside Village one or two volunteers have stepped forward and offered to handle this responsibility. Through their individual and combined efforts, thousands of dollars are saved each year within each of these strata. In Shorehaven and at the Onyx this responsibility is handled by an external contractor and this becomes a part of their annual strata budget. Meadow Beach and Seaside also contract out some of their larger repair work. One contractor charges $70 / hour for these services, so we can quickly see the true value of the work carried out by the volunteer teams in the three largest strata within Craig Bay.

Irrigation systems have two critical time periods each year:

- The start-up in the spring, when the whole system has to be tested to detect leaks, broken sprinkler heads, heads spraying water in the wrong direction that ends up watering driveways, sidewalks or the sides of a house or garage, etc. and
- The shut-down in the fall, when all of the lines need to be blown out to ensure there is no residual water left in the lines, which can freeze over the winter and end up splitting pipes open.

For each of these critical periods, some of the volunteer Irrigation Managers invite large teams of resident volunteers to help them complete these tasks. In most cases, these start-up and shut-down tasks can take 3-5 days to complete. However, it has become more and more difficult to mobilize sufficient volunteers to conduct these annual tasks. Seaside Village has recently started using an external contractor to assist with the task of starting up and shutting down the system each year.

Ongoing Monitoring:

Irrigation systems also need to be run and monitored throughout the irrigation season. When we had the Regional District of Nanaimo (RDN) Team Watersmart conduct a detailed audit of our system several years ago, this point about regular, ongoing monitoring was one of their key recommendations for us to follow.

You don't just flip on the switch in May and flip the switch off in September and never look at the system when it is running. Because we run our system during the night, regular monitoring can be problematic. Therefore, portions of the system need to be run periodically during the day, so that problems can be detected and rectified.

We became aware of several examples in the summer of 2022 where sprinkler heads had been damaged accidentally, but were never reported. Because of normal night time irrigation schedules, these problems could only be detected when portions of the system were operated in the daytime, as part of regular monitoring or repair practices. Teams of volunteers as well as individual homeowners have also discovered inoperable ground level sprinklers due to grass overgrowth and cases of sprinklers improperly spraying the sides of houses, driveways or roadways. In each of these situations, quick reporting can lead to quick repairs – which help to ensure water is not being wasted.

For our volunteer operation to work effectively, every resident has a role to play in helping to identify these types of problems whenever they occur and reporting them quickly so that the Irrigation Team can repair the damage quickly and resolve the problem. We have also experienced situations where a major leak has occurred, but no one was available to shut down that portion of the system. Identifying back-up contacts for reporting problems within each strata is critical. **Each Strata Council needs to be sure that residents have access to the contact information needed to report these incidents – and each Irrigation Team needs to ensure that more than one person can step in as needed, should the primary contact be unavailable.**

Sprinkler Head Mapping:

Arbutus Grove has developed a detailed map that identifies the location of every sprinkler for each lot within its strata. Based on the findings of a detailed assessment of their system, in the summer of 2022 by a team of volunteers, Shorehaven is working to prepare a binder with a satellite shot of each resident property within their strata, so that they too can identify the location of each sprinkler head, its type and the zone which the sprinklers are connected to.

These types or other forms of system mapping not only provide relevant information for current operators but also can form an inventory of knowledge for the succeeding generation of operators.

Real time information is very valuable in the ongoing maintenance and operation of our intricate irrigation system. It doesn't take a lot of time - but it does take a dedicated team of volunteers within each strata who are willing to give up a bit of their own personal time to help in the regular monitoring of the system. This enables Irrigation Managers and Contractors to make timely repairs and adjustments to the irrigation equipment to ensure that it is operating at peak efficiency.

Section 10: Unique Characteristics of the Craig Bay Landscape

The site which Craig Bay Estates sits on was the home farm area for the original Craig family. When the site was being developed by Intracorp, the rich top soil was stripped away and sold off. Then as the sections of the development were completed, replacement soil was put down – and it was of a much poorer quality than what existed previously.

Peter Hall developed the following explanation of the quality of our current soil conditions and the unique problems it poses for our irrigation practices.

Local Geology and How It Impacts Lawns in Craig Bay

In Craig Bay we do not have the luxury of golf course grade lawns. Consequently, a good portion of our lawns tend to brown out during the heat of summer – unless a significant amount of irrigation is provided.

Example 1

Example 2

Example 1:

This lawn section consists of 6 to 8 inches of grass (green) and 3/4 inches of loam and a deep root system of clay over sandy gravel or glacial till. Example 1 shows a healthy lawn that has developed a strong root system through proper watering. Deep watering once per week allows the water to slowly soak down deep into the soil, as the upper layer dries out the roots grow down to find the water, developing a strong root system.

Putting down one inch of water per week on the surface of 100 square feet (10 x10 feet) of lawn will equal about 60 gallons. On average a sprinkler under "normal pressure" will need to run about 2 to 3 hours to put down 1" of water on a lawn. Unfortunately, in Craig Bay we do not have the luxury of perfect lawns!

Example 2 (Craig Bay)

The original sod was laid down on the insitu material which was either dense sand and gravel or glacial till. Glacial till is a dense well graded mix of clay, silt, sand and gravel deposited at the base of the ice of the last glaciation period (Fraser Glaciation). It is impervious to water with the result it has no capacity for water or nutrient retention that is required for grass to develop a strong root system. A lawn in Craig Bay tends to grow upwards within itself and becomes a dense mat. As a result, we have to water frequently for short periods.

If we attempt to "soak" the lawns the water, simply runs off and is wasted. If we attempt to water lightly enough to completely dampen the root mass, evapo-transpiration consumes the applied water and within 2 days extensive dry out begins. For this reason, Craig Bay received special dispensation from the City of Parksville with regard to Stage II watering restrictions, in that we are able to water every other day instead of 2 days per week.

The disadvantages of watering lightly every other day are:

- More overall water use;
- Lawn develops shallow root system;
- Lawn dries out quickly;
- Soil compaction; and
- Salt build-up from lack of water not leaching and moving through the soil.

The other important feature of our topography is that much of our property slopes down towards the ocean. There is a lot of ground water run-off from above Northwest Bay Road and the Island Highway that drains down into Craig Bay Estates. Heavy rains and heavy watering only create run-off as the water cannot seep into the soil but rather it is drained off into the ocean.

Over time, our Irrigation Managers have experimented with various watering cycles in an attempt to find the proper balance point between too little water or too much water – as dictated by our geological constraints.

Section 11: Irrigation Sprinkler Cycles

The responsibility for establishing the watering cycles rests with each of the Irrigation Managers. As a result, the practices vary from one strata to the next, based on their own local conditions. As part of the study completed in 2019, the Irrigation Managers agreed to begin using a common watering cycle for each strata. Since we were trying to reduce our overall water consumption at that time, the watering cycles were reduced a bit. However, this started to create some problems and as a result modifications began to be introduced on a strata-by-strata basis.

As an example, for the summer of 2021 this was the watering cycle being used in Seaside Village:

A) Flower Garden Sprinklers
   - 10-minute watering cycle – two 5-minute cycles with soaking time between cycles

B) Lawn Pop-up Sprinklers
   - 10-minute watering cycle – two 5-minute cycles with soaking time between cycles

C) Large Rotary Sprinklers (for large open areas)
   - 20–minute watering cycle – two 10-minute cycles with soaking time between cycles

Watering occurs every second day, as per agreement with the City of Parksville – half of SSV is covered one day and the other half on the second day.

NOTE: In discussion with Larry Powers, Irrigation Manager in Seaside Village, he noted that this current watering pattern provides too little water at present, and it is almost a waste of water. He suggested that we should consider adjusting the cycles:

- for the lawn pop-up sprinklers from a 10–minute watering cycle to a 20–minute watering cycle (broken into two 10-minute periods)
- for the large rotary sprinklers from a 20–minute watering cycle to a 30 or 36-minute watering cycle (broken into two equal periods)
- For the garden sprinklers, the current watering pattern is okay.

These comments were based on the fact that this watering cycle for the lawns around the homes produced early brown outs last year and for the large open areas, several were severely impacted and while they did recover in the spring – it was only for a short period of time. The grass did not have a chance to become firmly established from year-to-year.

Making these types of adjustments will obviously lead to larger overall water consumption -not less - unless adjustments are also made to the number of days between watering, such as watering every third day instead of every second day. We may need to do some experimenting with this type of adjusted watering cycle in order to see what the overall impact is on our water consumption and whether or not it produces a real overall improvement.

Many of our residents have a tendency to complain because they don't think we are watering sufficiently and for only short periods of time. As noted above, a double watering cycle allows for the initial water to soak in so that the second watering cycle does not become run-off. In addition, our watering cycles are scheduled for night time – always after midnight, so many residents don't actually see when it is being done.

There are also concerns expressed that when the irrigation system is operating, not all of a homeowner's property is being watered. It is necessary to understand that there is a sequential watering pattern to ensure that the lawns and gardens are watered at different times, because of the water pressure limits within our system.

The routing of our supply lines also makes it impossible for us to water even-numbered properties on even-numbered days and odd-numbered properties on odd-numbered days, as called for in the City of Parksville's Water Restriction Guidelines. We do follow the intent of those guidelines though, for only half of Craig Bay properties are watered on even-numbered days while the other half are watered on odd-numbered days.

The intricacies and complexities of our irrigation system and irrigation practices are described fully in Appendix # 2 on page 53. This report was prepared by Wally Chinn and it provides a wealth of vital information in order to understand how our system operates and what it can and cannot achieve. His set of recommended Best Practices have been incorporated into this Craig Bay Water Study Final Report in Section 15.

In this report, he also outlines the results of an experiment he conducted in the summer of 2021 to calculate exactly how much water is actually being applied by the various types of sprinkler heads and the depth of water penetration. From this he concluded that our current watering cycle times are not providing a sufficient amount of water – just as Larry Powers also concluded. That is why we are putting forward the recommendation that the decisions about watering cycles must be left to the discretion of the individual Irrigation Managers.

In another experiment conducted by Chris Chilton, he saturated a section of lawn with a hose, then waited for a bit of time and then cut out the piece of sod that had been soaked. To his surprise, there was no moisture at all below the first few inches of soil. That certainly reinforced the point that our sub-soil conditions (glacial till) require some different irrigation practices than some of our past initiatives, in order to be fully effective.

These two experiments led us to one of the key discoveries from our current study - that the individual Irrigation Managers are the ones who are best suited to determine what the best watering cycles are for their strata. Attempts to introduce a common watering cycle approach across all of Craig Bay Estates is not workable. There are too many variables within a strata and between each strata because of terrain, shaded areas, large open areas, groundwater run-off, etc. Therefore, one of our Best Practices for Irrigation Management recommends that this be left to the discretion of each Irrigation Manager.

What would be extremely beneficial for the whole community is for the Irrigation Managers to come to an agreement each year about the recommended start-up date and the shut-down

date for the whole system. In the past each strata determined these dates individually. In some cases, irrigation was stopped in early September while others continued to operate for as much as another six – eight weeks.

It appears that we can only tweak the existing system so much, as we look for ways to reduce consumption. The one approach that seems to offer the greatest overall benefit and does not harm our landscape is the one that reduces the total number of weeks the system is functioning. This is done by delaying our start-up in the spring, provided that the weather conditions support that decision and by reducing the number of weeks that the system is operational into the fall. Since lawns and plants start to shift into their dormant stage for the coming winter season in early September and October, less water is not harmful and the lawns and plants will regenerate in the spring, as part of their natural growth cycle.

As the data in Section 7 on page 14 illustrates, our greatest cost period is in the late stages of the summer and the fall, when we are paying the Level 4 rate for water. If we start irrigating in late May or early June and stop irrigating in early September, we effectively save about seven weeks-worth of irrigation water consumption. **The water analysis for 2021-2022 (on page 17) shows that the average weekly cost to irrigate is about $9,856**. Introducing this modified operational cycle could produce annual savings of $ 59,136 with a 6-week reduction to $78,848 with an 8-week reduction.

This year (2022), the start-up was delayed until early June. In comparing the data of our water consumption for May of 2022 to May of 2021, we discovered that our consumption rate in 2022 was 227 m3 over a 29-day period compared to 772 m3 over a 31-day period in 2021. This is a reduction of 72% year-to-year. The same situation applies in September – only then it is more significant because every cubic metre is charged out at the highest rate. For the first 15 days of June in 2021 we consumed 550 m3, and this year, for the first fifteen days of June, we only consumed 300 m3. Naturally, a lot of this delayed start-up depends on the level of rainfall we receive each spring. That is why we must empower our four Irrigation Managers with the responsibility of coming to an agreement on the best start and stop dates each year, as conditions dictate. This would then be carried out by each strata.

Using the data from our 2019 study, we paid for 68 m3 at the Level 4 rate (see page 14). These changes to the length of our operating period could mean that we can delay the time before we reach the Level 4 rate in coming years – which would be a huge cost saver.

Section 12: Irrigation Requirements – City of Parksville

The City of Parksville follows the same watering restrictions for dry periods as each of the communities within the Regional District of Nanaimo. There are four different stages that increase the restrictions from Stage 1 to Stage 4. The information shown on the next two pages is taken from the City of Parksville website.

City of Parksville Watering Restrictions

WATERING RESTRICTION STAGE	1	2	3	4
EFFECTIVE DATES	April and October	May to September	Only as Required	
Frequency	Any Day	Every Other Day: Even# Houses – Even# Days Odd# Houses – Odd# Days	Voluntary Reductions on top of Stage 2	SPRINKLING BAN: Lawn Watering NOT PERMITTED
Lawn watering times	Between 7pm and 7am	Between 7-10am or 7-10pm for 2 hrs MAX		
Hand-watering, drip irrigation, micro irrigation	ANYTIME	ANYTIME		Between 7-10am or 7-10pm
Washing vehicles, boats, houses (siding)	ANYTIME	ANYTIME		NOT PERMITTED
Filling fountains, pools, hot tubs	ANYTIME	ANYTIME		NOT PERMITTED
New lawn permits	Can apply for a permit	Can apply for a permit		NO PERMITS ISSUED
Pressure washing walkways, driveways, siding	ANYTIME	ANYTIME		ONLY prior to application of paint, preservative, stucco, or sealant

Vegetable gardens and fruit trees are exempt from all watering restrictions, even Stage 4.

City of Parksville

PLEASE KEEP FOR FUTURE REFERENCE

team watersmart
because every drop counts

Questions should be directed to the Operations Department, City of Parksville:
250 248-5412 | ops@parksville.ca | parksville.ca | teamwatersmart.ca

Water Restrictions for City of Parksville

Water Service System Bylaw 1320

The City of Parksville's watering restrictions provide for a coordinated approach with the other water service providers within the Regional District of Nanaimo.

Following the drought and elevated water restriction levels experienced in 2015, differing watering restriction definitions created confusion for residents and businesses. With a common framework across the region, customers within each water service area now have greater clarity on watering restrictions. While the definitions of water restriction stages will be consistent across the region, each water purveyor determines the level specific to their needs.

QUICK FACTS:

Stage 1 (April and October) consists of night-time watering only, 7 pm to 7 am.

Stage 2 (May through September) limits use to "even and odd day" watering.

Stage 3 requests further voluntary reductions prior to implementing a ban, enabling residents to choose where they cut back. Focus is on lawns and an opportunity to defer a comprehensive watering ban.

Stage 4 bans non-essential water use such as automated sprinkling, vehicle washing and outdoor surface washing when supplies are stressed.

Vegetable gardens and fruit trees are exempt from all watering restrictions, even Stage 4.

Hand-watering – delivering water by hose with spring-loaded nozzle shutoff device or handheld container.

Businesses which require water for operations, essential municipal sports fields and nurseries are exempt.

Questions should be directed to the Operations Department, City of Parksville:
250 248-5412 | ops@parksville.ca | parksville.ca | teamwatersmart.ca

team watersmart
because every drop counts

Team Watersmart conservation partners are the City of Nanaimo, Regional District of Nanaimo, North Cedar Improvement District SW Extension Waterworks District, City of Parksville, Town of Qualicum Beach, Deep Bay Improvement District, Bowser Waterworks, Qualicum Bay Horne Lake Waterworks and EPCOR French Creek.

Back in 2010, the City's requirements only permitted watering twice a week. Craig Bay had a verbal agreement with the City Engineer of the day, and we were allowed to water every other day. Then in 2011, the City developed a new bylaw for watering guidelines and adopted the pattern of watering every other day with even numbered properties being watered on even numbered days and odd numbered properties being watered on odd numbered days. Under "Quick Facts" above, Stage 2 clarifies this point.

As noted back in Section 11, on page 26, Craig Bay's irrigation piping system does not enable us to follow this pattern. Therefore, we have had to seek an annual exemption from the City which

allows us to water half of Craig Bay properties on even numbered days and the other half on odd numbered days. This meets the intent of the bylaw even though it does not conform fully to the letter of the bylaw.

Since 2012, when our first exemption was granted, things remained constant – until there were senior staff changes in the Utilities Department, when we would be asked to explain and justify the need for this exemption. In 2022, a new Manager of Utilities, Heidi Cao, was appointed. When Larry Powers, on behalf of the CLC, submitted our annual request for exemption, we were advised that the City would agree to this exemption for 2022 and 2023, but that we would be required to submit a plan that would enable us to meet their future Water Restriction Program which was being considered for modification in 2023 with implementation in 2024.

After discussions with the new Manager of Utilities, we agreed to meet once our Final Report on the Craig Bay Water Study was completed to determine whether or not the proposed recommendations and planned changes to our irrigation management and irrigation practices would meet their anticipated expectations.

Section 13: Summary Results of Residents' Survey

As we initiated our study, there were a variety of opinions about what the residents of Craig Bay really wanted regarding landscaping and irrigation practices. It was decided to conduct a survey to obtain sound data that we could use as a guide as our study progressed. The survey was conducted in June of 2021 and the analysis was completed in July and presented to the five Strata Councils in August.

We had 225 surveys returned out of the 426 that were distributed to all homeowners within the community. This response rate of 59.9% was exceptionally high and provided a good base for us to work with, as we carried out our study.
The survey included questions about our current landscaping practices, our current irrigation practices and an opportunity to provide open comments and suggestions. Here is a brief summary of the key results:

Landscaping Practices:

- The vast majority (82%) agreed that our landscaping was "beautiful" or "reasonably sustainable.
- 58% felt that some of our landscaping practices needed to be changed – 21% said we should "let the lawns go brown in the summer"; 21% felt that more xeriscaping and the introduction of drought resistant plants were needed; and 43% noted that "better pruning practices", "removal of old trees and shrubs", "pruning by experts" and "modified lawn maintenance" were areas for improvement.
- There was strong support for culling or reducing our current supply of trees and shrubs, for relocating shrubs and bushes that are too heavily shaded by large trees and modifying our landscaping in large common areas. People agreed that while what was

originally planted was quite beautiful, over time these same plantings have become overgrown and need to be reduced and trimmed back significantly.

- This is a key point, because larger plants, shrubs and trees require extra water for irrigation, so reducing the size of some of our plantings can contribute to lower water consumption and lower water cost.
- People's priority preferences for watering, when we have to consider cutbacks are:
    - Priority 1 – garden beds around homes,
    - Priority 2 – shrubs and bushes around homes,
    - Priority 3 – lawns and trees around homes, and
    - Priority 4 – lawns in large open spaces.
- Some residents are open to "letting lawns go brown in late summer" (43%) and 81% agreed that having minimum / maximum standards to "keep lawns reasonably green" was acceptable.

Irrigation Practices:

- There was significant support for efforts to modify watering cycles to enhance absorption (98%) and for modifying practices to try and reduce irrigation costs (95%).
- 83% agreed with letting large common areas go brown as we work to reduce overall water consumption for irrigation purposes.
- There was strong support (86%) for Strata Councils to consider establishing a capital reserve fund for improving and upgrading our irrigations system over the next ten years. Further investigation by our Working Group clarified that a full replacement of our system would be very impractical and much too costly. However, investments in new, updated equipment that can make our system more efficient and effective would be very wise. Serious consideration for this type of capital investment is encouraged.
- When asked about past personal experience that could be helpful for our landscaping and irrigation efforts, twelve people stepped up – five of them are already very actively involved but there were seven new people who stepped forward. We have contacted each of these individuals to see how they might be able to assist in the future and this information has been forwarded to the appropriate Landscape Committees and Irrigation Managers for a direct follow-up.

In the Summary Report of Survey Results submitted to Strata Councils, the following concluding comments were made:

Preliminary Conclusions from Survey Analysis:

1) The landscape of Craig Bay was an important factor when people chose to move here – and it's important to maintaining the value of their property investment into the future.

2) There are many different opinions about how to manage the irrigation system to maintain our landscaping features:
    - Some are very sound.

- Some are based on past personal experiences from having lived in other areas of Canada and the USA – which are not effective, given our soil conditions.
- Some are based on ideas that have already been thoroughly studied and have been shown to be unworkable, such as:
    - Use pond water for irrigation
    - Use alternate water sources such as wells and streams
    - Install individual water meters for each home
    - Use lawn maintenance practices that are incompatible with our local soil conditions

3) It is clear that a solid program needs to be developed to help residents become more informed about what our local conditions will and will not support. We live with decisions made by the developer as Craig Bay was being built. An informed, common understanding is needed throughout the community.

4) The majority of residents are in favour of establishing a set of shared community expectations about how to best manage our landscaping and irrigation practices.

5) The majority of residents support practices that could result in reducing irrigation that lets large common area brown out in the hot summer periods.

6) Residents are most concerned about focusing on maintaining robust green areas around the Langara entranceway, the Beach Club complex common areas and most specifically, the gardens, trees and shrubs around their homes, as areas of priority.

Closing Comments:

When considering the introduction of large change initiatives within any organization or community, there are three critical questions that need to be answered:

1) What? (What is really going on?)
2) So what? (So, what does this mean to us?)
3) Now what? (Now, what are we going to do about it?)

- The survey and the results obtained provided good answers to the first question.
- Our detailed analysis of the survey results provided answers for the second question and provided us with guidance on how to proceed.
- The recommendations coming out of our study project and the follow-up action to implement recommendations by each of the five Strata Councils provides the answers to the third question.

When people are asked for their opinions in a survey, they have an expectation that something constructive will be done based on their input. As such, we must never underestimate the importance of their expressed opinions. The set of Best Practices that are presented in Section 15 of this report and the set of Recommendations for Action outlined in Section 16 are a direct response to much of the information gleaned from the survey results. The test of legitimacy always comes from the actions that follow a study of this type and the related survey results.

Section 14: Various Misconceptions of Residents

Over the years there has been no shortage of well-intended suggestions from residents about how the landscaping and irrigation should be handled. These are often based on limited knowledge of what can and cannot be done here in Craig Bay because of the geological conditions we must cope with and some are based on people's own experiences and practices from places they have lived in before moving to Craig Bay.

Our study brought clarity to many of these issues, so let's try and set the record straight on these misconceptions, so that we can focus on changes that will be constructive.

A) Use the Pond Water for Irrigation: In April of 2021, Wally Chinn, who serves as the Chair of the CLC Pond Sub-Committee, prepared a very comprehensive report that provides everything one needs to know about the Craig Bay Pond System. This report is included as Appendix 3 on page 63. When people read this report, they will have a very clear understanding as to why this suggestion is not possible.

This system was constructed by the developer as a necessary component in residential development's infrastructure for storm water management. The pond water is storm water run-off and is untreated so some feel that this would be ideal for irrigation purposes, rather than use the potable water provided by the City.

Our irrigation piping system is directly connected to our main water supply system and it would be cost prohibitive and impractical in order to allow for the use of water from any other source. We would have to design and install a completely new irrigation system, including pump house facilities, to accommodate this suggestion, which would be extremely expensive.

The pond system provides a valuable aesthetic feature for our community. It is maintained through the volunteer work of our Wednesday Morning Project Group (WMPG) who have put in thousands of hours of work on the pond system over the past twenty years. A review of the CLC operating statement for the eight-year period of Oct. 2012 – October 2018 showed that the pond operating costs amounted to $106,929. During the same period, the pond capital costs amounted to $469,900. That is a total of $576,829 over an eight-year span – for an average annual cost of about $72,100 / year. The ponds are beautiful and useful, but they are costly and there are limits to what can be done with that water.

B) Use Alternative Water Sources for Irrigation: The original Craig Farm used water from four wells on the property. The available water supply from the wells no longer provides a steady supply of ground water. This option was investigated thoroughly several years ago and was deemed insufficient. Any other sources of external water

supply, such as Craig Creek, are also insufficient for this purpose, which is why our current system is tied into the City's main water supply line.

We did give some limited consideration during our study to the possibility of installing a small desalination plant that could be used to supply Craig Bay as well as some surrounding areas, such as Madronna Point, and Nanoose Bay. This type of system is apparently being used on some of the Gulf Islands, so the technology does exist however it is very expensive and would need to be contemplated as a "regional facility" not just a "Craig Bay facility". Any decision of this type would have to be a long-term strategic one, with the collaboration and cooperation of various different government groups to be feasible.

C) Install Individual Water Meters for Each Home: This suggestion has been investigated several different times over the past fifteen years. In his report on the Craig Bay Water Supply System (Appendix #1), Dave Montgomery summarizes the results of these past investigations.

The key points on this issue are:

- The City's charge for individual meters would be $600 / property and this cost would have to be paid by the homeowner, not the strata.
- Individual meters would only measure household water use, not the water used for irrigation. This would still remain as part of our existing strata fees, as it is now.
- The City will not take responsibility for issuing 396 water bills, rather than the four bills it currently issues for Craig Bay (five when the Onyx is included). City jurisdiction ends at the main meter, since Craig Bay is considered private property. So, the task of reading meters, billing and collecting the fees would end up as a strata responsibility.
- The potential benefits do not outweigh the costs and responsibilities.

D) Modify Our Lawn Care Practices: Many people have recommended that we use practices such as lawn aeration or thatching to improve lawn growth. Past experiments for both of these suggestions were completed in Arbutus Grove several years ago – with very poor results.

For aeration to be effective, the machine must be able to remove plugs that are approximately 3-4 inches in length, as we often see on golf courses. In the Arbutus Grove case, the plugs were only about 1-2 inches in length, because of the heavy glacial till that lies just below the surface of our lawns. This did not create enough oxygenation for any improvement and it was a costly project, so it was abandoned. Some individual home owners have attempted this on their own – with similar results, so this practice is not recommended for consideration.

Thatching is intended to remove dead lawn clippings to allow for better oxygenation and permit better lawn growth. However, once again, our poor soil conditions create a problem. When lawn roots cannot grow deep to reach a water supply in the ground, the roots grow upwards in search of water and this results in a very thick matted lawn. Thatching does not improve the growth conditions - it only thins out the lawn temporarily.

While these practices can be very effective in many of the places where our residents lived previously, they are not practical here in Craig Bay. That does not mean that our lawn maintenance contractors can and should be using other practices more regularly, such as fertilizing, to aid lawn growth. This discussion needs to be held with each contractor by the respective strata if people feel improvements can be made.

Section 15: Recommended Best Practices

During this study, one of the major breakthroughs in our thinking occurred when we fully understood the importance of using an integrated approach in how we handle landscaping and irrigation practices, as well as efforts to improve water conservation practices by homeowners. This was outlined back in Section 3: An Integrated Study Framework.

With input from members of each of the Strata Landscape Committees, each of the Strata Irrigation Managers, along with technical input from a local Master Gardener (Wendy Smith Rowe), a local irrigation expert (Kevin Lutterbach from Iritex Pumps & Irrigation Inc., in Errington), and Team WaterSmart at the RDN, our study group was able to compile a comprehensive set of Best Practices for Landscape Management, Irrigation Management and Homeowner Water Conservation Management.

Craig Bay Water Study Group - Best Practices

A) Best Practices for Landscape Management:

1) During particularly dry periods, allow lawns in large common areas to go brown. The Resident Survey conducted in 2021 provided clarity on the hierarchy of concerns for residents for irrigation efforts:
   - 1st Priority: Ensure gardens around homes are well watered;
   - 2nd Priority: Ensure plants, shrubs and trees around homes are well watered;
   - 3rd Priority: Water the lawns around homes regularly, provided that there are no water restrictions in place, prohibiting lawn watering;
   - 4th Priority: Water the large common lawn areas as needed, reducing irrigation during hot, dry periods.

2) In the 2021 Residents' Survey, home owners clearly confirmed the importance of maintaining a high standard of landscaping for the Beach Club Precinct (Beach Club, pool, tennis court area, cottages and xeriscape pond area) and the entranceway to Craig Bay, along Langara Drive. This high profile area must be kept green and well maintained, to preserve the high impact value of our beautiful community.

3) Investigate options for low maintenance, flower and shrub areas that can be used to replace sections of water-dependent grassed areas. Drought resistant plants should be planted in these areas to reduce watering requirements.

4) Landscape Committees should conduct random water application depth measurements in garden beds with soil moisture sampling to better understand system and sprinkler performance, so that application procedures can be adjusted to improve both efficiency and effectiveness.

5) CPMRs for landscaping projects must describe any impacts on the irrigation system for that specific housing unit, to ensure proper irrigation modifications can be completed, as needed.

6) Where shrubs and plants are interfering with sprinkler spray patterns, undertake removing or replacing these plants and shrubs to allow for improved water application. Homeowners may need to be informed that the reason is to improve our irrigation practices and offering to replace any removed shrubs or plants with smaller ones that won't impede irrigation efforts.

7) The proper pruning and trimming of shrubs and trees are critical to ensure that our landscape features do not become overgrown, which requires additional watering. This has not been done properly for several years though, and we are now faced with excessive overgrowth in many areas, which needs to be corrected.

8) Update the CLC's "Approved Plant List" (which was last updated in 2016) to make more drought resistant plants the norm. Cultivate Garden Centre in Parksville, provides an excellent pamphlet – "Fire Smart BC Landscaping Guide" – that identifies many of these drought resistant plants.

9) Install alternative landscaping features - xeriscape areas - in those small areas around homes that have perennial problems of being either too wet or too dry. To retain the "look and feel of the community", this should be limited to side yards and back yard areas only. In cases where front yard changes are required, professional input from a landscape architect should be provided to enable the Strata Council to make an informed decision to approve or deny the request.

10) Proper mulching practices can reduce water evaporation in gardens by 25% while also reducing the spread of weeds that tend to use the available water. Using an organic mulch, such as Sea Soil Mulch, helps to retain moisture while also adding nutrients to the soil. This is a good alternative to adding top soil, since it ultimately becomes top soil. Mulching works best when applied twice a year (spring and fall) after a rainfall, which ensures that the soil is soaked before the mulch is layered on top. Adding mulch to the base of trees or in tree wells is not effective because it encourages the tree roots to grow upwards seeking the moister mulch area. This practice should be avoided. This practice needs to be included as a requirement in each Landscaper Contracts to ensure consistency.

11) Due to Craig Bay's poor sub-soil conditions, past practices such as lawn thatching and lawn aerating have not been effective and yielded no real improvements, so these practices should not be pursued. Our top soil layer is too thin and the subsoil is too dense for these practices to have any positive impact.

B) Best Practices for Irrigation Management:

1) Irrigation Managers should annually coordinate a common date for start-up and shut down of irrigation operations, for all strata, as dictated by the soil moisture conditions and the longer term weather forecasts. These dates will not necessarily be consistent from year-to-year, but the consistent application of annual dates for all four strata will ensure uniformity in irrigation water consumption and shared billing for irrigation services.

2) During start-up, there should be an examination of all sprinklers, replacement of damaged ones as needed, adjustment of spray zone coverage as needed, and noting of cases where plants or shrubs are impeding spray zone coverage.

3) The Irrigation Managers should be supported in exercising their expertise with site specific adjustments to sprinklers and to water scheduling to decrease water applications in defined areas where irrigation requirements are notably less (e.g., groundwater discharge effects). Conversely, they need to continue to carry out adjustments where application amounts are lacking and can be implemented practically.

4) Program the irrigation set times to apply as much water as possible within the soil infiltration capacities, topographical limitations and the overall time available for a daily irrigation period. Higher application amounts can be offset with reduced application frequencies. This is a more effective and more efficient water use strategy, rather than simply reducing application amounts during times of imposed water restrictions.

5) Utilize our Solar Synch Systems to ensure maximum functionality during periods of high or low air moisture, to fine tune our irrigation practices.

6) Water meters in our irrigation system were installed in 2010-11 and have never been calibrated since then. Ensure that all meters are examined regularly and properly calibrated, so that we can be confident about their accuracy. It is also extremely difficult to get replacement parts for these specific meters and it may be necessary to consider replacing all of these meters with more current models at some point in the future.

7) Volunteers should be recruited to routinely monitor the irrigation meters within each strata's system, in order to quantify consumption within an irrigation block and identify any irrigation deficiencies or leaks that may occur.

8) Investigate options for replacing damaged sprinklers with new units that improve efficiency without compromising effectiveness.

9) Each strata should develop and maintain an Irrigation Manual that clearly documents the irrigation system and operations of their respective system.

10) Randomly carry out water application depth measurements to better understand system and application device performance, utilizing these measurement techniques to collate a better understanding of irrigation system application efficiency and effectiveness.

11) Document areas where irrigation has been shut off so that these areas are not inadvertently re-activated (e.g., the tree line on top of the North West Bay Road berm, or the three-foot boulevard strip between Saltspring Place and the Heritage Lands).

12) In order to ensure continuity in the event of the loss of an Irrigation Manager, each strata should have a knowledgeable successor(s) in place.

C) Best Practices for Home Owner Water Conservation Management:

NOTE: *Since Craig Bay has an underground irrigation system in place, the City of Parksville By-Law, which prohibits the use of additional lawn sprinklers by individual residents, applies throughout our community all year long.*

1) Using a watering can, rather than a hose, can be more effective for targeted areas and to foster early growth and development, especially for new plantings. This will also contribute to water conservation without harming plantings.

2) Toilets account for almost 30% of household water use. Some older toilets in Craig Bay use anywhere between 6 – 10 litres per flush. When undertaking bathroom renovations, replace these large flush volume toilets with ones that require less water.

3) Use the food waste / green bin - not the garburator - to dispose of food waste. This saves on both water use and the water treatment facility sewer charges.

4) When watering garden areas via hand-held hose application, a thorough soaking of the soil area is encouraged, rather than just a light surface watering that does not infiltrate into the plant root zone and will easily evaporate soon after. These light applications make little contribution to water uptake by plants. The soil surface should first be "conditioned" with a light application that will allow for better water infiltration in a more generous application immediately thereafter. Hose watering just prior to or soon after irrigation system applications will help ensure the best utilization of water applied.

5) Avoid washing recreational vehicles and boats within Craig Bay. These should be washed off-site at a commercial washing station. By doing so, we can reduce the Craig Bay water consumption while eliminating the flushing of excessive debris into our storm water system.

6) Reconsider the frequent washing of cars and be more aware of how much water is being wasted if a car is washed more frequently than necessary. When your car is dirty and needs to be washed, use a bucket and cloth or brush and then rinse off, rather than only using running water from a hose for the full job.

7) Our Tidelines Newsletter could offer a suggestion each month about ways to reduce our household water consumption without compromising our daily needs. If we each adopted one or more of these suggestions and altered our daily practices, the cumulative impact on water conservation would be very valuable.

Section 16: Summary of Recommendations for Action

1) The set of Best Practices that has been developed for landscaping, for irrigation and for homeowner water conservation will only be helpful if these practices are practiced routinely. Each strata council needs to ensure that efforts are made to instill these practices into the regular routine of their ongoing strata operations.

2) To avoid the possibility of an Irrigation Manager retiring and leaving a strata with no one to handle this role, each strata needs to recruit at least one additional volunteer to serve as an understudy, who could step in and carry on without any interruption in service or loss of knowledge about how the system functions.

3) We need a designated Irrigation Manager or Irrigation Contractor identified for each strata and one for the Beach Club precinct, to service and operate the irrigation system.

4) Depending on rainfall conditions, we need to delay irrigation start-up as late into the spring as reasonable and cease irrigation in early fall, provided that this schedule does not have any adverse impact on our landscape. Significant water conservation and significant cost savings can be realized through this practice. Irrigation Managers need to meet in the spring and again in the fall to determine the common dates for start-up and shut down, so that each strata follows the same schedule.

5) Reduce irrigation of large common areas during dry spells. This will require an alternate method of watering the trees and shrubs in the periphery, which is currently provided through the large common area sprinkler system.

6) Our investigation clearly points out that a total replacement or rebuild of our current irrigation system is impractical and cost prohibitive. Our resident survey clearly indicated that homeowners are supportive of future investments, through our contingency reserve funds, in order to keep our system running properly. Strata Councils need to ensure that annual budgets include a line item for "re-investment in irrigation system" and ensure that a reasonable amount is included in the budget for this purpose.

7) Examine each of our Solar Synch units to ensure that tree and shrub growth is not compromising the effectiveness of their operation.

8) Consider testing out the Hydro-Wise system as a replacement for Solar Synch (at a cost of $1,000 / unit and we would need 35 units) to see if there is any real cost saving with this new technology. This system requires a local Wi-Fi system to function, so we could conduct the test at the Beach Club complex.

9) If the current landscape contractor for a strata does not have staff who are trained and skilled in proper plant pruning and tree trimming techniques, then separate contracts should be considered – one for ground scaping (lawns and gardens) and for plant scaping (shrubs and trees).

10) We need to better inform / educate residents on the findings of our study and the final set of recommendations, so that they can support the proposed changes – not fight them. This could be done through a set of public information sessions once the Final Report has been reviewed and accepted by each Strata Council.

11) Conduct a set of three pilot projects in each strata:

    A) on the feasibility and acceptability of using well designed rain barrels to capture water run-off and use this for hand watering of plants and gardens. There should be

one or two test sites in each of the four strata groups. This type of initiative should be eligible for a rebate from the RDN for wise water conservation.

B) to install some small, well-designed xeriscape areas to convert problem landscape areas, which are either perpetually wet or perpetually dry, into more beautiful spaces that require less maintenance.

C) to experiment with a drip irrigation system in garden beds, rather than sprayers and misters to see if this yields better watering results and reduces water consumption. This could be more complex than it appears at first, since homes in the same area need to be on the same type of system to allow for suitable watering of all garden beds in the area.

12) To help in informing and educating homeowners on good water conservation practices, provide regular notes and tips in Tidelines on ways to reduce water wastage by modifying some of their daily practices within their own home.

13) We need to ensure that readings are taken regularly of all zone meters. This will require local volunteers who have some familiarity with meters to record the readings and report any anomalies. If volunteers cannot be mobilized, then the CLC should seek to have a contractor handle this function.

14) Continue to investigate emerging new irrigation technologies in order to ensure our irrigation systems remain up-to-date. Some equipment can become obsolete and impossible to repair or replace, so updating our equipment periodically will help to ensure its continued operation in an effective and efficient way.

Section 17: Closing Comments and Next Steps

The issue of studying and analyzing our water use and water consumption in Craig Bay has been thoroughly studied on many different occasions by many skilled and knowledgeable volunteers over the past fifteen years. Many suggestions to help improve our irrigation system as well as our irrigation and landscaping practices have been put forward and many of these have been implemented and are now part of our practice. Some of these proposals for improvements have been initiated but not continued, which in turn brings about another review or study.

Overall, these past efforts have been very helpful in improving our use of water and in bringing our overall consumption down to a reasonable level, thus helping to lower our costs for water.

The conclusions from this study by the Craig Bay Water Study Group (2021-2022) show that there is a strong need to use integrated techniques in our landscaping and irrigation initiatives. They have to be seen as one integrated system - not two distinct and separate ones.

The development of a comprehensive set of Best Practices for Landscape Management, for Irrigation Management and for Homeowner Water Conservation Management provides a

valuable set of tools to use as we move forward. BUT … these will only be useful if we focus on making these best practices our normal, everyday practices.

By examining these issues through the lens of *water conservation* rather than just *water consumption* or *cost of water*, we realized that we could raise the bar on what we were trying to accomplish. Good water conservation practices throughout Craig Bay will reduce our water consumption, which in turn reduces our overall water costs. Recognizing this fact proved to be a critical turning point for our Study Group and enabled us to see the whole picture more clearly.

The set of fourteen Recommendations for Action outlined in Section 16 capture the best suggestions we could find that will enable us to continue to operate our irrigation system in the most efficient and effective way, while also retaining the beauty of our community.

Our decision to include the three appendices with this report is intended to keep as much of the relevant information related to our use of water in one place – for easy reference in the future. We found it difficult at times to locate some of the information from past initiatives and hope that this document will avoid this problem into the future.

Next Steps:

For our work to prove fruitful for the residents of Craig Bay, there are four specific initiatives that need to be undertaken by the Strata Councils and the CLC once this report is submitted. These are:

1) Our Study Group is prepared to make presentations to each of the five Strata Councils and the CLC to share our report and answer any questions that you may have about our study, our conclusions and what needs to happen next.

2) We need to develop and deliver a series of information sessions for homeowners to help in establishing a broader understanding of our water system, what can and cannot be done with it and to encourage homeowners to use the Best Practices for Homeowner Water Conservation. Everyone has a role to play in our water conservation efforts – and being better informed is the best place to start.

3) Re-establish a monitoring group, such as the former Water Usage and Conservation Committee of 2007, that will report to the CLC. This type of “standing committee” can play an active role in coordinating the communications and work between the individual Strata Irrigation Management Teams and the individual Strata Landscape Committees. This group can also continue to monitor our water needs and water conservation activities as well as record our water consumption patterns from year-to-year. It will be important to establish some standard recording practices, to ensure consistency of the data collected form year-to-year. There have been a number of variations over the years, which makes comparisons from year-to-year somewhat questionable.

4) The Strata Councils for Arbutus Grove, Meadow Beach, Seaside Village and Shorehaven must come to a decision about whether or not an approach should be made to the City of Parksville in an effort to have their current billing practices modified. The only plausible option identified by our Study Group was to try and create a modified rate scale for "large residential developments served by a common water line and a common meter". This type of appeal was made by the various local resorts several years ago on the basis that their high consumption rates were due to providing water for a large number of people. This led to the creation of the fifth level of water consumption for high volume commercial customers. The City of Parksville currently has both a Residential Rate and a Residential Family Rate. The Residential Family Rate applies to families of five or more people. This rate scale allows for larger volumes at each of the first three rate levels before the price is increased, making it a bit less expensive. However, their Current Utility Rates sheet states specifically that this Residential Family Rate "… will not apply to properties where multiple units are serviced by the same water meter." There might be a case for reconsideration on this point.

Respectfully Submitted:
Craig Bay Water Study Group
October 25th 2022

Appendix # 1
Craig Bay's Water Supply System

Prepared by Dave Montgomery

Four of the five strata in Craig Bay Estates – Arbutus Grove, Meadow Beach, Seaside Village and Shorehaven – share in one water supply system. The Onyx Strata has its own.
By understanding the system, one can realize that it is not easy to achieve a significant reduction in water consumption and associated costs.

- The four strata have limited opportunity to reduce water consumption because water delivery is handcuffed by three major issues.
  - The design capability of the Craig Bay's pipeline system will only deliver water from one source, that being from the City of Parksville's water treatment plant. There is no way the pipeline configuration can be modified.
  - There is no practical alternative source of untreated irrigation water, even if delivery by separate pipelines could be segregated.
  - The separation of domestic (household), irrigation and utility uses was never a design consideration of the original pipeline installation.
- No major cost-effective changes can be made to this existing system that could have a major impact on present volumes of use.
- There are no major leaks in the pipeline system. The present wintertime domestic consumption rate shows the same volumes as measured from earlier years.
- Previous studies comparing seasonal consumptions concluded that about 70 percent of water purchased in the summer goes for irrigation use. Again, this volume is all potable water that is filtered and chlorinated at the City of Parksville water treatment plant.
- Major savings can only be realized by reducing our water consumption, particularly at the tail end of the summer cycles when the City's tiered cost structure for water increases to the highest rate.
- Once the water has been purchased, an additional cost is added to the user billings that includes proportional sewer treatment and infrastructure factors.

1. <u>Pipelines and Operations</u> – *(See Figure 1: Craig Bay Water Delivery Pipeline Schematic")*

- Sanitary sewer charges from the City to Craig Bay estates are calculated at a rate proportional to potable water consumption. Once the water has been purchased, an

additional cost is added to the billing that includes sewer treatment and infrastructure charges.

- The City of Parksville supplies water to the Craig Bay Estates-owned 250mm main header trunkline. It runs north/south paralleling Langara Place, down to Saltspring Place. A 200mm custody transfer water meter is located within this line.

- The meter measures the overall volume of water consumed by the four strata over two, six-month periods in the year. The City of Parksville reads the meter semi-annually and bills each strata independently, pro-rated according to the number of residences in each strata.

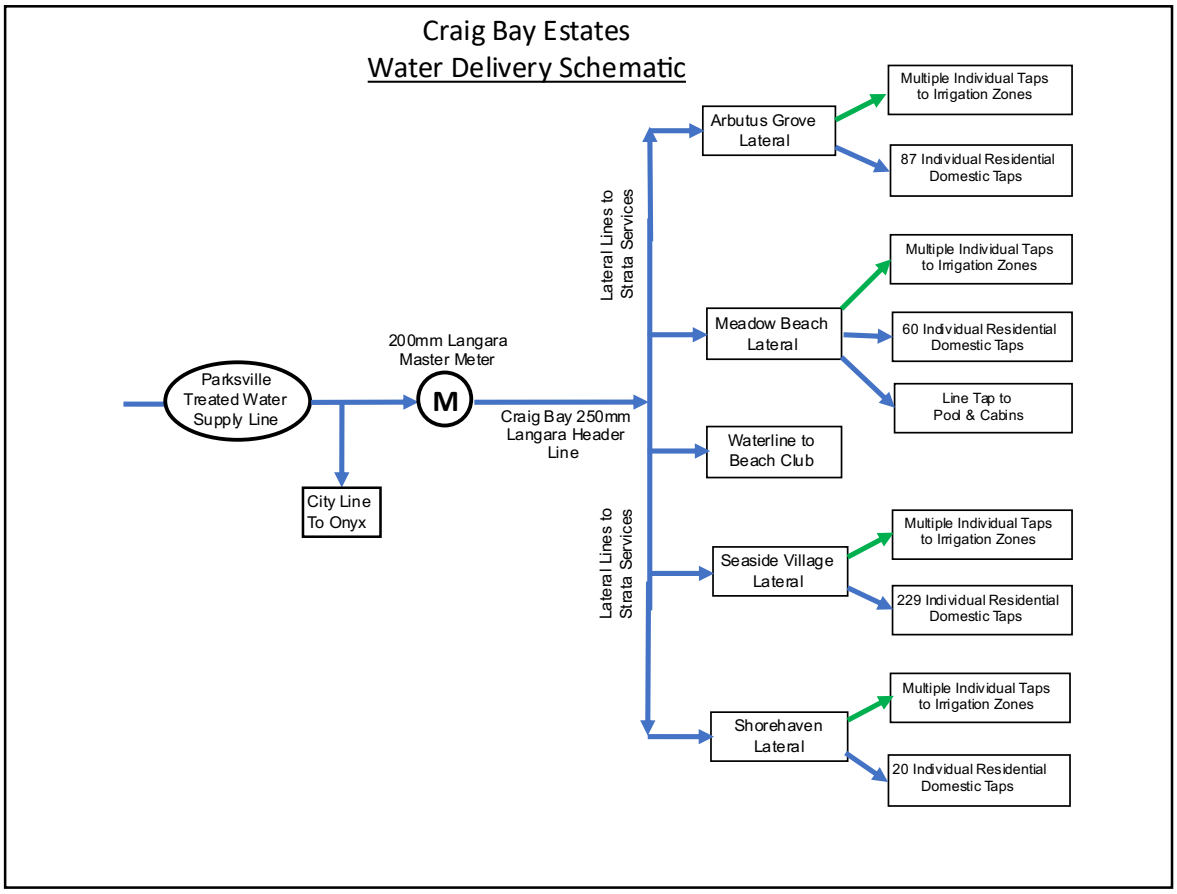


Figure 1: Craig Bay Water Delivery Pipeline Schematic

- Smaller diameter lateral pipelines branch off the main header, running in east and west directions. These delivery laterals vary from 250mm in diameter, tapering down to 100mm in diameter. They feed a variety of residential services required throughout the specific four strata in the community as well as the Beach Club facilities.

- The Beach Club receives its water supply through an individual 50 mm lateral that ties in downstream from the community's 200 mm master meter. Water is supplied to the hot tub, swimming pool and four cottages via a supply line tapped off of the Meadow Beach lateral.

- Some laterals are multipurpose, serving more than one strata. One lateral, for example, running down Gabriola Drive services both Meadow Beach Strata and Seaside Village Strata. Another lateral line services both Shorehaven Strata and Seaside Village Strata.

- The water conveyed by these laterals is for domestic use (household use), to supply fire hydrants and for the irrigation of lawns, shrubs, gardens and trees.

- There currently are no means to measure the water consumption separately for each of the four strata.

- Many of the lateral feeds are looped, meaning they join or connect back into another lateral. This design allows for flow in multiple directions from two independent lateral pipelines, thereby avoiding dead-ends and allowing internal water pressures to be evened-out along the system. This looping also allows for a greater flow capacity to the hydrants in the event of a fire.

- Smaller diameter independent lines tap off the main laterals to supply water for domestic and irrigation uses.

- Most homes have their own individual line tap for domestic supply use, complete with a "curb-stop" shut-off valve.

- Likewise, an independent irrigation line taps off the main lateral. Each area within a given strata has a series of irrigation lines supplying water to a designated group of irrigation areas or "zones". Water meters, to measure flow rates and quantify consumption to individual zones, have been installed downstream of manual shut-off valves.

- Water delivery to several irrigation zones within a certain area is regulated through a programmable "control box" situated in a central location to those associated zones. A single control box regulates water delivery to a variety of sprinklers, including pop-up spray heads and rotors for lawn irrigation, as well as misters and fixed spray heads for the garden beds. Figure 2 provides a simplified schematic of the essential components of these water delivery systems.

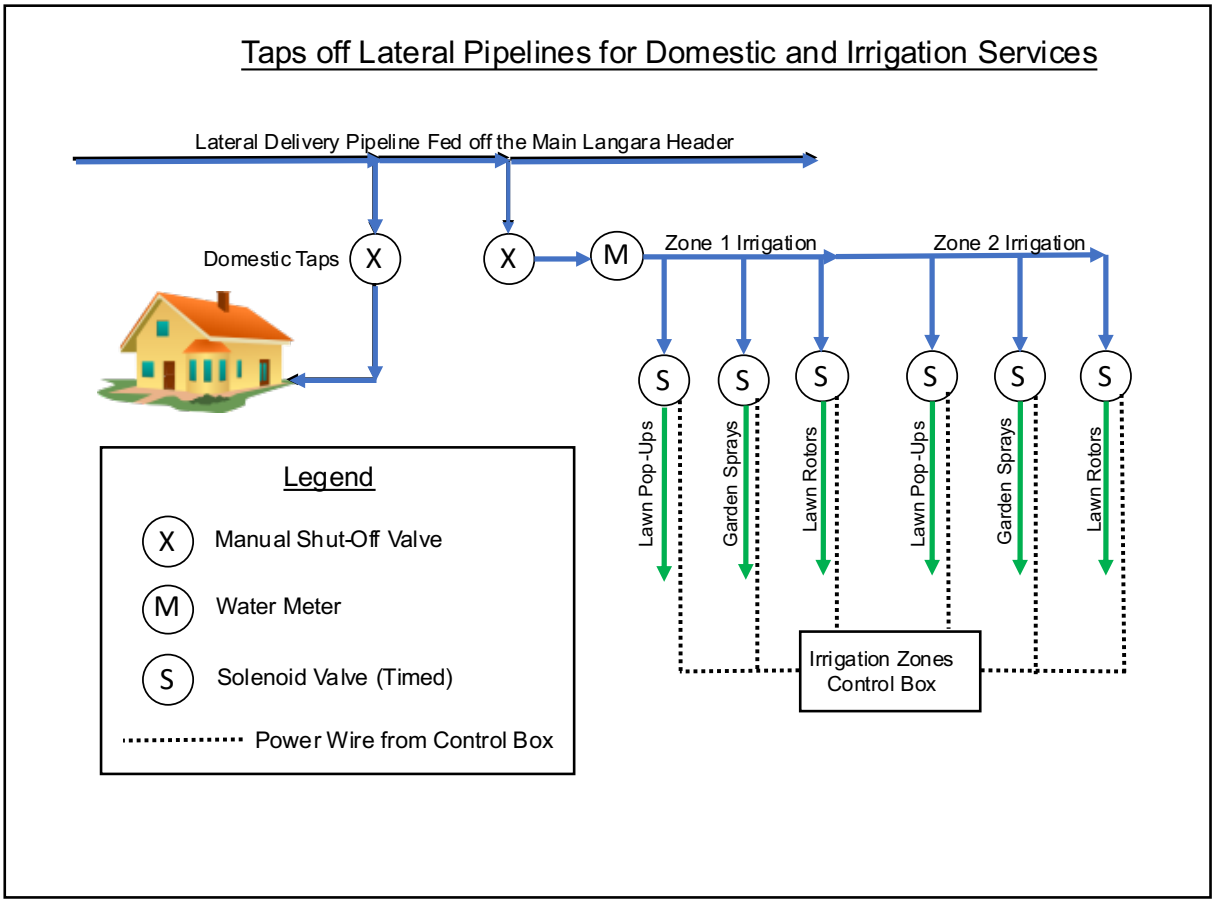


Figure 2: Schematic of water delivery routing for domestic and irrigation uses.

- Timers within the control box stations regulate the on/off cycles of solenoid control valves, allowing pre-determined scheduled water deliveries to each of the specific service supply lines.

- Each strata has an Irrigation Manager. The Managers program the control boxes, record water meter readings, monitor and repair all the irrigation equipment in service, including the blow-out of the irrigation lines in the fall and the commissioning of them in the spring.

- Provincial regulations require that the potable water lines for household use are adequately flushed each year and that all fire hydrants are serviced annually.

- The Onyx Strata has a separate tap off the City's main supply line, with Onyx consumption being metered and billed separately by the City.

2. Cost Distribution

- The 200mm master water meter, located at the corner of Langara and Gabriola, measures the water diverted from the City supply to the four specified strata of Craig Bay Estates. This water is for use by households, irrigation, fire hydrants, the Beach Club facilities and the four cottages.

- The City of Parksville bills each strata for its share of the overall water cost. The apportioned share is equal to each strata's percentage of a collective of 396 homes. The cost is shared as follows:

  - Arbutus Grove - 87 homes = 21.9%
  - Meadow Beach - 60 homes = 15.15%
  - Seaside Village - 229 homes = 57.83%
  - Shorehaven - 20 homes = 5.05%

- As there is no metering of water supplied specifically to the swimming pool, hot tub and four cottages, the specified four strata share in its cost proportionately. The cost of water supplied to the Beach Club is apportioned similarly.

- In addition to charging for the water, the City of Parksville adds sewage treatment and sewer infrastructure improvement costs to the regular billing. The annual sewer charges are based only on domestic water consumption. The City doubles the six-month wintertime (or non-irrigation season) potable water consumption to determine the total annual household consumption. (For example: 33,000 m^3 of wintertime consumption translates into a yearly sewer services charge related to 66,000 m^3.)

- As mentioned previously, the Onyx Strata is serviced by an independent water line and water meter that ties into the City of Parksville's main distribution line. Water supplying the Onyx Strata does not flow through the Langara 200 mm master meter. The Onyx Strata is billed directly by the City for its water consumption.

- Based upon a previous agreement with the Community Lands Committee (CLC), the Onyx Strata does not share in the cost of the water delivered to the Beach Club, the swimming pool and the cottages because it covers the annual cost of power for the two common streetlights in front of the Onyx complex. This would normally be a CLC responsibility. This cost, borne by the Onyx Strata, offsets the equivalent water costs so that everyone is paying their fair share of common costs.

3. Assessment of Present System Operations

- The water conveyance system is functioning properly. Everyone has good quality potable water, lawns and trees are green and healthy, but the operation is relatively expensive.

- The need for domestic water conservation and avoiding poor use of water cannot be over-emphasized. Arriving at innovative ideas on water conservation practices is an ongoing challenge to effectively and economically implement and must be a top priority for all residents.

- The Irrigation Managers are doing a great job in walking the fine line between over and under-watering. As the irrigation systems age, these Managers are also heavily-tasked with ongoing repairs of broken water lines and sprinkler heads.

- Historical and recent water meter reading exercises clearly indicate that there are no major leaks within the irrigation piping systems.

- Water meter readings taken prior to irrigation start-up each year, indicate that household water consumption in Craig Bay Estates is virtually the same, statistically, as households within the Regional District of Nanaimo. This consumption is approximately 0.44 m3/day per household through the winter period, increasing to about 0.65 m3/day per household in the summer, when the residential population in Craig Bay estates increases substantially.

- During the summer months, approximately:
  - 70% of the water supplied to Craig Bay Estates from the City is used for irrigation, while 30% goes to domestic/household consumption.
  - The cottages, pool and hot tub consume approximately four m3/day.
  - Daily readings taken at the 200 mm master meter show a distinct upwards spike in consumption as the four strata start up their irrigation systems, and a rapid decrease in the fall when the irrigation systems are shut-down.

- The present irrigation metering system, although not perfect, is adequate to quantify water consumption volumes. The strata Irrigation Managers are able to take regular readings from the irrigation meters to monitor the performance of each of the metred irrigation blocks. It is not clear if this practice is exercised on a regular or routine basis by all the Managers.

4. Historical Adaptations to Achieve Water Conservation

- In 2010, 29 "Solar Sync" sensors were installed to integrate with the operations of all the irrigation controllers in Seaside Village, Arbutus Grove, Meadow Beach and Shorehaven Strata, as well as for the Beach Club. The main function of these sensors was to monitor air temperature, solar radiation and precipitation to automatically adjust the irrigation application amounts as dictated by the current weather conditions.

- In 2011, three strata corporations installed water meters into the irrigation lines within their operational areas. These included 13 meters in Seaside Village, four meters in Arbutus Grove and six meters in Meadow Beach, including the Beach Club. The purpose behind installing these meters was to help the Irrigation managers determine the water volumes being applied to individual irrigation blocks and also to send an alert should any line failures occur. The data collected from the reading of these meters is for operational monitoring only and not for any billing purposes.

- Shorehaven Strata previously had a water meter installed on their single irrigation service line.

- Low flow toilets and showerheads were also installed in the Beach Club and the four cottages.

- Consideration was given and an evaluation carried-out to install an individual water meter in each domestic household service. This is common in many other strata communities and particularly in conventional urban housing, where each homeowner pays directly for whatever water that household consumes.

- Findings from the evaluation of this individual household metering consideration revealed that:
  - Water that was used for common property irrigation would still have to be calculated and billed back to individual residents.
  - The City of Parksville indicates that meter installation costs would be charged back to each household at a cost of approximately $600 each.
  - The City would not take responsibility for the reading of the 396 individual meters and the respective billing to those 396 households. City jurisdiction ends at the downstream side of the 200 mm master meter and their policy reads that the City is not responsible for any equipment it does not own and maintain. The City sees no need for it to take on such an ownership responsibility in a multi-strata situation.
  - The task of implementing a "meter reading, billing and collection service" would have to be implemented by the four independent strata.
  - All residents would have to approve of the meter installation concept.

- As a result of the foregoing, individual household meters were not considered to be an effective cost reduction or economically practical water-saving solution and should not be pursued any further.

5. <u>Reduced Irrigation Volumes</u>

- As noted above, irrigation constitutes about 70% of summer water period water consumption.

- The charges by the City for water increase in stages as consumption increases during the billing cycle. Therefore, for Craig Bay Estates, the cost of water escalates through the summer. When the summer volume exceeds 186 m3 per household, the applied water rate rises dramatically.

- Water consumption during the winter (non-irrigation) season is relatively constant from year to year. The only variable is the population fluctuation during that winter cycle. Water demand during the summer cycle (irrigation period) varies from year to year depending on daily temperatures, rainfall amounts, changes to the City's water restriction levels and the expectations of residents when it comes to the appearance of landscape vegetation and its relationship to irrigation application amounts.

- Of the four main factors impacting irrigation demand listed in the bullet above, the only one that strata councils can control is setting an irrigation level that satisfies the landscape "wants" of the community. The main consideration is how much can irrigation be limited (to conserve water and associated cost) without doing long-term damage to the lawns, trees and shrubs.

Appendix # 2

Best Management Practices – Irrigation in Craig Bay Estates

(Prepared as a Reference Document by Wally Chinn)

Introduction:

In the realm of water management, it is a fundamental concept expression that states, *"You can't manage what you don't measure!"*. One of the most significant steps that Craig Bay Estates implemented several years ago was the installation of numerous water meters within the various irrigation systems. Assuming that these devices are properly maintained and regularly monitored, they provide, on a broad scale, a read-out of the water consumption within individual irrigation blocks, quantitatively indicating where water use was high or low, where system performance functions varied from the expected and even where system failures (e.g. line leaks) may be occurring.

Beyond that macro quantifying process, it can be questioned as to whether the management of the irrigation systems actually knows what is being achieved in the water application process. Certainly, the vitality, or lack thereof, of the variety of vegetation within the Craig Bay Estates' landscape is an indicator, but that doesn't necessarily reflect the overall efficiency of irrigation water use. This can be a major aspect in the water conservation discussion. So, before proceeding further, it may be productive to get a better understanding of (or even agreement on) the interpretation of and application of these terms.

Understanding the Metrics of Water Use:

In the current exercise by the Water Committee established by the Craig Bay Community Lands Committee (CLC), its mandate is to determine a path forward that would propose a water management plan that could yield reductions in the community's water use and thereby save the community financially (i.e. minimize strata fee cost increases). During this process, the concept of "water conservation", from an ethical standpoint, has gained appropriate traction, complementing the original intent to just reduce water use.

It is likely important, then, to better understand what "conservation" truly means and how that concept can be realized within Craig Bay Estates' irrigation systems. In simplistic terms, if the goal is to reduce water use, then one could "conserve" water by just irrigating less. However, the true spirit of ***"conservation"*** is defined as:

"The prevention of wasteful use of a resource".

As simplistic as this definition may appear, the word *"prevention"* implies actions taken, or an operations management plan. The word *"wasteful"* requires more interpretation and some kind of measurement metric. Two of these metrics are "*effectiveness"* and *"efficiency".*

The definition of ***"effectiveness"*** is:

"The degree to which a process is successful in producing the desired result."

In the case of irrigation practices, the desired result is sustainable healthy and productive vegetation. Therefore, the application of unrestricted amounts of water could be very

effective, assuming that those unrestricted amounts of irrigation do not cause collateral damage to the local soils or the adjacent environment.

The definition of ***"efficiency"*** is:

> ***"The performance of a system or process that uses the least amount of input to achieve the highest amount of output."***

So, in the irrigation efficiency context, it is desirable to attain the preferred level of vegetation viability and productivity ("effectiveness") through the application of the least amount of water.

Factors Affecting Water Application Efficiency:

Fundamentally, and ideally, the overall purpose of an irrigation system is to supplement any growing season natural precipitation to provide a sufficient amount of water that ensures an adequate supply of *"readily available moisture"* to the plants. When developing a strategic plan through a group consensus, it is important that all participants are of the same understanding of the basic concepts being considered and/or applied. For a more complete understanding of the factors that come into play in soil-plant-water relationships, particularly as they relate to irrigation management, some further explanation or definition of terms may be helpful. These can also form a "Glossary of Terminology", or the like, in any subsequent reporting.

"Soil Texture" – Soils are composed of three main categories or sizes of particles, namely sand, silt and clay. The proportion of each of these defines the type of soil texture, whether it be a loam, a sandy-clay loam, a sandy loam or clay, just as some common examples. Soils are often generically referred to as coarse, medium or fine-textured, again depending on the proportional make-up of the various particle sizes.

"Water-Holding Capacity" - Every type of soil texture has a different capacity to retain water. This is a function of the adhesion forces between the soil particles and the water molecules, which overcomes the force of gravity to drain (percolate) water downward through the soil profile. Because coarse-textured soils (e.g. sandy-loams) are made-up of larger particles, there is less surface area for water to adhere to and hence a lower water-holding capacity. The converse, then, is true for fine-textured soils such as clay-loams which have a much greater water-holding capacity.

"Available Moisture" - Because of the strong adhesion forces exerted between water molecules and soil particles, not all the water held within a soil profile will be available for uptake by plant roots. Therefore, for any given soil, the moisture available to sustain plants will be less than the Water-Holding Capacity of that soil. As plants draw water down to the lower end of the Available Moisture range, wilting will begin to set-in and plant productivity suffers noticeably. This is generally a fixed amount and is specific to soil texture.

"Readily Available Moisture (RAM)" – This amount is that proportion of the Available soil Moisture that a given plant can "readily" withdraw from the soil without impacting plant growth or plant productivity. This proportion is plant specific. In other words, plant type A may have a RAM of 60%, meaning it has the capacity to draw down the Available Moisture to where only 40% is left, without impacting growth and productivity. These plantings are often referred to as "more drought-resistant". Other plants are more moisture sensitive and will only function adequately where available soil moisture is drawn down by no more than 40% (RAM = 40%),

ensuring that 60% of the available soil moisture still remains. These plantings are often referred to as "drought-sensitive".

"Wilting Point" - This is the degree to which Available soil Moisture has been reduced to somewhat below the Readily Available Moisture level and plant physiology processes (particularly osmosis) begin to fail. The stress of reduced osmotic function causes the plant to wilt and potentially lose productivity. However, if soil water is added within a short period of time, the plant will regain vigour. Some plants will begin to "shut-down" their physiology at this depressed moisture level in order to retain some viability through a limited period of dormancy.

"Permanent Wilting Point" - This is another approach of expressing that level at which all available moisture that a plant is able to consume has been withdrawn, such that the plant can no longer recover and dies.

"Plant Rooting Pattern" - This describes the manner in which plant roots develop under normal or ideal growing conditions. Normally, again depending on the plant variety, assuming there are no other soil limiting factors, plants will develop their roots where 40% of their development and moisture uptake will occur in the upper 25% of the soil profile, 30% moisture withdrawal in the next 25% of soil depth, 20% in the next 25% and 10% in the lowest 25% of the rooting zone.

"Soil Root Zone" - This is the depth to which and how plant roots will develop within a given soil. It can be affected by the changing variability of a given soil's profile and a plant's roots ability to penetrate variable soil layers and where a plant's roots are able to most likely secure "Readily Available Moisture".

"Soil Infiltration Capacity" - Sometimes commonly referred to as the "soil intake rate". However, a given soil texture's Infiltration Capacity is the base rate at which water will penetrate the soil surface and continuously move through the soil profile on a sustained basis. The "soil intake rate" is more variable depending on to what degree the soil profile is already retaining some extent of moisture and what the soil surface conditions may be (e.g. density of vegetation cover, such as grass).

"Deep Percolation" - Describes that portion or amount of water infiltrating the soil profile that moves downward through the profile to depths below the active rooting zone of a plant such that it is not available for uptake by the plant.

"Topographical Features" - The slope of the water application area and combined with the nature of the groundcover vegetation will ultimately affect the soil intake rate. This means that, the greater the land slope, the greater the density of vegetation cover on the soil surface, the finer-textured the soil, and the higher the water application rate, the greater the potential for water runoff.

"Water Application Efficiency" - The proportion of water applied that infiltrates into and is held within the active root zone, not being lost due to ambient evaporation, surface run-off or deep percolation (movement of water below the active root zone).

"Evapotranspiration (ET)" - The process through which water is transferred from the land to the atmosphere by *evaporation* from the soil and plant surfaces and by *transpiration* through the physiological processes of the plants. It is to be noted that this is a two-component process. Irrigation systems are intended to replace that portion of the ET which is not met by precipitation.

The Basics of the Functioning of Irrigation Systems:

Irrigation systems, such as have been installed within Craig Bay Estates are complex networks of many different components and devices. There are the extensive lengths of buried piping, of various diameters, connection and diversion fittings, shut-off valving, water meters, electronic control valving and a variety of application devices themselves. The latter are often referred to, in an over-arching generic reference, as "sprinklers", devices that come in a wide variety of operational attributes.

The following are the basic component devices or parameters that dictate how much water gets applied during and irrigation event.

"Sprinkler" - In Craig Bay Estates a variety of devices are used for applying water to turf and garden beds. These include small, medium and large pop-up rotors and pop-up spray heads, both generally used within grassed areas and when not in use (under pressure) they slide back down just below ground level into a retainment sleeve; fixed riser spray heads and misters, which are commonly used in garden beds.

"Sprinkler Nozzle" - A replaceable spray outlet specifically sized for a sprinkler device's required water output. Sprinkler devices are generally designed to support various sizes of discharge nozzles that are individually and selectively installed to meet the required water flow discharge and the area to be covered for that device.

"Operating Pressure" - There is a designed water pressure that a given device and nozzle pairing should operate at to deliver the rate of water application and area of coverage as desired. If water pressure is insufficient, the sprinkler could perform below expectations, meaning less water applied than required and also applied less uniformly. With too much pressure, too much water could be applied and/or the aerial stream could be too misted, leading to higher ambient water loss. Within Craig Bay Estates, water is delivered, under pressure, by the City to the community at a single point near the main entrance to the community. *(More detail on this water supply is provided in a companion document.)* From this single delivery point, irrigation water is distributed through several kilometres of pipeline, through a variety of pipeline fittings, valves and other devices until it reaches a sprinkler device. Although the water pressure provided by the City holds reasonably consistently, all these pipelines, fittings, valves, etc. cause pressure losses along the routing. In addition, elevation changes within the system, for example from the south end of the community down to the north, also impact available water pressure. Therefore, water discharge at various points along the system will vary as does the pressure, that is unless individual nuzzling adjustments can be made. Because water pressure gauging is virtually non-existent in the system, not having been previously installed within the network, the selection of appropriate nozzle sizing has been more of an art than a science and has required the experience and judgement of the irrigation managers/operators to make appropriate adjustments on site-specific-by-site-specific bases.

"Irrigation Coverage" - All conventional sprinkler-types used irrigate in circular or part-circle patterns. Therefore, to achieve better uniformity of application, sprinklers need to be arranged where there is at least 70 percent overlap in coverage. Where that requirement isn't met, some of the irrigated area will receive notably less water than others.

"Irrigation Set-Time" - This the number of minutes that an irrigation controller is programmed to allow for the irrigation of a particular irrigation zone. These can vary from 10 to 30 minutes, depending on zonal coverage and devices involved.
"Irrigation Period/Cycle" - This is the number of days between complete irrigation of a given zone, as programmed into the associated system controller.

Irrigation Fundamentals in a Residential Setting:
Managing an irrigation system within the complexities of a built-up residential setting can be a challenging operation, mostly due to the potential variabilities in irrigation requirements as determined by vegetation type and configurations, soil conditions, topography, exposure to direct sun or amount of regular shade, and by localized groundwater conditions. The nature of the development of Craig Bay Estates encompasses all of these challenges. Further, the design (nature) of the given systems installed by the community developer, combined with the diversity of plantings, not only complicates management paradigms but also applies inherent management limitations in terms of operational flexibilities.
Urban irrigation systems are conventionally developed to operate in *"zones"* where all irrigation application devices are networked through piping such that all devices within a single zone will operate simultaneously. These operations are dictated by the timing cycles programmed into a central controller for that given zone. Individual application devices can be selected to apply the water necessary to meet the specific requirements of the vegetation within the coverage of that specific application device and the programmed time of operation per cycle.
Ideally, the management of an irrigation system will see as much water applied in an irrigation set (cycle) where the highest percentage thereof is able to infiltrate the soil surface and be retained as *available moisture* within the active root zone of the vegetation requiring irrigation. This equates to striving for the highest *practical irrigation efficiency*. Water lost in the irrigation process can be caused by the ambient evaporation from the spraying process, the ambient evaporation from the soil and plant surfaces, from runoff due to topography and limited infiltration capacity, through deep percolation, or through any combination of the foregoing. Therefore, to achieve the highest practical level of irrigation efficiency, it is desirable to minimize these losses, most of which can hopefully be achieved through appropriate site-specific system management.
Of particular note is the question of how to manage irrigation applications during periods of rainfall. There is a misconception that irrigating while it's raining is wasting water. Although that can be true during very significant rainfall events, most of the time, rainfall and irrigation applications are complementary to each other. In the heat of the summer, when precipitation is at a minimum, most irrigation systems cannot keep up to the water demands of the vegetation they are trying to support. Therefore, it's important to use both rainfall and irrigation to build-up the soil moisture reserve during times of lower evapotranspiration so that there's a reserve of soil moisture available when the demand vs. supply ratio increases dramatically.

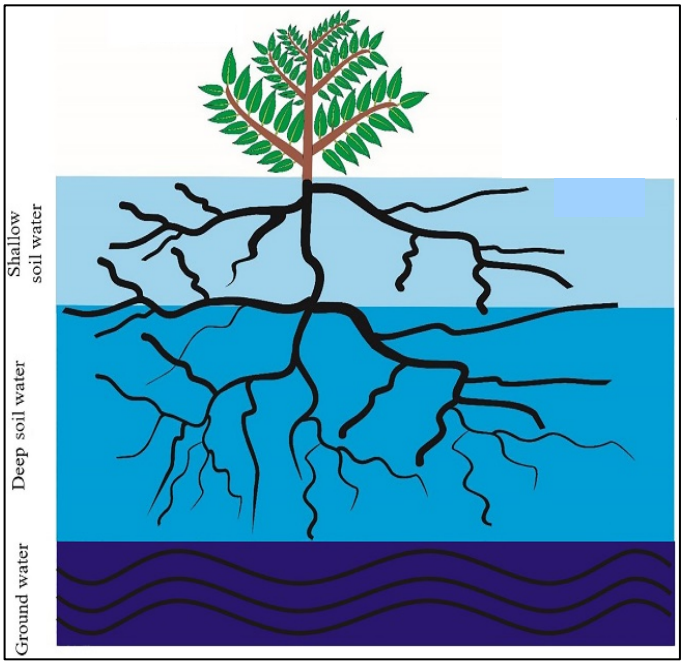


Fig. 1: Ideal soil profile and root-zone development.

Soil profile characteristics provide for another challenge in managing the irrigation systems of Craig Bay Estates. As has been indicated in other documentation related to this irrigation subject, the local soil profile conditions are certainly less than ideal. Through the building development process, topsoil has largely been lost, leaving a thin layer of sand or loam covering a somewhat impermeable heavy clay parent material, often referred to as "glacial till".

Figure 1 depicts ideal soil and root-zone development characteristics, where there is considerable soil depth for extensive root development. It is that lower "Deep soil water" zone that is critical to keep replenished as it is the moisture retained there that supports vegetation in the later hot and dry summer months.

Figure 2, on the other hand, depicts much of the reality for Craig Bay Estates where the topsoil conditions can be quite limited, overlying the somewhat impermeable heavy clay content of glacial till. Root penetration to depth is restricted, meaning more limited access to soil moisture.

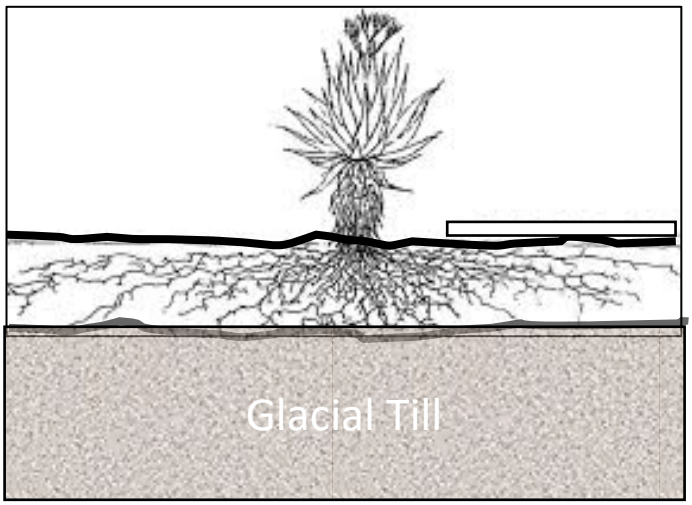


Fig. 2: Constrained soil profile and root-zone development.

Irrigation applications under these conditions have to balance the need to effectively retain sufficient moisture to support growth and survival, and to apply that water as efficiently as possible to limit losses due to ponding and run-off. Some automating weather monitoring devices have been incorporated within the Craig Bay systems, most notably "Solar-Sync" devices that monitor temperature, humidity and precipitation regimes so that these devices can direct the main control boxes to adjust their irrigation cycles to compensate for high daily temperature conditions (i.e. apply more water) or for high precipitation periods (i.e. apply less water). Although such devices can provide some additional irrigation management

assistance, they are another piece of technology that should be constantly attended to in order to be sure the devices are functioning properly and as required.

"The "ambient losses" through evaporation, as mentioned above, will generally amount to the same extent of measured loss (mm) under any given situation, regardless of the total amount of water applied. For example, in a given application, there could be two millimetres of water lost due to evaporative effects, regardless of whether the overall application amount is 10 millimetres or 15 millimetres. As a result, in this example, evaporative losses could increase the net irrigation efficiency, pertinent to evaporative losses only, from 80% to 87% simply by increasing the gross application amount by 50% (i.e. a 50% increase in a set/cycle/application time).

Understanding Craig Bay Estates Irrigation System Performance:

The original question posed at the outset to this report still remains, that is, *"How do you manage a system that you don't/can't measure what's happening?"*. Given that the current system network is a given, as handed-over by the Developer, and that water metering generally only serves to quantify water use through a large block area comprised of many zones, there is virtually no available measurement of localized operating pressures. The success and failures of adopting the correct sprinkler configuration for water application has been achieved by committed trial and error by the strata irrigation managers. The task that they faithfully have been and are attending to cannot be overly-emphasized.

Nonetheless, what is the measurement that quantifies or qualifies the operational characteristics of the systems? To date, the trial-and-error approach has pretty well been based on the subjective appearance of the vegetation or the evidence of overly-saturated ground.

Therefore, in the hope of developing some of the recommendations for this report from the analyses of information that could be derived, small field test experiments have been carried-out to actually measure water application under various sprinkler types and under various vegetation and operational conditions.

Conventional irrigation application uniformity and quantification testing involves setting-out a number of "catch-cans" that will capture the total amount of water applied during a given set. These tests were repeated several times in several locations to try and determine some sense of what's really happening application-wise during those irrigation sets.

The devices tested included pop-up spray heads in lawn situations (Fig. 3), large pop-up rotors covering large lawn areas (Fig. 4), fixed-riser spray heads in garden beds (Fig. 5) and fixed misters in garden beds (Fig. 6). These are all illustrated in the following figures. These are the most common types of application devices used within Craig Bay Estates irrigation systems.

Fig. 3: Pop-up spray heads for lawns.

Fig. 4: Pop-up rotors for larger lawn areas.

Fig. 5: Mister head in garden area.

Fig. 6: Fixed spray head on riser in garden areas.

Tests were also carried-out to measure application amounts in garden hand-watering (Fig. 7). For these tests, the flow rate from a hand-held sprinkler on the end of a garden hose was determined (litres/minute). The garden area being hand-watered was measured (sq. metres). The pop-up lawn spray heads and the fixed-riser garden spray heads operated within 10-minute set times. The rotors and misters operated within 20-minute set times. The 12.5 square-metre garden area was hand-watered for 15 minutes.

After several night-time tests were conducted, the <u>average</u> application depths were determined to be:

- Pop-up spray heads for lawns: 4.7 mm
- Pop-up rotors for large lawn areas: 3.3 mm
- Fixed riser spray heads for gardens: 5.5 mm
- Mister spray nozzles for garden beds: 8.7 mm
- Hand-held garden hose sprinkler: 9.8 mm

Fig. 7: Hand-watering garden area.

Fig. 8: Catch cans set-out under mister-irrigated area.

<u>Developing Irrigation Best Management Practices (IBMPs):</u>

Ultimately, the goal is to have whatever amount of water applied and then retained as available soil moisture to be as ***<u>effective</u>*** as possible in supporting plant viability and applied as ***<u>efficiently</u>*** as possible. It bears repeating that if irrigation water conservation is to be achieved, ***<u>irrigation efficiency</u>*** and ***<u>irrigation effectiveness</u>*** must go hand in hand.

However, with a lot of the aforementioned landscape characteristics/parameters (soil, topography, and vegetation type) potentially impacting the irrigation application efficiency within landscape settings, such as are prevalent in Craig Bay Estates, achieving high water application efficiencies and effectiveness can be easier said than done. Because of the wide variability of soil conditions (and topography to some degree) that exist across Craig Bay Estates, and the variability of the vegetation grown in any one location, even within a single *"irrigation zone"*, an effective "one-size-fits-all" application solution can be very challenging to derive. Any zone-specific irrigation strategy is complicated by the high probability of extensive variability in the nature of the vegetation grown in that particular zone. Complicating all of this is the reality that available water pressure throughout the systems varies significantly so that what water application devices or nozzle sizes work in one area are not necessarily applicable in another.

Therefore, recommended Best Management Practices (IBMPs) for irrigation within Craig Bay Estates would include:

1) Program application set-times to balance applying as much water as possible within the soil infiltration capacities, topographical limitations, and the overall time available for a daily irrigation period.

2) Balance higher per-event application amounts with reduced irrigation application frequencies. This would be a more effective and water-use efficient strategy than simply reducing application amounts during times of imposed water-use constraints.

3) Continue with site specific adjustments to irrigation devices to decrease water applications in defined areas where irrigation requirements are notably less (e.g. groundwater discharge effects). Conversely, continue to carry-out such adjustments where irrigation application amounts are lacking and can be implemented practically.

4) Randomly carry-out water application depth measurements to better understand system and application device performance, utilizing these measurement techniques to collate a better understanding of irrigation system application efficiency and effectiveness.

5) Standard irrigation system start-up and shut-down dates should be coordinated across all four strata to achieve uniformity in water use and shared billing.

6) Consider delayed start-up and earlier fall shut-down as dictated by both recent weather experiences and the projected resulting soil moisture conditions, as well as the longer-term forecast weather conditions.

7) Determine the functionality and applicability of utilizing passive agro-climatic (rainfall, humidity, air temperature, evapotranspiration) monitoring systems that can be used to assist in effective and efficient irrigation scheduling.

Appendix # 3

OVERVIEW OF THE CRAIG BAY ESTATES POND SYSTEM

(Prepared for the Craig Bay Water Committee – April 2021)

(Note: In the following, "CBE" is understood to refer to "Craig Bay Estates", also referred to as "the Community", whereas the "City of Parksville" is referred to as "The City" and "Intrawest or Intercorp Development Corporation" is referred to as "the Developer".)

Purpose:

The CBE Pond Water Management System was constructed by the developer as a necessary component in the residential development's infrastructure for stormwater management. The main stormwater receiving and interconnecting components, as of 2021, are illustrated in the following graphic (Fig. 1). The CBE Pond Water Management System, as it is today, was developed in stages through the period of approximately 1995 through 2006.

Fig. 1: Craig Bay Estates Pond Stormwater Management System main infrastructure.

The three overall objectives of the system, in descending order of priority, are:

1) **Stormwater Detention** – The concept of establishing a system of ponds that would be able to accept and temporarily accumulate large amounts of instantaneous storm runoff water, for later and slower release, is a common design approach in contemporary municipal water systems. The concept allows for much less expensive infrastructure to convey very high stormwater inflow rates out to a receiving body such as a river, lake or ocean. Typically, such systems have been designed to handle a 1 in 100-year storm event, buffering the high storm inflow against the lower outflow capacity. (Note: In recognition of projected climate change effects, many municipalities are now adopting stormwater flow management capacities notably higher than 1 in 100-year.)

   The buffering is achieved by utilizing surcharge capacity in the ponds to temporarily **detain** said high inflows while reduced outflow takes place. This surcharge capacity is achieved through a temporary increase in pond water levels. Note: It is not necessary for this buffering and stormwater detention to be achieved through the use of a "pond system". It is possible, as utilized in many municipal settings, to buffer the high inflow rates through water detention in depression areas that fully drain after a major storm inflow. These areas are often used, when not in flood of stormwater detention, as parks, playing fields, and the like.

   Therefore, it is not necessary for CBE to have an actual pond system to achieve the required stormwater management, but only to have those same areas occupied by the ponds available to receive stormwater discharge. In other words, if the ponds were filled-in with earth to an elevation equivalent to the Full Supply Level (FSL) of the ponds (e.g., elevation of the top of the main outlet weir), the required detention functions would still be achieved.

   2) **Silt Retention** – In the original approvals for the development of CBE, the environmental protocols of the Department of Fisheries and Oceans (DFO) would only allow discharge of stormwater to the ocean body of Craig Bay as long as there would be no silt deposit/discharge into the ocean. Therefore, it was obligatory for such transported silt from the Community's drainage system to be retained onsite. The established pond system achieves such requirements. However, it can be mentioned that the extensive nature of the current pond system is not necessary to provide for silt management. If the ponds were not as extensive as they currently are, large silt traps within smaller pond bodies could be established in defined areas accessible for periodic clean-out.

   3) **Aesthetic Appeal** – The development of the ponds, built upon the prior water drainage system inherit within the property, pre-development of CBE, provides an environmental ambience that has an attractive appeal of the natural surroundings, which, for many residents, is a positive attraction or asset for the community.

History, Geographics and Hydrology:

Fig. 2 is an aerial shot of the lands within which CBE was developed, but many years prior to that. The yellow outline depicts the "footprint" of the later development coverage including a few reference points, (not the least of which is the would-be location of the all-important "Serious Coffee" in the Heritage Mall). Many changes in and around the adjacent lands have occurred since the aerial photo was acquired, including the relocation and extensions of portions of Northwest Bay Road and the extension of Franklin's Gull Road.

The lands within which CBE was developed was originally privately owned and utilized in part as a farming enterprise. Later, a campground enterprise and a large private residence development formed what is now known as the Provincially-controlled "Heritage Lands".

Fig. 2: Aerial photo of the lands within which CBE (yellow outline) was later developed.

Of particular significance, as illustrated in Fig. 3, was the presence of natural slough areas and a constructed tree-bounded drain outlet to the ocean, pre-dating the development of CBE. Those natural slough areas formed the foundation of today's main lower pond areas in CBE. The tree-bounded or tree-lined drainage channel has been maintained and enhanced by the Developer to serve CBE's needs today for stormwater discharge to the ocean. It is important to note that prior to the development of CBE, the regional hydrology from west of Northwest Bay Road and west of the Island Highway (19A) also all collected through the properties of what today are the CBE development and the Heritage Lands, exiting to the ocean.

Fig.3: Natural slough areas of local regional hydrology prior to development of CBE.

In order to facilitate the necessary stormwater management that the CBE development required, the pre-existing slough areas were engineered for expansion and deepening, with new pond areas excavated to provide sufficient surface area to meet the designed stormwater detention needs. Hence the existence of the current pond system. The "footprint" area of CBE is approximately 43 hectares while the estimated or potential additional regional drainage area to the west is approximately 48 hectares.

NOTE: In the approvals that the Developer received authorizing the original building of CBE, the City required CBE to continue to provide a means for the natural regional hydrology to be discharged to the ocean (a.k.a. Craig Bay). As a result, any regional

drainage collected from offsite of CBE is funneled through a major drain pipeline running down the length of Langara Place and discharging into the lower pond system beneath the Langara Bridge. Some of this drainage is also conveyed through a common drainage pipeline running southwestward along Gabriola Drive through Arbutus Grove Strata, connecting with the main Langara Place pipeline.

The designed run-off of stormwater from CBE itself is rated quite high due to the nature of the development (roof areas, paved streets and parking lots, turf areas, etc.). However, the runoff potential from the industrial and treed areas west of CBE was estimated to be less than 25 percent of that generated within CBE itself.

A recent field reconnaissance was carried-out by the writer of this report to determine the actual functionality of drainage moving through the City's Industrial Area toward the Northwest Bay Road and CBE perimeter drainage collection routes. In short, the drainage network and infrastructure are very undefined and showing little evidence of any notable amount of accumulating water flows moving toward the CBE drainage provisions.

Commitments with The City:

In the approvals from the City for development of CBE, many agreements were made that obligated the Developer, and hence CBE, to accept various responsibilities. These included such things as trail maintenance, natural forested area protection and some infrastructure responsibility. Of note as an example for the latter is the Langara Bridge. Although the right-of-way of Langara Place and the associated street infrastructure is owned by the City, the responsibility for maintaining the Bridge rests totally with CBE. It is surmised that had the Development not created the enhanced system that it did, there would be no bridge required and therefore the onus was on the Developer/CBE to provide the required maintenance. Similarly, the crosswalks across Langara Place are built with in-laid bricks. These crosswalks were a Developer initiative and not a City standard, so CBE is responsible for maintaining the crosswalks within Langara Place.

The foregoing is emphasized to illustrate that CBE is subject to conditions imposed and agreed to with the City almost three decades ago. This is no less the case related to the requirement to manage stormwater drainage from off-site of the CBE "footprint".

In more recent meetings between the City and representatives of CBE, the City has committed to provide routine clean-out of drain catch-basins upstream of CBE in order to minimize the amount of silt that may be transported into the main lower pond within CBE. In addition, at the request of CBE, the City has undertaken clean-out of the accumulated silt beneath and immediately adjacent to the Langara Bridge; once in the summer of 2012 and once more in the late summer of 2017, both at times when pond levels were low enough, lowered either naturally or artificially, to facilitate effective clean-out. The clean-out in 2012 was likely the first time such work had ever been carried-out, so there was a lot of buildup to be extracted. The clean-out in 2017 indicated that there was much less silt and debris accumulating beneath and adjacent to

the Bridge. Hopefully, that was a reflection of the increased diligence on the part of the City to clean-out upstream catch-basins. Continued communication with the City to encourage regular/annual upstream catch-basin clean-out is recommended.

Pond Maintenance:

In 2009, on the initiative of the then CBE Property Manager (Concise Property Management) for the four strata, excluding Shorehaven Strata, a formalized program of routine and longer-term pond maintenance was initiated. Some contracted clean-out of cattail build-up had been started two or three years earlier, but the contracted crew left the jobsite approximately half-way through the prescribed work upon realizing the amount of work required and associated challenges were beyond the contractor's capabilities and contracted price.

In order to expand the advisory base to the Community Lands Committee (CLC) as well as to provide a vehicle to communicate pond-related matters across all five strata, the CLC Pond Sub-Committee was established in 2010 and continues to be in place up to today. Through the annual deliberations of that Sub-Committee, the CLC has been and continues to be advised of recommendations to address pond maintenance requirements and associated budget requirements.

In 2009, it was evident that the American Bullfrog invasion was making its way up the Island and into the CBE ponds. A three-year expenditure program was implemented in 2010, in conjunction with the University of Victoria, to eradicate or at least attempt to control the invasion. Although many adult and juvenile bullfrogs were removed during these night-time extractions, the net result revealed a losing battle. Upon the advice of another amphibian biology specialist, the program attempting to control the bullfrogs was abandoned to allow for nature to achieve its own natural equilibrium.

During 2009, most maintenance attention was directed at two components. One was to acquire as much information as possible about pond aquatic plant behaviour and potential pond treatment(s) that would deter or control the spread of aquatics, especially fibrous algae. Arising from that knowledge acquisition, a monthly program of Algae control was initiated in 2010. Each month, from May through to September, a treatment of micro-biotic enzyme is added to each pond area. This enzyme interferes with the nutrient supply supporting algae growth, thereby minimizing its development and presence. This treatment has made a remarkable improvement in the pond water quality since 2009.

The second component of initial work was the "paring" of cattail growth along the pond shorelines to help sustain water flow at connecting channels and reducing cattail encroachment further into the ponds. (See Fig. 4.)

The cattail extraction/paring efforts were carried out routinely each year by the Wednesday Morning Project Group (WMPG). This work started in earnest in 2010 and continued annually, to various degrees, primarily through to the late summer of 2019.

Despite the benefit of cattails to the ponds, as far as helping to filter-out soluble nutrients and contaminants, if left unchecked in some areas, their continual encroachment was encouraging shoreline “creep”, thereby incrementally reducing pond surface area which in turn could cause various degrees of flooding should a major precipitation storm event blanket the area.

Fig. 4: One example of cattail encroachment and shoreline “creep” requiring cattail removal and later dredging-out.

Similarly, the WMPG also used their forces to extract other aquatics that were tending toward clogging-up the ponds and creating a lot of unsightliness. A couple of the major invasive species needing extraction attention were Eurasian Milfoil and Yellow Floating Heart. These proved to be unrelenting as even the bringing-in of contracted boat-based aquatics harvesting operations could not get these aquatics under control. (See Fig. 5.) As a result, it was concluded that the only remaining option to gaining any sense of removal and control on these invasive species was to implement a herbicidal treatment program. This undertaking began in 2019 with a late summer intensive application of the chemical Diquat, marketed under the brand name of “Reward”. That effort had significant positive results, but it was understood that subsequent applications in following years would still be required to achieve a state of “control” of these aquatic species. As a result, another but less intensive application of Reward was carried-out, in 2020, again with positive results. It is anticipated that low intensity herbicide treatments will continue to be required, annually, in order to sustain a control program.

Fig. 5: Yellow Floating Heart & cattail encroachment choking-off "The Narrows".

Nonetheless, one of the persisting aquatics that continues to demand clean-out attention each year is the expanding masses of decorative water lilies, artificially introduced into the ponds by local residents somewhere in the 2012 to 2016 period. These plantings have so far proven resistant to the herbicidal treatment and have therefore only been controlled to a lesser degree by mechanical removal on the part of the WMPG. The CLC now has a firm policy prohibiting the addition of plantings of any kind into the pond system.

From 2010 through fiscal 2020, the annual CLC Operating Budgets have committed a total of $135,635 to "Pond Maintenance". On average, for each month for each of the 426 homes in CBE, this expenditure has translated into approximately a cost within monthly strata fees of $2.41 per home per month. All five strata contribute proportionally to the annual pond maintenance operating costs.

The foregoing costs do not include the WMPG input costs or the value of the volunteer efforts of the WMPG forces. Within the 11-year period, 2010 through2020, it is estimated that the WMPG contributed approximately 2,500 person-hours toward pond maintenance work.

Capital Works Rehabilitation Program:

In 2013, Koers and Associates Engineering Limited (KAEL) was contracted by the CLC to develop a long-range strategic plan for major pond maintenance and rehabilitation. Within that plan, three specific pond areas were defined as requiring major improvements, primarily involving clean-out of accumulated silt and deepening, particularly in designated areas which were not originally constructed adequately. These three areas, in order of priority, were defined as: The "Sunset Pond"; "The Narrows"; and the southern portion of the "East Shorehaven Pond". Design work to attend to rehabilitating these three areas was undertaken, under CLC contract, by KAEL in 2015. Soil sampling throughout all of these pond areas unexpectedly revealed concentrations of zinc and chlorides that were in excess of Provincial standards for soil disposal. As a result, a different approach to excavation and soil disposal needed to be developed. This delayed the planned start-up of the remedial cleaning and deepening work from 2016 to 2017.

In addition to the engineering and environmental assessments, an archeological study was required to be undertaken to ensure that any excavation work that was carried-out would not impact the indigenous midden that stretched along the reach of land adjacent to Craig Bay.

As a result of the technical complications and forced delay, the area behind (north of) the Meadow Beach Strata and specified as the "East Shorehaven Pond" was first excavated as Phase 1 of the three-phase overall project. Rehabilitation of the "Sunset Pond" and "The Narrows" was completed in 2018 and 2019, respectively.

The costs of all the foregoing associated work, from the planning to the soil sampling to the environmental and archaeological assessments to the actual construction / excavation work, were all funded through the CLC Community Lands CRF. Therefore, from 2013 through fiscal 2020, the community expended, through this three-phase capital works pond rehabilitation program, a total of $343,688. On average, for each month for each of the 426 homes in CBE, this expenditure has translated into approximately a cost within monthly strata fees of $6.11 per home per month. All five strata contribute proportionally to the annual pond maintenance operating costs.

Additional Notes:

In years when the weather has been very hot and dry and the demand for irrigation has been significant (meaning resulting higher water costs), it has been suggested that or questioned if pond water could get used to supplement irrigation needs. The answer to that question is that it is not at all feasible. The main reason is that the irrigation system network operates as spur lines off of the Community's potable water supply. Therefore, the mixing of the two water sources through one overall supply system would make the overall water supply completely unusable for domestic consumption purposes.

Secondly, a whole new piping supply would have to be installed and the water very well treated or at least filtered to make it compatible with typical turf irrigation applicators. This would mean developing a separate pumping and filtration station adjacent to the pond(s), also requiring the installation of a suitable electrical power supply system to such a pumping and filtration station.

In the early days of examining methods of treating the ponds to control aquatic vegetation development, aeration in different formats was considered. After examining various alternatives and noting their relative effectiveness, the aeration concept was discarded. Once again, one or more pumping and/or electrical supply stations would have to be developed. Further, the extensive aeration infrastructure required for an effective system would require a significant capital investment and significant subsequent maintenance costs each year.

The main source of water for recharging the ponds is captured precipitation that is funneled through catchments to the ponds through a little over a dozen stormwater discharge outlets. However, there is also an unquantified amount of groundwater that discharges into the ponds at indiscrete locations. These have proven to be quite effective in some years when it may have been expected, in very dry and warm conditions, that water levels in the ponds would normally drop notably due to evaporation. However, in some years, pond water levels have remained higher than expected through the discharge of some of the regional groundwater flow into the ponds. As these pond water features are almost at sea level and near or at a contact zone of impervious material beneath, groundwater and spring flow from upslope areas well to the west of CBE continue to percolate to a surface discharge point. This subterranean hydrology does impact the ponds and surrounding topography in indeterminate ways, always subject to upslope recharge conditions from precipitation events in seasons previous.

Respectfully submitted by:

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Craig Bay Estates CLC Pond Sub-Committee