From: Tom Mommsen [redacted]
Sent: Tuesday, April 12, 2022 12:57 PM
To: Brad Smith <bsmith@islandstrust.bc.ca>; Dan Rogers <drogers@islandstrust.bc.ca>; Jane Wolverton <jwolverton@islandstrust.bc.ca>; Tahirih Rockafella <trockafella@islandstrust.bc.ca>; William Shulba <wshulba@islandstrust.bc.ca>
Subject: Analysis of Water Availability on Land Proposed for Rezoning from F1 to Crystal Mountain Retreat Centre

Dear Brad, William, Jane, Tahirih and Dan,

Re: Analysis of Groundwater Availability on Land Proposed for Rezoning from F1 to Crystal Mountain Retreat Centre

I am writing to share with you an analysis of the water availability at Crystal Mountain Society (CMS) that I have done based on the reports and updates on well testing prepared by Hy-Geo Consulting (HGC). Recognizing how much time an analysis like this takes, I am offering it to you to facilitate your own deliberations on a water management plan for CMS. I believe that these findings are substantially relevant to the CMS proposal to rezone its F1 lot.

I am looking to meet with each of you to:

1. Discuss this analysis and how it can inform decision-making for the CMS proposal
2. To obtain a response from you on how this analysis will be used to inform your personal decision-making on CMS

I will contact each of you individually to set up a meeting.

This is the most extensive analysis that anyone has done so far. I did not expect what I found, namely that:

- The minimal testing done at CMS in 2015 already showed that there is not enough groundwater to support the proposed number of people visiting and resident at the site;
- The unusually low daily water consumption rates proposed for CMS were based on a personal communication from a Crystal Mountain member, with no evidence supporting their claim;
- The production of the central well has declined drastically since it was first drilled over 25 years ago; yet no tests were done to measure actual water production by the well;
- HGC itself concluded that even at a reduced rate of pumping on their second test, which was 30.5% of the production when the well was drilled, and exhausted 86.7 % of the available drawdown within the 12 h test, "*…it is evident that the well would not be able to sustain this rate for a period of 100 days without recharge*".
- The central well is drilled to a depth of approximately 7 meters below sea level, making it vulnerable to the same salt-water intrusion already reported in nearby coastal wells;

- There is a pressing need to determine, through a summer drawdown study at CMS and neighbouring wells, the impacts of the proposed water usage on seasonal water availability and quality in the neighbourhood before this rezoning is allowed.

Sincerely,

Tom P. Mommsen

[redacted]

April 11 2022

Analysis of Groundwater Availability from
Hy-Geo Consulting Reports (2015 & 2021 & 2022) on Crystal Mountain Society land on Galiano

By Tom Mommsen, 10 April, 2022

Executive Summary

The 2015 report by Hy-Geo Consulting (HGC), which is being used to justify the proposed density of people at the Crystal Mountain Society (CMS) site, as well as the basis for a water management plan, raises several red flags concerning the current availability of groundwater at the CMS property and trends in water availability over the past 20 years and into the future.

1. The central well at Crystal Mountain Society does not produce enough water to sustain the proposed number of people over the dry summer months

1a. First pump test failed after 2 hours

The first pump test on the central well (WID 23227) had to be stopped because of excessive drawdown after only 2 h, into a scheduled 12 h test. This occurred even though the pump rate was just 64.5% (17.1 L/min) of nominal well production (26.5 L/min)[1].

1b. Second pump test exhausted 86.7% of available drawdown within 12 hours

A second pump test on the central well the following day, at only 30.5% of nominal production (8.07 L/min) exhausted 86.7% of the available drawdown in 12 h. In this case, HGC noted that "*As the drawdown showed no evidence of stabilization at the pumping rate of 8.07 L/min, it is evident that the well would not be able to sustain this rate for a period of 100 days without recharge".* Clearly, the aquifer, this well or both are severely compromised.

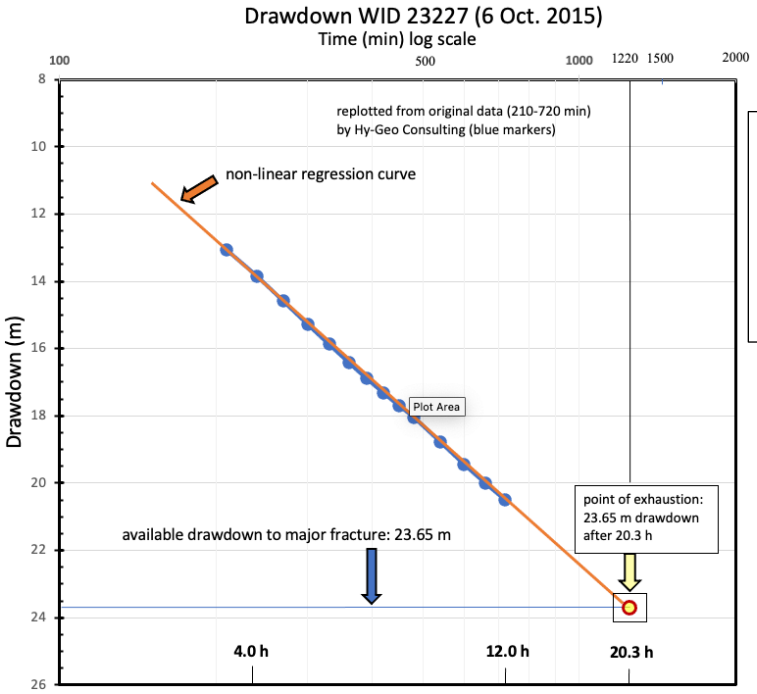


Figure 1:
Reanalysis of pump test data (WID 23227) from 210 min time point to 720 min point. Non-linear regression line fitted to determine exhaustion point

[1] Although HGC indicated that the first test was at 90% capacity, based on 5 US gal/min (WID 23229), they were actually testing the central well, which was rated at 7 US gal/min (WID 23227).

As a re-analysis of the original data shows (Fig. 1), this second pump test, at less than a third of nominal production by the central well, would have also failed - after 20.3 h. This is shorter than the revised and proposed testing protocols for Galiano (LTC 7 March, 2022, page 73, see Appendix I) stipulating 24 h to 72 h pump tests. Surprisingly, HGC did not include comments on the drastic (about 85%) decrease in sustainable water production from this well since its initial drilling 20 years earlier.

Because the central well came within 8 hours of being exhausted by the second test, an extrapolation to a sustainable yield by simply halving the rate of the near-failed test plus incorporating a 70% buffer seems unjustified.

1.c Author of the report made errors when pairing wells and production

Treatment of the data is even more concerning since the author – erroneously – assumed to be dealing with a well that produced around 18.9 L/min on drilling date, instead of 26.9 L/min, confusing the reference well (WID 23229, 5 US gal/min) with the central well (WID 23227, 7 US gal/min).

2. ***Daily sustained yield was not measured***

HGC did not provide factual data on the current sustainable yield of the central well, but rather calculated it to be 4.035 L/min and derived water availability at 2.826 L/min based on a common safety factor of 70% of production. Given the serious concerns raised from the two pump tests, it would have been common sense to actually assess the current sustainable yield and not rely on calculated values, especially for a well that had shown such drastic decline in flow from the original drilling date.

3. ***The maximum day use at the CMS property, using a conservative estimate from the many reference points available, would be fewer than 10 persons***

The proposed water usage for visitors per person of 55 L/day at 35 people and 32 L/day at 60 people suffers from many critical shortcomings: i) it significantly underestimates the water allocation for the caretaker dwelling (see details below); ii) it is well below BC, Canada, NRCan average use; iii) it is well below Galiano bylaw standards, ranging from 22% of Galiano by-law standards for 35 people to 13% of Galiano by-law standards for the average for 60 people; iv) it is also far below requirements set for two affordable housing developments (GIGAHRS & GALI 2022). In addition, the daily water usage per visitor was revised **downwards** from the HGC 2015 study to the HGC 2021 addendum. HGC admits that the extremely low estimate for water use was guided by a verbal estimate of water use from K. Lenglet, a CMS member. No supporting study, no data, or any evidence of this miniscule per person water use estimate has been provided.

Using a more realistic (200 L/day x person) - derived from averages and standards - would set the maximum day use for visitors at the CMS property to fewer than **10 persons.**

4. ***Known effects of climate change not addressed in defiance of the Islands Trust declaration of a climate emergency***

Although the Islands Trust declared a climate emergency in 2019, and committed "to take urgent and fair climate action", the calculations on water demand fail to establish proper existing reference points, they also lack any built-in safety buffer to make allowances for existing impacts of climate change for what we know is coming. In addition, salt-water intrusion – a known issue at the North End of Galiano Island - is ignored. Although HGC study does not provide elevations, we calculate from contour lines and well siting that the central well is about 48 m above sea level (WID 23227; depth 183 ft, 55.8 m) and is drilled to a depth of about 7 meters below sea level, making it vulnerable to the same salt-water intrusion already reported for near-by coastal wells.

Detailed Analysis

1a. First well test failed at pumping rate of 64.5% of nominal production

The HGC report states: "*Initially the well was tested on October 5, 2015 (Test 1) at a rate of 0.285 L/s* (17.1 L/min) *but it soon became apparent within 2 hours that the well was being over-pumped at that rate since excessive drawdown was occurring. A second test (Test 2) was therefore started on the well on October 6, 2015 at a reduced rate of 0.135 L/s* (8.07 L/min)" (green numbers are calculated to provide consistent units)

The initial, unsustainable testing (Test 1; 17.1 L/min) was done at 64.5% of nominal well production, while the testers were operating at what they erroneously thought was 90.5% of nominal well production[2], likely reflecting their expectation that the well could produce close to original capacity. It is surprising that neither the operator nor the hydrogeologist would have re-examined their assumptions, when a 20-year-old well catastrophically fails a pumping test at seemingly 64.5% of initial production within two hours. The question should have arisen immediately whether the surprising failure was specific to the central well or perhaps a worrying indication of the compromised status of the entire aquifer. Red flags should have gone up, if not on-site, then at least when the data had been plotted and discussed.

1b. Second well test close to failure

Next day's pump test (Test 2) at 8.07 L/min (30.5% of nominal production) had exhausted 86.7% of the available drawdown by the end of the test (12 h) (see Attachment II-1 and II-2 - HGC Fig. 5; also HGC Appendix B, Fig 1). Another red flag should have gone up, since such a drastic drop in production is highly unusual, as well, it does not seem to be a good idea to over-pump any well close to maximum drawdown, especially considering its proximity to areas suffering from saltwater intrusion.

The regression line in HGC Fig. 5 (Attachment II-1) indicates that the well would have been exhausted within 20-22 hours even at the lower pumping rate, confirming a compromised well and/or aquifer. Since HGC Fig. 5 etc. (Attachment II - 1) is a semi-log plot, and HGC did not supply the equation for the linear (semi-log) portion of the drawdown curve (sadly also without error terms), I used a visual fit for a regression line (see Figure 1, above). Upon this re-analysis it is obvious that the central well would have definitely failed a standard 24 h pump test at 8.07 L/min. In fact, the lines of maximum drawdown and pumping time intersect at 20.3 hours.

Note that the proposed, revised pump testing protocol for Galiano (LTC 7 March, 2022), stipulates 24 h to 72 h pump tests (Attachment I).

HGC noted (HGC 2015 report, page 15) "*As the drawdown showed <u>no evidence of stabilization</u>* (my underline) *at the pumping rate of 8.07 L/min, it is evident that <u>the well would not be able to sustain this rate for a period of 100 days</u> without recharge*". Surprisingly, no further comment on well or aquifer health had been added.

My conclusions are that:

(i) a modern pump test (>24 h) would have failed at 8.07 L/min (which is 30.5% of the well production when it was drilled);

(ii) HGC 2015 report substantially <u>overestimates</u> the sustainable water production by this central well; and

(iii) a drop in sustainable well production approaching 85 % (from 26.9 L/min to 4.04 L/min) in twenty years must be a major concern influencing water use decisions. Because no testing was done on adjacent properties, it is unknown whether the failure of the central well is unique or represents weaknesses of the entire aquifer.

[2] Although HGC indicated that the first test was at 90% capacity, based on 5 US gal/min (WID 23229), they were actually testing the central well, which was rated at 7 US gal/min (WID 23227). They clearly identify that they are testing WID 23227 in the text and figure headings (see Attachment III- 1 and 2 for ratings from original well tests).

1c. Well identification and nominal production incorrect

Nominal production of wells at drilling date from driller's records (Attachment III):

23227	26.5 L/min (7 USgal/min)	1994-Nov. 25	183 ft deep	#18 central well
23229	18.9 L/min (5 USgal/min)	1994-Aug. 19	125 ft deep	#17

HGC made obvious (2015 report: Table 2) and repeated (pages 14 and 15) mistakes in assigning 18.9 L/min to the central well (WID 23227) and 26.5 L/min to the observation well (WID 23229). The data conflict with the well driller's records (Attachment III) and such errors have repercussions on subsequent calculations.

Standardized Units

The HGC report does not use consistent units switching between US and imperial gallons and liters and seconds/minutes/day/year. For ease of comparisons, all units are standardized to litres/min (L/min) or L/day. The other unit used is liters per day per person.

Table 1: Summary Table of the Pump Test Results and Derived Yield

	Central Well	observation well	notes
WID	23227	23229	
nominal rate (US gal/min)	7	5	
nominal rate (L/min)	26.5	18.9	
Pump Test 1 (L/min)	17.1		64.5 % of nominal rate - failed in 2 hrs
Pump Test 2 (L/min)	8.07		30.5 % of nominal rate - 86.7% exhausted in 12 hrs. Regression from data provided indicates well would have been exhausted in 20-21 hrs (Fig 1 above)
Calculated sustainable Yield (L/min)	4.035		Calculated as 50% of the nominal rate, although the current production rate was not tested and based on the 2 tests is likely significantly lower than nominal rate
Derived water availability (L/min)	2.826		Assumed to be 70% of production, although current production not tested and from pump tests it appears that production is significantly lower than nominal rate

2. Daily sustained yield was calculated, not measured

HGC presents a calculated (not measured) sustainable water availability from the central well of 4.035 L/min (50% of 8.07 L/min) and uses this number to derive water availability for usage (applying a common 70% safety factor) to arrive at a potential well yield of 2.826 L/min (4069 L/day). Given the results of the pump tests, I suspect that if actual well production had been measured it would have confirmed that sustainable production was significantly lower than when the well was drilled. Therefore, the derived number (4069 L/day) must be treated with extreme caution. A summer pump test to determine the current production rate of the well as well as the summer drawdown is critical information that is missing.

3. Unrealistic water usage estimates

Values for daily total use listed on various submissions by the applicant:

Source	Total Daily Usage (L/day)	Daily usage after caretaker's allocation (L/day)	No of visitors	Daily usage per person (L/day* person)
HGC 2015	2839	2379 (460 L/day)	29	82
HGC 2021-07 2nd addendum	2616	1916 (700 L/day)	35	55
HGC 2021-07 2nd addendum			60	32
Recalculated for caretaker allocation (2000 L/day):				
HGC 2015-07	2616	616 (2000 L/day)	35	18

Caretaker dwelling (2 persons)

1. HGC (2015) 460 L / day
2. HGC (2022) 700 L / day
3. Galiano bylaw amendment 2000 L/ day dwelling

The proposed water use listed in the Galiano OCP amendment 4.4.2 (2022) (See Attachment IV) is 2000 L/day per dwelling (this would account for 50 % of the sustainable yield from the well). The current Galiano land use bylaw allocates 2275 L per dwelling per day, not 700 L/day.

Daily water use in Canada

BC regs (2012)	230 L/ day person
Env Canada (2015)	251 L/ day person
NRCan (2018)	249 L/ day person
Requirements for GIGAHRS & GALI (2022)	167 – 232 L/day person

Water available sustainably of 4069 L/d (an overestimate, see above), minus the water allocated to the caretaker's dwelling (realistically using the future standard for a dwelling on Galiano (2000 L)) leaves a maximum 2069 L for day use on the property. With a low estimate of 200 L/day person, this would set the maximum day use to fewer than 10 persons. At the proposed 35 persons, the well would be oversubscribed by at least 2-fold over the calculated (not real) maximum sustainable yield.

The HGC report states that "*actual reported water use during the period July 4 to August 2 2015 ranged from 284 to 852 L/day to provide water for 12 to 22 persons on the property for kitchen, handwashing and drinking water purposes (personal communication K. Lenglet, August 2015*)". ***No data, no study, and no evidence was provided to support this claim . Neither does it include any subsequent adjustments for the major water uses at the proposed development, such as flush toilets, dishwashers, showers, and laundry.*** It is well below the usage estimated by any credible sources, including the usage required for the two affordable housing projects currently being considered on Galiano. Further, no evidence has been presented supporting claims that visitors at CMS will use a fraction of the water of residents or other visitors to Galiano. Since rezoning is for land, not for the occupants, and covenants are known to be subject to (successful) legal challenges, it is absolutely paramount to err on the side of extreme caution when projecting day use.

The HGC report (stated in 2015 and implied in the numbers presented in 2021, 2022) recommends reducing water use by utilizing off-site laundry facilities and limiting shower use. CMS has been renting near-by properties and CMS members have been building properties with accommodation for CMS visitors adjacent to the CMS property. However, these properties will likely be using the same already over-subscribed watershed (class I (highest) vulnerability classification by the Islands Trust) and hence it is difficult to see how this would solve the problem.

4. Effects of climate change

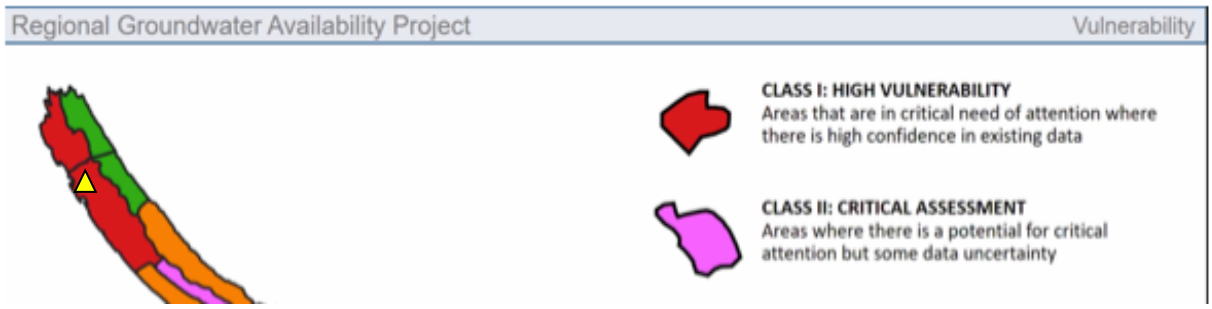
In 2019, the Islands Trust declared a climate emergency and committed "to take urgent and fair climate

action". The calculations on water demand for CMS are not only far below any existing standards, but also lack any built-in safety buffer to make allowances for existing impacts of climate change or what we know is coming.

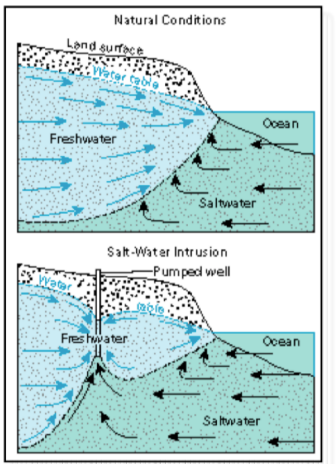
Islands are in an especially precarious situation concerning groundwater and the multiple effects of climate change. Finite freshwater input interacts with multiple of factors to determine groundwater availability. Specifically, islands will be faced with increases in water demand due to rising temperatures and population growth, in soil water losses due to increased evapotranspiration, in water run-off due to inability of soil to absorb water following extended drought periods, delays and decreases in groundwater recharge (drought and changes in rainfall patterns), sea level rise and salt-water intrusion in coastal areas, and finally coastal erosion. Therefore, any estimates about future supply and demand of groundwater must have sizeable buffers built into them. None of these factors have been considered in this HGC water availability report.

Two additional factors must be considered. First, the west coast of North Galiano already falls into Class 1 (highest) vulnerability classification for groundwater by the Islands Trust (Figure 2).

Figure 2: Screenshot from W. Shulba's presentation to the Galiano LTC (8 October, 2021) showing high vulnerability areas at the North end of Galiano. △ indicates CMS property



Second, saltwater intrusion is widespread on the NW corner of Galiano and many local wells reach below sea level, including the CMS central well. Oversubscribing any well increases the risk of saltwater intrusion, likely by up-coning (Figure 3), and multiple safeguards need to be put in place to prevent – usually irreversible – saltwater intrusion into any parts of an already vulnerable aquifer. It is surprising that none of these factors are touched upon in any of the HGC submissions on behalf of CMS concerning groundwater.



Saltwater Intrusion. Fresh water withdrawal in coastal areas can result in reduced freshwater flow, resulting in increased landward saltwater flow. (Source: U.S. Geological Survey)

Figure 3
from: PEI (2011) Saltwater Intrusion and Climate Change. A primer for local and provincial decision makers
www.atlanticadaptation.ca

Illustration of 'up-coning', a mechanism by which well pumping initiates saltwater intrusion into a freshwater lens

APPENDIX 3 - Land Use Bylaw Definitions and Cistern Requirements

Definitions

"potable" means water that is safe to drink, fit for domestic purposes and meets the Heath Canada Guidelines for Canadian Drinking Water Quality or any guidance documents or legislation which may be enacted in substitution.

"pumping test" means a flow test to determine the sustainable productivity of a well, conducted under supervision of a *hydrogeologist*, and that is consistent with the British Columbia Guide to Conducting Pumping Tests, Groundwater Protection Regulation Handbook, other guidance documents which may be issued, and applicable legislation, and consists of pumping groundwater from a well typically for 24 to 72 hours depending on aquifer characteristics.

"**Hydrogeologist**" means:

a) an engineer or geoscientist licensed under the *Engineers and Geoscientists Act* or any legislation which may be enacted in substitution; and

b) has competency in the field of hydrogeology.

"stream" means a stream as defined in the *Water Sustainability Act* or any legislation which may be enacted in substitution.

3.18 Secondary Suites

3.18.7 A building permit for a property outside a water service area shall not be issued for a secondary suite, nor shall a secondary suite be occupied, unless the building that is to contain the secondary suite is equipped with a freshwater catchment and storage system having a capacity of at least 18,000 litres .

3.19 Cistern Requirements

3.19.1 A building permit for a property outside a water service area shall not be issued for a new building to be used as a dwelling, including a cottage, unless the building is equipped with a cistern (or combination of cisterns) for the storage of freshwater having a capacity of at least 18,000 litres.

3.19.2 The floor area occupied by any cistern located in a building and the housing provided for such cistern is excluded from the calculation of the floor area of the building and the lot coverage of the lot on which it is located.

Attachment II -1

Figure 5. From Kohut report 2015, page 13

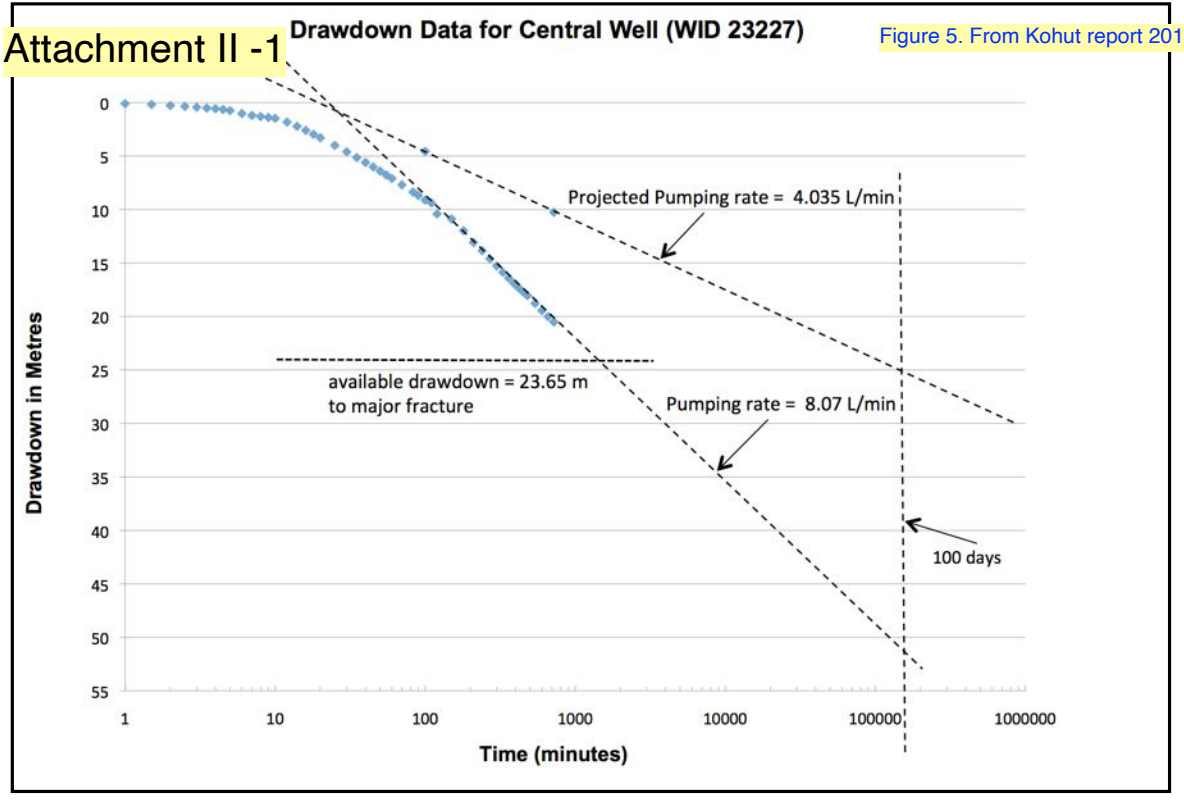


Figure 5. Drawdown in the central well observed during pumping at 8.07 L/min

Attachment II - 2

Figure 1, from Appendix B, Kohut CMS report (2015)

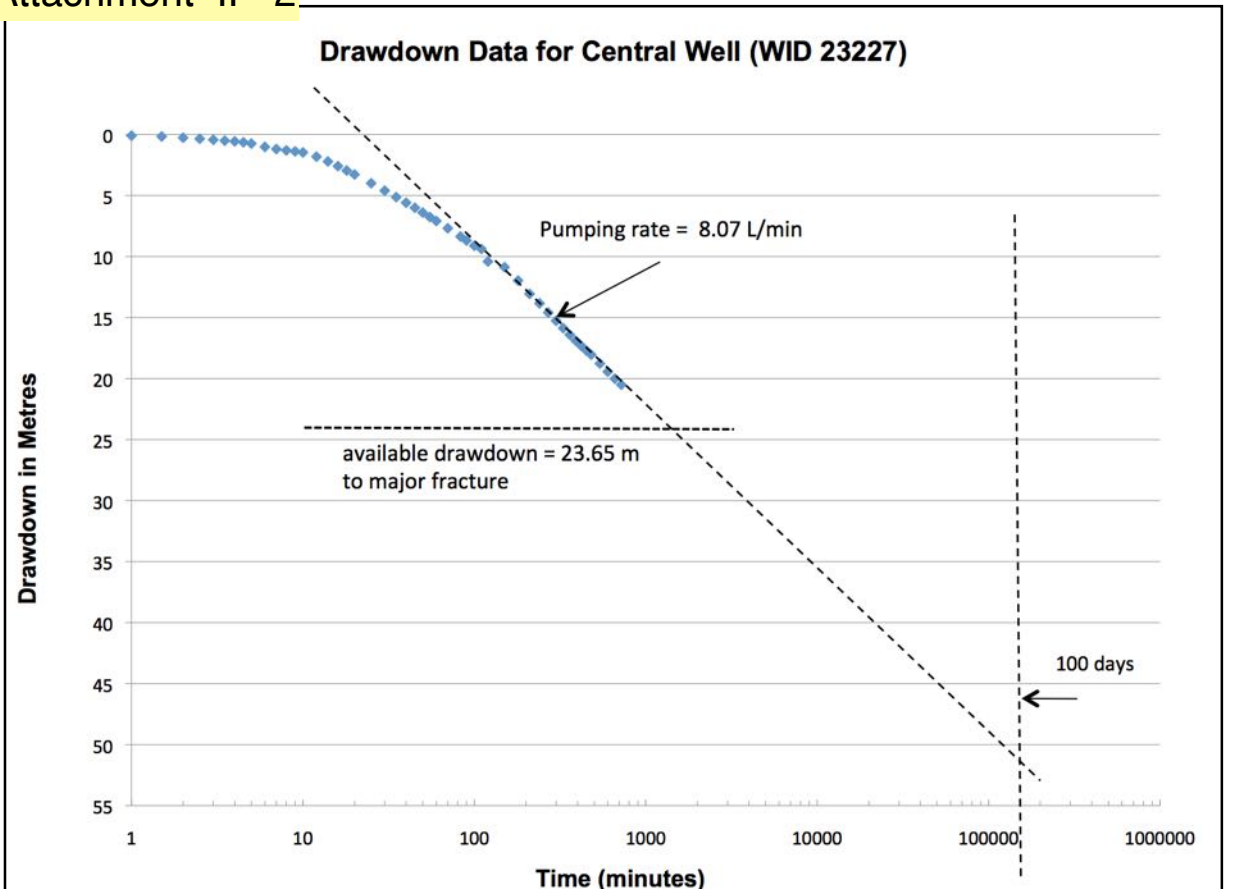


Figure 1. Drawdown graph for central well, pumped October 6, 2015.

Attachment III - 1 WID 23227 - central well

Well Site 18, Central Well (WID 23227)

Province of British Columbia — BC Environment — Water Management Division

FIBERMAX

WATER WELL RECORD

Date 94 11 25

N T S MAP | WELL No. | ELEV | Location Accuracy

Z | E | N | Date 19__ | Well Type

Owners Name & Address: 564 7 LAND CORP. c/o W.H. Stobbart, P.O. Box 219, Station "E", Victoria, BC

Legal Description & Address: District Lot 59, Galiano Island

Descriptive Location: Porlier Pass Rd

1. TYPE OF WORK: 1 ☒ New Well 2 ☐ Reconditioned 3 ☐ Deepened 4 ☐ Abandoned

2. WORK METHOD: 1 ☐ Cable tool 2 ☐ Bored 3 ☐ Jetted 4 ☒ Rotary a ☐ mud b ☒ air c ☐ reverse ☐ Other

3. WATER WELL USE: 1 ☒ Domestic 2 ☐ Municipal 3 ☐ Irrigation 4 ☐ Comm. & Ind. ☐ Other

4. DRILLING ADDITIVES

5. MEASUREMENTS from 1 ☒ ground level 2 ☐ top of casing; casing height above ground level ___ ft.

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	24	Brown Gravelly soil	
24	95	Grey Sandstone	
95	183	Laminated Lenses	
		Water Source 7gpm @ 177 ft	
		Static level 68 ft - 12 hours later	

9. CASING: Materials 1 ☒ Steel 2 ☐ Galvanized 3 ☐ Wood 4 ☐ Plastic 5 ☐ Concrete ☐ Other

		units
Hole Diameter		ins
Diameter	6	ins
from	+1	ft
to	37	ft
Thickness	.188	ins
Weight		lb/ft

Fittings unit ___ ft 1 ☐ above 2 ☐ below ground level
1 ☐ Welded 2 ☐ Cemented 3 ☐ Threaded | 1 ☐ New 2 ☐ Used

Perforations:

Shoe (s): No

Open hole, from 37 to 183 ft Diameter 6 ins

Grout:

10. SCREEN: 1 ☐ Nominal (Telescope) 2 ☐ Pipe Size
Type 1 ☐ Continuous Slot 2 ☐ Perforated 3 ☐ Louvre ☐ Other
Material 1 ☐ Stainless Steel 2 ☐ Plastic ☐ Other
Set from ___ to ___ ft below ground level

RISER, SCREEN & BLANKS		units
Length		ft
Diam. I.D.		ins
Slot Size		ins
from		ft
to		ft

Fittings, top ___ bottom ___
Gravel Pack ___

11. DEVELOPED BY: 1 ☐ Surging 2 ☐ Jetting 3 ☐ Air 4 ☐ Bailing 5 ☐ Pumping ☐ Other

12. TEST 1 ☐ Pump 2 ☐ Bail 3 ☐ Air Date
Rate, ___ USgpm Temp. ___ °C SWL before test ___ ft
Water Level ___ ft after test of ___ hrs

☐ DRAWDOWN in ft				☐ RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

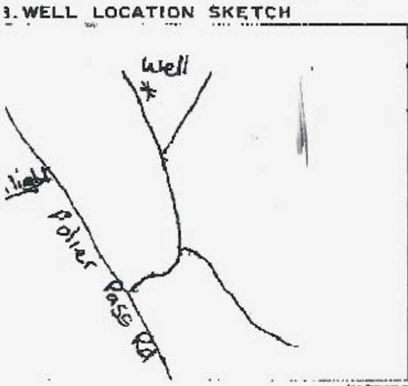
13. RECOMMENDED PUMP TYPE | RECOMMENDED PUMP SETTING ft | RECOMMENDED PUMPING RATE USgpm

14. WATER TYPE: 1 ☒ fresh 2 ☐ salty 3 ☒ clear 4 ☐ cloudy
colour ___ smell ___ ; gas 1 ☐ yes 2 ☒ no

15. WATER ANALYSIS: 1 Hardness ___ mg/L 2 Iron ___ mg/L 3 Chloride ___ mg/L 4 pH ___
Field Date ___ Lab Date ___

7. CONSULTANT ___
Address ___

8. WELL LOCATION SKETCH



SITE I D No

16. FINAL WELL COMPLETION DATA
Well Depth 183 ft Well Yield 7 US gpm
Static Water Level ___ ft Artesian Flow ___ US gpm Pressure Head ___ ft
Back filled Rock chip slurry
Well Head Completion ___

[redacted]

17. DRILLER (PLEASE PRINT) NEGGER, ANDY
Signature ___

18. CONTRACTOR RED WILLIAMS WELL DRILLING LTD
Address 980 PRATT ROAD, QUALICUM BEACH, BC, V9K 1W5
539-5339
Member, BCWWDA ☒ yes ☐ no

Attachment III - 2 WID 23229 - reference well

Well Site 17, (WID 23229)

Province of British Columbia

BC Environment

Water Management Division

WATER WELL RECORD

Date 94 10 8 19

NTS MAP | WELL No. | ELEV | Location Accuracy

UTM 2 | E | N | Date 19__ | Well Type

Owners Name & Address: Fibermax Timber Corp. c/o W.H. Stobbart, P.O. Box 819, Station E, Victo[ria] V8W 2M[…]

Legal Description & Address:

Descriptive Location: Porlier Pass Road Well #2

1. TYPE OF WORK: 1 ☒ New Well; 2 ☐ Reconditioned; 3 ☐ Deepened; 4 ☐ Abandoned

2. WORK METHOD: 1 ☐ Cable tool; 2 ☐ Bored; 3 ☐ Jetted; 4 ☒ Rotary: a ☐ mud, b ☒ air, c ☐ reverse; ☐ Other

3. WATER WELL USE: 1 ☒ Domestic; 2 ☐ Municipal; 3 ☐ Irrigation; 4 ☐ Comm. & Ind.; ☐ Other

4. DRILLING ADDITIVES

5. MEASUREMENTS from: 1 ☒ ground level; 2 ☐ top of casing; casing height above ground level 1.0 ft

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	4	Brown gravelly soil	
4	12	Brown crumbly sandstone	
12	14	Grey sandstone	
14	17	Brown crumbly sandstone	
17	42	Grey sandstone	
42	45	Brown crumbly sandstone	
45	50	Grey sandstone	
50	53	Shaley sandstone	
53	125	Grey sandstone	

Water source

1 gpm @ 100 ft

4 gpm @ 120 ft

Total yield 5 gpm

One 125 ft 4" PVC liner installed also 125 ft 3/8" safety rope

9. CASING: Materials: 1 ☐ Steel; 2 ☐ Galvanized; 3 ☐ Wood; 4 ☐ Plastic; 5 ☐ Concrete; ☐ Other

		units
Hole Diameter		ins
Diameter	6	ins
from	+1.0	ft
to	19'2"	ft
Thickness	.188	ins
Weight		lb/ft

Pitless unit ___ ft: 1 ☐ above; 2 ☐ below ground level

1 ☐ Welded; 2 ☐ Cemented; 3 ☐ Threaded | 1 ☐ New; 2 ☐ Used

Perforations:

Shoe(s): No

Open hole, from 19'2" to 125 ft Diameter 6 ins

Grout:

10. SCREEN: 1 ☐ Nominal (Telescope); 2 ☐ Pipe Size

Type: 1 ☐ Continuous Slot; 2 ☐ Perforated; 3 ☐ Louvre; ☐ Other

Material: 1 ☐ Stainless Steel; 2 ☐ Plastic; ☐ Other

Set from ___ to ___ ft below ground level

RISER, SCREEN & BLANKS

	units
Length	ft
Diam. I D	ins
Slot Size	ins
from	ft
to	ft

Fittings, top ___ bottom ___

Gravel Pack ___

11. DEVELOPED BY: 1 ☐ Surging; 2 ☐ Jetting; 3 ☐ Air; 4 ☐ Bailing; 5 ☐ Pumping; ☐ Other

12. TEST: 1 ☐ Pump; 2 ☐ Bail; 3 ☐ Air — Date ___

Rate ___ USgpm; Temp ___ °C; SWL before test ___ ft

Water Level ___ ft after test of ___ hrs

☐ DRAWDOWN in ft				☐ RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

13. RECOMMENDED PUMP TYPE | RECOMMENDED PUMP SETTING ft | RECOMMENDED PUMPING RATE USgpm

14. WATER TYPE: 1 ☒ fresh; 2 ☐ salty; 3 ☒ clear; 4 ☐ cloudy

colour ___ smell ___ ; gas 1 ☐ yes 2 ☒ no

15. WATER ANALYSIS: 1 Hardness ___ mg/L; 2 Iron ___ mg/l; 3 Chloride ___ mg/L; 4 pH ___

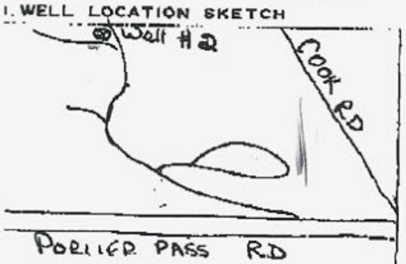
Field Date ___ Lab Date ___

SITE I D No ___

CONSULTANT

Address

WELL LOCATION SKETCH



16. FINAL WELL COMPLETION DATA

Well Depth 125 ft; Well Yield 5 US gpm

Static Water Level 60 ft; Artesian Flow ___ US gpm; Pressure Head ___ ft

Back filled: Rock chip slurry

Well Head Completion ___

[redacted]

17. DRILLER (PLEASE PRINT): SURNAME NEGGERS; FIRST NAME ANDY

Signature ___

18. CONTRACTOR: RED WILLIAMS WELL DRILLING LTD

Address: 980 PRATT ROAD, QUALICUM BEACH, BC, V9K 1W5

248-5552
339-5339

Member, BCWWDA ☒ yes ☐ no

APPENDIX 4 -Subdivision Standards for Potable Water

SUBDIVISION REGULATIONS

4.4 POTABLE WATER

4.4.1 Where a subdivision is not proposed to be served by a community water system, each *lot* in a proposed subdivision must be proven to have a supply of *potable water* in accordance with the requirements of this section.

4.4.2 Each *lot* in a proposed *subdivision,* not proposed to be served by a community water system, must be supplied with a sufficient quantity of *potable* water to supply the uses permitted on the *lot* by this Bylaw according to the standards set out in Table 1.

TABLE 1

POTABLE WATER SUPPLY STANDARDS FOR SUBDIVISION

USE Per Lot	**VOLUME (litres per day)**
One dwelling unit	2000
Each additional dwelling unit, including a cottage	2000
Other uses - TBD	

Information Note: If more than one dwelling unit is connected to the same source of water, the water system may be subject to the Drinking Water Protection Act, British Columbia Ministry of Health regulations of water supply systems, and may be subject to the Water Utility Act.

Information Note: Non-domestic uses serviced by groundwater or a stream may require a licence under the Water Sustainability Act.

4.4.4 Where *potable* water is to be supplied from a surface water source, the applicant for subdivision must provide proof of authorization (water licence) indicating the total volume of water granted to the licence holder.

4.4.5 Where non-domestic use exists on a lot proposed to be subdivided that requires a licence under the *Water Sustainability Act* the applicant must provide proof of authorization in the form of a water licence. Staff are reviewing authority relate to this.

4.4.6 Where *potable* water is to be supplied by a drilled well, a *pumping test* shall be carried out on each well in a proposed subdivision by:

a. pumping groundwater, at a constant rate, for a minimum period of 12 hours; and

b. withdrawing the daily required volume in accordance with Table 1 within a period of 24 hours; and

c. monitoring the recovery phase until at least 90 percent recovery has been achieved.

Attachment V
Results from a successful drawdown test on WID 23204, showing how drawdown levels off after an equilibrium is reached. Note the horizontal sections starting at around 400 min at pumping rate of 1.98 USgpm and again at 2500 min after pumping rate had been increased to 2.39 USgpm.

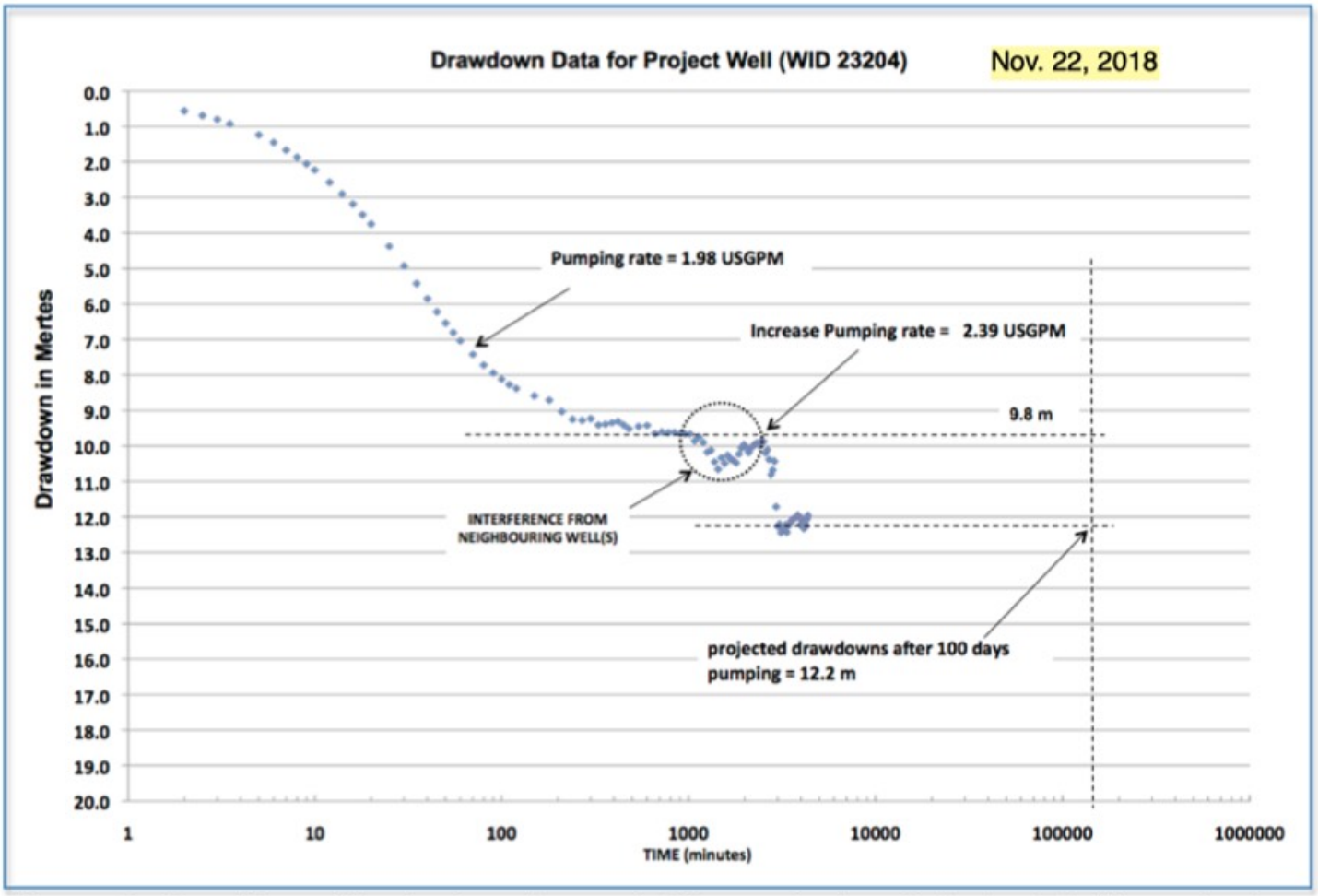


Figure 6. Semi-logarithmic drawdown plot for project well during 72.5 hour test.

Figure 6 from HGC report on GALI development. Available on Islands Trust website

GL-RZ-2021.1 (GALI)

Location: 409 Porlier Pass Road

Rezoning application to increase density from 1 dwelling per lot to 20 dwellings per lot for the development of non-profit affordable housing.

1 - Staff Reports

2 - Submissions from Applicant

July 26, 2020_Pump Test Results.pdf