



DATE OF MEETING: February 26, 2019
TO: Salt Spring Island Local Trust Committee
FROM: William Shulba, Senior Freshwater Specialist
Local Planning Services
COPY: Salt Spring Island Watershed Protection Alliance
SUBJECT: Groundwater Preservation Project: Community Aquifer Recharge Areas

RECOMMENDATION

1. THAT the Salt Spring Island Local Trust Committee amend the Groundwater Preservation Project Charter by allocating \$5,000.00 from the Water Sustainability 2018-2019 budget to identify *Community Aquifer Recharge Areas* on Salt Spring Island.

REPORT SUMMARY

The purpose of this report is to:

- provide a brief background and update on the Groundwater Preservation Project;
- describe the *Community Aquifer Recharge Area* concept and associated scope of work;
- present an updated project charter; and
- recommend next steps for program implementation.

BACKGROUND

Groundwater supplies approximately half of the water needs of the Salt Spring Island community and is a unique ecological amenity of our watersheds.

The Salt Spring Island Local Trust Committee (LTC) has maintained Water Sustainability (formerly “Watershed Management”) as a top priority since 2013. The LTC has, through a hired contractor, coordinated the Salt Spring Island Watershed Protection Alliance (SSIWPA); a forum to coordinate multiple jurisdictions in planning for water sustainability and watershed protection on Salt Spring Island.

In 2016, the LTC supported a *Groundwater Supply* project, now called the *Groundwater Preservation Project*, to coordinate SSIWPA agencies in developing a *Salt Spring Island Well Inventory Project* and the *Salt Spring Island Groundwater Wells Monitoring Pilot Project* with funding support from the LTC, SSIWPA member agencies, and the Real Estate Foundation of BC Freshwater Sustainability grant. Projects are on-going and are planned to be completed by the end of 2019.

The recommendations in this report will build on the community’s existing investment in coordinated groundwater management and aquifer protection strategies on Salt Spring Island.

SSIWPA undertook a strategic planning process in spring 2018 to consider the objectives of the integrated freshwater management program (IFWMP), agree on tasks requiring coordination, and develop a new work plan and framework for short, medium and long term projects.

A series of strategic planning workshops were led by facilitator and hydrogeologist Mike Wei, recently retired Section Head of Aquifer and Watershed Science at the *BC Ministry of Environment and Climate Change Strategy*. The process involved participation by the SSIWPA steering committee and its advisory groups (the Technical Working Group and the Conservation and Efficiency Working Group), as well as staff from the various agencies.

The strategic planning process resulted in the development of Salt Spring Island Water Sustainability Framework with two main themes; *Watershed Protection* and *Freshwater Preservation*. Groundwater resource preservation and aquifer protection were identified as priorities of focus for the framework. The framework was approved in principle by the SSIWPA steering committee on November 23, 2018 and the LTC on December 02, 2018.

The Salt Spring Island Water Sustainability Framework is framed into four categories; Data Stewardship and Information Inventory; Monitoring and Analysis; Policy and Planning; and Education and Outreach.

The objectives of the four categories are;

- Data Stewardship and Information Inventory:
 - *Provide access to watershed and water use information for member agencies and the public.*
- Monitoring and Analysis
 - *Coordinate monitoring and analysis strategies to address how natural and anthropogenic changes will impact watershed hydrological function and water use for Salt Spring Island.*
- Policy and Planning:
 - *Develop tools to protect watershed hydrological function and preserve Salt Spring Island's limited water resources.*
- Education and Outreach:
 - *Communicate to alliance agencies and public the state of the Salt Spring Island's watersheds, water resource, and water use.*

The Groundwater Preservation Project is aligned with the Salt Spring Island Water Sustainability Framework and is intended to address these four categories through existing and upcoming projects as supported by the LTC.

Sustainable management of groundwater resources often requires comprehensive aquifer characterization beyond the regional aquifer classification approaches by the Province. Salt Spring Island has several regional aquifers that have recently been reclassified to reflect new regional geological mapping. This report presents an ecosystem approach to groundwater management by identifying *Community Aquifer Recharge Areas* using existing aquifer and watershed mapping in concert with ecological, geological, climatological, land-use, and water-use information.

Community Aquifers are intermediate-scale groundwater management units that provide significant volumes of groundwater to domestic, commercial, agricultural, and water supply wells. *Community Aquifer Recharge Areas* promote replenishment of water to subsurface hydrogeological networks via bedrock fractures, geological faults,

and watershed ecosystems. Identifying recharge area for planning and conservation is a vital first step in an ecosystem approach to groundwater management.

GROUNDWATER PRESERVATION PROJECT UPDATES

Salt Spring Island groundwater Wells Inventory Project

As part of *Salt Spring Island Groundwater Wells Inventory Project*, Islands Trust staff collated over 150 professional groundwater reports from subdivision and re-zoning applications from the past 30 years to discover nearly 400 unregistered groundwater well records. These well records will be included in the GWELLS system to improve the overall functionality of the registry and will inform groundwater resource management strategies including technical assessments for groundwater authorization, hydrogeological models, and aquifer protection planning.

Salt Spring Island Groundwater Monitoring Pilot Project

With the support of agency staff and the SSIWPA coordinator, Islands Trust was awarded a Real Estate Foundation of BC Freshwater Sustainability grant to create the *Salt Spring Island Groundwater Wells Monitoring Pilot Project*.

In summer 2018, monitoring stations were installed to collect groundwater level, temperature, and in select locations salinity/conductivity from ten volunteered domestic groundwater wells across the island at varying elevations and aquifers. The project is currently in the pilot monitoring term with two additional groundwater wells and three surface water lakes will be instrumented before the end of fiscal, March 2019. Final reporting to Real Estate Foundation of BC is in December 2019 to allow for a full season of data collection and analysis.

The topography and geology of Salt Spring Island is complex which varies the behavior of groundwater across the island. Increasing the spatial coverage of long-term groundwater elevation monitoring allows for a closer look at how groundwater behavior and aquifer water budget analysis. A popular groundwater balance calculation is the “*Water Table Fluctuation*” method that is reliant on groundwater level monitoring data as the primary indicator of the availability of groundwater to meet demand. Increasing the density of groundwater monitoring locations across the island allows for smaller area units that are more realistic for analysis using the *Water Table Fluctuation* method. These types of analysis are used to determine the groundwater carrying capacity for specific aquifer regions on scales that are useful for land-use planning and conservation area designations.

Observation of groundwater levels across the island investigates how different groundwater regions react to climate and oceanic fluctuations. Furthermore; changes in groundwater levels in wells is due to fluctuations in the hydraulic pressure of the aquifer system. In addition to understanding volumes of availability and demand; investigating the hydraulic pressure of an aquifer is equally important and is a critical variable in groundwater management, especially in summer months when groundwater use is high and regional hydraulic aquifer pressures are lower.

Investigation of groundwater levels also gives insight to determining well capture zones; an identified area surrounding a groundwater well that is estimated to provide water to a well in approximately 100 days of regular use and withdrawals. As groundwater is pumped from a well, the level will drop creating a drawdown cone of pressure to induce radial flow toward the well. Estimating well capture zone is dependant on the behavior of the drawdown cone which is influenced by aquifer and well properties.

Long-term monitoring of groundwater levels in multiple areas of the island is of an investigative scale that is appropriate in observing impacts to recharge and for determining well capture zones both of which are central in determining carrying capacity of an aquifer or groundwater management region.

COMMUNITY AQUIFER CONCEPT: AN ECOSYSTEM APPROACH TO GROUNDWATER MANAGEMENT

Groundwater is one of our most valuable resources: it supports and nourishes life and is a foundation for island and provincial economies. Holistic ecosystems approaches to groundwater management have been proposed by [J.D. Henderson \(1998\)](#) and others to raise awareness of groundwater resource sustainability in island communities.

An ecological approach to groundwater management is the definition and identification of *Community Aquifers*. An intermediate-scale of regional aquifers; *Community Aquifers* are groundwater management units that provide significant volumes of groundwater shared by domestic, commercial, agricultural, and water supply wells. *Community Aquifers* are defined by topography, watershed ecology, aquifer geology, resource use distribution, and climatic risk.

The *Community Aquifer* concept for groundwater management has been proposed in several research initiatives and policy strategies. Notably in 1994, W.S Hodge of the Groundwater Section of the Water Investigation Branch of the Ministry of Environment authored [A Preliminary Geohydrological Study of Salt Spring Island](#); and presented intermediate-scale *groundwater regions*. Modern definitions of *Community Aquifers* on Salt Spring Island will be informed by the 1994 study in concert with other projects related to groundwater resources in the Gulf Islands.

The protection of aquifers is a shared responsibility. According to the [BC Groundwater Bylaws Toolkit](#), local governments have an important role to play in understanding groundwater science, protecting aquifers, and maximizing the recharge of water into watersheds.

Community Aquifer Recharge Areas

Aquifer recharge is considered to occur in most places on the Gulf Islands, however, due to changes in topography, geology, biogeography, climate and land-use, the magnitude and significance of recharge changes with the landscape. All *Community Aquifers* have associated recharge zones to sustain groundwater use in the region. *Community Aquifer Recharge Areas* are locations on a landscape that have potential to provide significant water replenishment to aquifers from interconnectivity of water on the surface landscape to subsurface environments.

Over the past decade or so several geographic aquifer recharge potential methodologies have been proposed; using available map data and remote sensing analysis of land cover, thematic geographical information system (GIS) data layers are developed to assess the potential groundwater recharge for defined *Community Aquifers*. Lithology, land use land cover, precipitation and slope are determined to be the most influential factors controlling recharge potential, followed by lineament density, soil type and drainage density.

The regional influence of mountain block recharge and the relationship to the recharge areas in the upper watershed needs to be investigated to better understand the groundwater system and the lateral movement of water between aquifers. Identification of data gaps and strategies to fill those gaps are required to further refine recharge assessment by using three-dimensional hydrogeological models and improve groundwater resource data sets. The proposed analysis will use weighted thematic layers relating to groundwater recharge to calculate relative recharge potential. The results identified groundwater recharge potential in two dimensions at or near ground surface, in a mapping form that can be used by land-use planners and groundwater management programs.

The main objectives of using of remote sensing and GIS techniques to map groundwater recharge potential on Salt Spring Island is to identify higher recharge zones can be prioritized for additional research, more in-depth analysis, or for source water protection.

2018-2019 PROJECT CHARTER EXPANSION AND SCOPE OF WORK

In 2016, the LTC supported a “Groundwater Supply” project, now called the Groundwater Preservation Project, to coordinate SSIWPA agencies in developing a *Salt Spring Island Well Inventory project* and the *Salt Spring Island Groundwater Wells Monitoring Pilot Project* with funding support from the LTC, SSIWPA member agencies, and the Real Estate Foundation of BC Freshwater Sustainability grant.

Throughout 2018-2019 LTC and SSIWPA funds have been allocated budgets on-going projects with deliverables planned to be completed in 2019. This report is recommending an expansion of the project charter to retain a consultant to identify *Community Aquifer Recharge Area* using 2018-2019 Water Management funds to be completed by the end of 2018-2019 fiscal year in March.

The goals of the Project are to:

- *Coordinate groundwater and aquifer information between Islands Trust, SSIWPA member agencies, and the consultant;*
- *Inventory information and data into a data framework to perform Community Aquifer Recharge Area analysis;*
- *Provide access of groundwater information data for the use of SSIWPA member agencies and related initiatives by way of a demonstration data dashboard;*
- *Create recharge potential base maps; and*
- *Recommend strategies to improve recharge area analysis and overall groundwater resource data gaps.*

Technical Coordination and Data Stewardship

Islands Trust is data-rich with respect to natural resources geographical information science (GIS); this project will involve technical coordination between Islands Trust Information Services and the consultant. Utilizing existing data datasets to create a recharge area map will leverage on existing data to provide a Spatial Decision Support System (SDSS) derivative knowledge product similar to the [Islands Trust Conservancy Regional Conservation Plan](#).

Recently, Ministry of Forests, Lands, Natural Resource Operations, and Rural Development have undertaken a significant project determining how much water is available in aquifers on Salt Spring Island by calculating monthly water balance for the island aquifers. The data collected in that project will inform the quantification of groundwater recharge however the 2018-2019 *Community Aquifer Recharge Area* analysis will focus on *where* recharge occurs and out of scope at this time is to determine *how much* recharge is occurring.

Various datasets are needed to complete the recharge area analysis, therefore organization of the data into a framework is imperative. Over the past couple of years, information networks and data visualization software has advanced. Islands Trust staff have explored various data management strategies including watershed/aquifer centric data dashboards that can be explored by the end-user, asking questions of the data intuitively and timely.

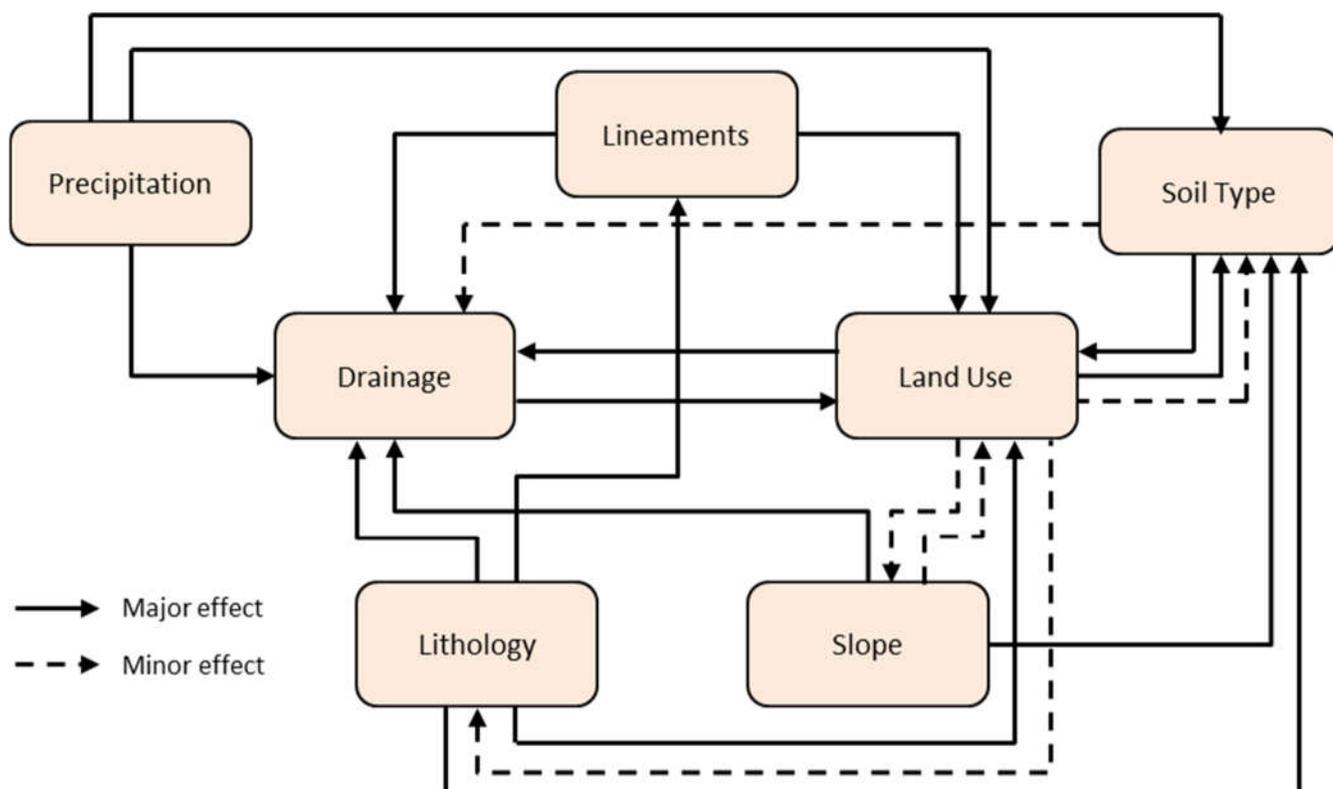
In addition to the recharge base maps; this project will result in a demonstration dashboard and three-dimensional hydrogeological model of Salt Spring Island, which due to the limited time and budget of this project expansion, will be further modified and defined at a later date.

Methodology and Analysis

The proposed *Community Aquifer Recharge Area* identification will be using a modified Groundwater Recharge Index method proposed by [G. Henderson \(2018\)](#) when determining groundwater recharge potential in the Englishman River watershed on Vancouver Island. Henderson modified a methodology of interrelationship influences of factors affecting groundwater recharge. The influence of the interrelationship between potential recharge factors varies between factors. Ecological consideration is taken when classifying relationship strengths based on the influence strength that the parameter has on the other interrelated factors.

The methodology includes, but is not limited to, the following associated datasets:

- **Topography and Slope** – in a gravity driven drainage system, groundwater is influenced greatly by the topography of a landscape, and the classification of types of slopes and slope breaks is essential in determining areas that promote aquifer recharge.
- **Lineament density** - a quantitative measurement of the length of lineament features per area that are used as a proxy to infer higher potential for groundwater recharge in bedrock-dominated areas.
- **Drainage density** - the length of stream features per area. Higher drainage-length density is an indicator of lithology suitable for percolation rates associated with higher groundwater recharge
- **Soil type** - one of the key factors that control groundwater infiltration.
- **Precipitation** – island aquifer are gravity driven systems and rainfall is the primary source of recharge for groundwater.
- **Land Cover** - Groundwater recharge rates are dependent on the land use or land cover at surface. Impermeable developed areas and non-fractured bedrock surfaces have little or no permeability, while surface water and vegetated areas have much better potential for groundwater recharge.
- **Lithology** - a primary factor controlling the infiltration of rainfall into aquifers



Outcomes and Deliverables

The proposed deliverables of the proposed project expansion will be;

- *Community Aquifer Recharge Areas* Base Maps;
- *Community Aquifer* demonstration data dashboard, and
- *Community Aquifer Recharge Area* demonstration three-dimensional hydrogeological model.

Staff recommends the allocation of \$5,000.00 from the LTC Water Sustainability 2018-2019 fiscal budget to hire a groundwater-focused consultant to develop a data framework and analysis methodology to identify *Community Aquifer Recharge Areas* on Salt Spring Island and provide base maps and other outlined deliverables by the end of fiscal in March 2019.

The deliverables are intended to be updated as new information, data, and priorities arise. The deliverables align with the Salt Spring Island Water Sustainability Framework objectives and staff will work with the consultant to prioritize information that is required for long range planning to advance the project objectives.

SUMMARY

Groundwater supplies approximately half of the water needs of the Salt Spring Island community and is an ecological component of our watersheds. Aquifer protection measures are integral component of land-use planning for protecting watershed ecosystems and management of groundwater resources for island communities.

The Salt Spring Island Local Trust Committee (LTC) has maintained Water Sustainability (formerly “Watershed Management”) as a top priority since 2013. The LTC has, through a hired contractor, coordinated the Salt Spring Island Watershed Protection Alliance (SSIWPA); a forum to coordinate multiple jurisdictions in planning for water sustainability and watershed protection on Salt Spring Island. In 2016, the LTC supported a “Groundwater Supply” project, now called the Groundwater Preservation Project with on-going data stewardship and monitoring projects.

Staff recommended that the LTC endorse the expansion of the Groundwater Preservation Project to include *Community Aquifer Recharge Areas* and continue to pursue Water Sustainability as a top priority work program. The proposed expansion is align with the Salt Spring Island Water Sustainability Framework and the LTC will have to prioritize long range planning resources to advance the outcomes of these proposed objectives.

RATIONALE FOR RECOMMENDATION

The recommendations in this report will build on the community’s existing investment in coordinated watershed protection on Salt Spring Island. The Groundwater Preservation Project as presented in this report, aligns with the Salt Spring Island Water Sustainability Framework and the LTC top priority Water Sustainability. Throughout its development the intention of the Groundwater Preservation Project is to address the four categories through existing and upcoming LTC projects and to support related projects conducted by SSIPWA member agencies through coordination functions.

Through coordination and collaboration with government agencies, stakeholders, and community consultation, the LTC may receive additional information to support the Groundwater Preservation Project and to guide consideration of a different approach for addressing aquifer protection and groundwater resource preservation across multiple jurisdictions.

ALTERNATIVES

The LTC may consider the following alternatives to the staff recommendation:

1. THAT the Salt Spring Island Local Trust Committee not endorse the expansion of the Groundwater Preservation Project to include *Community Aquifer Recharge Areas*.

The LTC may defer consideration of the project expansion. The impact would be to lose the opportunity to use current existing available funding and feasibly to lose momentum on protecting and preserving watersheds.

NEXT STEPS

If the LTC chooses to endorse the expansion of the Groundwater Preservation Project charter;

1. A direct award service contract will be awarded to a groundwater-focused consultant to develop a data strategy and methodology to define *Community Aquifers* and to define *Community Aquifer Recharge Area*; *which will include* base maps, a demonstration data dashboard, demonstration three-dimensional island hydrogeological model and a technical report.

| | | |
|---------------|---|-------------------|
| Submitted By: | William Shulba, P.Geo Senior Freshwater Specialist | February 14, 2019 |
| Concurrence: | Stefan Cermak, Regional Planning Manager | February 19, 2019 |

ATTACHMENTS

1. Project Charter 8.2: Water Sustainability – Groundwater Preservation Project

Water Sustainability: Groundwater Preservation Project

Project Charter v8.2

Salt Spring Island Local Trust Committee

Date: February 26, 2019

Purpose

This project addresses the need for information inventory, mapping, and data analysis to preserve groundwater use and protect aquifers through land-use planning and coordination function of the SSI LTC. Islands Trust staff and the LTC are supporting this project through project management, coordinating funding, and cooperating with other governments and organizations to inform groundwater resource management decisions through evidence-based groundwater-use planning and aquifer protection strategies.

Community Aquifer ecosystem mapping is essential to determining aquifer protection strategies and groundwater well monitoring is a primary variable in calculating carrying-capacity of groundwater resources on Salt spring Island. Surface water resource monitoring has been recommended to further understand interactions between groundwater and surface water to further define calculations of aquifer water budgets.

Background

The Salt Spring Local Trust Committee has advanced water sustainability as a top priority including coordinating the Salt Spring Island Watershed Protection Alliance (SSIWPA). Through the SSIWPA strategic planning process in 2018, the Salt Spring Island Water Sustainability Framework was established to address projects relating to *Watershed Protection* and *Freshwater Preservation* identifying aquifers. The Ministry of Forest Lands and Natural Resources (FLNRO) is an active member of SSIWPA that has funded a two year program to revise the aquifer mapping (2016-17) and develop island-scale aquifer water budgets (2017-18); with mutual outcomes linked and benefited by this project. The Capital Regional District CRD is an active member in SSIWPA and is supporting this project through the lake monitoring component of this project. With the assistance of grants manager at Islands Trust and support from CRD and FLNRO, SSIWPA acquired a freshwater sustainability grant from the Real Estate Foundation of BC for the *SSI Groundwater Wells Monitoring Pilot Project (2017-2019)*.

Objectives

- Inventory groundwater quantity and quality information to inform land use planning decisions.
- Identify priority areas of groundwater recharge and targeted investigation.
- Supplement existing Provincial GWELLS inventory.
- Inventory and review well reports on file at Islands Trust and survey targeted private well owners.
- Receive Real Estate Foundation grant for groundwater monitoring pilot program.
- Establish a community well monitoring program to supplement provincial observation well network.
- Identify locations for surface water monitoring including lake level monitoring stations.
- Identify aquifer ecosystem types and areas.

In Scope

- Coordination with various Islands Trust staff, FLNRO staff and SSIWPA coordinator.
- Procurement and contract management for well data review, inventory, and well-owner survey.
- Map project results; cross reference well data to WELLS database and enter new records.
- SSI LTC application for funding (REFBC).
- Pilot program to monitor changes in water levels in 12 groundwater wells and several lakes.
- Investigation of long-term monitoring strategy
- Development analysis framework to determine of Community Aquifer Recharge Areas
- Development of a data framework to explore groundwater data and information.

Out of Scope.

- Consumption metering
- Drilling of new wells
- Decommissioning of wells
- Monitoring wells outside of identified priority areas.

| Project Team | | Budget | | |
|---|---------------------------|--|---|--|
| Jason Youmans, Islands Trust Island Planner | Program Manager | Budget Source: SSI LTC Watershed Management - 4014 | | |
| William Shulba, Islands Trust Senior Freshwater Specialist | Project Lead | Fiscal | Item | Cost |
| Sylvia Barroso, FLNRO Hydrogeologist | FLNRO/TWG Project Lead | 2018-19 | Community Aquifer Recharge Area Analysis and Demonstration Watershed Data Dashboard | 5,000.00 |
| Mike Richards, Islands Trust Grants Administrator | Grant Administrator | 2018-19 | Total | 5,000.00 |
| Mark Van Bakel, Islands Trust Information Systems Specialist | Information Coordinator | | | |
| Shannon Cowan, SSIWPA Coordinator | Project Coordinator | RPM Approval: Stefan Cermak | | LTC Endorsement: Resolution #: |
| Dale Green, CRD, Senior Environmental Science Officer | Project Technical Support | Date: February, 19, 2019 | | Date: 124 |

Work plan Overview

| Deliverable/Milestone | Lead | Staff Time | Target Date |
|---|---|---------------------------------|---|
| Process to issue contract the well inventory/survey. | William Shulba, Nancy Roggers, Islands Trust; Shannon Cowan, SSIWPA; Sylvia Barroso, FLNRO; . | 14 hours | Complete |
| Project management, coordination between leads. | Jason Youmans, Island Planner and Shannon Cowan, SSIWPA. | 35 hours | On-going |
| Identify priority areas for inventory and monitoring. | William Shulba, Islands Trust; Shannon Cowan, SSIWPA; Sylvia Barroso, FLNRO | 2 hours | Complete |
| Wells Inventory: Review of Islands Trust well reports, survey of well owners, data gathering and compilation. | Contractor, supervised by Sylvia Barroso, (FLNRO); coordinated by Shannon Cowan (SSIWPA), IT file orientation by SSI Staff. | 2 hours (SSI Staff) | Complete |
| Final well inventory and report to Local Trust Committee | Contractor with assistance from: William Shulba, Islands Trust; Shannon Cowan, SSIWPA; Sylvia Barroso, FLNRO | 14 hours | Complete |
| Facilitate Real Estate Foundation Grant Application | Shannon Cowan (SSIWPA) /Mike Richards (Islands Trust) | 5 hours | Complete |
| Evaluate List of Potential Monitoring Locations. | William Shulba, Islands Trust; Shannon Cowan, SSIWPA; Sylvia Barroso, FLNRO | 1 hour | Complete |
| Establish agreements with well owners and dock owners for monitoring. | William Shulba, Islands Trust; Shannon Cowan, SSIWPA; Sylvia Barroso, FLNRO | 7 hours | May 2018— Dec 2018 |
| Fieldwork to install monitoring equipment. | William Shulba, Islands Trust | 100 | Aug 2018— March 2019 |
| Data collection, transfer and analysis. | William Shulba, Islands Trust | 100 | Spring 2018— Dec 2019 |
| Process and interpret data. | Contractor supervised by: William Shulba, Islands Trust | 100 | After 4-6 months of data collection at regular intervals. |
| GIS Data Input and Analysis | Islands Trust GIS Staff in consultation with Sylvia Barroso, FLNRO and William Shulba, Islands Trust | Freshwater specialist : 100 hrs | November, 2019 |
| <i>Community Aquifer Recharge Area</i> mapping and demonstration watershed data dashboard | William Shulba, Islands Trust Groundwater Sciences Consultant | 40 hours | February 2019— March 2019. |
| Final Project Report and presentation of work result to Salt Spring Island Local Trust Committee. | Jason Youmans, Islands Trust; William Shulba, Islands Trust; Shannon Cowan, SSIWPA; Sylvia Barroso, FLNRO | 7 hours | Update before Oct 31 2018; Final Dec, 2019. |
| | | TOTAL: 527 hours | |