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Rainwater Connection
• Harvesting Systems
• Design
• Installation
• Service

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TO:

Doug Latta, Chairman
Galiano Land and Community Housing Trust
cc Tom Hennessey

RE: **Feasibility of Rainwater Self Sufficiency for Residences in the Proposed Galiano Green Affordable Housing Project**

You have asked me to comment on the feasibility of using Rainwater as the sole or predominant water source for the proposed 20 residential dwelling units on a 4 hectare site at 409 Porlier Pass Road on Galiano Island.

After reviewing the material it is my professional opinion that it is feasible to design homes with sufficiently large water catchment areas and storage capacity to provide 100% of the indoor potable water demand for residences in this affordable housing project.

To support this conclusion the following addresses three key questions.

- What is a reasonable assumption of potable water indoor use?
- Are proposed roof areas large enough to supply sufficient water to meet these levels of water demand?
- Will the RWH system provide safe, high quality water with a minimum of maintenance and an affordable capital cost?

1. Indoor Potable Water Demand

The experience and research of the Rainwater Connection indicates that the new standard for indoor water demand from households that are committed to conservation is below 135L (30 imp gal) per person per day. This is due to an increased commitment to spend the extra capital cost for water conserving fixtures, and the increased efficiency of these fixtures.

Increased use of water conserving fixtures over the past 10 years has significantly reduced indoor water demand - even from public water districts. The Regional District of Nanaimo (RDN) water services report that water use in 7 of the water districts they operate has declined 28% from 2001 to 2011. Average winter demand has dropped to 204L (45 imp. gal) per person per day – and this includes system leaks; some winter outdoor use, and a number of older homes without modern water conserving fixtures.

For the past 12 years The Rainwater Connection has been using an indoor water demand figure of 160L (35imp gal) per person per day to assist homeowners find a "comfort level" with the amount of water storage they want to build. Information from more than 100 households relying on rainwater for their daily indoor water supply testifies to use levels consistently below that figure. More than half have reported average per person indoor water use at or below 136L (30 imp gal). Those with disciplined water conserving habits (e.g. turning off the shower to soap up) report demands closer to 114L (25 gal).

Technological advances in water conserving devices for homes have further increased the possibility of lower indoor potable water use. As summarized in the attached *Water Savings Appliances Handout*, the new standard for toilets is an average of less than 1 gal per flush (4.2L). The more efficient laundry washing machines now use as little as 18L (4 gal) for small loads and 70L (15gal) for large multi rinse washes. Modern dishwashers use less water than hand washing in the sink. The efficiency of sink faucets and shower heads has almost doubled over the past 5 years. Faucet regulators and aerators as well as shower heads typically run on 7L (1.5 gal) per minute.

With these advances in the efficiency of water conserving fixtures (and more likely to come) it is estimated that water conserving households will be using between 114 and 136L (25 - 30 imp gal) per person per day. Increasingly these figures represent the "comfort level" of clients of the Rainwater Connection when planning their water systems.
In 2011 the City of Guelph estimated per capita indoor water use of 139L (30.6 gal) for homes using "market available technology". Three of the recently completed and occupied CMHC EQuilibrium demonstration projects reported daily per capita water demand figures of less than 90L (20 gal).

2. Comparing Supply with Demand

The next step in determining the feasibility of rainwater self sufficiency is to compare water demand to supply – i.e. the amount of rainwater that can be collected during the winter months and stored for use throughout the year. Given our wet winters and dry summers a monthly table is used to determine if the tanks can retain sufficient water to meet household demand during the dry summer months.

The water supply and demand information from the *Water Calculator* developed by The Green Affordable Housing Project has been analyzed and compared to standard water balance tables use by the Rainwater Connection. The conclusions are summarized in the following Table 1.

Table 1. Storage Capacity and Roof Areas Required to Meet Demand

Dwelling Unit Scenario	Unit Size	Roof Catchment Area	Water Storage Capacity	Additional Water Catchment Area Required
1 person household With own laundry	500 SF 46.5m^2	724 SF 67.3m^2	3,400 gal 15.5m^3	30 SF 3m^2
1 person household No in-house laundry	500SF 46.5m^2	724 SF 67.3m^2	2,300 gal 10.5m^3	00
2 person household With own laundry	750 SF 69.7m^2	1,044 SF 97m^2	6,700 gal 30.5m^3	500 SF 46.5m^2
2 person household No in-house laundry	750 SF 69.7m^2	1,044 SF 97m^2	5,300 gal 24.1m^3	200 SF 18.6m^2
3 person household With own laundry	1,000 SF 92.9m^2	1,296 SF 120.4m^2	10,000 gal 45.5m^3	1,000 SF 92.9m^2
3 person household No in-house laundry	1,000 SF 92.9m^2	1,296 SF 120.4m^2	8,000 gal 36.4m^3	550 SF 51.1m^2

All of the data in the table assumes:

- Average rainfall at the Saanichton CDA Weather for the reporting years 1971-2000. This average rainfall of 35.7" (907mm) is a conservative estimate for rainfall amounts for this area of Galiano Island. The St Mary's Lake weather station on SSI is often used for this area. The average rainfall for this station is significantly higher at 38.5" (978mm).
- Average per capita indoor water use of 30 imp. gal (136L) per day. No deductions are made for days away from home, as this is typically offset by extra water use by guests.
- Water use will decline by 20% if laundry is done outside the home
- All water supply must come from roof catchment.

The above table shows that the basic roof areas of most of the proposed houses are too small to collect enough water to both serve monthly demand during the winter and fill a sufficiently large storage tank to get through the dry summer months.
For example a 1 person household (doing their laundry at home) would need an additional 30 SF (3 m^2) of roof catchment area to fill a 3,400 gal (15.5m^3) cistern which would in turn provide sufficient water to supply the household all summer. (This example is fully described in the attached Calculator Sheet)
The worst case scenario is 3 people sharing a 1,000 SF home and doing all their laundry in the home. In this case the roof catchment area would have to be

increased by approx. 1,000 SF (92.9m^2) during the winter months to supply sufficient water to fill the 10,000 gal (45.5m^3) cistern.

The roof size areas are not considered a serious impediment to the project's viability. Many existing rainwater supplied residences face this issue. It can be addressed in several ways.

- ☑ Add to the house roof area with larger overhangs or porches. For example an increased overhang of less than 12" would provide the extra 30 SF (3 m^2) required in scenario 1.
- ☑ Collect from the roofs of nearby structures such as woodsheds or carports. For example an 18 by 20 ft (5.5 x 6.1m) porch addition or adjacent woodshed would provide an extra 500 SF (46.5$m^{2)}$ of roof catchment area
- ☑ Add to collection areas (during the winter) with secondary rain catchment surfaces such as awnings. This type of device can be designed to be a safe and effective water catchment source. They need not be attached to the house structure, and can be removed in the spring and summer. A combination of the above noted porch and a temporary catchment device with a 500SF catchment area would address the insufficient roof size of the worst case scenario of a 3 person household that decided to do all their own laundry.
- ☑ Alternatively the water shortage issue related to roof areas could be addressed by using an alternative water supply to help fill the water storage tanks during the winter and spring. Taking water from on-site water sources such as winter streams or the well would provide the extra water supply at a time when most of the rainfall is running off to the ocean, and the ground water levels and wells are at their maximum capacity.

Outdoor water demand has not been addressed above. It is assumed that irrigation and outdoor washing water would be supplied from additional private or communal storage tanks. These tanks could be filled during the late winter months by water from on-site streams. Alternatively locally supplied trucked water could be used as the water is not being used for potable water.

3. Assurances of Quality Water

In a residential development such as the proposed Green Affordable Project it is relatively simple and less expensive to put procedures and practices in place that assure a safe quality of water - both during construction and as the systems are maintained over time.

It is assumed that each of the RWH systems will adhere to the same design, building and maintenance standards that the Rainwater Connection has incorporated into hundreds of potable roof-to-tap water systems over the past 12 years. Many of these required an Engineer's seal to certify that the potable water would meet the

Canadian Drinking Water Standards. The characteristics of these systems can be summarized as follows.

- All materials used are CSA or NSF 61 approved for potable water use. This includes collection piping, tank (cistern) interior, pumps/float switches etc.
- All piping and components such as overflows are sized to meet the plumbing code hydraulic loads, and are vector proofed.
- All electrical components conform with the appropriate standards for electrical installations close to or within water (e.g. float switches and power supply grounding for pumps).
- The roof top rainwater is filtered to remove all particles larger than 500 microns before it enters the cistern. This is the internationally recognized standard to ensure the stored water will remain fresh for extended periods of storage.
- A First Flush Diverter (FFD) is used to reject the first 0.5mm of each rain event (to reduce the concentrations of air borne toxins dissolved in the water and tannins from gutter debris).
- Water Purification Equipment is provided after the house supply pump to provide two barriers of protection from bacteria, cysts (giardia) and viruses. This is a higher standard than provided by many public water utilities.
- If required, all plans can be reviewed by a Registered Geoscientist used by the Rainwater Connection before the start of construction, and at completion.
- As-built photos and alterations to the Building Plan are provided after construction.
- A 15-20 page Owner's Operation and Maintenance Manual is prepared for the owner including as-built photos, system description, detailed operation/maintenance instructions and a Maintenance Checklist.
- A tour with owner and/or the maintenance person responsible for the on-going maintenance and cleaning is carried out.
- Help is provided to undertake a water sample for testing prior to use of the water system. The testing will be done by a qualified lab, and will include test parameters similar to the standard drinking water analysis for BC. This includes bacteria, TDS, UVT, PH, turbidity, and a standard metals scan.
- The Owner's Manual emphasizes the maintenance required of the water disinfection equipment and the frequency of on-going water testing. These "instructions" can be incorporated into requirements for reporting of such maintenance and testing procedures to a regulatory authority if this is deemed necessary.

Conclusions

1. There is ample evidence to demonstrate that the proposed households will use less than 135L (30 imp. gal) per person per day for indoor water, and that this demand level can be achieved with the use of readily available, affordable water conserving fixtures.
2. There is sufficient water to meet this level of demand. House roofs with overhangs or porch roofs combined with roofs of nearby ancillary buildings or

separate secondary rain catchment devices such as awnings will meet the indoor water demands of any of the anticipated households. Alternatively, extra water could be supplied by collection from on-site streams or the well during the winter months.

3. The proposed water system is capable of providing a safe and reliable source of potable water for the residences. It uses technologies, practices and regulatory procedures that have been tested and used for over a decade.

I thank you for asking me to do this review, and I welcome any further questions you may have.

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