REFERENCES

(in date order)

Nov.30, 1993 *SSI Water Allocation Plan*: Ministry of Environment, Lands and parks

Jan. 1995 H*ydrology of Maxwell Lake Water Supply*: R. Hamilton

1995 *Groundwater Conditions on Salt Spring Island*: W.S.Hodge

March, 2000 *NSSWD Capital Expenditure Charges Report*, Chatwin Engineering Ltd.

Jun.28, 2001 *Land Use Bylaw*: Islands Trust

July, 2001 *North Salt Spring Water Study; Potential Groundwater Resources*: R. Potter, Gulf Islands Geotechnical Services

July, 2003 *Water Supply and Demand Analysis for NSSWD*: AQION Water Tech. Ltd

Oct.24, 2005 *Comments on NSSWD Supply and Demand*: R. Nordin

Nov. 2005 *"At a Watershed",* O.Brandes, POLIS

May, 2006 *Future Water Supply and Demand on SSI*: M. Larmour

Jun.30, 2006 *Staff report on NSSWD build-out estimates*, Islands Trust

Dec. 2006 *Cusheon Lake Watershed Management Plan*

May 9, 2007 *Potable Water Focus Group Report*, OCP Review:

Appendix 1: *NSSWD Supply-Demand Graph & Explanatory Notes*: M.Larmour

Appendix 2: *NSSWD Supply & Demand Report:* D.Russell & B.Watson

Appendix 3: *Review of NSSWD Supply & Demand Report*: M.Larmour

Appendix 4: *Groundwater*: H.J.Greenwood & R.J.Gilleland

Sep.27, 2008 *Healthy Ecosystems Healthy Community Initiative*, D.Rapport & L.Maffi

Oct.2, 2008 *Official Community Plan*: Islands Trust

2008 *St. Mary Lake Watershed Management Plan*

May 13, 2008 *Water Licences and Future Directions for Land Trusts in BC*: Brandes & Curran

Nov. 2009 *Nine Lakes on SSI; Size, Watershed, Inflow, Precipitation, Runoff & Evaporation:* J.B. Sprague

Nov.4, 2009 *Water For Life on SSI*: P. Henley, HEHCI

Jan. 2010 *Cedars of Tuam Draft Manual*: Ron Bain

Feb. 2010 *A Soft Path Strategy for SSI:* POLIS Project on Ecological Governance, UVIC

Feb. 2010 *Living Water Smart: website*. BC Ministry of Environment

Mar.20, 2010 *Future NSSWD Water Supply and Demand: A "What-if" scenario*. R. Watson

APPENDIX 2

Salt Spring Island Land Use Bylaw 355, December, 2009

5.5 POTABLE WATER

5.5.1 Each *lot* in a proposed *subdivision* must be supplied with *potable* water in accordance with the *service* levels specified in Part 9 of this Bylaw.

5.5.2 Each *lot* in a proposed *subdivision* must be supplied with sufficient water to supply all u*ses*, *building*s and *structures* permitted on the *lot* by this Bylaw according to the standards set out in Table 1. Where more than one *use* is permitted on a *lot*, the amount of water to be supplied is the sum of the amounts required for each permitted *use*, calculated separately.

Information Note: If two or more lots are connected to the same source of water,the water system is subject to the Safe Drinking Water Regulations, administered by the Capital Health Region.

5.5.3 Where water is to be supplied by a *community water system*, the *community water system* must provide written confirmation of the amount of water it is able to supply to each *lot*.

5.5.4 Where water is to be supplied from a surface *water body*, the applicant for *subdivision* must provide proof of a water license issued after November 30, 1994, that permits the withdrawal of the required amount of water.

Information Note. The provincial Water Management Branch completed a study of surface water availability in November of 1994. Water licenses issued before this time may not be a reliable indication that water is actually available in the necessary quantity.

5.5.5 Where water is to be supplied by groundwater, the applicant for *subdivision* must provide written certification under seal of an *engineer* with experience in groundwater hydrology that there is sufficient available groundwater to provide the required amount of *potable* water on a continuous basis, and that the extraction from the groundwater table of that amount of water is not reasonably expected to adversely affect the quantity or quality of water obtainable from any existing well or surface water that is used as a source of *potable* water.

TABLE 1
POTABLE WATER SUPPLY STANDARDS FOR SUBDIVISION

USE	**VOLUME** (litres per day per lot)
Dwelling unit	1600
Seasonal cottage	680
Bed and breakfast home-based business	225/bedroom
Commercial or Industrial use	900
Community hall or church	1590
School	50/classroom
Commercial guest accommodation units	450/unit
Campgrounds	225/campsite

5.5.6 If the required amount of water cannot be supplied or if the certification, water license or confirmation referred to in Subsections 5.5.3, 5.5.4 or 5.5.5 cannot be made, the *Approving Officer* may nonetheless approve the *subdivision* if the applicant grants a covenant under the Land Title Act to the Salt Spring Island Local Trust Committee that restricts the development of the *subdivision* to the *building*s, *structure*s and *use*s for which the required amount of water can be supplied, licensed or certified under Subsections 5.5.3, 5.5.4 or 5.5.5.

5.5.7 For the purposes of the certification referred to in Subsection 5.5.5, the *engineer* must supply supporting documentation of a pump test conducted by the *engineer* which must indicate that the test was of sufficient duration to establish the long term reliability of the water supply in accordance with generally acceptable hydrological engineering practices.

5.5.8 Where the water supply is provided through a groundwater well or through a private surface water license, an *engineer* must also provide a water quality analysis that demonstrates that the surface water or the groundwater from each proposed water supply source or well is *potable* or can be made *potable* with a treatment system that is customarily used in a *single-family dwelling*. The certificate must include a plan of the proposed *subdivision* indicating each well location where a water sample was taken, and a statement that the water samples upon which the water quality analysis was performed were unadulterated samples taken from the locations indicated on the plan. If the water to be supplied is not *potable*, but can be made *potable* with a treatment system that is customarily used in a *single-family dwelling*, then the *Approving Officer* may nonetheless approve the *subdivision* if the applicant grants a covenant under the Land Title Act to the Salt Spring Island Local Trust Committee that requires on-going treatment of the water to ensure that it is *potable* before it is used as drinking water.

Table 1. Physical characteristics of the larger lakes on Salt Spring Island. Lakes are in order of drainage basin size. Information is from surveys and reports in the footnote***.

1. Lake	2. Depth (metres)		3. Surface area (hectares)	4. Volume (thousands of m^3)	5. Drainage basin, lakes included (hectares)	6. Yearly inflow* (thousands of m^3)	7. Time to fill if empty (years)	8. Time for 95% replacement of water	
	Mean.	Max.						Years	Months
Cusheon	4.5	9.1	26.9	1,214	839**	4,100	0.30	0.89	11
Ford	3.0	3.5	4.25	127	780	3,915	0.032	0.09 7	1.2
St. Mary	8.8	16.7	182	15,960	690	3,269	4.9	14.6	176
Blackburn	3.0	5.0	3.08	92.4	619**	2,943	0.031	0.09 4	1.1
Stowell	4.6	7.5	4.57	210	389	1,806	0.12	0.35	4.2
Bullocks	3.9	7.0	9.40	370	212	1,005	0.37	1.1	13
Weston	5.9	12.2	18.5	1,090	170	789	1.4	4.1	50
Roberts	4.1	8.2	3.44	140	120**	586	0.24	0.72	8.6
Maxwell Original Modified	 6.5 7.7	 17.0 19.2	 27.7 29.9	 1,810 2,310	 115 217	 533 910	 3.4 2.5	 10 7.6	 122 91

* Inflow is estimated from size of the drainage basin, using annual precipitation in that region, and an average (island) value for proportion that runs off the land. Inflows for the three lakes of the Cusheon system are estimated from a more detailed model shown in Table 5 of the Appendix.

** Areas of the three drainage basins in the Cusheon system were estimated by Islands Trust (Korteling 2006); areas shown here include basins of upstream lake(s). Definitive areas of the total Cusheon and St. Mary basins were measured by Grange (2008a, b) and are incorporated into this table.

*** Maps and data from government lake surveys are provided on a web site of B.C. Environment, at time of writing http://a100.gov.bc.ca/pub/fidg/bathyMapSelect.do. (Cusheon 1972, Ford 1978, St. Mary 1978, Blackburn 1972, Stowell 1960, Bullocks 1981, Weston 1960, Roberts 1972, Maxwell 1981). Precipitation for areas of Salt Spring Island were provided by Aston (2006), Barnett et al. (1993), Hamilton (1995), Environment Canada (2006) and Watson (2006b). Other information on lakes and flows was given by Barnett et al. (1993), Hamilton (1998), Holms (1996), McKean (1981), Nordin (1986), Nordin et al. (1983), Sprague (2007b), and Watson (2006a,b).

3.0 Summary of Recommendations

3.1 Apply the *Precautionary Principle* to the Planning, Utilization and Protection of Potable Water Resources on Salt Spring Island

The *precautionary* principle should be applied with regard to potable water supplies. Where the risk to the quality or quantity of potable water is considerable and long lasting, decision makers should act with caution, taking a highly conservative approach that comfortably offsets uncertainty of the impact of proposed actions that may impact on water supplies.

3.2 Coordinate Governance of Water Management Issues

As the governing body most affecting water demand by its actions and the only government body with protocol agreements with all other bodies concerned, the Islands Trust should include water management issues in existing protocol agreements with the CRD and all other bodies concerned.

3.3 Undertake a Comprehensive Water Management Plan for Salt Spring Island

Assess the potential magnitude of demand under present zoning and projections. Combine this information with other relevant information on supply, quality, conservation methods and costs to develop a comprehensive water management plan. Review the entire zoning framework of the island and make the changes necessary to secure reliable water resources for the future.

3.4 Control Growth in Areas Supplied by Surface water to Ensure Supply/Demand Balance.

The capacity to provide potable water from surface water sources is limited by hydrologic, economic, regulatory and environmental constraints. One water district will reach its legal limit to supply water before the build out projection in the current OCP is reached. Others are at or close to their licensed capacities. Revise planned development and settlement patterns in accord with the licensed and known capacities to provide high quality potable water at a reasonable cost.

3.5 Improve the Method of Proving the Adequacy of Groundwater Supplies

With the advice of a competent hydrologist, with local knowledge, the Trust should develop tests for proof of groundwater quantity and quality that are strict, well defined and cover conditions likely to apply through the year. Concerns of well interference, reliability under severe drought conditions, and overall sustainability at the permitted density and intensity of land use should be covered. The protocols thus established should serve as criteria guiding hydrologists acting for developers and for Approving Officers acting for the citizens of Salt Spring.

3.6 Place Every Community Watershed for Surface Water within a Development Permit Area

Place each watershed serving a community drinking water supply lake within a Development Permit Area. Define measures specific to each watershed with the objective of reducing sedimentation and nutrient loading in the lake it serves. Implement the Cusheon Watershed Management Plan. Prepare individual watershed management plans for other community drinking water lakes.

3.7 Require Minimum Lot Size in Areas Served by Groundwater
Establish minimum lot sizes to ensure sustainability of groundwater supply. This will require an area-by area approach to the hydrology in order to establish reasonable local limits.

3.8 Require a Permit and a Development Plan for All Construction
All construction, whether a new subdivision, a house on an existing lot, or a renovation to an existing dwelling shall, in addition to a building permit, require the developer or owner to submit and have approved by the Islands Trust, a plan indicating how all water-related issues will be addressed.

3.9 Establish a Water Conservation Policy
Develop an island-wide water conservation policy. In addition to education, a conservation policy should encourage imaginative development of demand management measures, incentives and disincentives including user pricing priorities and progressive rate structures.

APPENDIX 7

Future North Island Water Supply & Demand
A "What If" Scenario

Prepared by Bob Watson, NSSWD Trustee; March 20, 2010

What if the community wished to make some changes to island settlement patterns, accommodate affordable housing, and provide an alternative for north island areas with groundwater problems – would it be feasible?

A well thought out water supply and infrastructure plan would minimise costs and allow costs to be shared fairly between present and new development. It would include the environmental, fisheries, recreational, water quality and aesthetic aspects of using our lakes for water supply. It would need to be acceptable to the community and to regulatory authorities.

The following describes one possible scenario of future water demand and supply infrastructure for the northern portion of the island, just to start the thinking. All estimates are "ball-park".

1.0 Summary

Current development within NSSWD totals about 2,515 SFEs (single family dwelling unit equivalents. With growth allowed within present zoning, NSSWD is expected to increase to about 4,070 SFEs by build-out.

In addition to allowed growth, irrigation needs are expected to increase with future drier, warmer summers, and more intensive island agriculture and home food gardening. Watermains may need to be extended to replace supply for areas with failing groundwater. Affordable housing may increase home occupancy, thus water demand within the areas being served. Increased emphasis on density transfer to within the serviced area may increase demand. **The water demand estimate was adjusted for each of these and other items, including a 1,600 SFE (single-family equivalents) allowance for groundwater supply replacement, affordable housing, and density transfer combined.** With the above 1,600 SFE allowance included, NSSWD plus CRD's Fernwood/Highland waterworks will need to serve about 6,100 SFEs by build-out.

If the community wishes to proceed as outlined in this scenario, it appears feasible to provide sufficient water supply, subject to confirmation by independent hydrology and fisheries specialists, and subject to licensing, as follows:

- Water filtration plants would be constructed to treat all water supplied to current Vancouver Island Health Authority standards. NSSWD's plan includes a initial 0.5 mgd WTP at Lake Maxwell and a 1.0 mgd WTP at St Mary Lake.

- All feasible conservation measures would be undertaken, reducing annual, summer storage season, and peak day demand.

Reclaimed water from the Ganges WPCP would be utilised, mainly for irrigation in the Ganges core area. A low water use fixtures and appliances incentive program would be established. Planned pressure control and water treatment improvements, and planned watermain replacement will reduce water used for waterworks operations and water quality maintenance and will reduce losses from leaks. **Watermain leak detection surveys could be undertaken if needed. Increasing costs of water consumption in combination with conservation methods education is expected to result in improved water conservation.**

- Adjustable stoplogs would be added to the St Mary Lake weir to provide at least 0.9m of live storage, to improve fisheries protection during major droughts.

- "Andrea" and "Gossett" creeks would be diverted to Lake Maxwell to increase the watershed area (before NSSWD reaches 3,000 SFEs).

- The Lake Maxwell dam would be raised to increase storage and thus reduce St Mary Lake drawdown by providing most of NSSWD's supply during severe single-year droughts (before NSSWD reaches 3,300 SFEs). Lake Maxwell aeration would be installed if needed to prevent phosphorus resolubilisation from summer oxygen depletion in the lake bottom water.

- The Maxwell WTP would be expanded to 1.0 mgd (before NSSWD reaches 3,900 SFEs).

- A pumping station would be built at Cusheon Lake and a connecting supply main to St Mary Lake installed (before NSSWD reaches 4,400 SFEs). Part of the overflow from Cusheon Lake each winter would be transferred to St Mary Lake until St Mary Lake had refilled.

- The St Mary WTP would be expanded to 1.5 mgd (before NSSWD reaches 5,000 SFEs). The expanded WTP would serve both NSSWD and CRD service areas plus most areas where service had been extended to replace groundwater supplies.

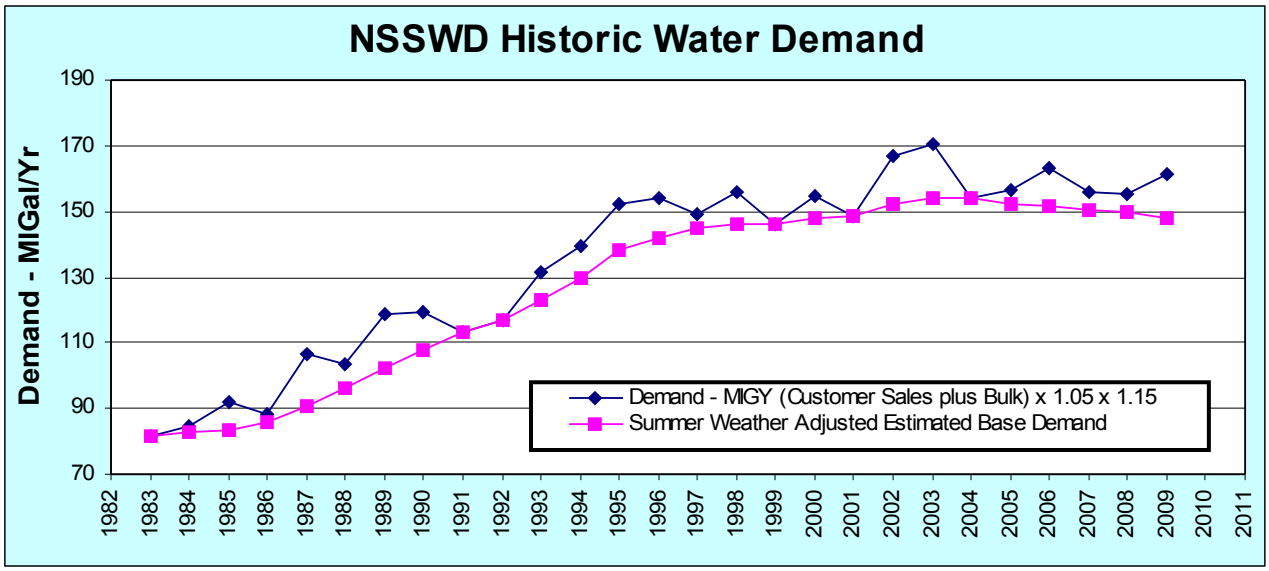
- The NSSWD/CRD combined Maxwell/St Mary waterworks would serve about 6,100 SFEs. The net waterworks demand would be about 350 MGY. The overall demand on the Maxwell plus St Mary watersheds would be about 480 MGY.

- The Beddis waterworks would be expanded to serve Scott Point and adjacent areas to replace inadequate groundwater supplies.

- The Ford watershed would be held as a major climate reserve to supplement Cusheon diversion to St Mary Lake if needed in the future.

The main limiting water supply factors appear to be St Mary Lake drawdown to protect fisheries, watershed area for major multi-year droughts, and storage for major single year droughts.

St Mary Lake drawdown should not exceed 0.9m during an average year, and should not exceed 1.5m during severe drought years, to protect fisheries.


NSSWD Historic Water Demand
Demand - MIGal/Yr
190
170
150
130
110
90
70
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Demand - MIGY (Customer Sales plus Bulk) x 1.05 x 1.15
Summer Weather Adjusted Estimated Base Demand

APPENDIX 10

POLIS "A Soft Path Strategy for Salt Spring Island (Extract only)

Section 4 – Getting from Here to There: Action Items for Implementing a Soft Path Strategy

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 or asking 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.

The following action items and associated recommendations represent the immediate (and likely most effective) opportunities to begin creating a more sustainable approach to water management for Salt Spring Island regardless of which scenario is adopted.

4.1 Screening Measures for Action Items

Potential water conservation and efficiency measures were subjected to an informal screening process based on the following criteria: Technical Feasibility, Applicability, Social Acceptability and Cost-effectiveness

4.2 Action Items - All Sectors

4.2.1 Set an Overall Water Use Goal of "Preserving Water Supplies for the Next Generation"

An overarching water conservation target sends a clear signal to islanders that water conservation and efficiency are essential to continued economic and ecological health.

4.2.2 Create a Water Demand Management Coordinator Position

Hiring a permanent staff person (either full-time or part-time) with technical skills and understanding in fields such as ecology, social marketing, economics, and education is a critical first step in developing and implementing any long-term water conservation strategy.

4.2.3 Implement Full-Cost and Volume-Based Pricing

Canadians paying flat rates use 74% more water than those under volume-based structures. Full cost water rates should extend to protecting the source, replacing aging infrastructure at a reasonable rate, water conservation planning and programming, education, research, and treatment of wastewater as opposed to a narrow focus on water treatment infrastructure.

4.2.4 Plan for Sustainability Through "Wet Growth"

Land use decisions determine water use and watershed health now and in the future, and many patterns of development are problematic. SSI should explore implementing water and land use policies that require all new developments to either offset new water demands with conserved water or purchase water rights.

4.3 Residential Use

4.3.1 Efficient Indoor Residential Water Use

Mandating best available efficient fixtures in all new construction that meet or exceed existing international standards through bylaws and by updating specifications regularly is much more cost effective than conducting retrofits later, and ensures all new demands for water are the most efficient possible.

4.3.2 "Go Golden" Campaign to Reduce Outdoor Water Use
Outdoor water use is a primary factor contributing to peak demands in Canadian communities. For this reason, outdoor summer demands should be one of the primary targets of Salt Spring's water conservation programme.

4.4 ICI Sector
Increase efficiency and conservation across the ICI sector.

4.5 Agricultural Sector
4.5.1 Data Collection
In order to make informed decisions about water use, the SSI Water Council should make a concerted effort in close cooperation with farmers to gather more data about agricultural water use on Salt Spring.
4.5.2 Improve Water Efficiency for Irrigation
Irrigation represents the biggest opportunity for improving efficiency in agriculture

4.6 Looking to the Future
4.6.1 Rainwater and Waste(d) Water as the Source
In 2010 the BC Ministry of Housing and Social Development is looking to update the Building Code to include rainwater harvesting in response to government's commitment to "mandate purple pipes in new construction for water collection and reuse by 2010" outlined in the Living Water Smart strategy.

4.7 Five Year Implementation Overview
1. Hire a co-ordinator, funded through NSSWD, the CRD, who will make use of existing resources in the CRD and adapt for use on SSI.
2. Launch toilet rebate program and offer rebates ONLY for high efficiency/dual flush toilets that meet MaP testing specifications to maximize effectiveness.
3. Co-ordinator to develop and deliver an educational campaign consisting of (at a minimum) water bill inserts, education for commercial facilities on the hot water cost benefits of pre-rinse spray valves.
4. Education/liase with hardware stores that sell water efficient fixtures to ensure they stock the best models, train employees and have signage to guide purchases.
5. Co-ordinator to hold rainwater harvesting workshop including pitfalls to avoid, regulatory constraints and approvals, tank sizing and connections, etc.
6. Revisit targets, successes, failures and adapt and adjust strategy for next 5 years to meet targets.

4.8 Implement for Success
The observed rate of water savings will depend on the aggressiveness, available funding and effectiveness of the program; the residential, industrial, commercial and agricultural growth rates; and natural replacement frequencies of water use fixtures.

4.9 Cost Comparison
The case for the cost-effectiveness of water conservation programs has been made in many communities across Canada. In addition to the direct one-time capital cost savings for upgrading supply, additional operating savings and environmental benefits could potentially be realized.

APPENDIX 11

CONVERSION TABLE

1 Imperial gallon = 4.546 litres

1 cubic metre (m3) = 1,000 litres

1 cubic metre (m3) = 220.2 imperial gallons

1 million imperial gallons (MG) = 4546 cubic metres (m3)

1 acre = 0.4047 hectare

1 hectare = 2.471 acres