

Water Management Plan

CRYSTAL MOUNTAIN SPIRITUAL EDUCATION CENTRE

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V1.1

Table of Contents

1	Introduction	4
1.1	Site Plan	4
2	Site Stormwater	6
2.1	Description of Soils and Ecology.....	6
2.2	Stormwater Management Summary.....	11
3	Groundwater	12
3.1	Summary	12
3.2	Sustainable Yield.....	13
3.3	Water Quality	13
3.4	Wellhead Protection.....	13
4	Water supply – Water Balance	17
4.1	Overview	17
4.2	Fire Storage	17
4.3	Maximum Daily Demand	17
4.4	Storage.....	19
5	Water Safety Plan – Area 1	21
5.1	Risk/hazard identification	21
5.2	Mitigation (LRT/LRV)	21
5.3	Treatment.....	22
5.4	Supply system	22
5.5	Operations and Monitoring Overview	23
5.6	Emergency Response Plan	23
6	Waste Water	25
7	Rainwater	26
8	APPENDICES	27

1 Introduction

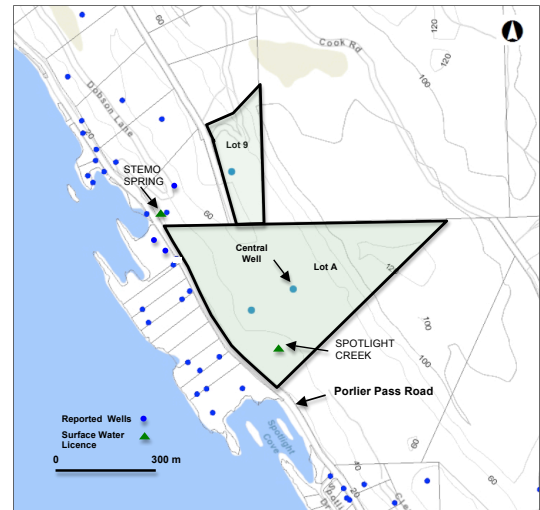
Crystal Mountain Spiritual Education Centre (CMSEC) is located adjacent to and east of Porlier Pass Road at the north end of the island near Spotlight Cove (Figure 1). The Crystal Mountain lands include Lot A, District Lots 88 and 89, Plan VIP68079 and Lot 9, District Lot 90, Plan 31200, Galiano Island, Cowichan District. Lot A is zoned Forest 1 (F1) and Lot 9 is zoned Rural 2 (R2) in the Galiano Land Use Bylaw (Islands Trust Staff Report, 2015).

The Society has applied to rezone the two lots to create a nature protection area comprising 75% of the combined total lot area along with a spiritual education retreat centre on the remaining 25%. This report summarizes an overall water management plan covering the use of groundwater to meet the potable water needs for year-round usage of the spiritual education centre portion that includes retreat participants and fulltime caretaker occupancy.

Included are summaries of:

- Groundwater
- Stormwater
- Water demand
- Potable Water Safety Plan
- Fire Suppression
- Waste Water
- Rainwater

Figure 1 Subject area



1.1 Site Plan

The changes from the existing land use (Figure 2) to the proposed rezoning (Figure 3) are provided for reference. The proposed plan includes two defined areas – Area '1' and Area '2' and the amenity transfer demarcation to Islands Trust Conservancy (ITC). See Appendix A and B for larger versions of Figure 2 and Figure 3

Lot A, District Lots 88 and 89, Plan VIP68079 will be comprised of two retreat areas:

- *Primary Retreat Area '1'* (Figure 3)
 - Central Kitchen (existing)
 - 14 meditation/sleeping huts (no plumbing)
 - Rainwater collection system
 - Water treatment system
 - Central Washroom
 - Caretaker Building
 - 1 Meditation Hall (no plumbing)
 - Central Well (WID# 23227) – 125 ft depth; currently in use
 - Observation Well (WID# 23229) – 183 ft depth; not in use
- *Upper Ridge Retreat Area '2'* (Figure 3)
 - Left undeveloped until a new well is drilled and registered
 - Future Upper Bathroom and Kitchen
 - Future 3 sleeping huts (no plumbing)
 - No existing well – planned to have new well developed

Lot 9, District Lot 90, Plan 31200 is undeveloped – comprises part of the amenity transfer to ITC

- Well (WID#23228, WTN56538) – 280 ft depth; not in use

Figure 2 Existing Land-use (larger version found in Appendix A)

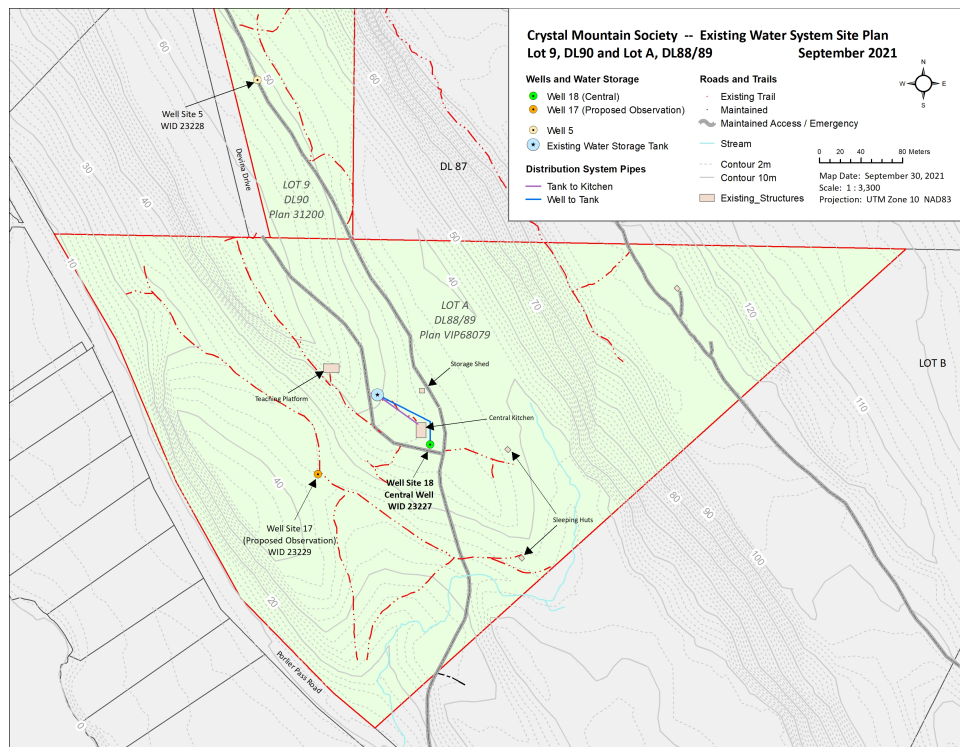
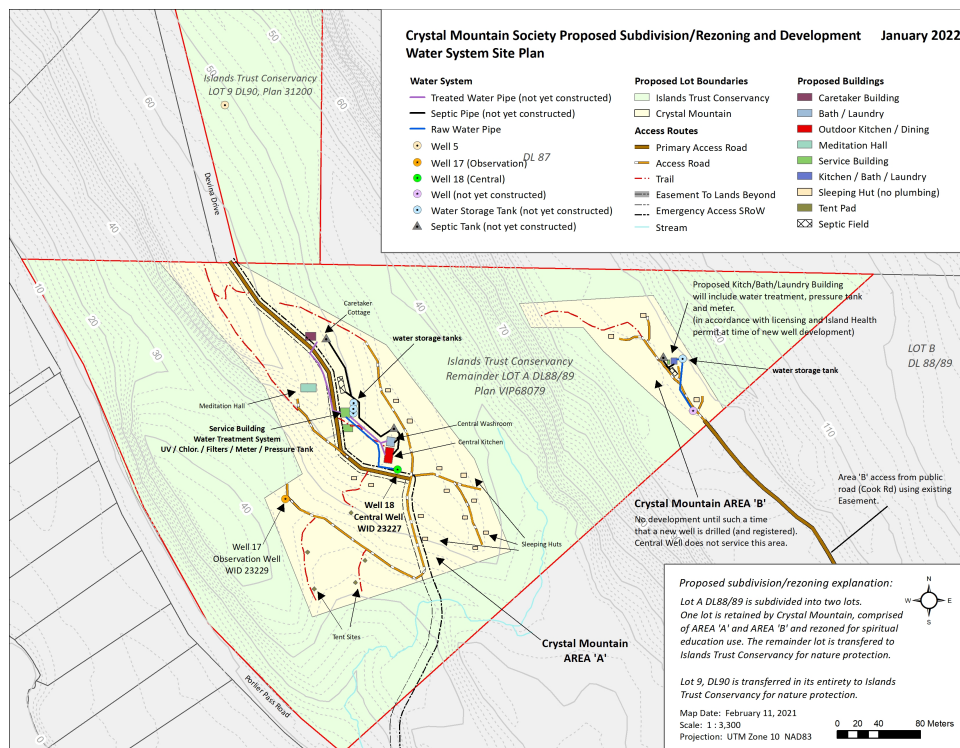


Figure 3 Proposed Land-use with Rezoning (larger version found in Appendix B)



2 Site Stormwater

Proposed development has been restricted to two areas of the property Area 1, which is approximately 5.1 hectares in size and Area 2, which is approximately 1 hectare in size. Both areas are forested and naturally vegetated, they are characterized by gentle to moderate slopes and well-drained soils over permeable fractured sandstone bedrock.

The primary disturbance in these areas is logging. They were logged at least twice. MacMillan Bloedel records suggest that Area 2 was cut for the first time in the late 1870's while Area 1 was cut in the early 1920's. More recently, both areas were clearcut between 1993 and 1996 (by the owner previous to Crystal Mountain). It appears that the cut area was not planted and is regenerating naturally with mixed vegetation. The clearcut was intensive and appears to have been completed with excavators and skidders resulting in significant impacts to the soils, especially in moist and seasonally flooded areas outside of the development areas. Dirt roads were constructed in association with the logging. Crystal Mountain has used and maintained these roads and has not constructed any additional routes.

Except for building footprints, no impervious surfaces are proposed. All roads and parking areas will remain unpaved. The total allowed building footprint is 842m² in Area '1' (1.6% of area) and 109m² in Area '2' (1% of area). New buildings will be situated within the natural forest with minimal clearing. Where clearing around buildings occurs, surfaces will be vegetated with grass and other landscaping vegetation. Gravel or mineral soil may be maintained within a 1.5m perimeter around buildings in compliance with Firesmart recommendations. A large, maintained grass clearing will be maintained around the Kitchen and Washhouse site in Area 1 to accommodate a solar PV system.

Crystal Mountain access routes utilize existing logging roads through well-drained areas where no significant surface flow has been observed, including during high intensity storm events such as those occurring in November 2021. The one exception is the portion of proposed emergency access road where it crosses the creek (see Figure 4). This portion is being transferred to the Islands Trust Conservancy for nature protection purposes. Prior to transfer, Crystal Mountain has agreed to complete minor road upgrades to bring it up to standard for emergency vehicles. This will include the creation of bioswales alongside the road, to capture surface water, slow its velocity to allow for absorption into soil, and in the case of high intensity storm events, discharge excess surface flow into the creek across rubble to prevent scouring.

Crystal Mountain has also committed to rehabilitating old logging roads that currently provide access to sleeping hut sites outside of the development area, slated for decommissioning. They will use the "rough and loose" method, restoring soil permeability, reducing surface runoff, and improving groundwater contribution (see Figure 4).

2.1 Description of Soils and Ecology.

Soils Overview

Soils in both the upper and lower sites have been generally classified as "Saturna" (Soils of the Gulf Islands of British Columbia Vol 3 Soils of Galiano, Valdes, Thetis, Kuper and lesser islands (1989); Report No. 43, BC Soil Survey. Agriculture Canada). Saturna soils are well drained and droughty during the summer. They have developed on shallow deposits of channery, sandy loam to channery, loamy sand textured, colluvial and glacial drift materials over sandstone bedrock within 100cm of the surface. Areas of the property are characterized by very shallow lithic Saturna soils often associated with bedrock exposures or very thin mineral soil layers less than 50 cm deep. Coarse fragment content varies between 20 and 50%.

2.1.1 Area '1'

Natural forest characterized by a regenerating Douglas-fir – salal (CDFmm/01) young stand. Arbutus, red alder, and bitter cherry remain in the stand (though will be shaded out over the next few decades). The ecosystem includes scattered larger diameter, dominant bigleaf maples, Douglas-firs and the odd western redcedar that were likely left as seed trees after the last logging. Areas towards the lower slope and proposed lot boundary include a higher density of grand fir and slightly moister and richer soils more representative of a CDFmm/04 ecosystem.

- Slope: 10-20%
- Aspect: 180-210°
- Structural Stage: YFc
- Mesoslope Position: Mid to upper slope
- Site Series: CDFmm/01
- Soil Nutrient Regime: M
- Soil Moisture Regime: 2-4
- Cover by Layer (%) Tree: 70 Shrub: 20 Herb: 7 Moss: 5

Soils: Silty loam over top of a silty clay loam with approximately 25 to 35% coarse fragment content. Some orange/red mottles observed between 30 and 40 cm deep. Coarse fragments increase towards the upper slope areas. Well drained. Moister richer areas are moderately well drained silty clay loam with 25% coarse fragments and moder humus form.

Disturbance History: Clearcut approximately in 1993 or 1994. Slash burn is indicated by scattered patches of charred material in soils and remaining coarse woody debris on site is charred. The site appears to have been left to naturally regenerate. Machine use on the site has disturbed the soils in general and has left scattered areas of higher disturbance where staging areas or access routes were located.

2.1.2 Area '2'

Natural forest characterized by Douglas-fir, western redcedar naturally regenerating young forest (CDFmm/01 – 90%, CDFmm/04 – 10%) approximately 25 years in age with scattered young 60 to 70 year old seed trees. There are a number of microsites of varying slope, aspect and mesoslope character ranging from moister micro depressions to dryer rock outcrops. Soils are generally well drained silty loams with moderate coarse fragment content and vary in depth between 30 centimeters to greater than 80 cm.

- Slope: Variable, generally 5%
- Aspect: Concave - southwest to northeast
- Structural Stage: PSc
- Mesoslope Position: Flat / Bench
- Site Series: CDFmm/01 (90%), CDFmm/04 (10%)
- Soil Nutrient Regime: M-R
- Soil Moisture Regime: 2-4
- Cover by Layer (%) Tree: 50 Shrub: 60 Herb: 10 Moss: 10

Soils: Silty loam with 25-50% coarse fragment content, well drained to moderately well drained. Soil depth varies from 30 to greater than 80cm.

Disturbance History: The area was logged 25 to 30 years ago leaving a variety of scattered young seed trees that may not have been worth removing at the time of logging. Area is regenerating naturally. Char marks on cwd and stumps indicates low intensity slash burn after logging.

Photo 1 Current meditation platform (to be replaced by ≤ 125 m² structure)



Photo 2 The view out from the meditation platform across the road



Photos 1 and 2 show the current meditation platform and related clearing. Photo 1 (left) is looking at the platform from the road, and Photo 2 (right) is looking out over the road from the platform. This structure is to be replaced with a 125m² (max) meditation hall.

Photo 3 Open air kitchen and landscape



Photo 3 shows the current open kitchen and surrounding cleared area. Access roads branch both to the left and to the right of the photo. Roads are permeable and landscaping is permeable.

Photo 4 Forested area leading to the kitchen - uphill from kitchen



Photo 4 shows the main access road running down from the end of Devina Road to the Kitchen site. A septic field will be constructed amongst the maple trees on the right. A hydro power line will run down the side of the road and water/electrical lines will be buried underneath. The landscape is rough, undulating, absorbent with no signs of scouring from overland flows of stormwater.

Photo 5 An existing meditation hut and the 'trail' located in Area '2'



Photo 6 Updated meditation hut design being considered for future construction



Photo 7 Emergency access road to be transferred to ITC



Photo 7 shows the portion of the emergency access road to be transferred to the Islands Trust Conservancy and brought up to standard. The creek flows under the road from right to left below the depression. A stepped bioswale will be constructed on the right side.

Photo 8 Access road from kitchen toward Devina Dr. (traveling north)

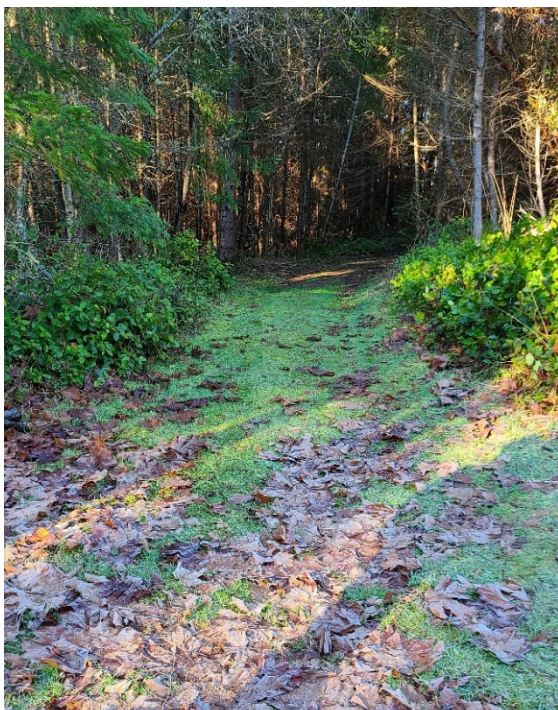


Photo 9 Access road from kitchen toward creek (traveling south)

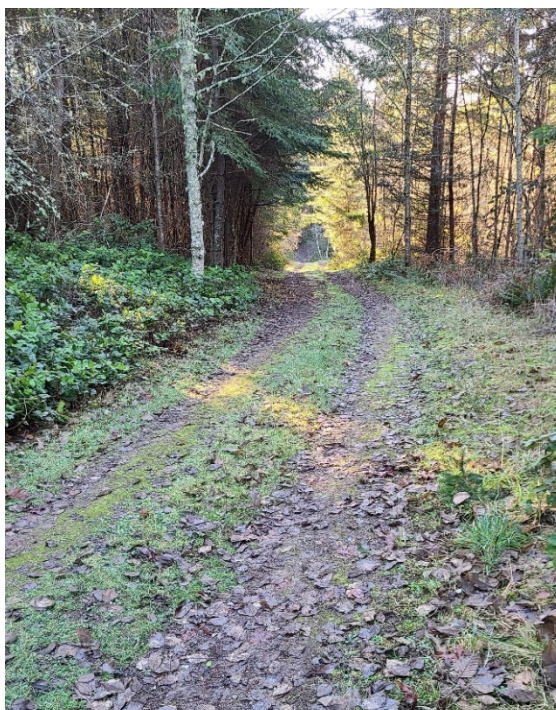
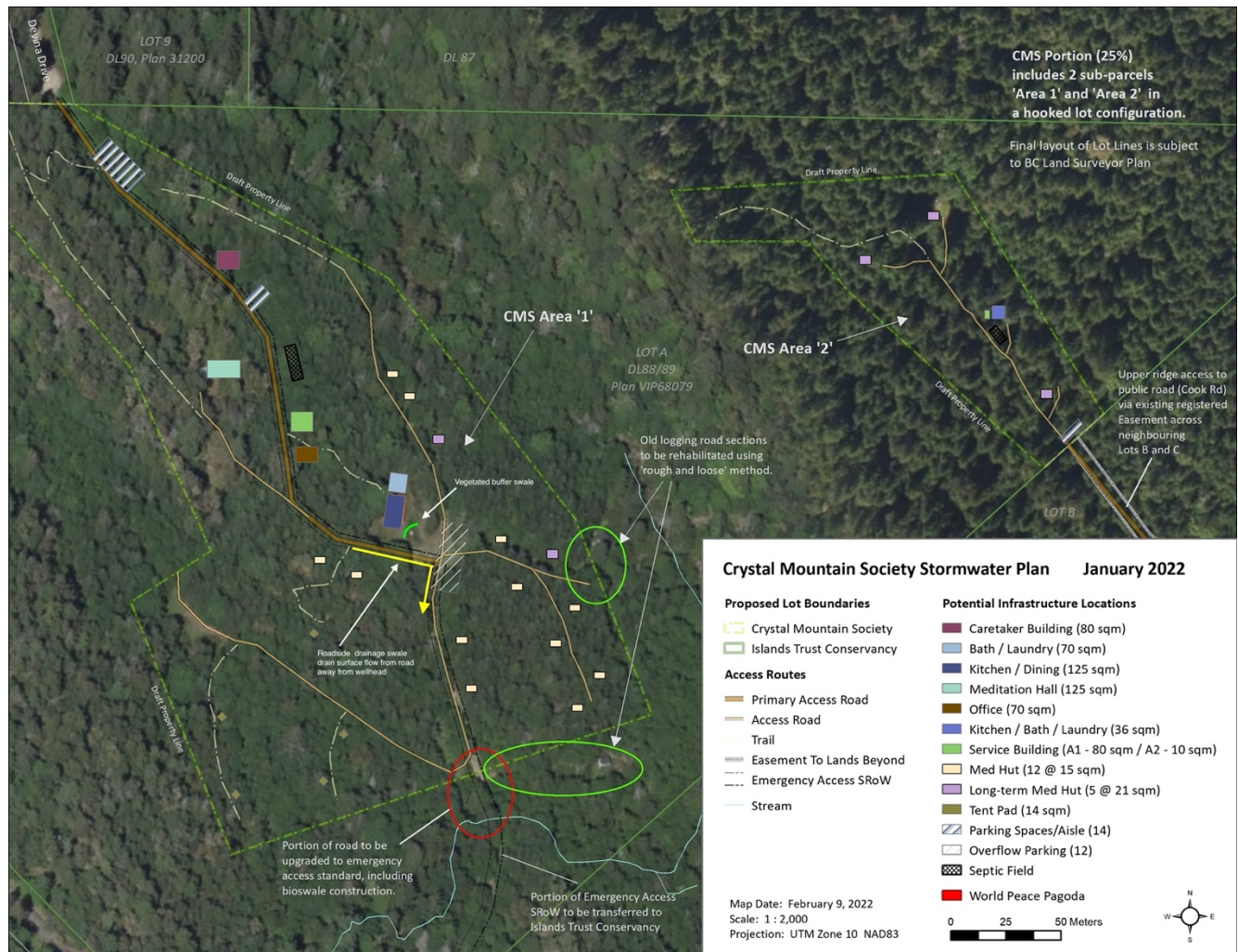


Photo 8 (left) shows the primary access road leaving the kitchen site up towards Devina Dr. Photo 9 (right) shows the access road leaving the kitchen site down towards the creek.

Figure 4 Aerial map of vegetation, proposed development footprint, and stormwater management



2.2 Stormwater Management Summary

Summarizing the site characteristics, the proposed development will not be changing the soils or existing drainage noticeably from pre-development. The history shows exceptional ability to naturally absorb rainfalls even in the extremes experienced in 2021. The additional footprints of the buildings will be designed in accordance with the BC Building code with some potentially serviced by independent small rainwater capture for non-potable use and standard perimeter drainage (refer to Section 7). Roadways will continue to be permeable surfaces.

Modifications will be made that will further enhance absorption and provide wellhead protection.

- Two sections of logging roads will be rehabilitated to for conservation measures – with added benefit of increased absorption
- Vegetated swale across the north west of the Central Well in Area 1 between the well and the kitchen will act as a natural exclusion boundary to the Central Well and mitigate for overland surface flows
- Upgrade to a portion of the emergency access road prior to transfer to the Islands Trust Conservancy (the only area onsite that has shown impact from excess rain events) (Photo 7).
- All buildings subject to building permits will have perimeter drainage as per the BC Building code, with those within the 30 metre buffer zone of the Central Well to drain/infiltrate outside the buffer.

3 Groundwater

3.1 Summary

CMSEC has a comprehensive history documenting groundwater beginning with the initial groundwater assessment in 2015 that assessed sustainable yield, initial water demand assessments in 2021, and the initial ground water level monitoring January 2022. Alan Kohut the senior hydrologist of Hy-Geo Consulting has authored all the reports.

- Appendix C – Groundwater Assessment Report for Crystal Mountain Spiritual Education Centre, Galiano Island, A. Kohut (2015)
- Appendix D – Revised Estimated Water Supply Demand, A. Kohut (June 2021)
- Appendix E – Groundwater Level Monitoring, Crystal Mountain Spiritual Education Centre, Observation Well WID 23229 and Central Well WID 23227, Galiano Island, A. Kohut (January 2022)

Table 1 Well Summary Table

	Central Well WID 23227	Observation Well WID 23229	Observation Well Lot 9 WID23228/WTN56583
	<ul style="list-style-type: none"> • 6 inch (15.24 cm) dia. • 125 ft (38.10 m) depth • Est. flow 18.9 l/m (5 USgpm) • Tested flow 1.06 USgpm (4.035 L/m)² • Sustainable Yield 2.826 L/m (70% of 4.035 L/m) • Static level 68 ft (20.73 m) btoc at drilling; 8.96 m Jan. 2022 • Surface Casing extends 28 ft (8.5m) 	<ul style="list-style-type: none"> • 6 inch (15.24 cm) dia. • 183 ft (55.78 m) depth • Est. flow 26.5 l/m (7 USgpm) • Static level 68 ft (20.73 m) btoc at time of drilling; 14.77 m Jan. 2022 • Surface Casing extends 28 ft (8.5m) 	<ul style="list-style-type: none"> • 6 inch (15.24 cm) dia. • 280 ft (85.34 m) depth • Est. flow 22.7 l/m (6 USgpm) • Static level 55 ft (16.76 m) btoc
Well Use Status	ACTIVE USE	NOT IN USE To be maintained as a Observation well.	NOT IN USE
Sustainable yield¹	2.826 L/m 4069 L/d	Not evaluated	Not evaluated
Observations from pump test	See Appendix C – report summarizes pump test results and sustainable yield calculation	No effects observed during pumping test. Appendix C has graphical record of pump test	No effects observed during pumping test. Appendix C has graphical record of pump test
Ownership after rezoning	CMSEC	CMSEC	Islands Trust Conservancy
Water Quality 2015	<ul style="list-style-type: none"> • Meets GCDWQ on chemistry • Exceedance on presence of Total Coliforms • GARP Status – due to presence of coliforms, depth shallower than 160 ft • Two forms of disinfection required 	Not Tested	Not Tested

1 – Longterm yield is determined by providing an artificial stress and determining the longterm drawdown rate to safe margins to the water-producing aquifer over a simulated 100 days of pumping. Once this rate is determined then the yield is multiplied by 70% provide a security margin

2 – Testing was performed during the seasonal lowest groundwater availability (mid October)) before fall recharge.

3.2 Sustainable Yield

- 2,426 L/m
- 4069 L/d
- 28,483 L/w
- 1.49 mil. L/y

See Groundwater Assessment Report for Crystal Mountain Spiritual Education Centre, Galiano Island, A. Kohut (2015) (Appendix C)

3.3 Water Quality

Water testing originally performed in 2015 was assessed to the 2015 Guidelines for the Canadian Drinking Water Quality (GCDWQ). Those result have been reassessed to the GCDWQ (2020). Physical and chemical parameters meet and exceed the GCDWQ. Presence of coliforms after disinfection were found in 2015 suggesting influence from surface sources. Subsequent testing that is performed regularly for Island Health has shown a consistent absence of coliforms.

This said, the water system will be designed as GARP status due to the historical influence and the location of the well within the contoured landscape and proximity to buildings.

See Groundwater Assessment Report for Crystal Mountain Spiritual Education Centre, Galiano Island, A. Kohut (2015) (Appendix C)

3.4 Wellhead Protection

Upon rezoning, CMSEC will maintain ownership of two wells, the Central Well (WID 23227) for active use, and the Observation Well (WID 23229) for periodic observation.

Maps of the wellhead setbacks and surface water flows in relation the wellheads are found in Figure 5 and Figure 6

3.4.1 Central Well

The central well sits at 45 m elevation with downward gradients radiating away to the east, south and west. North of the well, surface water flows are more prominently directed east and west, except along the crest which is heavily vegetated and buffers surface water flows from the North and Northwest.

Activity within the 30 m setback exists (see wellhead potential source contaminants Table 2). These activities include a road access that passes through, two buildings, overflow parking with vegetated surface that is used 1-2 times a year, and foot trail.

The access road will require a ditch or swale to mitigate and divert surface flows to the east and west at regular intervals to avoid surface flows that could migrate toward the wellhead protection area (30 m setback from the wellhead).

The buildings within the 30 meter buffer will have perimeter drainage extend out beyond the buffer zone to infiltrate down gradient of the wellhead.

A small vegetated buffer will be placed between the wellhead and the central kitchen.

A greywater infiltration system currently servicing a sink in the nearby open 'kitchen' building is located just outside of the 30m buffer. The greywater infiltration system will be decommissioned and removed upon completion of the wastewater system as per Section 6 of this report.

3.4.2 Observation Well

The observation well is set far away from onsite activities. There are no apparent risks to water supply due to land slope, remote location, and locked well cap.

Figure 5 Well Head Protection Map

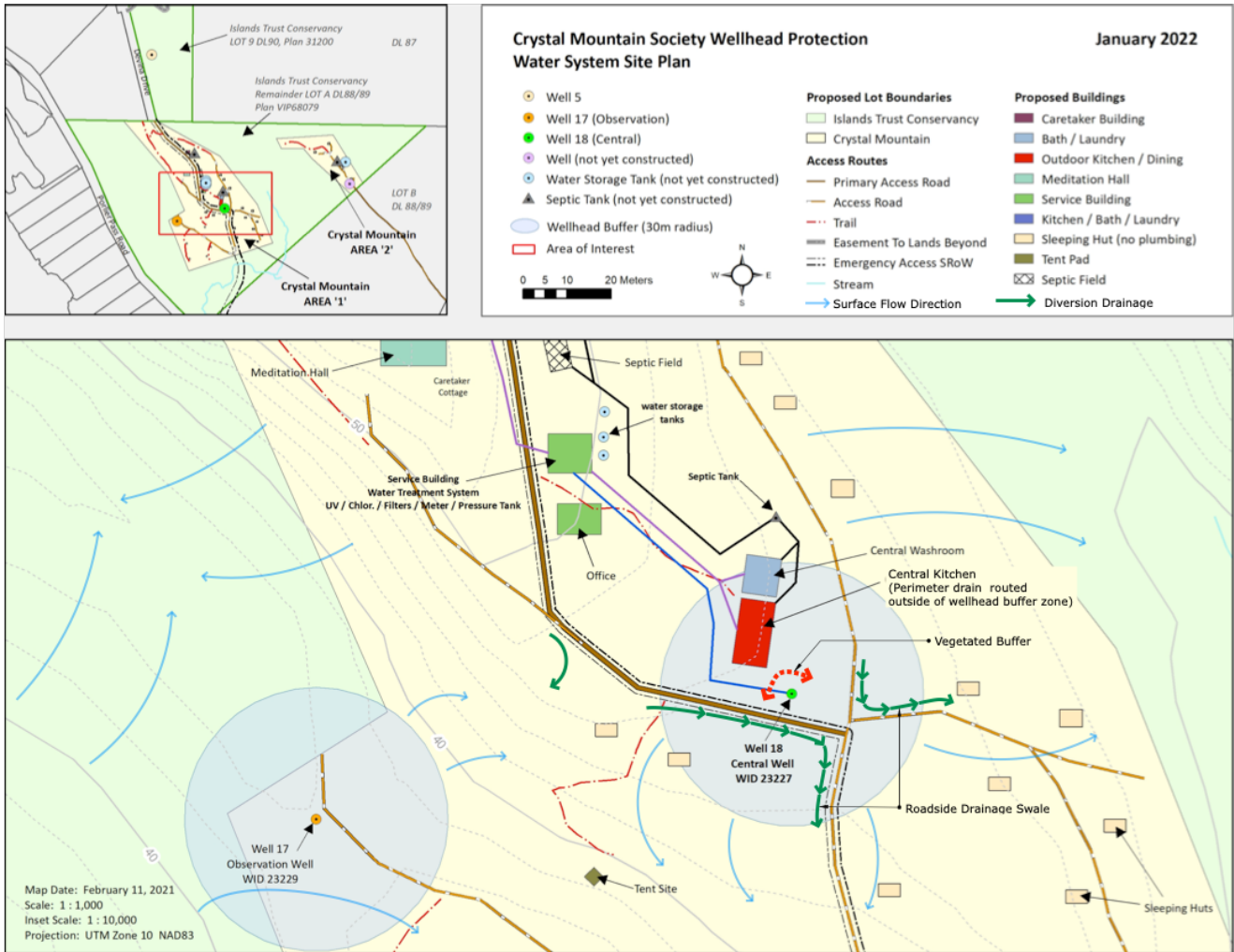
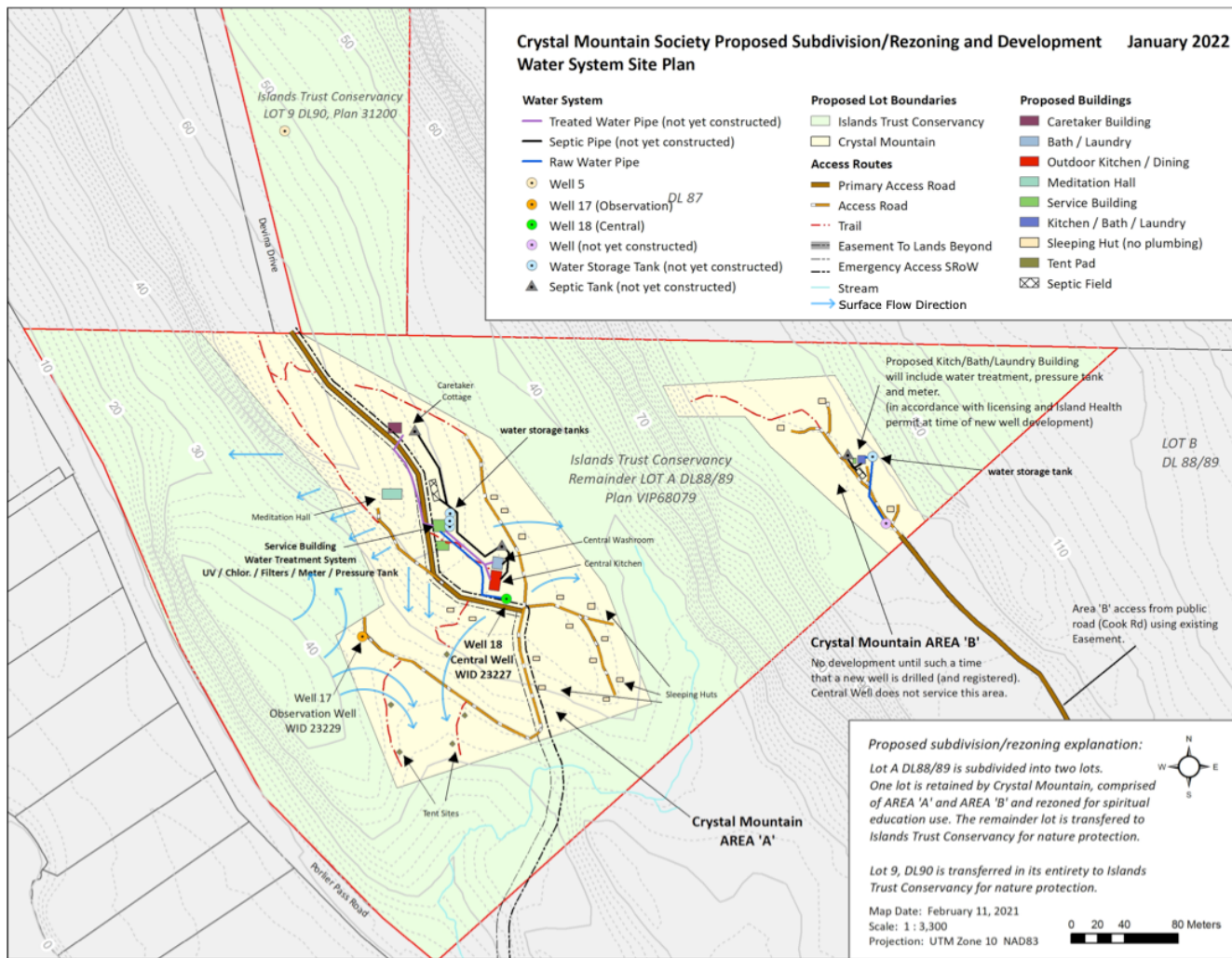


Figure 6 Surface Water Flows in Relation to Wellheads



3.4.3 Groundwater Monitoring

Initial ground water monitoring began in September 2021 for the Observation Well (WID 23229) and October 2021 for the Central Well (WID 23227). The groundwater monitoring report is found in Appendix E.

Observation Well – Static water level 14.77 m below surface.

The water level in the Observation Well was static through September and then gradually rose 3.7 m through to late December. Rainfall events did not cause correlational spikes in levels meaning that waters recharge in a slower gradual fashion tied to cumulative precipitation. This demonstrates that the water infiltration is slower and has more opportunity for filtration potential from the delayed recharge (less potential for short circuiting via cracks and fissures).

Central Well – Static water level 8.96 m below surface

The Central well demonstrated a similar long-term trend rather than rapid responses to rainfall events. Minor fluctuations of 4cm – 8 cm were found and not correlated to tidal fluctuations. The gradual recharge is beneficial for the filtration potential of the well water quality and reduced risks from short circuit recharge via cracks and fissures.

3.4.4 Wellhead Information and contacts

Table 2 Well potential source contaminants

Crystal Mountain Society 20300 Porlier Pass Rd Galiano Island, BC, V0N 1P0 Representative: Keith Erickson			
Health Authority Contact:		Environmental Health Officer 3rd Floor, 6475 Metral Dr Nanaimo, B.C. V9T 2L9 250-755-6215 Fax: 250-755-3372 Email: HPES.Nanaimo@islandhealth.ca	
Water License #		Being processed (refer to Appendix K for application)	
Well ID #23227 (Central Well – active use) WTN# 118140		<ul style="list-style-type: none"> • 6 inch (15.24 cm) dia. • 125 ft (38.10 m) depth • Sustainable Yield 2.826 L/m (70% of 4.035 L/m) • Static level 68 ft (20.73 m) btoc • Surface Casing extends 28 ft (8.5m) 	
Well ID #23229 (Observation Well – not in use) WTN# 118139		<ul style="list-style-type: none"> • 6 inch (15.24 cm) dia. • 183 ft (55.78 m) depth • Est. flow 26.5 l/m (7 USgpm) • Static level 68 ft (20.73 m) btoc • Surface Casing extends 28 ft (8.5m) 	
Potential Source Contamination	Type of Contaminant	Likelihood	Mitigation
Pets and feces	Bacterial	Likely	<ul style="list-style-type: none"> • On Leash policy; dedicated signage restricting pets from well setback area
Sewer line leak	Bacterial, viral	Unlikely though possible	<ul style="list-style-type: none"> • Monthly microbiological monitoring (part of Island Health operating permit)
Road	Chemical (hydrocarbon)	Likely	<ul style="list-style-type: none"> • Swale, ditch or curtain drain to the north of the well head setback area, draining east/west to shunt surface flows downslope and away • Where road is within 30 radius, install swale/ditch along road and drain to the southwest
Overland surface flows	Various	likely	<ul style="list-style-type: none"> • Swale, ditch or curtain drain to the north of the well head setback area, draining east/west to shunt surface flows downslope and away
Waste water infiltration	Bacterial, viral, chemical	unlikely	<ul style="list-style-type: none"> • All wastewater infiltration to meet horizontal separation as per SSR SPM Table III-19; • Historical greywater infiltration to be removed and remediated; • Monthly microbiological monitoring (part of Island Health operating permit)
Access to well head	Various	Potential	<ul style="list-style-type: none"> • Fenced perimeter around well head at 3 m radius • Locked well cap • Signage • Disinfection procedure upon accessing well equipment (data logging, pump, piping)
Overflow Parking (1 to 2 uses per year)	Hydrocarbon	potential	<ul style="list-style-type: none"> • Maintained grassy vegetated surface • Develop spill response protocol for visual leaks (dig out soil, remove to outside buffer, fertilize, cover, wait 1 year)

4 Water supply – Water Balance

4.1 Overview

The water balance includes evaluating the site’s potable and non-potable needs, sustainable withdrawal from the well, and storage for all uses, in a manner that protects the aquifer.

The CMSEC lands will eventually have two areas as noted (Area 1 and Area 2).

Summary of water supply and demand:

Fire Storage	Not required as per Chief Harris correspondence
Sustainable yield	Area1: <ul style="list-style-type: none"> • 2.426 L/m • 4069 L/d • 28,483 L/w • 1.49 mill. L/y Area 2 – To be determined upon future well installation
Max. Daily Demand (MDD)	Area 1 – 2616 L/d at peak daily demand Area 2 – 284 L/d at peak daily demand
MDD as % of well’s sustainable yield	Area 1 – 64% Area 2 –to be determined (well not installed)
Trickle top up flow rate (l/m)	Area 1 – ≤2.83 L/m Area 2 –to be determined (well not installed)
Storage volume (2 weeks + additional 25% buffer)	Area 1 – 45,780 L (10,000 IG; 12,000 USG) Area 2 – 4970 L (1100 IG; 1300 USG)

4.2 Fire Storage

The Crystal Mountain property is within the service area for firefighting from the Manastee Road water supply and does not need an independent water supply for fire purposes. This is from written correspondence from Chief Harris, dated December 21, 2021. A copy of the correspondence is found in Appendix G.

Fire storage does not factor into water balance evaluation as it is not required.

4.3 Maximum Daily Demand

Water demand for the retreat was performed by A. Kohut, P. Eng.. The Water Needs Analysis dated June 24 2021 is the current model – the model was revised to adjust demand for the most recent occupancy model for the expanded retreat (Appendix D). The water demand is premised on the understanding that all potable and non-potable needs will be serviced by groundwater. Crystal Mountain Society may choose to incorporate independent small rainwater harvesting systems for non-potable uses on a building by building approach, ultimately reducing demand from wells, but is not considered in the water balance evaluation.

4.3.1 Primary Retreat Area ‘1’

The Primary Retreat Area (Area 1) will be serviced by the existing ‘Central Well’ with water storage of 45,780 L (10,000 IG, 12,000 USG). The well by itself would be able to meet the required seasonal needs (Kohut 2015).

The water supply from the well would be provided as a trickle charge top-up as required. A water needs analysis was performed in June 2021 by Al Kohut, P.Eng – Hydrologist (Table 3)

Table 3 Water Needs Analysis - Primary Retreat Area 1

Number of persons served	Facilities Used	Period	Estimated Maximum Daily Demand (MDD) (Litres/day)	Comments
2	Caretaker Dwelling	<ul style="list-style-type: none"> Year Round 	700	Residential Use ¹
14	14 Meditation Huts 14 Meditation Huts (no plumbing)	<ul style="list-style-type: none"> May-Oct (100%) Nov-Apr (10%) 	N/A	Sleeping & Meditation use only
5	Tent sites	<ul style="list-style-type: none"> July-Aug (100%) 	N/A	Sleeping & Meditation use only
14	Central Kitchen 3 meals/p/day	<ul style="list-style-type: none"> July-Aug (100%) May/Jun (70%) Sept/Oct (70%) Nov-Apr (10%) 	285	Food preparation, dishwashing, hand washing station, drinking water and limited toilet use ²
14	Laundry (located in either Central Kitchen or Central Washroom TBD)	<ul style="list-style-type: none"> July-Aug (100%) May/Jun (70%) Sept/Oct (70%) Nov-Apr (10%) 	428	1 washer/dryer Periodic use ³
14	Shared Central Washroom	<ul style="list-style-type: none"> July-Aug (100%) May/Jun (70%) Sept/Oct (70%) Nov-Apr (10%) 	1083	2 showers ⁴ 4 washbasins ⁵ 2 toilets ⁶
8	Shared Central Washroom for additional day use persons and teacher	<ul style="list-style-type: none"> July-Aug (100%) May/Jun (70%) Sept/Oct (70%) Nov-Apr (10%) 	120	Food preparation, dishwashing, hand washing station, drinking water and limited toilet use ⁷
TOTAL Peak Demand			2616	

4.3.2 Upper Ridge Retreat Area '2'

The Upper Ridge Retreat Area "Area 2" has very limited water demand needs as it services a washroom facility to be accessed by long term retreat users. It is estimated that MDD is 284 L/day (Table 4).

¹ Based on 350 litres/day/person

² Based on 15 litres/day/person

³ Based on 45 litres/day/person and 50% alternate day use

⁴ Based on 50 litres/day/person and 50% of guest with alternate day use

⁵ Based on 20 litres/day/person

⁶ Based on 12 litres/day/person

⁷ Based on 15 litres/day/person

There is no well at this time for Area 2 – upon development of a new well a hydrological assessment will inform sustainable yield and withdrawal rate.

Table 4 Water Needs Analysis - Upper Ridge Retreat Area 2

Number of Facilities Used persons served	Facilities Used	Period	Estimated Maximum Daily Demand (MDD) (Litres/day)	Comments
3	Shared kitchen 3 meals per day/person	Year Round	45	Food preparation, dish washing, hand washing station, drinking water ²
3	3 Meditation Huts (no plumbing)	Year round	N/A	Sleeping & Meditation use only
3	Shared laundry	Year round	68	1 washer/dryer – periodic use ³
3	Shared Washroom	Year round	171	1 showers ⁴ 1 washbasins ⁵ 1 toilets ⁶
TOTAL Peak Demand			284	

4.4 Storage

Usage patterns will fluctuate throughout the year and throughout the week with the MDD for Area 1 most likely occurring Friday through Monday. Storage is planned to provide for two weeks supply at the MDD, plus an additional 25% buffer capacity. Well water will be pumped at a constant flow rate limited to 2.8 L/m, to an HDPE above ground tank array. Weekly recording of pumped water volume (well totalizing meter) will be evaluated against the expected modeled demand and the safe (sustainable) weekly yield allowance. The storage also acts as the chlorination contact system, sized to ensure the treatment outcomes for chlorine CT (min•mg/L) are achieved.

4.4.1 Water System Storage

- 3 Tanks – Premier Plastic 3330 IG HDPE NSF 61
- Total volume is 45,415 L (9990 IG, 12,000 USG)

4.4.2 Managing groundwater withdrawal

- Sustainable yield is 4069 L/d
- Suggested trickle flow rate 2.8 L/m
- MDD 2616 L/d
- Modelled peak weekly usage 18,312 L/w

The method to manage the trickle feed and the well pump cycling rely on both system design and monitoring program.

System Design – storage level control and flow control (see Figure 7 Storage level controls)

Flow Control Valve:

- adjustable to 2.8 L/m
- ensures withdrawal rate does not exceed the rate of sustainable withdrawal

Automated Actuator Valve:

- Controls the well supply feed to the storage system, when valve is off, well pump sees no demand and shuts off.
- Open/close functions are based on float levels in storage

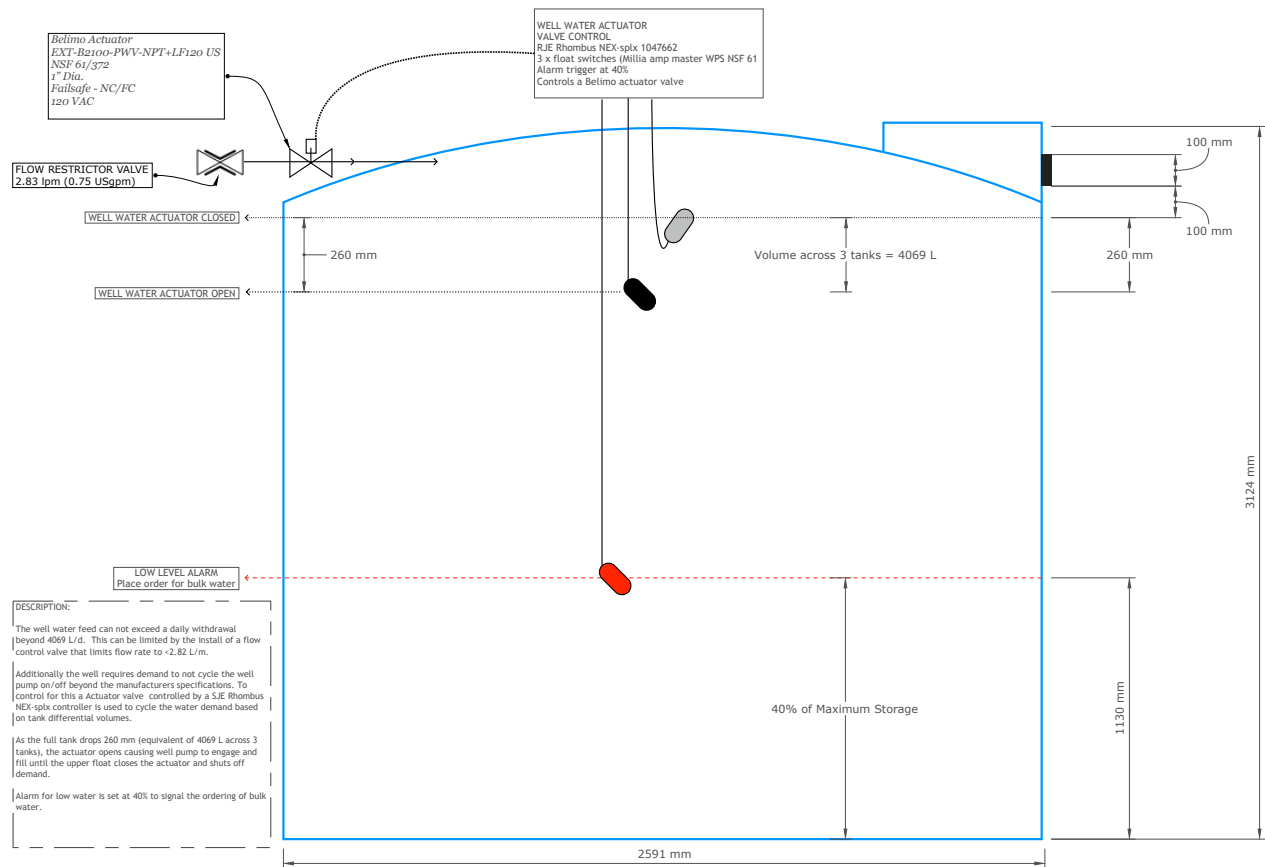
Float Controller:

- SJE Rhombus NEX-splx allows water levels to drop a set volume before engaging the actuator, and to fill a set volume before closing the actuator
- A low level float is set at the height determined to be an alarm for low water levels and used to inform when bulk water delivery should be sought
- The 'ON' condition would be engaged when water levels drop 260 mm (the equivalent to 4069 L when measured across 3 tanks).

Flow Monitoring – storage level and flow control

Weekly recording of the well's totalizing meter provide a management control to check actual flows against (1) safe allowable weekly yield of 4069 L, and (2) predicted peak weekly demand, and (3) to record the well water withdrawal for Provincial reporting. Weekly withdrawal is not expected to exceed 18,312 L (modelled usage); if weekly withdrawal exceeds 28,483 L (a volume beyond the safe weekly sustainable yield) it is indicative of equipment failure (flow restrictor valve) and allows timely response.

Figure 7 Storage level controls



5 Water Safety Plan – Area 1

The CMSEC’s water system serves the public and therefor falls under the regulations as set out under the BC Drinking Water Protection Act & Regulations (DWPA & DWPR). Island Health is delegated authority by the Province to be the regulator and responsible for reviewing designs, issuing construction permits, setting operational conditions, and issuing operating permits.

Island Health requirements:

- All active wells be registered with the Province under the Water Sustainability Act and water usage reported annually (requiring install of totalizing water meters at each service well)
- All wastewater systems be designed in accordance with the Provincial Sewerage System Regulations (SSR) and that proper setbacks are maintained between source water and sewerage components (the DWPR and SSR are aligned in the required setbacks)
- System designs must assess the quantity and quality of the source water, via a water need/balance analysis, and a risk assessment analysis
- Wellhead and source water protection plans,
- Emergency response plans
- Treatment, commissioning, operation & monitoring plans.

5.1 Risk/hazard identification

- Well is drilled in fractured sandstone - risk of quick infiltration of surface water demonstrated to be a low hazard based on the ground water monitoring result showing slow delayed recharge response.
- Variable flow rates due to seasonal use – offers risk of biofilms and legionella in piping and fixtures
- Public facility that could serve immune compromised guests – higher degree of protective measures
- One historical water quality result with coliforms – demonstrates the limited filtration capacity of the sandstone at depth.
- Two buildings within 30 metre buffer setback
- Existence of a greywater infiltration in close proximity to the 30 m buffer setback , but will be decommissioned and replaced by the septic system
- Overflow parking (used 1-2 times per year) within 30 metre buffer setback

5.2 Mitigation (LRT/LRV)

Treatment targets for this water system will be assessed by the health authority. Initial design will be to consider the well water as GARP.

	Cryptosporidium LRV	Giardia LRV	Viruses LRV
5 µm cartridge filtration	0	0	0
1 µm Absolute cartridge	2	2	0
UV – NSF 55 Class A 40 mJ/cm2	3	3	.5
Chlorination @ .5 mg/L at 10°C, pH > 8.0 with CT of 15.1 min¶mg/L	0	0	4
Total LRV Credits	5	5	4.5
Island Health Targets for GARP – virus only sources	3	3	4

5.3 Treatment

Water requires two types of disinfection and filtration to meet the LRT targets for GARP groundwater. Following is the treatment train to achieve targets:

- Filtration at 5µm for raw well water at flow rate for 2.8 L/m -
- Filtration at 1µm for raw well water at flow rate for 2.8 L/m
- UV treatment >40 mJ/cm² - UV sized at 10 gpm to minimize pressure drop
- Chlorination of stored water at 0.5 mg/L free chlorine residual via a recirculation system
- Recirculation provides 3 changes per day, drawing waters from last tank in tank array, chlorinating and depositing in the first tank, controlled by a ATI Q46H monitor/controller, a Grundfos DDA 7.5-16 dosing pump and recirculated via a Grundfos Magna 3-32 recirc pump.

5.4 Supply system

Well Pump:

- Existing well pump will be utilized to supply water to the new storage tank array by re-routing (and extending) the supply lines.

Flow Control (see Figure 7):

- Flow control valve rated at 2.8 L/m (0.75 USgpm)
- SJE Rhombus NEX-splx 1047662 Float Controller
- Belimo EXT-2100 PWV NPT+LF120, NC/FC failsafe, controlled via SJE Rhombus controller
- Float heights set as per Figure 7

Storage:

- 3 Tanks – Premier Plastic 3330 IG HDPE NSF 61
- Total volume is 45,415 L (9990 IG, 12,000 USG)

Supply Pump:

- Grundfos CMBE 3-93 – VFD constant pressure
- Operating pressure 40 psi; peak flow rate 64 L/m (16 USgpm)

Monitoring:

- **Well water volume** – weekly reading of the well water totalizing water meter. Water volumes expected to be 18,312 L/w based on 7 days at the MDD of 2616 L/d, warnings of equipment failure if readings exceed 28,483 L/w (suggesting failure of flow control valve)
- **Well water quality** – monthly testing of microbiology for E. Coli, fecal coliforms and total coliforms. Existence of coliforms suggests well influence by surface water contamination, E. Coli suggests infiltration of human wastewater.
- **Treated Water Use** – weekly readings of the water supply totalizing water meter. Difference between the well water and supply water meters indicates system leakage.
- **Treated water quality** – monthly microbiology testing for Island Health to confirm water meets potability requirements as per the Drinking Water Protection Regulation+
- **Daily observation UV Intensity** – ensure UV intensity is stable
- **UV Intensity Alarm** – All recognized UV systems for water small water systems have auto alarms when failures occur; triggering audible sound and automatic solenoid valve to close and shutting down water supply.
- **Chlorine (free chlorine) level** – The chlorination system is automatically controlled via a free chlorine monitor which doses the chlorine injection. Out of spec chlorine levels trigger an audible alarm. Free chlorine to be set between 0.5 mg/L-0.7 mg/L.
- **Monthly chlorine residual sampling** - water samples (grab samples) are taken monthly from the furthest connection point and tested via Hanna HC Colormetric free chlorine checker to ensure residual ≥0.2 mg/L

5.5 Operations and Monitoring Overview

5.5.1 Management

The Society will be the operator of the water system (pending VIHA approval). Support for operations is provided by Eco-Sense (system designer).

The society is responsible for preparing an annual report documenting water quality testing results, operations and maintenance history, major incidents, costs, anticipated expenditures for the coming year, and noted changes to any updated plans (i.e. updated emergency response plan contacts). The water system will be allocated as its own cost center for budgeting needs and to observe trends across years.

5.5.2 Scheduled tasks

Daily: daily check on UV intensity, chlorine monitor

Weekly: record volume of flow for each of the well, treated water, and chlorine recirculation, confirm chlorine solution level, record pressure drop across filter housings

Monthly: Monthly water sampling for Island Health

Yearly: Annual filter replacement, UV servicing, system flushing, annual report

5.5.3 Reporting

Health Authority:

Reporting will be set by Island Health and stipulated in the Operating Permit by the Drinking Water Officer as to the reporting requirements they set.

Province:

The society will submit the yearly water usage to the Province as part of the water licensing agreement.

5.6 Emergency Response Plan

The emergency response plan is a requirement of the operating permit under Island Health. The following Emergency response plan is a draft of what will be part of the application package to Island Health. See Appendix J for the draft emergency response plan.

5.6.1 Notices

Pre written signage with notices will be available within the office.,

Do Not Use Water Notice:

Used when a significant health risk or public health threat exists in the water supply system that cannot be adequately addressed by a water quality advisory or boil water notices. (e.g., oil/ pesticide spill).

Boil Water Notice:

If E.Coli is detected in treated water samples from:

- Treated Water Storage Tank
- Monthly microbiology water sampling

If Turbidity > 1NTU downstream of filtration

Used when testing reveals E. coli or other coliform organisms in the water supply, and/or the system fails to meet drinking water treatment objectives, and the associated public health threat from the water supply system can be effectively addressed by boiling the water

Water Quality Advisory:

Used when a public health threat from the water supply system is higher than considered normally acceptable, but is not serious enough to warrant, or will not be resolved by, a boil water notice.

5.6.2 Emergency Contact Information

WHO TO CALL:	ADMINISTRATION:	Name
	WATER SYSTEM OPERATOR:	Phone: (primary and backup) Crystal Mountain Society
	VIHA ENVIRONMENTAL HEALTH OFFICER:	Phone: Anthony Griffin 250-755-6215 Fax: 250-755-3372 Email: HPES.Nanaimo@islandhealth.ca
	VIHA PUBLIC HEALTH ENGINEER:	Darrell Bélanger 250-331-8518
	GROUNDWATER SPECIALIST:	Alan Kohut – Hy-Geo Consulting 250-744-7859 Information@hy-geo.com
	INSTALLER: DESIGNING ENGINEER:	Gord Baird ASSE 41612 (Eco-Sense) Sharon McGeorge P.Eng (Integral Group) Phone: Gord Baird 250-818-7986 Email: gord@eco-sense.ca Phone: Sharon McGeorge 250-418-1288 x 5008 Email: smcgeorge@integralgroup.com
	BULK WATER DELIVERY:	South Island Water 250-516-5066 Email: southislandwaterltd@gmail.com

6 Waste Water

CMSEC has received approvals from Island Health for sewerage system designs for both Area 1 and Area 2. The approvals for each system are attached in Appendix H (Area 1) and Appendix I (Area 2). The designing ROWP is Fred Stevens, of Galiano Excavating, and the standards used were the Standard Practices Manual.

The daily design flows used to prepare both filings are based on the water needs analysis provided by Kohut, which have been reviewed and approved by Island Health.

Area 1 summary

Daily Design Flow	3252 L per Day
Septic tank at Caretaker Dwelling	Dan's Precast 600 IG L.P. c/w PL122 filter
Septic tank at kitchen/washroom	Dan's Precast 1700 IG L.P. c/w PL122 filter
Pump chamber at kitchen/washroom	Dan's Precast 300 IG
Pump	Little Giant WS50HM-20
Field Type	Premiere Tech EC 3500 Eco Flow Bio Filter (pressurized)
Piping	100mm CSA Sewer & 50mm CSA SCH 40
Area of Infiltrative Surface	23m ² (8.5 m x 2.7 m)

Area 2 summary

Daily Design Flow	284 L per Day
Septic tank	Dan's Precast 600 IG L.P. c/w PL122 filter
Distribution box	7 hole Dan's Precast
Field Type	7 Eljen modules (gravity fed)
Piping	100mm CSA Sewer & 50mm CSA SCH 40
Area of Infiltrative Surface	10.4m ² (8.5 m x 1.21 m)

7 Rainwater

Rainwater for non-potable use (i.e.. laundry, toilet flushing) will be considered on a building by building basis. CRD Building Department will assess each building permit/design with respect to the BC Building and BC Plumbing codes.

General rainwater design specifications:

- Designed by an ASSE Certified Rainwater Installer/Designer (Gord Baird, Eco-Sense)
- Standard designed to CSA B805-18 Canadian National Rainwater Harvesting Design Standard
- Installation to meet BC Building/Plumbing code
- Gutters screened by 550µm stainless steel gutter guards
- First flush diverter sized to accept 2 minutes of IDF 15 min. rainfall denoted in BC Building Code Division B-Appendix C, Climatic and Seismic Information for Building Design in Canada, Table C-2.
- Storage pre-filter ≤180µm
- Non-potable plumbing to non-potable fixtures as per BC Building code Division B (independent supply piping, purple in colour, not connected to potable, and all outlets labelled with non-removable tags denoting non-potable water)
- Non-potable water top up provided via Jobe float operated top-up valves with outlets being ≥100 mm above top of rain storage overflow.
- Overflows to be of equal size as inlet, and exit to perimeter drainage piping with a swing-check backwater valve installed to exclude vermin.
- Tank lids are locked, and tagged with 'Confined Space – Do Not Enter'
- All aspects design for year round seasonal conditions
- Filtration and disinfection designed to CSA B805-18 Teir 3 End Use (prescriptive design standard)
- Monthly maintenance includes servicing pre-filters, inspecting gutters, recoring pressure differentials across filter housing and replacing filters as necessary, servicing NSF 55 Class B UV units.
- All systems come with their own Water Safety Plan, design drawing and operation and maintenance manual.

8 APPENDICES

[Appendix A – Crystal Mountain Existing Water System Site Plan, September 2021](#)

[Appendix B – Crystal Mountain Proposed Water System Site Plan, January 2022](#)

[Appendix C – Groundwater Assessment Report for CMSEC, A. Kohut, November 2015](#)

[Appendix D – Water Demand Analysis, A. Kohut – June 2021/ March 2021](#)

[Appendix E – Crystal Mountain Well Monitoring Report, A. Kohut, January 2022](#)

[Appendix F – Wellhead Protection Map, February 2022](#)

[Appendix G – Chief Harris – correspondence, December 2021](#)

[Appendix H – Septic Filing – Area 1](#)

[Appendix I – Septic Filing Area 2](#)

[Appendix J – Draft Water System Emergency Response Plan February 2022](#)

[Appendix K – Water License Application – consolidated files](#)