Make Every Drop Count

Water Conservation Forum

Final Report on the Salt Spring Island Water Conservation Forum held on July 19, 2015

Salt Spring Island Water Council

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Executive Summary

Salt Spring Island faced an unusually severe drought in the summer of 2015. With no public education program planned, the Salt Spring Island Water Council organized a public advertising campaign called "Make Every Drop Count" and a public meeting entitled the "Water Conservation Forum". Twelve specialists volunteered their time to provide information to the public on why the drought has occurred this year and what steps to take now and in the future.

Information was presented strongly suggesting the limited resource water has become on the Island. Lake levels are low and wells began running dry.

The Forum made it clear that the Island needs to develop a new water ethic – one of conservation and planning. One model was suggested at the forum – Water Centric Planning – and a second model was developed in 2010 at the request of the Water Council by POLIS called the Soft Path Strategy for Salt Spring Island.

A variety of water conservation steps the home owner can take this summer and in the future were described are included in the text below.

Future steps the home owner can take are the installation of rain water harvesting equipment, low drip technology and drought resistant plants for the garden and installing swales, ponds or rock gardens.

Water Council was surprised to learn Salt Spring does not have a water conservation program as do Nanaimo and the Capital Regional District and many other regions of the Province.

Using Australia, California and Arizona as models, the Island building code needs to be amended to allow the safe use of grey water.

Water Council recommends the Islands Trust and the Regional Director of the Capital Regional District work to establish a comprehensive water conservation strategy for the Island with water use as the centre of future regional planning.

Four clear steps local governmental bodies can take are:

- Develop an Island wide water conservation plan outlining immediate steps and steps to be taken to make water the focus of all island planning;
- The Capital Regional district needs to develop grey water recycling guidelines and a building code setting out safe methods for grey water plumbing. If implemented throughout the Island, as much as 40% of indoor water usage could be saved;
- In addition, the CRD needs to reduce taxes on property assessments when rain water harvesting systems are installed and used. As it is now, the installation of water catchment systems are considered improvements and increase the assessed value of the property;
- The Islands Trust can do its part by requiring rain water conservation plans including rain water harvesting equipment and the appropriate use of ponds, swales and rain gardens in future development permits issued for new construction on the Island.

Without these steps and other water centric approaches, the Island will continue to face water shortages as our population grows.

Introduction

Salt Spring Island is entirely dependent on its annual rainfall to provide potable water to its residents and businesses year round. The population of the island hovers around 10,000 during much of the year, swelling to 25,000 or more during summer months. Much of the rainfall drains into the sea after each storm but the island has a number of lakes that store water for use during summer months. The lakes' watersheds vary in size and thus each lake's ability to refill during the rains of the fall and winter also varies.

Half of the islanders use groundwater as their potable water source. The aquifers on the island need to recharge each winter, or over a number of years, to provide this source of water to the island. The expected recharge rate is reflected in the community plan by establishing a minimum lot size and setbacks from septic fields.

The economy of the island depends on its summer tourist trade. This trade comes at the time of minimal precipitation on the island and is characterized by a large increase in the demand for potable water. Potable water supply planning must take these characteristics into account.

During the last few summers, Salt Spring Island appears to have been experiencing longer periods without rain. But 2015 was a shocker. From April until August only 20 mm total precipitation had occurred.

As the summer progressed and the temperature steadily rose into the low 30s ^{o}C, the province declared first a Level 3 drought, and then in June, a Level 4 drought for Vancouver and the Gulf Islands. But there was little action or information being provided to the public on the causes, the steps to mitigate a worsening situation and what steps homeowners and businesses might take to plan for the future.

Water supply crises were beginning to accumulate in the water districts around the island and individual wells began running dry much earlier in the year. North Salt Spring Waterworks District had been reporting lower lake levels on St. Mary Lake than had been seen in years and had to apply for an exceptional water withdrawal license in case the lake level fell below the allowable limit of 40 meters. Cusheon Lake levels were also much lower than in previous years. Water districts relying on wells had to institute water use restrictions.

It was against this background that the Salt Spring Island Water Council decided to organize a public forum on the current drought, its causes, mitigating steps that could be taken this summer and what homeowners needed to consider for the coming years.

The Council applied for grants to hold a three hour Water Conservation Forum. The invited speakers (Appendix A) were asked to answer questions concerning the causes for the drought, its extent, how to conserve water in the short term and what planning could be done in future years.

Funders

The forum was supported primarily by the Capital Regional District, the North Salt Spring Waterworks District, the Islands Trust and by the Water Preservation Society whose charitable tax status allowed funding to be provided by the Salt Spring Foundation. Water Council thanks each of these organizations for their support.

Structure

The Forum was designed to allow the presentation of specialist information driven by the audience's knowledge and interest expressed through questions. The discussion was broken into three distinct parts. First there was a discussion on the causes of the drought, what future summers might be like, how extensive the drought was on the British Columbia west coast and through the rest of the province and how regulations to the Water Sustainability Act might affect future drought planning.

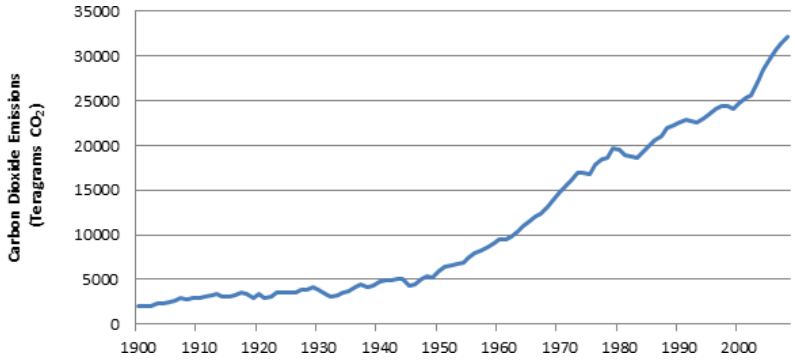
The second portion of the Forum tackled the issue of what steps island residents could take to lessen the drain of potable water on the island water resources. Many common sense ideas were presented that individuals and businesses might take.

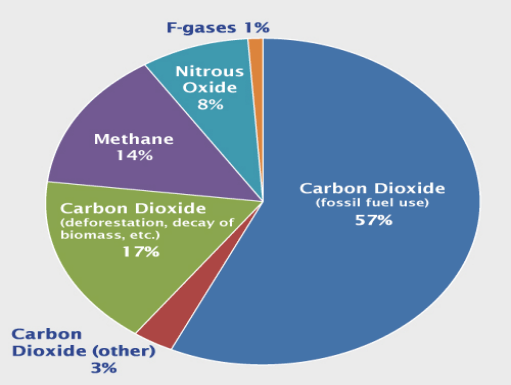
The third portion of the Forum discussed future steps to make homeowners and businesses more independent of future droughts.

Part 1: What is happening

Why the drought?

Climate change is here. 2014 was the warmest year around the globe ever recorded. It was characterized by extreme events with an overall increase in temperature. The increasing temperature is due to the accumulation of carbon dioxide in the atmosphere, which holds the heat from the sun longer than atmospheres with less carbon dioxide. The graph to the right (taken from the US EPA—http://www.epa.gov/climatechange/ghgemissions/global.html) shows the rapid rise of Greenhouse gas emissions while the next figure shows the composition of Greenhouse gases. The largest component of the emissions is carbon dioxide at 57%.



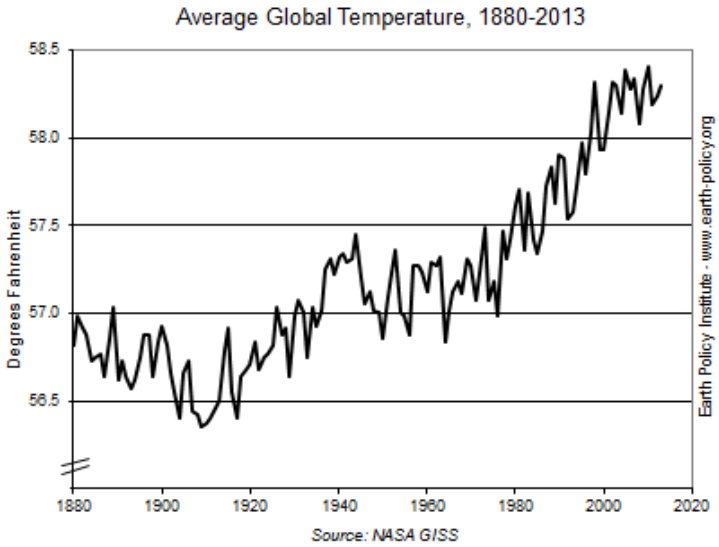


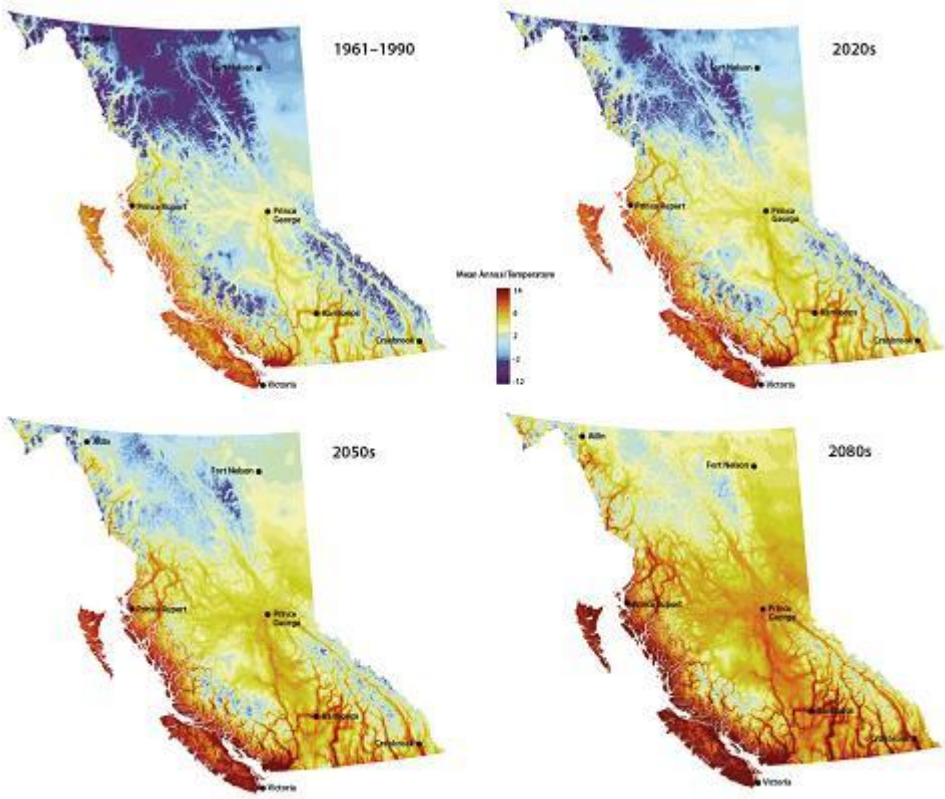
Models predict that average world temperature will increase by 3 degrees. The graph to the right shows the average global temperature over the past 133 years. The trend toward higher average temperatures around the world began in earnest in 1980.

What is happening elsewhere

The intensity of the jet stream has decreased. This enabled hurricane Sandy to remain over the East Coast much longer than expected.

This is an El Niño year. Warm water accumulates in the waters off Mexico and may bring dryer weather to the Pacific North West. In addition, a large blob of warm water has moved across the Pacific and settled off the North Pacific Coast bringing even warmer weather.





Mean annual temperature for British Columbia for 1961-1990 and that predicted for British Columbia in 2020s, 2050s, and 2080 for the A2 scenario from CGCM2

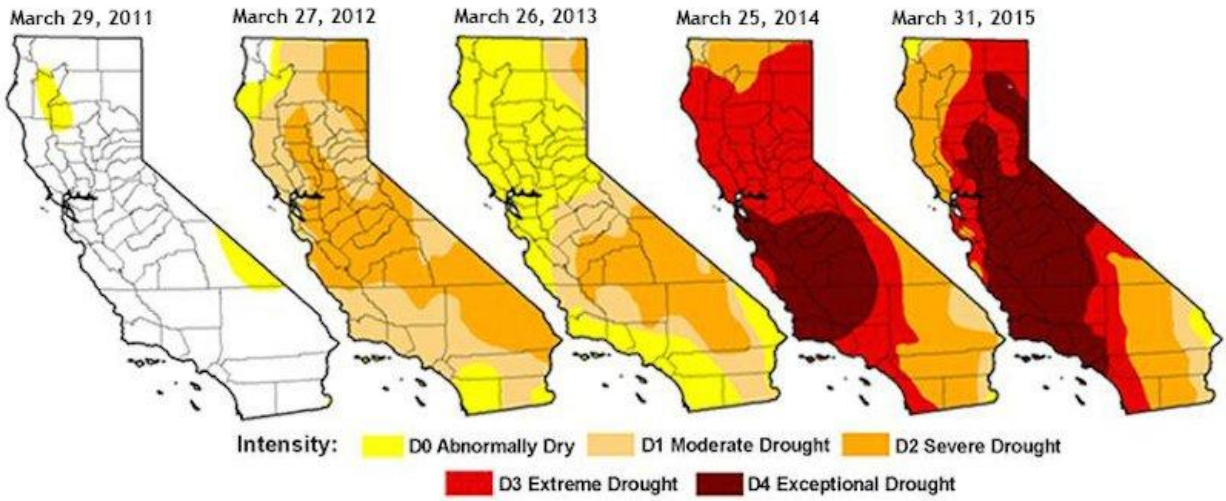
(https://www.google.ca/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0CAcQjRxqFQoTCLDdiNDFjcgCFQotiAod2wkJdg&url=https%3A%2F%2Fwww.for.gov.bc.ca%2Fhre%2Ftopics%2Fclimate.htm&psig=AFQjCNGmQ8bgf9GX33xRwbMUXCMnjzA1Ag&ust=1443110698764036)

Average precipitation for the Pacific North West in the summer months may drop by 18% to 30%. The graphic above shows the mean average change temperature expected by 2050 for B.C.
Winters are expected to be wetter while summers are expected to become drier.

The drought conditions extend from Mexico along the entire west coast including Vancouver Island. The figure shows the extent of the drought in the United States for 2015.
(http://www1.ncdc.noaa.gov/pub/data/cmb/sotc/drought/2015/02/20150303_usdm.png)

Washington State has declared it is in the midst of a Level 4 drought.

But it is California that is undergoing one of the worst droughts since the 1930s. The drought began four years ago and has steadily increased in intensity as can be seen below
(http://www.businessinsider.com/californias-drought-situation-is-worse-than-ever-2015-4).

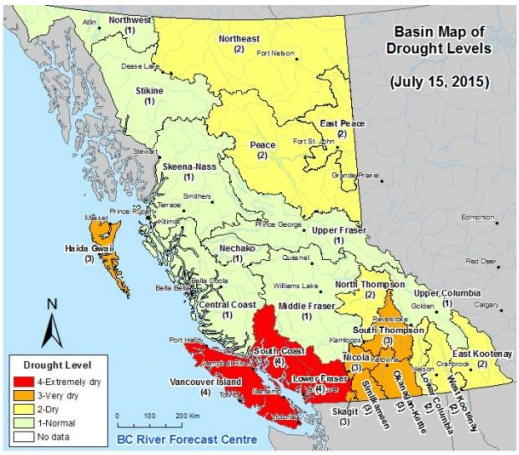


And the reservoirs are in all cases less than 50% of their capacity. (http://scienceblogs.com/significantfigures/index.php/2015/01/13/the-state-of-the-california-drought-still-very-bad/)

The El Niño effect is expected to be one of the largest ever recorded and is expected to carry over to the summer of 2016. This might mean that next spring and summer could be similar to this year's.

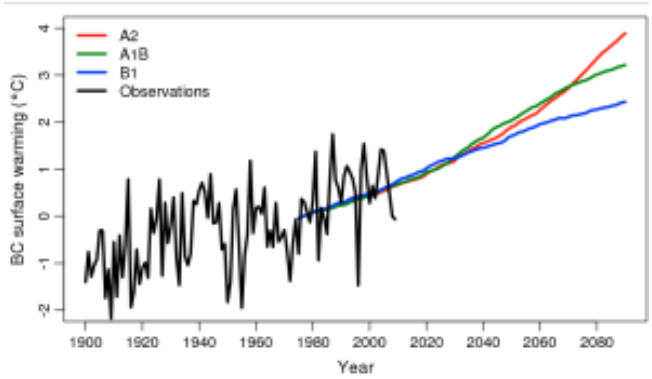
In British Columbia

The drought along the west coast extends into British Columbia. Vancouver Island, the Gulf Islands, the South Coast and the Lower Fraser Valley have been declared to be in Stage 4 Drought Conditions. The province has issued low stream flow advisory on Vancouver Island and water restrictions have been implemented in many cities/municipalities.

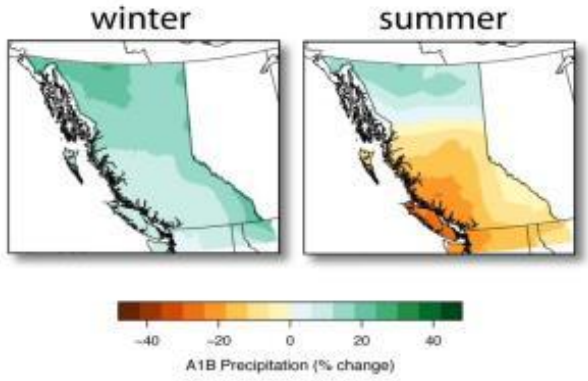


The map to the right shows the B.C. drought levels in various parts of the province for July 2015.

While the graph below shows B.C.'s surface temperatures for the past 120 years with projections into the future. The four projections are the result of computer modeling with different scientifically based assumptions. As is apparent, temperatures are expected to continue to rise.



And the following graphic shows the expected precipitation changes B.C. will face in the future. The winters become wetter all over the province while the summers become drier particularly along the south coast.



Local Situation

All of this is affecting Salt Spring Island. The predicted changes are that average rainfall will be the same however our springs and summers will be dryer and most of our rains will occur in the fall. Extreme weather events such as high temperatures and heavy rains that in the past have occurred every 25 years are expected to occur three times more frequently.

The rainfall this summer is 85% below normal. This leaves our lakes without the replenishing rains we have all come to expect (even if we grouse about them). Not only does water usage increase during non-rainy periods due to our desire to keep our plants alive and beautiful, but the warm sunny days increase the amount of evaporation from the lakes and transpiration from the trees.

Plants carry large amounts of water from their roots through their stems or trunks and into the atmosphere through the leaves. In the summer, one mature pine tree needs about 20-40 litres of water per day! This water is taken up from the ground and then transpired (released into the air). http://www.livingwatersmart.ca/didyouknow.html)

In General

Salt Spring Island is unique when it comes to its water dynamics. It has been likened to a wooden bowl floating in the ocean. It can only hold so much rainwater until it overflows. Once the island lakes are full, additional rain runs into the ocean.

Taking the analogy one step further, the water that soaks into the wooden bowl is similar to our groundwater. Water is stored in the wooden fibres of the bowl and in the soil, fissures and cracks of the bedrock for the island. Getting the water out of the wood is just as problematic as getting water out of the ground.

And just like a bowl, the deeper a well is drilled, the more likely it is that the well will drill through the island's fresh water stores and run into the salt water below the island. It is for this reason that drilling wells on the island is not the solution to water shortages.

Salt Spring Island has around 10,000 permanent residents. Nearly 50% of Salt Springers get their potable water from wells. The other half of the population relies on water systems to deliver their drinking water.

In good economic years the population of the island can triple during the summer. It is the summer that provides many islanders with much of their income for the year. Bed and breakfasts, restaurants, local farmers and artists depend on the tourist trade. And, of course, sunny dry weather is more attractive to tourists—and the more of it the better.

In addition, summers are what gardeners wait for. Sunny days bring forth colourful blooms and good crops of vegetables. With the push around the world to grow more food locally, agricultural activity on the island will likely increase.

However, if there is a drought, water for these activities can become scarce.

North Salt Spring Waterworks District

North Salt Spring Waterworks District (NSSWD) is the largest improvement district on the island with 1,721 connections (the equivalent of serving 2,553 dwelling units or 5,500 individuals). These include residences and the business community of Ganges. NSSWD uses two lakes to supply potable water to its ratepayers. St. Mary Lake is the largest lake on the island, but has a small watershed. If the lake were emptied, 14 years of average rainfall would be required to refill the lake. The watershed contains resorts, residences and farms.

Maxwell Lake is the second largest water source for the island. It is the only lake on the West side of the island, has the highest elevation and lies in a watershed with little development.

Looking ahead and being concerned about providing adequate potable water to its ratepayers, NSSWD commissioned a hydrology report for both lakes. The St. Mary Lake report concluded the lake has been fully allocated and that no new connections can be made unless storage is increased. With rainfall this year at 13.5% of normal, the danger of the lake not refilling fully during the winter must be considered and planned for. In addition, the province requires a minimum flow of water out of the lake so that the fish are not in danger of dying and habitat is no damaged.

The NSSWD hydrology reports examine the 1 in 10 year return period drought condition; however, as the climate changes and our total average rainfall as well as the timing and intensity of rainfall changes, the volume of rainfall that constitutes a 1 in 10 year drought may change as well. Timing of rainfall is critical. If most of the annual rain arrives in February when the lake is already full and overflowing, it can't be stored. The duration of the summer drought period determines how low the lake will be drawn down. The solution to these problems is to create more storage to get us through the drought period even during a 1 in 100 year drought or worse.

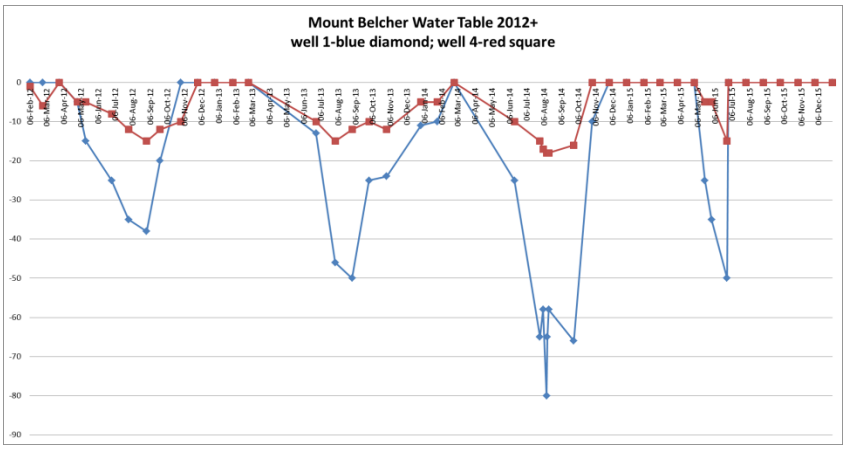
In the longer term, this can be accomplished by increasing the height of the Duck Creek weir (small local dam) to enable the lake to hold more water. Given the small size of the watershed and the possible variable rainfall, the lake could take more than one year to fill to the higher level once construction is complete.

The conclusion is that in all circumstances, conservation measures need to be the order of the day.

The situation on Maxwell Lake has improved through the reduction of losses by 21%.

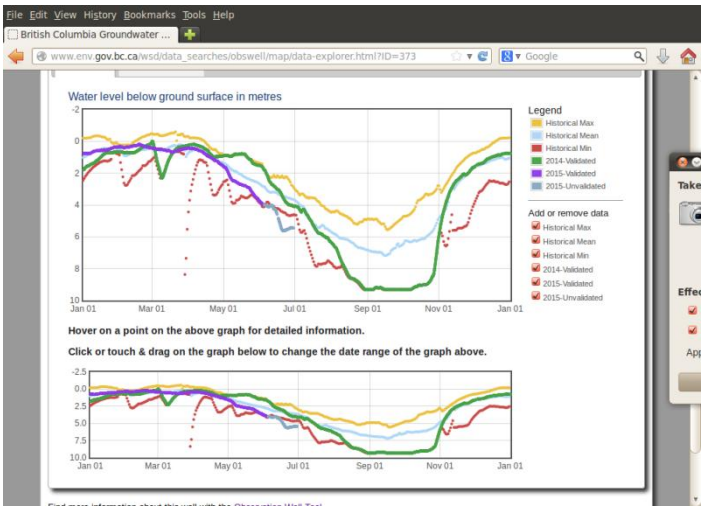
Groundwater

The status of the island's groundwater is much harder to assess. Two of the island improvement districts use groundwater as the source of their potable water. Mt. Belcher has provided the following record of water table for the past three years.



The graph shows the dramatic drop in the water table during the late summer months.

A second reference for the condition of groundwater is the record kept by the provincial government in its island observation wells.



The green line showing water the table level for 2014 was far below the historical mean shown in blue. Alarmingly, the 2015 purple plot is substantially below the 2014 levels as far as June, the last data point.

At the surface, plants withdraw a significant amount of water through the process of transpiration. Water from the ground flows through the roots, the stem or trunk and into the leaves or needles. The plants need this water to live. However, in the process they quickly draw off the surface water. Although water at deeper levels is not affected by this process, the surface layers dry out due substantially to this process.

Groundwater is unpredictable because it depends on so many variables. The soil, the types of rock and its fracture pattern are invisible and change in every direction: up, down and sideways. In addition storage depends on the height of the rock above other local features and the drainage patterns above and around. Rock close to a lake is more likely to contain water than the same type of rock at the same altitude on the other side of the hill. Some rock above what could be an aquifer can form a barrier preventing penetration of the water to lower levels. Yet the water may come in sideways from another feature. (See appendix F)

Forest Fire Danger

In an extreme drought year the possibility of forest fires increase dramatically. As outlined above, the process of transpiration dries out the ground and the trees and other plants as well. These tinder dry conditions can have a substantial impact on potable water.

First, water from the local lakes will probably be used to fight the fire. Fire trucks will refill their tanks wherever they can do so safely and helicopters will fill their buckets from the nearest water sources. Fresh water is preferable to salt water since salt water can contaminate the ground for future growth.

Second, the forest destroyed by fire has entirely different physical and chemical properties. Rain is more likely to run off the ground and not be absorbed, and the chemicals in the water can contaminate a lake changing the biology of the lake substantially.

And third, forest regrowth can be substantially delayed if salt water is used to fight the fire. Rains would need to dilute the salt concentrations before many plants would be able to germinate.

When it comes to fighting a fire all measures are used and control may be taken away from local authorities. Decisions on what water is used to fight the fire may be made by government personnel not knowledgeable about the precarious water situation on the island. Their first priority will be saving lives and preventing the fire from spreading.

Given the truth of this situation every islander is advised to watch the horizon and discover a fire before it grows out of control.

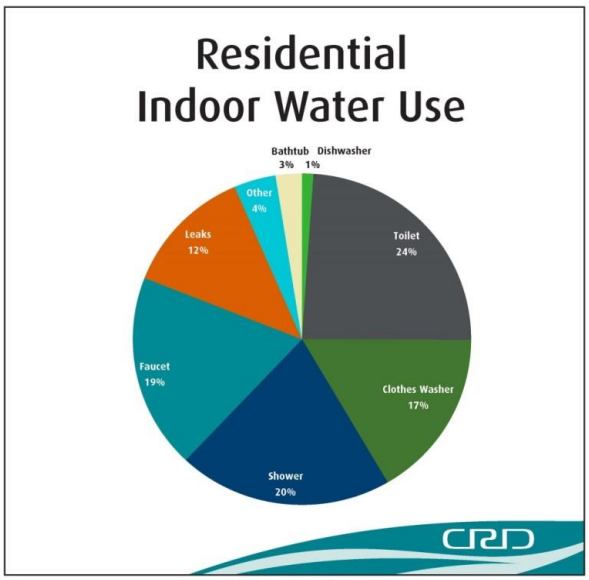
Part 2: What Steps Need to be Taken This Year

So, in July, we were experiencing a drought. At the time of the Water Conservation Forum, the island had not received any substantial rainfall in three months. The lakes were getting low and water conservation steps were being implemented by the various water districts.

What steps would the various sections of Salt Spring need to take if the drought were to continue for the rest of the summer? Below are suggestions broken down into domestic users, businesses and farms.

Household conservation: Reduce domestic uses (toilets, taps, outdoor)

Keep in mind while reading the steps below that about 3% of all treated drinking water is actually consumed as a beverage. We need about 1.5 litres per day to sustain life, but consume hundreds of litres.



The figure to the right shows residential water usage in the Capital Regional District (CRD).

To see if your home on Salt Spring uses water the same way as a Southern Vancouver Island home, the homeowner can develop a water budget (how to make one is described in Appendix D). Depending on the thoroughness of the budget, water usage could be examined by water outlet (tap, shower, etc.), activity (dishwashing, bath or shower, hand washing, garden vegetables or flowers) and user (mother, father, child). The user category is the most sensitive because it usually relates to personal hygiene.

Inside

Suggestions for water conservation inside the house include:

- Reduce domestic uses overall by being conscious of the amount of water being used (toilets, taps, outdoor).
- The yellow mellow rule cuts down significantly on the number of times the toilet is flushed, but is not pleasant and is hard to live with.
- Composting toilets, of course, cut out all toilet water and if installed and maintained properly do not smell. But this, understandably, is more than most of us want to do.
- Install low flush/flow water appliances. Low flush toilets can save up to half the water each time the toilet is used. Toilets are one of the main users of water in the home. Front loading washers use less than half of the water of top loading washers.

- It is normal for most people to turn a tap on while performing some activity at a sink and let it run. Turning off the tap while brushing teeth, washing hands and between rinses of dishes if they are being washed by hand will cut down on unnecessary water going down the drain.
- Water run to get a hot shower can be saved in a bucket and used in any way clean water can be used. It can be used in the garden, to rinse dishes, or to flush the toilet. Set a timer for your shower to remind you when your time is up.
- Less frequent and shorter showers save water. While showering, the water can be turned off while soaping. Between showers, sponge baths can be taken. Since baths use so much water it is best to have NO tub baths.
- Check your appliances for leaks. 20% of toilets and taps have been found to be leaking. Running toilets or taps can allow a lot of water to escape. A single drop per second adds up to 25 litres a day. In two weeks the dripping could fill a bathtub. And toilets run faster than a single drop at the sink.
- When doing the laundry or dishes, fill the appliance to capacity.
- Don't wash the car. It was suggested at the Forum that a prize for the dirtiest car be awarded at the end of the dry period. To everyone's great relief, the rains of early September made this impossible;
- If washing dishes by hand, use a small tub that can be lifted out when finished and the soapy water used for plants. Be sure the dishwashing soap is biodegradable.

We, in our modern world, are water hogs using far more water than we need. And water use is increasing as we increase the number of bathrooms in the house, buy more cars that need washing, and increase the size of our gardens.

You can live easily live on 75 litres/day/person for all your domestic needs.

Outside

Outside water use is the largest single drain on the water budget. Aside from washing our cars, outside watering is mainly for gardens and lawns. Efficient outside watering is important. A great deal of water goes up in evaporation. A sprinkler shoots water into the air and, depending on the temperature, some of it evaporates. When the water does hit the ground, more of it evaporates before it soaks into the ground.

Below are suggestions for outdoor water use:

- Plant drought resistant flowers and vegetables;
- Use drip technology whenever possible. These systems water a specific plant right at the stem drip by drip so the water soaks into the root structure.
- Water in the cool of the day out of the sun. Late evening watering cuts down on evaporation and allows the plants to rehydrate during the night. Early morning watering takes place at the coolest time of the day so evaporation is minimized.
- If you don't have a drip technology watering system, then watering by hand ensures you know how long the watering takes place. One of the biggest water wasters is turning on a watering system and forgetting about it. A water timer on a drip irrigation system is the most efficient and easiest to operate.
- Mulch on a garden cuts down on the evaporation during the day.

- Don't water your lawn. Lawns grow back when the rains come and, besides, your neighbours can see you are not interested in saving water.
- Although it may seem to be a perfect time to use the pressure washer on the driveway, the deck or the house siding, these functions can be performed after the rains begin.

If most of these steps are followed, the average household can save as much as 50% of its normal water usage.

Businesses

On Salt Spring, most businesses make their greatest returns during the summer. This is when the tourists are in town wanting to drive away their cares and responsibilities and let it all hang out. Businesses, of course, want to cater to these indulgences. But a severe drought, as we were in at the time of the Forum, requires everyone's cooperation.

Restaurants

- Let customers know about the drought (it has been announced on the ferry when the tourists travel to the island) and enlist their support by asking them to save water by asking for a glass of water rather than putting it in front of them.
- Stack the dishwasher FULL, FULL, FULL so not a spot is empty.
- Use water for vegetable washing a second or third time.

B & Bs, Resorts and Hotels

- As with restaurants, enlist the visitor through signage or a brief friendly talk as they register. A pitcher of cool water in their room can remind them to limit running water for a cool drink.
- Ask them to request a change in linen only when it is needed and not daily.
- A sign in the shower can urge them to shorten their showers and to turn the water off while soaping. (My grandson wanted to take three showers a day while on Salt Spring thinking everywhere in the world was no different from his home.)

Farms

As Salt Spring raises more and more of its own food, the amount of water used in agriculture will increase. California has found that 70% of the water (85% in the Midwest) used in the state is for agriculture.

Watering farm crops can be expensive. So the best strategy is to capture the rain when it falls and keep it in the ground. Oregon State recommends using the tractor in the fields as little as possible to keep soil loose and able to absorb water. They suggest using a no-till system of planting. This technology plants seeds and plants directly through the debris left from the previous year's crop. The debris not only shades the plants but supplies nutrients (depending on last year's crop) and prevents water evaporation. It cuts down on the tractor compaction of the soil and lowers the tractor fuel bill.

Cover crops are planted after the main crop is harvested. Rye grass, cereal rye, sunn hemp and vetch have been effective in breaking up the soil and providing ground cover for the following year's planting. The additional biological material and the water retention encourage worms which fertilize the soil and keep it porous.

If the crops need watering during the dry summer months, early morning or night watering close to the ground is more efficient than day watering. Row watering every other row has been found to be almost as effective as watering between every row of corps. Again night watering with a timer or meter lowers the evaporation and the chances of over watering.

For more information refer to Appendix D.

North Salt Spring Waterworks District (NSSWD)

North Salt Spring Waterworks District is licensed by the province to use only the top 70 cm of the water in the lake. The province requires a constant flow down Duck Creek for conservation of fish populations. This flow must be included in NSSWD plans.

NSSWD is the primary supplier of potable water on the island. They monitor St. Mary Lake regularly in a variety of ways and have done so for many years. In particular they have records of rainfall and the water level in the lake.

With these records and the expertise of their consultant, the NSSWD has established a sustainable water management plan.

The elements of the NSSWD Sustainable Water Management Plan are:

- Limit new demand until the weir is raised. This, in simple language, means no new water connections will be made until the level of St. Mary Lake is raised by the installation of the weir, at which time the situation will be reassessed.
- NSSWD will perform additional monitoring to follow groundwater changes around the lake. Monitoring groundwater levels can provide information on the inflow or outflow seepage into the lake. If groundwater levels are lower than the lake level, water will flow out of the lake and if groundwater levels are higher than the lake, groundwater will flow into the lake and will help maintain water levels in the lake.
- Reducing system losses is an ongoing campaign at NSSWD. They have found and eliminated many losses in the past few years and are on the hunt for others. Losses in the Maxwell Lake system have been reduced by 21%.
- Reducing demand is key to providing potable water to their ratepayers. The NSSWD has begun an “every drop counts” public information campaign. As a result of this campaign the local newspaper, *The Driftwood,* reported water demand dropped in the North Salt Spring service area by 32% on the traditionally highest demand day.
- Conservation-oriented pricing is a multi-level rate structure that charges a higher rate for higher water usage. It is a well-known fact that the single most effective method of motivating water conservation is the introduction of a block price structure. Such a structure increases unit prices for water uses above specifically defined levels. Economists have long advocated the "polluter pays" principle—the idea that the polluter or consumer should pay for any environmental damage or resource depletion created. (US EPA) Block structured rates implements this concept. In 1994, Canadian households paying for water by volume used **263 litres per person per day compared to the 450 litres per person per day** used in households paying a flat rate — a 39% savings (http://www.canadiangeographic.ca/magazine/mj00/water_use.asp).

- Water Restriction Bylaw 268 outlines the water usage practices for each level of drought. (Provincial descriptions of these levels are contained in Appendix C1.)
- End bulk water sales. This practice allowed individuals to purchase bulk water at very low rates and became a large drain on the lake water supply during the summer.

For more information on the NSSWD Water Management Plan see:
http://www.northsaltspringwaterworks.ca/wordpress_water/wp-content/uploads/2015/06/Managing-for-a-Sustainable-Water-Supply-June-2015.pdf

Capital Regional District Water Conservation Program

The Capital Regional District (CRD) has developed a long range *Strategic Plan for the Greater Victoria Water Supply System*. This plan has three different planning horizons:

1. Actions required over the next decade in support of identified priorities.
2. Challenges and opportunities facing the Water Supply System over the coming two decades.
3. A target of deferring the expansion of the water supply for at least 50 years.

Although the plan (three volumes) covers many aspects of water supply, water conservation is one of the topics receiving a great deal of attention over the past few years. The program includes advertising, education, a rate structure and other steps. Implementation of this plan has reduced water consumption by 15% over the past 10 years despite of a population increase of 40,000 people.

Why conserve water

Water conservation has many benefits not usually thought of. Some of these are listed below:

1. Prolongs the Lifespan of Existing Supply: when aquifers and reservoirs are depleted, recharge and refill can take years depending on the amount of depletion.
2. Defers Costly Infrastructure Expansion: more water is available through conservation for new residents and businesses.
3. Defence Against Drought: lowering lake and aquifer water levels lowers the water table, thus drying out the watersheds, accelerating defoliation and the ability of the watershed to store rainwater.
4. Lowers Water System Operating and Maintenance Costs: water conservation requires less pumping, less water purification and fewer repairs of these systems.
5. Contributes to High Water Quality: low reservoir levels encourage algal growth and turbidity, both requiring increased water treatment.
6. Reduces Energy Use, Carbon Footprint & Climate Change Impacts: if the energy required for pumping, treatment and maintenance are reduced, the carbon footprint of the system is reduced. In addition healthy aquatic and watershed systems encourage growth and not decay, thus sequestering carbon instead of releasing it through decay.
7. Fosters Good Customer Relations for the water supply organizations and local government.

Part 3: Preparing for the future

New water ethic

First and foremost, we islanders need to embrace a new water ethic.

A water ethic is essentially the way we look at and use water. Currently we take water for granted. It has been cheap and plentiful in the past and it is hard to imagine a future of shortage. We need only to look at our daily use to observe how we take water for granted—the average B.C. resident uses 353 litres per day while the average Canadian uses 25% less than a B.C. resident. Yet we can live comfortably on 75 litres a day and survive on 1.5 litres. And, unfortunately, there is no substitute for water.

> ***Canadian households use twice as much water*** *as European ones and pay less than half as much for it.*
>
> –Environment Canada

Although we love (and curse the long cloudy, rainy days) living in a rain forest, we can no longer count on summer rains to relieve a drought. Winter rains may come in torrents rather than a drizzle. We need to adjust to these new realities and plan for the future in case it is dry and hot.

Two proposed approaches re-envisioning water's place in our lives

The first approach suggested by POLIS is that Salt Spring Island decides to **Preserve Water for the Next Generation**. This ethic asks us to consider what water we actually need, not what is convenient for today. It calls on us to think about how our water use now will affect the next generation. It falls in line with the Climate Change ethic of thinking about the legacy we will be leaving our children.

POLIS soft path summary

In 2010 Water Council asked POLIS if they would review Salt Spring Island's water supply and demand situation and make recommendations for the island's future. The report entitled **A Soft Path Strategy for Salt Spring Island, B.C.: A Soft Path for Water Case Study** outlined the suggestions made by Carol Maas and Susanne Porter-Bopp. A summary of the report follows:

A Sustainable Future for Salt Spring Island

A commitment to "preserve water for the next generation"—meaning that all new demands for water will be met through conservation and efficiency rather than expanding supply, would be a significant step toward water sustainability and sustainable water leadership on Salt Spring.

Aiming for water neutrality on Salt Spring would mean mandating the highest level of water efficient fixtures and appliances in all new construction, use of alternative sources of water (e.g. rainwater capture and recycled water) for toilet flushing and landscape management, the use of off-site recycled water where available, conservation-based pricing for the residential and industrial, commercial and institutional (ICI) sectors drawing water from centralized systems, and a progressive programme that targets reductions in residential outdoor water use and in the agricultural sector.

Based on population projections, three scenarios for future water use were calculated:

1. Business as Usual
2. No New Water Until 2026
3. 20% Reduction of 2006 Levels

The No New Water Until 2026

scenario targets average day reductions from **Business As Usual** of approximately 30% by 2026. The **No New Water Until 2026** scenario should be considered readily achievable provided funds and personnel are directed to the program.

The 20% Reduction of 2006 Levels

scenario explores a commitment to securing the water necessary for a thriving community through conservation efforts. A 41% reduction in annual average daily water use over 20 years would be required to meet this target while providing services for the increasing population.

For both of these scenarios, short-term strategies include expanding the prohibited uses of water, enforcing prohibited uses of water, extending outreach efforts, and encouraging regional conservation measures. Long-term strategies include increasing water conservation through reduction of outdoor water use and new technology, maximizing water recycling, and enhancing storm water capture.

All too often, contemporary water efficiency efforts are viewed as ad hoc measures aimed at buying time until new supplies can be secured and developed. The soft path differs fundamentally from these efforts by directing planners to look beyond programs aimed at simply using water in more efficient ways. Instead the soft path tackles broad questions— asking not only how to use water more efficiently, but, in some cases, why use water at all? This shifts the objective of water management from expanding and maintaining water supply infrastructure to providing water-related services, such as new forms of sanitation, drought resistant landscapes, rain-fed ways to grow certain crops, or even influencing what crops are grown in the first place.

Choosing a New Path Forward

This analysis demonstrates that it is not difficult to envision a better water future for Salt Spring Island—one that is sustainable yet permits some development and agreeable lifestyles for residents and local businesses. However, conservation does not just happen. It will take concerted action and political leadership for Salt Spring Island to move to a sustainable use of fresh water. As this strategy illustrates, this action does not require immediate radical change, but it does require new thinking on getting an early start on implementing a step-by-step process that will, over the next 20 to 30 years, change the way water is managed and consumed on Salt Spring Island.

(See the Soft Path Document on the Salt spring island Water council web site http://ssiwatercouncil.com/wp-content/uploads/2011/05/POLIS-Soft-Path-Strategy.-Final.2010.pdf)

Water centric planning

The second approach actually expands on the POLIS Soft Path approach by making water use and conservation as the primary principle to be considered in rural or urban planning.

Water centric planning is endorsed by the Ministry of Environment: “One approach is to Water-centric planning (which) means planning with a view to water—whether for a single site or the entire province.

At the core of water-centric planning is a water balance way-of-thinking and acting. The underpinning premise is that resource, land use and community design decisions will be made with an eye towards their potential impact on the watershed," Executive Director of the Partnership for Water Sustainability in British Columbia.

"A water-centric approach puts water stewardship and sustainability front and centre on the agenda of comprehensive land use, development, or resource planning initiatives. Water-centric planning considers the amount of water available, the amount of water needed, innovative efficiency strategies, the quality of water leaving an area, how rain and snow water are managed, and the impact on the natural environment," continues Erik Karlsen, a member of the team that created the Water Sustainability Action Plan for British Columbia in 2003. Erik Karlsen was Chair of the Agricultural Land Commission from 2005 through 2010 (http://waterbucket.ca/wcp/2012/07/07/water-centric-planning-community-of-interest/).

Water centric planning would include planning for our environment, particularly our forests. The natural setting and the beautiful ecosystems on Salt Spring are what draws our tourists and a strong reason many of us to live here.

We need to plan for the needs of our forests.

Learn from Arizona, California and Australia

In its publication *California's Oranges, B.C.'s Apples*, the Polis Project emphasizes the lessons B.C. can learn from the California experience. It focuses primarily on proposed legislation in the form of the B.C. Water Sustainability Act and does not make practical recommendations for the homeowner or business.

However, the recommendation to look elsewhere for suggestions and solutions needs to be taken to heart. Australia, California and Arizona have endured lengthy water shortages and have developed extensive water conservation plans. Each of these areas recommend, among other things, that we match water quality with water use (grey water for toilets, etc.), that rainwater catchment be used and encouraged, to catch roof and lawn runoff and that water use be monitored.

Grey water

When water was plentiful during the summer, pouring grey water down the drain was wasteful but was the simplest, safest way of disposing of possibly contaminated water. Now, however, this practice is clearly wasteful and if handled correctly could take a large burden off our potable water purification and delivery systems.

Grey water is plentiful but carries the real possibility of disease. For this reason, reusing grey water needs to be done with care. Island Health (formerly VIHA) has very real concerns about reusing grey water. But Australia and California have been successful in developing grey water systems and codes.

Grey water in Australia is handled in two different streams. Laundry, bath and shower water, bathroom sinks and laundry tubs are all sources of grey water. Kitchen sink and dishwasher water with their food particles, fats and harsh detergents must be treated before being used in a grey water system.

(http://www.savewater.com.au/how-to-save-water/in-the-home/greysmart/greywater-technology/greywater-treatment-systems).

The manual entitled *Code of Practice for the Reuse of Greywater in Western Australia* is an excellent primer discussing short and long term consequences, theory of greywater treatment, treatment systems and installation codes and practices. (http://www.public.health.wa.gov.au/cproot/1340/2/COP%20Greywater%20Reuse%202010_v2_130103.pdf)

The CRD in its 2012 revision of its *Strategic Plan For The Greater Victoria Water Supply System* concluded: "Although the re-use of grey water was found to be uneconomic and technically complex with the current technologies, the plan recommended seeking opportunities to facilitate the use of grey water in both the residential and institutional, commercial and industrial (ICI) sectors when the technology becomes more user-friendly, reliable and cost effective."

From the foregoing it is clear that grey water, even though abundant is a long term solution requiring research and public education. However, with the lessons of the drought of 2015, work on grey water systems for the island needs to begin.

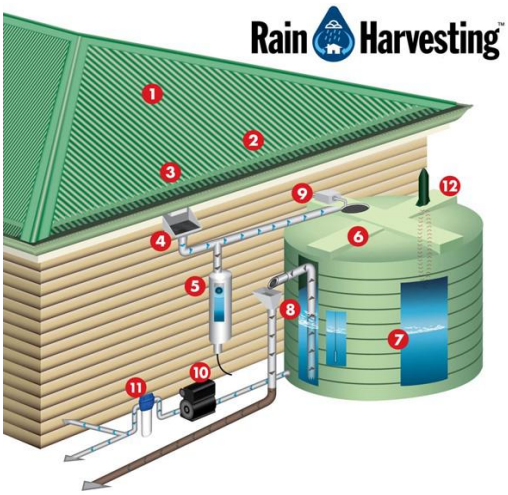
Rainwater harvesting

Rainwater harvesting is much simpler than grey water. Although usually thought of as collecting rainwater off roofs, there is a second less obvious rainwater harvesting method. And it is simply catching runoff before it leaves a property.

But first, harvesting rainwater from roofs:

The concept is simple. Collect rainwater off the roof and store it until needed. In principle rainwater from any roof can be collected and used later. But different roof types have runoff with different contaminates. Metal roofs provide the cleanest runoff while old cedar shake roof runoff is filled with biological contaminates.

If rainwater is stored for a long period of time, bacteria are likely to multiply and the storage tank may develop an algal bloom. The safest way to store rainwater collected from the roof is to filter out or kill all of the biological elements in the rainwater before it is placed in a storage tank and then to keep all light away from the water. There are simple and expensive methods of cleaning the water and can be either chemically or mechanically based or a combination of both.



The equipment for roof rainwater harvesting is conceptually straight forward. After the water is collected, it is cleaned and pumped to a storage tank.

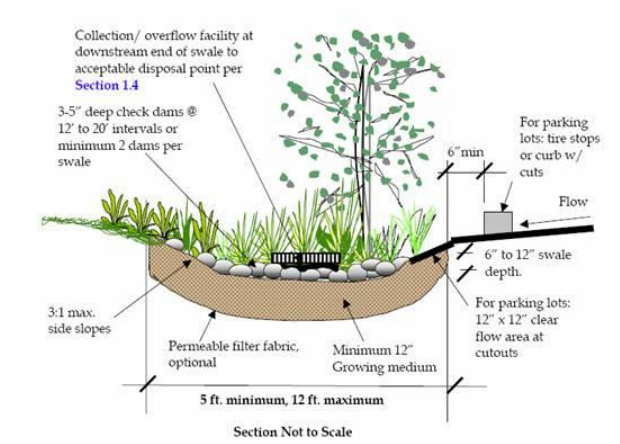
A full diagram of the equipment shown above is described more thoroughly in the Water Council report *Rainwater Harvesting Workshop* May 25, 2013 (http://ssiwatercouncil.com/wp-content/uploads/2013/11/WCSoc-Rainwater-Workshop-Final-Report-June-4-2013.pdf).

Although the diagram shows the storage tank placed next to the house, an alternative is to locate the tank on a hill above the garden so that the water can flow down to the garden and the only pump needed is to pump the collected rain water into the tank..

Swales, rain gardens and ponds

The second type of rainwater harvesting is catching rainwater before it leaves a property as runoff. Ponds, swales and rain gardens perform this function and allow the water to soak into the ground.

Ponds can be ornamental or used for water storage. Ornamental ponds are usually lined to keep the water from soaking into the ground. Unlined ponds allow the water to soak into the ground and to build the water table necessary for aquifer recharge.



A swale (right) is a hollow or trench dug in the earth and filled with rock or some permeable environmentally friendly substance. One can think of it as an unlined pond filled with soil and rock. And a rock garden is a swale planted with a variety of decorative plants.

With well recharge being so important on Salt Spring, every drop of rain caught and encouraged to soak into the ground adds to the probability that an aquifer may be recharged. These improvements also prevent heavy runoff into our lakes. Heavy runoff causes erosion and the phosphorus carried into the lakes with it can cause algal blooms.

A primary source of runoff comes from the ditch and culvert system around our roads. Main Roads needs to be recognized and thanked for not clearing the ditches along roads close to our lakes. The grasses in the ditches slow the runoff and clean the water.

One hopes sometime in the near future the road system will include swales wherever water flows in bulk under a road and into a lake.

Looking Forward

Analysis

Salt Spring was lucky this year. From April until the first week of September, the island had around two inches of rain (September 2015 Fernwood School: http://www.victoriaweather.ca/station.php?id=119). The rains of the first week of September saved the island from a water crisis no one had expected or planned for. Even though the Capital Regional District has developed a comprehensive water

management plan and it has been in place since 1999 and updated as recently as 2012, this plan has not been used on Salt Spring.

With the summer of 2015 in the record books, it is time to plan for the future. It is clear that the island has a limited supply of water. The wooden bowl theory shows that the island must live within the water left on the island after the winter rains. Our lakes have a limited capacity and the quantity of groundwater is also limited.

Groundwater is not a solution

As the future alternate supply of potable water is a limited answer at best. Groundwater recharge depends partly on saturated soil sitting for weeks to allow infiltration in the earth. If our rain events—as are predicted—take place as intense storms, the rain will run off before being absorbed into the earth. Groundwater withdrawals need to be handled in a sustainable manner. Appendix K outlines the recommendations for sustainable groundwater action resulting from the SSI Water council workshop on groundwater.

The NSSWD is or has developed a water management plan for St. Mary and Maxwell Lakes and the ratepayers they supply. This plan is designed to handle 1 in 10 year droughts, but will need a few years to be fully implemented. The Salt Spring Island Water Protection Authority is about to release its St. Mary Lake Management Plan.

No other improvement districts (water districts) have demonstrated they have comprehensive water conservation plans even though they are under the wing of the CRD.

With the new normal of longer, dryer summers and wetter more intense storm focused winters, the island cannot thrive without a water conservation plan.

We need to respect and care for our watersheds and the forests growing in them. If you walked through a natural forest this summer in the middle of the drought, it is impossible not to notice how cool the air is and how green the ground cover. The forest canopy shelters the earth under it and reduces evaporation. As the forest is cut, the ground dries out and the ferns begin to die.

As a community we need to set a goal of reducing our water usage by some agreed upon goal—say 20%. How much water we can conserve is only limited by our imagination and creativity. We can choose either Business as Usual, No New Water Until 2026 or a 20% Reduction of 2006 Levels. The success of our choice will depend a greatly on the planning model we use. A water centric model puts water usage at the centre of all of our decisions.

How much water we can conserve is only limited by our imagination and creativity.

Conclusion

Water is essential for life. We need it, our gardens need it, as do our forests.

Climate change has shown us its future face in the form of a major drought only relieved after 4 months of no rain. We need to re-examine our understanding and use of water in our daily lives. We need a new water ethic, one that focuses our efforts on conservation of our existing limited water resources and one that enables reuse of waste water.

The St. Mary and Maxwell Lake Hydrology Reports and the moratorium placed on new connections by the NSSWD is a warning that the island is reaching the limit of summer potable water supply. Even with the installation of the weir, only so much growth can occur before the limit of our lake resource is reached.

Water Council learned with some dismay that Salt Spring Island does not have an island wide water conservation plan. Water Council calls on our local government bodies to develop a water centric plan for the island—one that places the environment and the next generation at the centre of such a plan.

Four clear steps local governmental bodies can take are:

- Develop an Island wide water conservation plan outlining immediate steps and steps to be taken to make water the focus of all island planning;
- The Capital Regional district needs to develop grey water recycling guidelines and a building code setting out safe methods for grey water plumbing. If implemented throughout the Island, as much as 40% of indoor water usage could be saved;
- In addition, the CRD needs to reduce taxes on property assessments when rain water harvesting systems are installed and used. As it is now, the installation of water catchment systems are considered improvements and increase the assessed value of the property;
- The Islands Trust can do its part by requiring rain water conservation plans including rain water harvesting equipment and the appropriate use of ponds, swales and rain gardens in future development permits issued for new construction on the Island.

Without these steps and other water centric approaches, the Island will continue to face water shortages as our population grows.

Appendix A: Water Conservation Forum Panel Biographies

Chief Tom Bremner joined the fire service in 1976 as a Volunteer Firefighter, remaining a volunteer until 1988. In 1999 he joined the career Fire Service, where he still remains today, while never forgetting his foundational roots. In 1995 he became Chief of Chester Fire Dept.; in 1999 he became the First Career Chief of the Amherst Fire Dept.; in 2005 became the First Career Chief for the Truro Fire Service; and in Sept. 2009 became the Chief of the Salt Spring Island Fire Rescue, B.C. He has served on various Provincial Committees including the Zone One Fire Chief Association where he served as a director. He completed courses in Administration and Leadership at Dalhousie University. Tom is proud to have received numerous awards including the Queen Elizabeth II Diamond Jubilee Medal. He is married with four children.

Sharon Bywater has lived on Salt Spring for 21 years. During her years on SSI she has put her energy as a volunteer into a broad range of projects and issues. Living the life of conservationist, water quality, supply and the impacts of the environment became particular area of interest. In 2004 she became a commissioner for the CRD Highland Water District and continues in that role. As a commissioner she has learned a lot about St. Mary Lake as an ecosystem as well as how complex and expensive it is to treat water to drinking quality standards. She also sat on the CRD Liquid Waste Commission for a number of years. Recently she helped organize the first Water Council Rainwater Harvesting Tour and the Water Fair held in the spring of 2015. Motivated by the desire to lessen the burden on St. Mary Lake and feeling it is wasteful to use water treated to drinking quality for watering the garden and other chores, Sharon began harvesting rainwater. Over the decade her collection system has grown so that for the past two summers, she hasn't used any first cycle drinking water for the garden. Rainwater takes care of the food garden and very little if any goes to the ornamental garden. During the dry season, she uses a lot of mulch throughout the garden. Chores such as cleaning the deck are done with rainwater early in the spring. Dishpans, jugs and buckets are used to collect water from chores such as dishes to give it a second cycle by watering the ornamental garden with it. Their water district is metered and their water use changes very little from their winter through summer. As a couple they use between 7 and 8 cubic meters every 3 months.

Peter Clarke has worked in irrigation and plumbing sales at Windsor Plywood for the last 12 years gaining knowledge and ideas mostly through his contacts with his clients, the contractors, landscapers and homeowners honing their collecting and conserving skills as they fulfill their goals. Irrigation and water collection continues to be a strong interest. Before joining Windsor, Peter worked on his own as a property caretaker and manager for residential customers.

Shannon Cowan is a PhD botanist and published research scientist: plant taxonomy, phytochemistry, aboriginal health, and sustainable agriculture (agroecology). Since October 2013, Shannon has been Coordinator for SSIWPA—a consortium of government agencies and water district representatives who are responsible to the electorate and the ratepayers for delivery of safe potable water. SSIWPA is mandated to carry out collaborative integrated watershed management on Salt Spring Island. Shannon

has been Assistant Professor at UB.C. in the Food and the Environment program (2002-2008), then Adjunct Professor in the same program (2008-2015); she has taught 25 offerings of several different undergraduate and graduate courses in agriculture and sustainability science and trained six graduate students. She is also a facilitator, has been a farmer, enjoys growing food, is a certified yoga teacher and childbirth educator, and really enjoys wilderness boating and hiking, and learning about the natural world.

Linda Gilkeson earned a PhD in Entomology from McGill University in 1986, then moved to British Columbia to work for Applied Bio-Nomics Ltd., a company that produces biological controls. From 1991 to 2002 she worked for the provincial government, promoting programs to reduce and eliminate pesticide use. She was head of the provincial State of Environment Reporting Unit for the next six years, then the Executive Director of the Salt Spring Island Conservancy until the end of 2011. Linda now devotes her time to writing, teaching and consulting.

Rick Gilleland came to live full time to SSI in 2001 after retiring from an executive Aerospace electronics job. He joined the board of the Mount Belcher Water District before the end of that year. He has taken water system courses and was the certified operator of that system for eight years; he is now Ops adviser. Rick has been a member of Water Council's board and has also sat on the board of WSOC for a few years; he served on the Auxiliary Planning Commission for over three years and contributed to the OCP in the Groundwater resource area. He helped WSOC expand well water table measurement to several improvement Districts, and took the B.C. Ministry of Land, Water, Air Drought Management Course in 2005.

Julie Ann Ishakawa graduated from UBC with a degree in hydrogeology and soil science in 2003 and then completed a master's program in Water Resources Management from a university in the Netherlands. She worked as a hydrogeologist with a consulting firm in the Lower Mainland for 10 years before joining the Ministry of Environment's Groundwater and Aquifer Science group last fall.

Meghan McKee joined North Salt Spring Waterworks District in 2013 as the Water Quality Specialist. Prior to that, she worked in a scientific and technical capacity for a number of public sector organizations and has diverse experience in water and wastewater treatment, water quality monitoring and laboratory analysis. Meghan is responsible for the District's water quality monitoring program and various water management functions. Meghan is an EOCP certified Level 2 Water Treatment Plant Operator and a Level 1 Wastewater Treatment Plant Operator. She has a diploma in Water Quality Technology, a Bachelor of Science in Environmental Management and is currently completing a Masters of Public Administration. Meghan has lived on SSI for 10 years and, when not working, stays busy raising three young daughters and coaching soccer.

Michael Nickels and his family make their home at Seven Ravens, where they offer refreshing interactive courses that focus on the positive power of Permaculture and Eco forestry. Practicing permaculture throughout the world has given them an overview of the incredible challenges that face this planet and how to turn problems into flourishing solutions that empower communities. Training those who wish to teach permaculture is their passion. In their courses they teach the interconnectedness of all aspects of a healthy, functioning eco system. Covering forest and nursery management, rainwater harvesting, pond

systems, fruit and nut growing, perennial and annual gardens, farm business management, land restoration, value adding, alternative energy and implementing these practices in the developing world.

Rosie Simms is the Water Law & Policy Researcher/Coordinator at the POLIS Water Sustainability Project. In February 2015, she completed her MA at the Institute for Resources, Environment and Sustainability at the University of British Columbia, where her research explored histories and interactions between First Nations and water governance in British Columbia. Prior to her MA work, as part of the McGill Panama Field Study Semester, Rosie was involved research and media outreach concerning conflicts between Canadian mining development and Indigenous rights in Panama.

Ron Stepaniuk has worked for the North Salt Spring Waterworks District for over 29 years. Starting as the lone system operator he has progressed through the ranks to become the District Manager. He supervises a staff of 12 and oversees the daily operations of the NSSWD and six other local water systems. Ron has managed many of the districts projects and can often be seen on the side of the road looking at pipes and things.

Deborah Walker is the Supervisor Outreach and Residential Water Conservation Programs for the Capital Regional District (CRD) Environmental Partnerships Division. She has been responsible to promote the wise and efficient use of water in the CRD since the year 2000. Deborah is also the supervisor for residential environmental outreach activities. Her responsibilities include the design, development and delivery of water conservation programs to 350,000 persons in the CRD. Previous to this position she was the Manager for the Water Efficiency Section for the Regional Municipality of Waterloo, Ontario for six years. Prior to the position in Ontario, she owned and operated an Energy Efficiency consulting firm that delivered the R-2000 housing program in Nova Scotia on behalf of the Federal Government. Deborah has also provided marketing expertise for both Nova Scotia Power and Ontario Hydro in the residential/commercial energy efficiency sectors. She holds a degree in Consumer Studies from Mount Saint Vincent University and has presented academic papers and provided consultation services for countries such as Chile, Brazil and the United States.

Appendix B: Water Conservation Forum Evaluation form

Salt Spring Island
WATER COUNCIL

Water Conservation Forum Event Survey

Thank you for attending our event.
Please take a moment to complete this short feedback survey.

1. How informative did you find this event?
   1 = not informative 2 = OK 3 = informative 4 = very informative 5 = exceptional
2. Will you use conserve more water after attending this event? Yes No
3. Why or why not? _____
   _____
4. What did you like about the event? _____
   _____
5. Name one area of improvement for future events: _____
   _____
6. Do you currently have rainwater harvesting equipment? Yes No
7. Do you currently have a drip water irrigation system? Yes No
   If yes, what is the capacity? _____
   If not, what would encourage you to install a system? _____
   _____
8. Where did you hear about this event? _____
9. If you would like to offer any other water conservation tips, please state them here.
   _____
   _____
   _____

Presented with support from:

CRD
Making a difference...together

The North Salt Spring Waterworks
flowing fresh and clean

Salt Spring Island Water Preservation Society

Appendix C: Water Conservation Forum Evaluations Results

1. How informative did you find this event?

1 = not informative	0
2 = OK	1
3 = informative	6
4 = very informative	16
5 = exceptional	3
No response	2

2. Will you use conserve more water after attending this event?

Yes	20
No	5
Yes & No	2

3. Why or why not?

No:

- lack of supply (local – global)
- I am already doing so with what infrastructure I have in place.
- Already doing this
- Already doing lots
- We are already doing everything plus more of the things discuss—did get some new ideas however

Yes:

- Reason is obvious
- Essential to do locally and beyond
- Inspired to go further in what we're already doing
- The importance of our water and to manage it to optimal
- Broad spectrum of information on the spot question and answer
- Rainwater trapment
- We've already been conserving, but wish to conserve more
- Some useful info, but too little practical info for conservation
- Because of our lack of understanding of overall groundwater water table and trends in south of SSI
- Will try to tighten up even more. Already saving however and dish water for a few trees, turning off tap while soaping up etc.
- Imperative
- We all have to
- We can never do enough
- We need to do more, build smaller houses designed for conservation
- Water availability seems to be declining at a high rate
- Because every person must do their part
- Right now we are only using 20 litres/day between two of us!! We are new to SSI and building as green as possible.
- Already trying

4. What did you like about the event?

- Diversity of speakers, the current information, the challenge to think outside of the box and connect with each other
- Diversity of expertise
- Diversity of expertise
- Diversity / new ideas
- Diversity of speakers and the opp. to connect with some key people
- Varied presentations
- Range of topics, products, audience participation
- Well informed speakers
- Variety of speakers
- Variety of speakers
- The variety of knowledge, expertise and aspects of water issues covered by the choice of panelists
- Lots of great smart people
- Subjects covered
- The large panel, diversity of info, format
- Local info
- Lots of info on a wide range of topics
- Level of knowledge of presenters—multiple short presentations
- Lots of info, maybe too much
- Meghan McKee, African experience
- All levels of government there
- Very informative
- Little wasted time
- More publicity

5. Name one area of improvement for future events:

- Shorten time
- Fewer speakers—though all were good
- Perhaps fewer speakers—got a bit rushed
- Too long—do a series—need to hear more from experts AND ask more questions
- Keep people on time, perhaps reduce the number of panelists and eliminate duplication.
- More time to look at displays
- More time for questions and discussion (just a bit): chairman to be a bit more forceful and to keep attendees on topic
- More direct control of audience participants to allow all speakers to have time
- Better mike system. People in audience need mikes.
- A mike for the audience asking questions.
- More consistent question taking
- Format with presentation
- More focus on specific conservation practices rather than generalities
- More specific details on solutions like Peter and Michael
- Grey water, St. Mary Lake

- More info about water catchment and recycling—solutions with info available
- More information on grey water recovery and use. What are the regulations?
- More info on greywater use, i.e. direct diversion to garden and push for code acceptance for grey water use.
- I'd like to hear from the Conservancy
- CEDC (Islands Trust) and SS Chamber of Commerce—do a study of the net costs and benefits of ??? (water consumption)
- Handout with 20 practical info for conservation

6. Do you currently have rainwater harvesting equipment?

Yes	15
No	12

7. Do you currently have a drip water irrigation system?

Yes	14
No	13

If yes, what is the capacity?

- Soaker hoses through gardens. I have a system that takes water from shower/tub to a tank, pumped into the two toilets. These should be supported and used.
- 5 gal/minute
- irrigation uses 200 gal/day
- 2 gals/minute (my system uses about 10% of its capacity)
- 9000 gals.
- 35,000 litres
- 200 gals.
- 4800 litres + 2500 litres
- 5500 gal.
- 2500 gal.

If not, what would encourage you to install a system?

- Money
- Budget. At the moment I have a spray control on the hose, do minimal watering early morning or evening
- Don't know enough
- I will look into it ASAP
- We want to install a grey water irrigation system
- We have just moved into our house. May look into it this winter (rainwater harvesting)
- Available time
- I'm thinking about it but my roof is old (shingles), no good place for the tank and not enough info on competition with other species
- Need to tend gardens in a water efficient manner

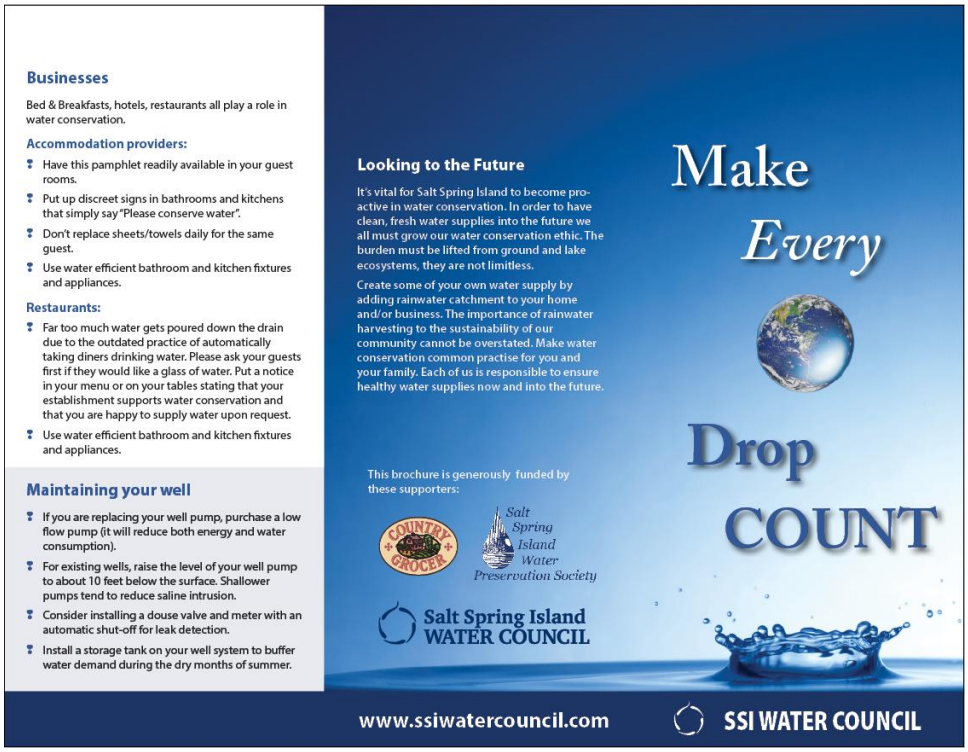
8. Where did you hear about this event?

Driftwood	10
Exchange	9
Marketplace	1
Email	8
Friend	4
WPS	1
Notices around town	1
Flyer	1

9. If you would like to offer any other water conservation tips, please state them.

- Water recycling—in Australia there are legal water recycling systems for domestic use that recycle ALL water (including toilet water) to produce completely potable water. One example is called BioCycle. The late Steve Irwin's Australia Zoo uses this system. I had friends on an acreage property who had one.
- We have buckets, pitchers around the house to catch anything from a faucet while water is warming or used for rinsing.
- An immediate and thorough survey of the shoreline of St. Mary Lake to check for unauthorized water extraction. I have heard over the years of several first hand reports of farmers (irrigation) and other businesses harvesting their own supplies to avoid water bills. (pipes hidden to opening well off shore).
- Immediate conversion of high use toilets in Ganges to low flush units (restaurants, coffee bars, etc.)
- Do a system-wide leak test. Arrange a two hour complete St. Mary System shut down, then watch the meter. If moves, track down the leak.
- Increase shade on Maxwell/St. Mary to reduce evaporation.
- Shower diversion of initial cold water using hoses attached to showerhead
- For grey water into whole house systems
- Never wash car in winter
- Add wine to compost—its nitrogen
- Shower less—wash pits, use a sitz bath.
- Have a simple sink wash with a few litres rather than a shower or bath
- Reduce population "build-out" figures for the island.
- Compost toilets instead of flush toilets
- The building code in BC has to change to ??? water conservation i.e. rainwater ???, greywater recycling etc. time to take action!
- Push CRD / VIHA to allow grey water systems
- Educate in Driftwood on 2-minute showering: 1 minute to pre-rinse and soap oneself, shut off water while washing oneself, 1 minute to post-rinse body. Shower off
- Gardening tips—mulching, limit use of annuals—instead use drought resistant perennials, watering very early and less frequently and deeply—better for root system development.
- When using shower or bath, collect water in bucket until hot water arrives (how much depends on distance to hot water tank) use to flush toilet etc.

Appendix D: Brochure: Make Every Drop Count



Businesses

Bed & Breakfasts, hotels, restaurants all play a role in water conservation.

Accommodation providers:

- Have this pamphlet readily available in your guest rooms.
- Put up discreet signs in bathrooms and kitchens that simply say "Please conserve water".
- Don't replace sheets/towels daily for the same guest.
- Use water efficient bathroom and kitchen fixtures and appliances.

Restaurants:

- Far too much water gets poured down the drain due to the outdated practice of automatically taking diners drinking water. Please ask your guests first if they would like a glass of water. Put a notice in your menu or on your tables stating that your establishment supports water conservation and that you are happy to supply water upon request.
- Use water efficient bathroom and kitchen fixtures and appliances.

Maintaining your well

- If you are replacing your well pump, purchase a low flow pump (it will reduce both energy and water consumption).
- For existing wells, raise the level of your well pump to about 10 feet below the surface. Shallower pumps tend to reduce saline intrusion.
- Consider installing a douse valve and meter with an automatic shut-off for leak detection.
- Install a storage tank on your well system to buffer water demand during the dry months of summer.

Looking to the Future

It's vital for Salt Spring Island to become pro-active in water conservation. In order to have clean, fresh water supplies into the future we all must grow our water conservation ethic. The burden must be lifted from ground and lake ecosystems, they are not limitless.

Create some of your own water supply by adding rainwater catchment to your home and/or business. The importance of rainwater harvesting to the sustainability of our community cannot be overstated. Make water conservation common practise for you and your family. Each of us is responsible to ensure healthy water supplies now and into the future.

This brochure is generously funded by these supporters:

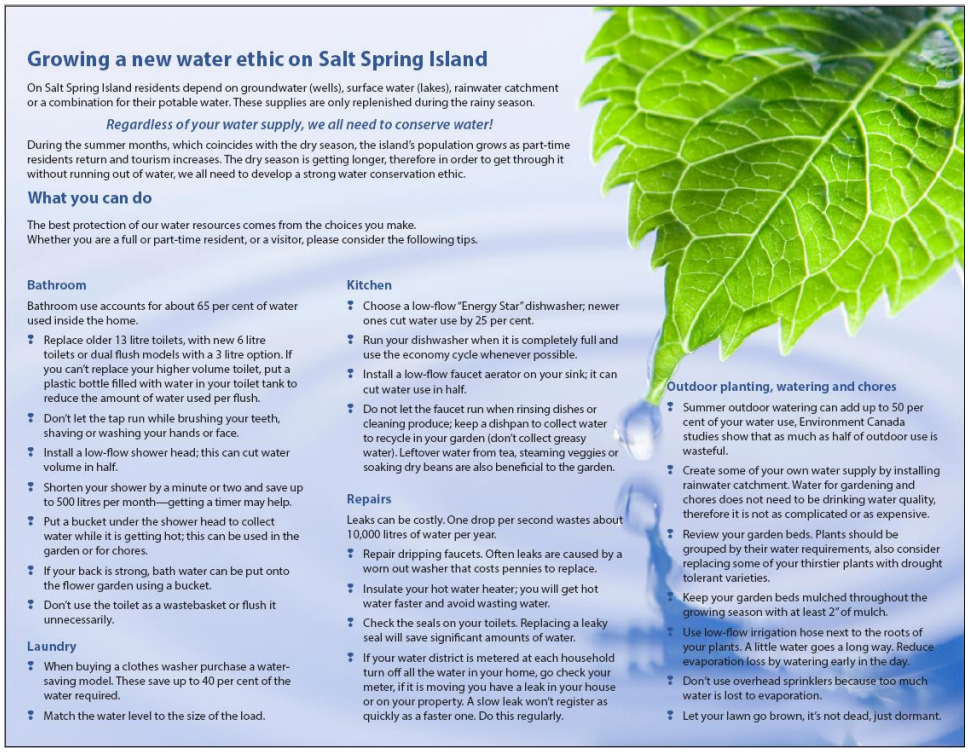
Salt Spring Island Water Preservation Society

Salt Spring Island WATER COUNCIL

Make *Every* Drop COUNT

www.ssiwatercouncil.com

SSI WATER COUNCIL



Growing a new water ethic on Salt Spring Island

On Salt Spring Island residents depend on groundwater (wells), surface water (lakes), rainwater catchment or a combination for their potable water. These supplies are only replenished during the rainy season.

Regardless of your water supply, we all need to conserve water!

During the summer months, which coincides with the dry season, the island's population grows as part-time residents return and tourism increases. The dry season is getting longer, therefore in order to get through it without running out of water, we all need to develop a strong water conservation ethic.

What you can do

The best protection of our water resources comes from the choices you make.
Whether you are a full or part-time resident, or a visitor, please consider the following tips.

Bathroom

Bathroom use accounts for about 65 per cent of water used inside the home.

- Replace older 13 litre toilets, with new 6 litre toilets or dual flush models with a 3 litre option. If you can't replace your higher volume toilet, put a plastic bottle filled with water in your toilet tank to reduce the amount of water used per flush.
- Don't let the tap run while brushing your teeth, shaving or washing your hands or face.
- Install a low-flow shower head; this can cut water volume in half.
- Shorten your shower by a minute or two and save up to 500 litres per month—getting a timer may help.
- Put a bucket under the shower head to collect water while it is getting hot; this can be used in the garden or for chores.
- If your back is strong, bath water can be put onto the flower garden using a bucket.
- Don't use the toilet as a wastebasket or flush it unnecessarily.

Laundry

- When buying a clothes washer purchase a water-saving model. These save up to 40 per cent of the water required.
- Match the water level to the size of the load.

Kitchen

- Choose a low-flow "Energy Star" dishwasher; newer ones cut water use by 25 per cent.
- Run your dishwasher when it is completely full and use the economy cycle whenever possible.
- Install a low-flow faucet aerator on your sink; it can cut water use in half.
- Do not let the faucet run when rinsing dishes or cleaning produce; keep a dishpan to collect water to recycle in your garden (don't collect greasy water). Leftover water from tea, steaming veggies or soaking dry beans are also beneficial to the garden.

Repairs

Leaks can be costly. One drop per second wastes about 10,000 litres of water per year.

- Repair dripping faucets. Often leaks are caused by a worn out washer that costs pennies to replace.
- Insulate your hot water heater; you will get hot water faster and avoid wasting water.
- Check the seals on your toilets. Replacing a leaky seal will save significant amounts of water.
- If your water district is metered at each household turn off all the water in your home, go check your meter, if it is moving you have a leak in your house or on your property. A slow leak won't register as quickly as a faster one. Do this regularly.

Outdoor planting, watering and chores

- Summer outdoor watering can add up to 50 per cent of your water use, Environment Canada studies show that as much as half of outdoor use is wasteful.
- Create some of your own water supply by installing rainwater catchment. Water for gardening and chores does not need to be drinking water quality, therefore it is not as complicated or as expensive.
- Review your garden beds. Plants should be grouped by their water requirements, also consider replacing some of your thirstier plants with drought tolerant varieties.
- Keep your garden beds mulched throughout the growing season with at least 2" of mulch.
- Use low-flow irrigation hose next to the roots of your plants. A little water goes a long way. Reduce evaporation loss by watering early in the day.
- Don't use overhead sprinklers because too much water is lost to evaporation.
- Let your lawn go brown, it's not dead, just dormant.

Appendix E: Provincial Drought Levels

Level	Conditions	Significance	Objective	Target
1 Green	Normal Conditions	There is sufficient water to meet human and ecosystem needs	Preparedness	Ongoing reductions in community water use
2 Yellow	Dry Conditions	First indications of a potential water supply problem	Voluntary conservation	Minimum 10% reduction
3 Orange	Very Dry Conditions	Potentially serious ecosystem or socioeconomic impacts are possible	Voluntary conservation and restrictions	Minimum additional 20% reduction to a minimum total of 30%
4 Red	Extremely Dry Conditions ;	Water supply insufficient to meet socio-economic and ecosystem needs ;	Voluntary conservation, restrictions and regulatory response ;	Maximum reduction
Loss of Supply	Potential loss of a community's potable water or firefighting supply	Emergency response	Ensure health and safety	

Appendix F: Making a Water Budget

What is a water budget and what good is it?

A water budget is as simple as an ordinary financial budget. It lists the family water usage tasks and records how much is actually being used for each task. Knowing how the family uses water and how much is being used allows comparisons to be made and how to allocate future water usage. For example, when we are in the midst of our rainy winters, we use water as if there is no limit—and we don't need to worry about overuse. When the summer comes, depending on how much rain the summer brings, the family can choose where to cut back.

A water budget is useful for well owners as well as ratepayers. Well owners only find out how much water is available to them when the well runs dry. When the well is drilled, the contractor determines and reports on the rate of water flowing into the well. This does not indicate how much water is in the aquifer tapped by the well. (See Appendix F.) If a well runs dry, the pump could be damaged and recharging the aquifer can take many months. A well thought out water budget may prevent the well from running dry.

As for ratepayers, their water costs depend on how much water they use. A water budget could show the water user where savings can be made.

How to make a Water Budget

One of the most important steps any household can take is to understand the way you use water. This requires what is called a water budget.

There are two ways of making a water budget. The easiest way is to put a water metre on the intake from your water source. Hose metres are inexpensive, while a whole house metre is in the neighbourhood of $100. The whole house metre is more difficult to install and may require a plumber.

The second method requires time and usually not more than a bucket and a liquid measuring cup or a litre bottle. Starting with the shower, place the bucket under the shower and run it at the level your family uses for say a minute. Then pour the bucket into the measuring container counting the number of times it is filled.

For the toilet, turn off the water source, remove the toilet tank lid and mark the level of the water. Flush the toilet and then fill the litre bottle and dump it into the tank. Repeat this until the water level is at the level you marked at the beginning.

The kitchen sink simply requires a plastic wash basin to be placed in the sink. Measure the volume of the wash basin dumping litre containers of water into the basin until filled (or read the label if it is still on the basin) Do the dishes until the basin is full empty it and count the number of times the basin is filled.

The dishwasher and washing machine require an online look-up or a referral to the instruction manual.

The garden taps are best measured with a hose water metre that can be purchased for under $20. Without one, the same steps as before are taken. The hose is run for a measured amount of time while

a bucket is being filled. At the end of the time, the water in the bucket is measured. If you have a restricted flow garden hose (some plastic hoses have small perforations along their length), place the entire restricted end in the bucket and repeat the test.

The water budget sheet is a fairly simple document listing all of the taps and toilets in the house. At each tap the amount of water is measured for a particular task and entered into a table. The number of times this task is performed each day and/or week is also entered. Below is an example:

Activity	Quantity	Minutes	Frequency/Day	Freq./Week	Total /Week
shower	5 litres in 1 min.	15 min	3 (1 per person)	3	675
load of wash	7 litres			5 loads	35
dish washing: by hand					
dish washing: by machine	15 litres			7	105
toilet 1	6 litres (low flush)		12 (4 x per person)	7	504
toilet 2	12 litres (old type)		3	7	252
wash basin 1	3 l brushing teeth, 3 l hand washing, 4 l shaving		2 6 1	7 7 7	588
wash basin 2					
garden tap 1: full	30 l/min	10 min	2	4	2400
restricted	5 l/min	60 min	2	4	2400
garden tap 2					
restricted					
total water usage					6959

Armed with this sheet a family can then see where they use the most water, what is optional, what is not needed, and where they would cut down on usage as water resources become scarcer. Instead of showers twice a day, a shower after exercising might be the best choice of one family member while another may choose a morning shower.

If a running tab of water use is kept, a family could easily see how to reduce their total water usage by 20—30%.

Appendix G: Basic Hydrology Concepts

Intro

The study of groundwater flow is complex and basically unknowable. Groundwater flow is affected by the soil type, rock type, fracture patterns and the surrounding hydrology patterns. A good understanding of geology is important as is the chemistry of soils. Not having any of these trainings the following is a lay person's understanding of groundwater and hydrology.

Soil

Different soil types react differently with water. The soil can absorb the water quickly and hold the water for considerable periods of time. (Every gardener knows that mulch prevents evaporation and loamy soil absorbs water quickly while clay prevents water penetration and sand does not hold water at all.) Usually soils are relatively shallow and their most important function is catching and holding the rainwater until it can soak in further.

One characteristic of soil is that when it is dry, water runs off until the soil becomes wet. So the first rains after a dry period run down the hill less and less as the soils becomes wet.

Rock

Different rocks absorb water differently. Shale can be a barrier to further water penetration. Other rocks have different permeability characteristics.

Rock fractures allow water to penetrate through the cracks more quickly than solid rock. And in fact substantial fracturing can hold significant amounts of water. Fractures can differ in size so a large fracture can allow more water to travel through it than small fractures (and in fact the salt spring in the north area of the island—from which the island gets its name—is said to be the result of a large fracture running to the sea.

Gravity (hydrologic pressure)

Gravity is the force driving our entire hydrological cycle. We all know gravity brings down the rain and causes water to run into streams, lakes and the ocean. Gravity is also responsible for infiltrating water into soil and rock.

But it is not the only force. Anyone who has washed dishes or put a towel or sponge into water knows that water defies gravity and creeps up the cloth. Water creeps up into drywall when a basement is flooded. This effect is most dramatically demonstrated in trees. Water from the ground moves up the trunk to the leaves at the very top. The trees don't have any mechanical pumps and yet water is transported as much as 150—200 feet into the air. Trees have combined a number of physical and chemical processes over millions of years to enable them to accomplish this task.

The lesson to be learned here, however, is that water can move in different directions based on the geology and the chemical properties of the rock and soil. So groundwater is a very complicated business.

As the rain is absorbed into the soil, the primary driving force is gravity. The water sinks into the soil and when it meets rock or clay or other layers with different absorption characteristics, it infiltrates cracks and runs downhill along the top of the layer until it finds some other path.

Time (to absorb—recharge)

The first rains tend to run along the surface of the ground because the ground has a dry layer not easily penetrated by water. After a period of time (partly dependent on the amount of rainfall), the soil absorbs the water. The depth of the absorbed water increases with time and with more rain. Given more time, the rain saturates the soil down to the rock underneath it or fills the cracks in the rock and the soil saturates all the way to the surface. At this point the soil can hold no more water and run off to the lakes and streams begins—or in other words the water table has reached the surface.

As the water table rises in the soil, the pressure of the water column above the rock increases and forces the water through the rock cracks more strongly. As the water infiltrates the rock, if the rain continues to add water to the surface, the subterranean water is makes its way deeper and deeper into the geology.

This entire process takes time. The amount of time depends on the rock and soil type and the degree of fracturing in the rock. So to recharge a well 50 feet below the surface may take much less time than a well several hundred feet deep in the same type of rock/soil fractures. Or maybe not depending on the geology.

Well characteristics

Well recharge very much depends on the water content of the surrounding rock. If a well is used excessively during a summer depleting the surrounding rock as well as the nature of the rock fracture pattern, the well will go dry even though water may be all around it since water takes time to move through rock. So well recharge could take a long time. Water recharge from the surface may take one, two or even three years but such a well would not be very useful once it runs low.

Often the solution resorted to is to drill deeper. But on Salt Spring there is a limit to the success of this manoeuvre. Here is why:

The island is surrounded by salt water but the fresh water table generally follows the land contour and fresh water can be found inland and at higher elevations. The hydraulic head of water at higher elevations results in fresh water being found below sea level. The contour of the base of fresh water forms a convex lens that mirrors the elevation contour but in a reduced ratio. So a well near the sea shore must be much shallower to avoid penetration into the salt water zone. Any fresh water above the salt water with enough head (pressure)keeps the salt water from infiltrating the rock above the lens contour. Salt Water is heavier than fresh water and so will stay below fresh water if there is no pumping. But if a well pumps out the fresh water above the salt water, the salt water will take the place of the fresh water and the well becomes salty and cannot practically be reversed.

Drilling wells deeper inland and/or at higher elevations to improve flows can cause severe problems for neighbouring wells if the new depth now accesses a zone in the aquifer that is already being used by others.

So the lesson is first not to drill deeper but to find out why the well has gone dry (or slowed in flow), learn if others are having problems, learn more about the geology, and determine what sustainable extraction flows can be adopted to give the geology the time to recharge and at the same time satisfy community user needs. Drilling in a new location may or may not be an answer for the same reason. Nevertheless, drilling deeper may be necessary but should be done with care, and only deep enough to relieve the problem and with sufficient testing to determine the impacts on neighbouring wells.

Salt Spring Island Groundwater

1. Groundwater on Salt Spring Island is contained mainly in fractures both in the sedimentary rocks of the Nanaimo Group and the metamorphic igneous rocks of the Sicker Group at the south end. The effective porosity or capacity to contain water is very low, approximately 0.01% percent of the rock volume, but a reliable quantitative estimate is impossible without an extensive field study of the hydrology by means of well pumping and monitoring.

2. All the fresh water on the island arrives in the form of precipitation, most of which either runs off into the sea or evaporates. The water that eventually enters the groundwater system represents, out of the annual precipitation of about 900 millimetres, somewhere between 150 millimetres and 25 millimetres. It appears that this is enough to annually recharge the groundwater system in some places but not in others. Once the fractures are filled any further precipitation leaves as runoff.

3. Groundwater systems that are dominantly based on fractures are more vulnerable to contamination than those that are based on homogenous porous media such as sand.

4. Groundwater is a community resource and must be shared and conserved. Individual property owners and users must realize that although they have the right use the groundwater under their property they do not have the right to exploit it at the expense of neighbouring users of the same aquifer. (*Water Act- RSBC 1996, Chapter 483 Part 5- Wells and Ground Water protection, Well Operation page 41.)* They have instead an obligation to use it wisely, conservatively, and to refrain from depleting it at the expense of others.

5. The amount of rainfall that can annually reach the water table is not great and consequently the area from which each well draws must be large enough to capture the required amount of water. This implies that a minimum average lot size should be established where the water is derived from wells.

6. Global climate change presents a challenge to water-planners in that precipitation and drought events must be considered. The annual precipitation may well increase but it will occur mainly during the winter, and as the aquifer appears to be already recharged by existing rainfall, any excess will only add to runoff. Further, extreme weather events such as droughts are likely to become twice as frequent with the result that drought events that are now considered to occur only once every 50 years could recur as often as every 25 years. Any planning for future water management must adopt a stance that will deal with this 'worst scenario' which is ever more likely to occur.

7. Some of our groundwater areas are already stressed beyond their capability to supply current demand.

8. The foregoing indicates we must adopt management strategies that will protect our groundwater resource and that we can no longer allow access to it without applying constraints to development, subdivision, well-drilling, and rates of water withdrawal. Some of these constraints may be applied by the Islands Trust but others will need outside cooperation and cooperation by all our users.

Source: Appendix 4. *Potable Water Focus Group Report to the Salt Spring Island Local Trust Committee*; March 13, 2007. Hugh J. Greenwood, P.Eng (ret.) and Rick J. Gilleland, P.Eng.

Appendix H: Provincial and Local Government Initiatives

Provincial requirements of local officials

At the local level, the main activities undertaken by local authorities and water licensees to prepare for drought include:

- establish Local Drought Management Teams;
- gather available local information on historic droughts, water supply and climate conditions; identify information gaps;
- identify streams and aquatic ecosystems of concern; complete water supply plans, local drought management plans and emergency drought consequence plans; update and practice implementation of plans annually;
- establish water conservation strategies and water use reduction targets;
- implement water conservation programs; continuously improve water use efficiency;
- complete a water assessment, a water audit, an environmental farm plan, or other water use evaluation;
- encourage water conservation, stewardship and education through local media;
- incorporate water conservation into planning and daily operations;
- continuously improve the efficiency of agricultural irrigation systems;
- agricultural producers should consider water status from the previous season when planning the next year's production. Soil water levels, reservoir levels, streamflows, snowpack and groundwater levels are all important factors;
- June 2015 11: agricultural producers should review information on crop selection, irrigation efficiency and water conservation; and
- municipal authority is required to enforce water restrictions. Local governments should develop bylaws for water conservation, drought management and emergency drought preparedness to respond to diminishing streamflow and water storage conditions. (Taken from British Columbia

Drought Response Plan p. 10 http://www.livingwatersmart.ca/drought/docs/2015/Drought-Response-Plan-Update-June-2015.pdf).

Water Sustainability Act

The B.C. Water Sustainability Act has been passed and is in the stage of drafting regulations. (The Water Council has submitted its recommendations. Refer to Large groundwater users including small farms using groundwater will be required to have a water license (100,000 wells in Province—20% non-domestic)). Better protection for fish and nature—must be in the calculation for water distributors. Water sustainability planning: takes into account local issues and situations—Gulf Islands can include groundwater in its planning.

CRD planning

As outlined above the CRD has a three volume water management plan see: https://www.crd.bc.ca/docs/default-source/water-pdf/2012strategicplanforthegvwss.pdf?sfvrsn=2

Nanaimo planning

Nanaimo developed a conservation plan a number of years ago and, like the CRD, has been implementing it over the years. NSSWD is now following the same path.

"In 2007, the City produced a 50-year vision for the City's water supply, reported in the Water Supply Strategic Plan. The plan includes a review of the water supply system, the capacity of the current water source and alternative sources, projected demand, and management recommendations. Three primary goals were identified in the plan as follows: (1) Provide safe drinking water (2) Ensure a sustainable water supply (3) Provide cost effective water delivery." (City of Nanaimo: 2014 Water Conservation Strategy http://www.nanaimo.ca/assets/Departments/Engineering~Public~Works/Water~Supply/Publications~and~Forms/2014WaterConservationStrategy.pdf).

Trust planning

The Islands Trust does not have the jurisdiction to develop a comprehensive water conservation strategy but can require water conservation plans as part of a development permit. A water conservation plan for a building site might include metal roofs (which are a step towards fire control anyway), water harvesting and storage equipment and property amenities such as swales and rock gardens would help the Island prepare for a water restricted future.

The Trust now provides a number of aids:

- Water Conservation Brochure: http://www.islandstrust.bc.ca/media/239933/SSI%20Water%20Conservation%20Brochure.pdf
- Rainwater harvesting information: http://www.islandstrustfund.bc.ca/initiatives/privateconservation/land-stewardship/rainwater-harvesting.aspx

- Land Use Planning Tools to Protect Water in the Islands Trust Area: http://www.islandstrust.bc.ca/trust-council/projects/water-resource-information-for-islanders/land-use-planning-tools.aspx

Appendix I: Ground Water Sustainability

GOALS FOR GROUNDWATER SUSTAINABILITY

1. **Protection of groundwater supplies from depletion:**

   Sustainability requires that withdrawals can be maintained indefinitely without creating significant long-term declines in regional water levels.

2. **Protection of groundwater quality from contamination:**

   Sustainability requires that groundwater quality is not compromised by significant degradation of its chemical or biological character.

3. **Protection of ecosystem viability:**

   Sustainability requires that withdrawals do not significantly impinge on the contribution of

   groundwater to surface water supplies and the support of ecosystems. Human users will inevitably have some impact on pristine ecosystems.

4. **Achievement of economic and social well-being:**

   Sustainability requires that allocation of groundwater maximises its potential contribution to social well-being (interpreted to reflect both economic and non-economic values).

5. **Application of good governance:**

   Sustainability requires that decisions as to groundwater use are made transparently through informed public participation and with full account taken of ecosystem needs, intergenerational equity, and the precautionary principle.

Source:

Report in Focus: The Sustainable Management of Groundwater in Canada; Council of Canadian Academies; 2009. http://www.scienceadvice.ca/en/assessments/completed/groundwater.asp