**RAINWATER HARVESTING SYSTEMS ON A WELL-RELIANT**

**PACIFIC NORTHWEST ISLAND:**

**A CASE STUDY OF GUEMES ISLAND, WASHINGTON**

by

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A Thesis

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This Thesis for the Master of Environmental Studies Degree

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Date

ABSTRACT

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**Keywords:** rainwater harvesting, rainwater catchment, saltwater intrusion, climate change, sea level rise, Pacific Northwest, island, sole source aquifer, survey, case study

**Research question:** *How can rainwater harvesting continue to be implemented successfully on Guemes Island to remedy saltwater intrusion?*

Guemes, a small Pacific Northwest island in Puget Sound, is well-reliant for its freshwater. Some near-shore wells on the island have been experiencing saltwater intrusion as early as 1992, a concern exacerbated by seasonal drought, increasing freshwater demand, and the threat of sea level rise.

Rainwater harvesting is a logical tool for water conservation, and the residents have a wealth of knowledge on implementation. This study, based on the surveys of 115 Guemes Islanders who have existing rainwater harvesting systems, is meant as a resource to explore their firsthand successes, frustrations, and recommendations for other islanders who might be considering a system of their own.

Key takeaways from the quantitative data portion of the study: rainwater harvesting users tend to be satisfied (46%) with their system, very satisfied (28%), or neutral (21%). A majority of users (55%) find they use less water, and the uses cited most for their collected water are watering plants (52%) and reducing aquifer depletion (22%). Rain barrels are the most prevalent system on the island (168 total barrels between 56 users), and 25% of users have professionally installed systems.

Key takeaways from the qualitative response portion of the study: harvesting rainwater can give a sense of independence in emergency preparation, as well as offer a way to flush toilets when the power is out and well pumps are not working. Also, 81% of systems do not have filtration or sterilization, and 19% do, with several types listed. There is also a reminder that, in the appendix, there are several hundred recommendations, frustrations, successes, and general comments from the 115 rainwater harvesting system users surveyed.

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And for Kathleen Saul, a 1 x 106 thanks.

Land Acknowledgement

Guemes is within the traditional territories of the Samish Indian Nation, who have been stewards of these lands since time immemorial. This connection between land and people reminds us to strive for respectful partnerships, collective healing, and the preservation of natural and cultural resources, as stewards of the indigenous land we inhabit.

A picture containing drawing, sketch, clipart, illustration

Description automatically generated

Introduction

Guemes is a small 21.2 square kilometer island immediately north of Anacortes, Washington and east of the San Juan archipelago. Completely well-reliant, the island has been experiencing saltwater intrusion in its freshwater aquifers since 1992.

There exists an expanding and impressive body of research on Guemes’ hydrogeology, most notably an extensive USGS study (Kahle & Olsen, 1995) that is currently being revisited. The existing research could be complemented with social science exploring how islanders themselves relate to the tools they need for effective saltwater intrusion remediation. Residents represent not just decades, but often multigenerational lifetimes of firsthand experience with Guemes’ water. In addition, they are increasingly installing rainwater harvesting systems, and have already experienced challenges and the successes to meet them. For an individual exploring rainwater harvesting, there can be a steep learning curve for implementation, but the collective community knowledge is vast.

The groundwater of Guemes Island, designated a sole source aquifer by the Environmental Protection Agency, is at risk of saltwater intrusion. Since freshwater (with a density of 1.000g/cm3 at 20 °C) is less dense than saltwater (1.025 g/cm3), it floats as a lens, exerting pressure against the saltwater interface (O’Reilly, 2010). When freshwater is pumped from wells faster than a near-shore aquifer can recharge with rainfall, that pressure against the interface decreases, allowing it to encroach into the aquifer. The Ghyben-Herzberg Relation formula is used to estimate the volume of an aquifer by measuring the freshwater above sea level, which is then used to estimate the depth to the saltwater interface (Rasmussen et al, 2013). For reference, in the diagram below, the thickness of freshwater below sea level, or ***z****,* is about forty meters for every meter of freshwater above sea level (***h***). As freshwater becomes depleted from over-pumping, the saltwater/freshwater interface permeates the aquifer, especially closer to the shoreline where the water table is lower. If the freshwater above sea level drops a meter, the pressure loss can allow the saltwater interface to rise 40 meters. A simplified version of the formula reads thus: ***z = 40h***

A diagram of a sea surface

Description automatically generated

Fig. 1, Ghyben-Herzberg Relation CC BY-SA 4.0

Rainwater harvesting is an effective tool to decrease saltwater intrusion by capturing rainfall during the winter months, when the aquifer is full and otherwise flows into Puget Sound. Many of the homes on Guemes are seasonal, and well pumping increases considerably during the summer while the aquifer is not being recharged by rainfall (Kahle & Olsen, 1995). Rainwater harvesting can significantly offset the seasonal aquifer depletion, and thus the resultant saltwater intrusion that spikes between April through September, by allowing islanders to store rainwater during months when it would otherwise course off the island as stormwater.

A water flowing through a ditch

Description automatically generated

Water coming out of a pipe

Description automatically generated

Top, Guemes Island Road, February 2018

Bottom, Ferry dock, Guemes side, February 2018

Methods

The original research question for this project was: *How can rainwater harvesting be implemented successfully on Guemes Island to remedy saltwater intrusion?* For this, an island-wide mailed survey was to be sent to every household on the island, and the largest-size post office box was rented in Anacortes, the nearest town, to manage the return mailings. A lottery was added to the research design for incentivizing return, with a random number generator used for selection.

A group of water drops on a white surface

Description automatically generated

Six-hundred and twenty-five surveys and self-addressed, stamped return envelopes, were mailed out in November of 2018 to addresses listed for property holders on Guemes Island. Thus, the data for this research consisted of an island-wide survey for all households, and a supplemental survey for rainwater harvesting system users. At this same time, a notice was posted on LineTime, the active Guemes community online message board, asking islanders for their assistance in filling out and returning the surveys.

Guemes Islanders were exceedingly generous with their responses; of the 625 surveys sent, 300 were completed and returned (a 48% return rate), with another 26 returned as undeliverable (4%). Of the 300 survey respondents, 115 were rainwater harvesting system (RWH) users, a remarkable 38%. This was such a happy surprise that it necessitated a subtle change to the research question: *How can rainwater harvesting* **continue to** *be implemented successfully on Guemes Island to remedy saltwater intrusion?*

There is potential bias in this 38%, as rainwater harvesting system users might be more likely to return the survey since they have a vested interest in the topic. It is possible that a portion of that RWH user bias was lessened, as they also had the inconvenience of filling out an additional survey-- a total of seven pages rather than three. Whichever way these two potential biases balance out, it was a welcome surprise to have such a generous rate of return.

This study focuses on the data collected from the 115 RWH system user surveys and is broken into two distinct sections, one for quantitative data and the other for qualitative responses. The quantitative data from fill-in-the-dot questions has been populated into a Microsoft Excel worksheet, from which the percentages are calculated. The qualitative section gathered written responses, organized by the questions asked, copied verbatim for transparency. A full copy of all verbatim replies for the Qualitative Responses can be found in the appendix, as can a full copy of both surveys with Excel-generated statistics from the Quantitative Data section. Those two appendices, with the raw data and the verbatim quotes, are the most important parts of this study.

Please note that *the respondents for the island-wide survey and the respondents for the supplemental rain collection system survey are the same*, and both surveys have quantitative and qualitative data. So all the data below, from both surveys, are the same respondents.

Recipients were asked to fill out the island-wide survey, and if they have an existing rainwater harvesting system, they were then asked to fill out the supplemental rain collection system survey as well.

Quantitative Data

This quantitative data chapter will be broken into three sections: rainwater systems, demographics of the users, and their motivations for rainwater harvesting.

**Rainwater harvesting systems**

With the survey responses populated into Excel for statistical analysis, we get a clearer perspective on the RWH systems themselves.

*Please tell me about your barrel(s), cistern(s)/water tank(s). [If you have multiple tanks and/or types, please list them. If you need more space, the back of the cover letter/prize entry is blank.]*

* Rain Barrel(s); how many do you have?

**56 users (49%) have 168 barrels, or 3 each, avg.**

* Capacity of your cistern(s)/water tank(s):

**3,281.4 gal avg, 2222.2 gal avg if not taking into account cisterns over 10k gal cap 377,361 gallons of RWH capacity (3281.4 X 115) for the 115 survey respondents**

* Material(s) your tank(s) are made of:

**57 plastic, 14 concrete, 2 fiberglass, 2 metal, 9 ponds**

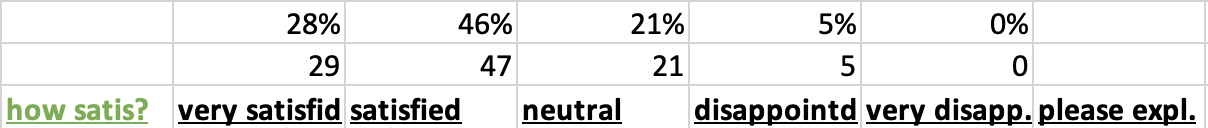
* Are they above ground  **59 (59%)**, below ground  **27 (27%)**, or semi-buried  **5 (5%)**? Pond  **9 (9%)**

By far, the most prevalent rainwater harvesting system on the island is the rain barrel; fifty-six users have a total of 168 barrels, for an average of three each. The appeal for the simple, affordable system is understandable, as it can be installed by the owner on most any guttered structure, without the complexities of groundwork, engineering, permits, or contractors.

These virtues might also have contributed to the initial implementation of RWH systems and the current high ratio of installations. Marianne Kooiman, a scientist on the island who has championed for water conservation and saltwater intrusion research, including the groundwork for having the E.P.A.’s sole source aquifer designation and the resultant approval for the USGS study of Guemes’ hydrogeology, also helped organize a group purchase for dozens of 55 gallon used pickle barrels to be used as rain barrels.

As contrast to the simpler rain barrel setups, there are also many surprisingly large, elaborate systems, which increases the average cistern capacity to 3,281.4 gallons. The 115 RWH system user responses examined for this study represents 377,361 gallons of rainwater capacity. Theoretically, we could hazard an island-wide estimate of the total cistern capacity on Guemes Island, though the results would be questionable. Population statistics for the 2022 Census have yet to be released, and existing population estimates are quite varied, which is why they have not been included in the report thus far.

Of the 115 RWH users on the island, only five are disappointed with their systems, and there does not appear to be any pattern to their dissatisfaction among the respective cistern types: one unsatisfied user has two 1,500 gallon tanks, while two others have three and five barrels respectively. Another disappointed user has a concrete cistern, and the last has a plastic above-ground cistern of indeterminate capacity. On average, users report to be happy with their systems, regardless of where they fall on the spectrum of size, cost, and complexity. There were zero users who were very disappointed. (Please note that not all responders fill in all the questions on the surveys. For instance, of the 115 users who returned surveys, we see 102 have marked how satisfied they are, though of those 102 that did reply, the percentage sum between the satisfaction choices is 100% of those 102 responses.)



One demographic does appear to have higher satisfaction with their systems; of the five largest rainwater harvesting systems on the island, with systems of 10,000 gallons or more, two users are satisfied and three are very satisfied. Two conclusions for this contentment come to mind:

1. The sheer capacity of the cisterns and the catchment surfaces ensure that, regardless of seasonal weather trends or water usage, user’s fresh water needs are met.
2. A larger system necessitates a great deal of initial planning, and would potentially utilize hardware engineered for prolonged industrial use with a longer service life.

In addition to barrel/cistern/water tank capacity, rainwater harvesting system users were asked the square footage, age, and composition of their roofing, this being the usual catchment surface for RWH systems (ponds being an exception).

*Approximately, how old is your roof?*

* \_\_\_\_\_\_\_\_\_\_years  **12.7 years, average**
* I do not know.  **3**

*What is your roofing type?*

* Asphalt shingle  **42 (35%)**
* Metal  **72 (61%)**
* Wood shake/shingle  **3 (3%)**
* Metal RV/trailer roof  **0 (0%)**
* Tile  **1 (1%)**
* Other:  **1 (1%)**
* I do not know  **0 (0%)**

Sixty-one percent of RWH users on the island have a metal roof (much higher than I had expected), with 35% having asphalt shingles. Had survey brevity not been a concern, several follow up questions would have been helpful, such as whether roofing was a factor in their initial RWH system design, and whether roofing material changes how collected rainwater is used.

Another survey question pertained to the use of water softeners. Its purpose was to explore if salt-based softener entering the aquifer from the top-down, as grey- and blackwater leaching from septic systems, was a potential issue to further explore, in addition to the bottom-up saltwater intrusion. There appear to be few journal articles that explore the topic, an exception being a 1993 study that investigated whether salt used for water softening was a background source of increased aquifer salinity in Stamford, Connecticut, in the Northeast United States, where aquifer chloride concentrations are often attributed to road salting for ice control (Kuntz & McBride, 1993). Their findings concluded that the chlorides from water softener salt represented a contaminant of a non-toxic nature, “…but are a cumulative contaminant of the aquifer and can result in levels of an unpalatable nature.” As the population on Guemes increases, this appears worthy of further study.

*Does your well water use a water softener?*

* Yes  **19 (20%)**
* No  **68 (72%)**
* I don’t know.  **7 (7%)**

*If yes, what kind? (Salt, potassium chloride,…)* **Salt: 12, potassium chloride: 1, not sure:1**

It was a pleasant surprise to discover so many residents have a meter of some sort to show water usage (61%), seemingly a useful visualization tool for water conservation. Survey brevity came at the cost of a follow-up question on meter type, so it remains unclear whether respondents’ wells are metered or if the metering referenced is for their rainwater tanks.

*Does your water source have a meter that shows how much water is used?*

* Yes  **65 (61%)**
* No  **42 (39%)**

*If yes, do you keep a record of water used?*

* Yes  **36 (47%)**
* No  **41 (53%)**

A later question in the survey inquires about rainwater tank measuring, though statistical analyzation within Excel does not help flesh out this distinction, as respondents often have a well in addition to their RWH system.

*How do you check the water level in your system?*

* Measuring stick  **14 (12%)**
* Gauge (either external or internal)  **6 (5%)**
* Visually  **63 (54%)**
* Tapping on the tank **25 (22%)**
* Other:  **8 (7%)**

**Quantitative**

**Rainwater system user demographics**

Within Excel, we can also explore the demographics of RWH system users.

*What percentage of the time do you reside on Guemes Island annually? (Please mark the answer that best applies.)*

* 0 - 25% **27 (23%)**
* 26% - 50%  **6 (5%)**
* 51% - 75%  **0 (0%)**
* 76% - 100% **83 (72%)**

*How many people live in your Guemes household (on average****)****?***\_\_2.1 average**

That 72% of RWH users live on the island year-round was not surprising, as full-time residents would potentially benefit greatly from an investment in water conservation measures. It was pleasantly surprising to see 23% only live on the island a quarter of the time, as this potentially means well pumping by part-time inhabitants during the summer months would be at least partly offset by stored winter rainwater.

*Do you rent or own your residence on Guemes?*

* Rent  **2 (2%)**
* Own  **107 (91%)**
* Non-resident, owner of undeveloped property  **1 (1%)**
* Non-resident, owner of developed property  **5 (4%)**
* Other **2 (2%) 1 caretaker, 1 family home**

*How many years have you been a resident of Guemes Island?*

* None  **2 (2%)**
* Up to 5 years  **18 (16%)**
* 5 to 10 years  **12 (10%)**
* 10 to 20 years  **28 (25%)**
* More than 20 years **54 (47%)**

Ninety-one percent of respondents are homeowners, with 47% having lived on the island more than 20 years. This makes 72% of users residents of more than ten years.

**Quantitative, motivations**

Both the quantitative data in this section, as well as the qualitative responses in the following section, give us an insight into the motivations for these 115 RWH system owners. When we look at motivations for installing RWH systems, those most cited are: outdoor use (37%), reducing aquifer depletion (22%), and backup water source (17%).

*What was your motivation for installing the rainwater catchment system? (Please check all that apply.)*

* I don’t have a well. **4 (2%)**
* Reducing aquifer depletion  **55 (22%)**
* Saltwater intrusion  **15 (6%)**
* Backup water source  **43 (17%)**
* It was installed by the previous homeowner.  **8 (3%)**
* Collecting rainwater for outdoor use  **91 (37%)**
* I prefer rain water.  **9 (4%)**
* Other:  **21 (9%)**

Six percent of users cite saltwater intrusion as a motivation, and we can see that ten percent of respondents have firsthand experience with it from a previous question.

That 37% of respondents consider outdoor use to be a contributing motivation can have a marked benefit to the reduction of saltwater intrusion, as groundwater is not being pumped for watering, with groundwater losses due to evaporation before runoff can wick into the soil and ultimately back into the aquifer.

*How familiar are you with the problem of saltwater intrusion into Guemes’ aquifers?*

* I am not familiar.  **3 (3%)**
* I am somewhat familiar. **45 (41%)**
* I am very familiar. **51 (46%)**
* I am very familiar and have experienced it. **11 (10%)**

For most users, RWH is supplemental to their well.

*Is the rainwater catchment system your only source for water, or is it supplemental?*

* Only source  **6 (5%)**
* Supplemental **91 (79%)**
* I have a rainwater catchment system installed, but don’t use it.  **8 (7%)**
* Other: **10 (9%)**

A full 52% selected watering plants when asked how they use their collected rainwater.

*For what do you use your collected rainwater? (Please check all that apply.)*

* Watering plants  **102 (52%)**
* Drinking/cooking  **10 (5%)**
* Water for animals  **26 (13%)**
* Fire protection  **27 (14%)**
* Other:  **29 (15%)**
* I don’t use it.  **3 (2%)**

Qualitative Responses

“*Until we started harvesting rainwater, I didn’t know how vulnerable I felt to be dependent on others for safe water. It’s nice to have the tanks full, in case some catastrophe did happen. Interestingly, Kitsap County recently had to tell its residents to boil their water for a week because e. coli had somehow gotten into their supply. I loved knowing I don’t have to think about things like that. Sure, I need to consider my safety, but I’m not playing a trust game with anyone.*

*Rain harvesting feels like the most natural thing to do*.”

I love that above comment.

This chapter explores the open-ended question responses that could not be answered by multiple choice and represents just a small selection of the replies from the 115 rainwater harvesting system users. If you are reading this in preparation for your own rain harvest system, every survey question response is in the following appendix, copied verbatim. There is quite a lot of experience in those short answers, and they might save some frustration.

*“I had to have my well water tested when I applied for a building permit for my starter house. It read 91ppm chlorides. I didn’t really know much in those days about chlorides but was here mostly weekends & summer. When we applied for a building permit for our current house in 2008 my chlorides level was just over the acceptable level so I had to restrict to 3gal/min pump rate. We put a 1gal/min restrictor and a 300gal reservoir tank. Since then our chlorides measure 70ppm & we’re here full time.”*

“*Rain Bank was great. Adam Mimnaugh did a good job of installing*.”

*“Forgetting to direct overflow into my tank this year. Lost 3000 gals!!!”*

*-*This seems a really good reminder, as it would be so easy to forget. Thank you for sharing.

***Do you use a filtration and/or sterilization system? (screens, UV light, charcoal filter,…?)***

* Yes  **21 (19%)**
* No  **88 (81%)**
* **Type(s):**

“charcoal/sand, limestone (calcite), UV

“UV light, sediment filters, carbon filter, intake screens”

“UV, charcoal filter, sediment filter, chlorine treatment”

“gutter screens, tank screens”

“screen at the top of the tank to keep out leaves and a filter on the hose when filling hot tub”

“3 filters (10 micron, 5 micron- carbon, 1 micron, UV light with safety function)”

“Berkey for drinking water. Mesh filters for everything else at the moment.” ***(note: Berkey is a brand of water filters.)***

“bleach, filtration screens”

“Charcoal?”

“screens”

Here is another example of discovering new information from an open-ended question. I would not have thought about the benefit of having water available for toilet flushing if the power is out to the well pump, but it was brought up six times.

“I have 2 barrels that catch rainwater for the garden and power outage toilet flushing.”

“flush toilet if power is off.”

“Toilet flushing”

“Flush toilets in event of long power outage”

“toilet flushing during power outages”

“Also used to flush toilet when I don’t want to use well water.”

“Generally thrilled to water young fruit trees & berries in August without guilt of using ground water.”

“Love having thriving garden during 70 day drought without using well water”

“Harvesting rainwater makes you appreciate it as a precious resource.”

Conclusion

*How can rainwater harvesting continue to be implemented successfully on Guemes Island to remedy saltwater intrusion?*

Rainwater harvesting makes sense as a concept. It is logical. But it can have a learning curve, and fortunately there are a slew of people on Guemes who have gone to great effort and expense to learn what works and the underlying science of why they are doing it. They have learned about it because they care, which says a lot.

I was thoroughly impressed with the survey responses, both with the thought that went into them and how many there were. That also says a lot.

“People will protect what they love, love what they understand, and understand what they’re taught.”

-Jacques Cousteau

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Appendix A

**Island-wide survey for all households of Guemes, part- or full-time**

This yellow survey is an island-wide survey for every household on the island, whether you live on Guemes part-time, full-time, or have property. All your responses will be kept anonymous.

Thank you very much for your response!

*What percentage of the time do you reside on Guemes Island annually? (Please mark the answer that best applies.)*

* 0 - 25% **27 (23%)**
* 26% - 50%  **6 (5%)**
* 51% - 75%  **0 (0%)**
* 76% - 100% **83 (72%)**

*How many people live in your Guemes household (on average****)****?***\_\_2.1 average**

*Do you rent or own your residence on Guemes?*

* Rent  **2 (2%)**
* Own  **107 (91%)**
* Non-resident, owner of undeveloped property  **1 (1%)**
* Non-resident, owner of developed property  **5 (4%)**
* Other **2 (2%) 1 caretaker, 1 family home**

*How many years have you been a resident of Guemes Island?*

* None  **2 (2%)**
* Up to 5 years  **18 (16%)**
* 5 to 10 years  **12 (10%)**
* 10 to 20 years  **28 (25%)**
* More than 20 years **54 (47%)**

*What is your age group?*

* 20 or under  **0 (0%)**
* 21 to 34  **0 (0%)**
* 35 to 49  **7 (6%)**
* 50 to 64  **30 (25%)**
* 65 or older  **81 (69%)**

*Including yourself, how many generations of your family have lived on Guemes?*

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**1.6, average**

*Does your property have an existing well?*

* Yes **84 (73%)**
* No **31 (27%)**
* I don’t know. **0 (0%)**

*If yes, have you experienced saltwater intrusion in your well?*

* Yes  **12 (13%)**
* No  **77 (87%)**

*Does your well water use a water softener?*

* Yes  **19 (20%)**
* No  **68 (72%)**
* I don’t know.  **7 (7%)**

*If yes, what kind? (Salt, potassium chloride,…)* **Salt: 12, potassium chloride: 1, not sure:1**

*Does your water source have a meter that shows how much water is used?*

* Yes  **65 (61%)**
* No  **42 (39%)**

*If yes, do you keep a record of water used?*

* Yes  **36 (47%)**
* No  **41 (53%)**

*Do you bring water for drinking and cooking onto the island?*

* Yes  **28 (25%)**
* No **82 (75%)**

*If yes, what is the source of the water you import onto the island?*

* Store-bought bottled water **19 (66%)**
* Municipal water  **9 (31%)**
* Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_  **1 (3%)**

*If yes, what is your reason for not using well water? (Please mark all that apply.)*

* My well water tastes funny.  **12 (36%)**
* Health concerns with well water  **6 (18%)**
* Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  **15 (45%)**

*How familiar are you with the problem of saltwater intrusion into Guemes’ aquifers?*

* I am not familiar.  **3 (3%)**
* I am somewhat familiar. **45 (41%)**
* I am very familiar. **51 (46%)**
* I am very familiar and have experienced it. **11 (10%)**

*How familiar are you with rainwater catchment? (Also referred to as rainwater harvesting.)*

* I don’t know about it. **0 (0%)**
* I know of it, but am not sure how it is used**. 5 (5%)**
* I know of it and how it is used, but don’t use it. **11 (10%)**
* Very, though I don’t use it. **5 (5%)**
* Very. I use it. (If you mark this one, please fill out the blue supplemental survey also.)

**89 (81%)**

*Have you considered rainwater catchment?*

* Yes.  **20 (18%)**
* No.  **1 (1%)**
* I collect rainwater already, or have a collection system (please fill out blue survey also).

**91 (81%)**

*If yes, were you apprehensive because of any of the following? (Please check all that apply.)*

* Cost  **20 (34%)**
* Lack of familiarity  **9 (15%)**
* Reliability  **5 (8%)**
* Code policy or permitting  **16 (27%)**
* Other:  **9 (15%)**

*Approximately, how old is your roof?*

* \_\_\_\_\_\_\_\_\_\_years  **12.7 years, average**
* I do not know.  **3**

*What is your roofing type?*

* Asphalt shingle  **42 (35%)**
* Metal  **72 (61%)**
* Wood shake/shingle  **3 (3%)**
* Metal RV/trailer roof  **0 (0%)**
* Tile  **1 (1%)**
* Other:  **1 (1%)**
* I do not know  **0 (0%)**

*If you are interested in rainwater catchment, what motivates your interest? (Please check all that apply, or share a reason not listed.)*

* Cost savings, compared to well  **14 (5%)**
* Water quality considerations of saltwater intrusion in well water  **26 (10%)**
* Reducing aquifer depletion  **74 (29%)**
* Resilience to climate change and how it might impact freshwater supply  **42 (16%)**
* Emergency preparedness (having water stored for emergencies, power outages..)

**49 (19%)**

* Fire protection (having water available for hoses,…)  **32 (12%)**
* Other:  **21 (8%)**

*Is there a question I’m not asking that you think is important? (Blank page on other side for more space.)*

***Thank you very much for filling out this survey!*** Your responses for the research will be completely anonymous. **If you have any kind of rain collection system, please fill out the blue supplemental survey also.**

**Supplemental survey; for *any* rain collection system**

**If you have any way to collect rainwater, please fill out this survey *in addition* to the yellow island-wide survey.**

This blue survey is a supplemental survey for anyone that has ***any*** rainwater collection system, *whether it is being used or not*; if you have a rain barrel for watering plants, a rain barn, a rain collection system that came with your house, a system you installed, or any other method of collecting rain, please fill out this blue supplemental survey ***as well as the yellow one.***

**Thank you very much for filling out the surveys!** Your responses will be kept anonymous and used in a social science study exploring the potential for rainwater catchment on Guemes Island.

*What was your motivation for installing the rainwater catchment system? (Please check all that apply.)*

* I don’t have a well. **4 (2%)**
* Reducing aquifer depletion  **55 (22%)**
* Saltwater intrusion  **15 (6%)**
* Backup water source  **43 (17%)**
* It was installed by the previous homeowner.  **8 (3%)**
* Collecting rainwater for outdoor use  **91 (37%)**
* I prefer rain water.  **9 (4%)**
* Other:  **21 (9%)**

*Is the rainwater catchment system your only source for water, or is it supplemental?*

* Only source  **6 (5%)**
* Supplemental **91 (79%)**
* I have a rainwater catchment system installed, but don’t use it.  **8 (7%)**
* Other: **10 (9%)**

*For what do you use your collected rainwater? (Please check all that apply.)*

* Watering plants  **102 (52%)**
* Drinking/cooking  **10 (5%)**
* Water for animals  **26 (13%)**
* Fire protection  **27 (14%)**
* Other:  **29 (15%)**
* I don’t use it.  **3 (2%)**

*Do you use a filtration and/or sterilization system? (screens, UV light, charcoal filter,…?)*

* Yes  **21 (19%)**
* No  **88 (81%)**
* Type(s):

*Roughly, what is the square footage of your roof catchment? (This is calculated with just a cross-section, or footprint, of your structure; for an example, if the barn you collect water from is 20’ long and 10’ wide, your catchment square footage is 20x10, or 200 square feet.)*

* **1183.6 square feet, average**

*Who designed your system? (Please mark all that apply.)*

* Self  **75 (66%)**
* Engineer  **5 (4%)**
* Installer **19 (17%)**
* Previous owner  **8 (7%)**
* Other:  **6 (5%)**

*Who installed your system? (Please mark all that apply.)*

* Self  **71 (64%)**
* Engineer  **2 (2%)**
* Installer  **25 (23%)**
* Previous owner **8 (7%)**
* Other:  **5 (5%)**

*If your system was installed by the previous owner, was the rain catchment system a consideration in purchasing or renting your home?*

* Yes  **2 (13%)**
* No  **4 (88%)**

*Please tell me about your barrel(s), cistern(s)/water tank(s). [If you have multiple tanks and/or types, please list them. If you need more space, the back of the cover letter/prize entry is blank.]*

* Rain Barrel(s); how many do you have?

**56 users (49%) have 168 barrels, or 3 each avg**

* Capacity of your cistern(s)/water tank(s):

**3281.4 gal avg, 2222.2 gal avg if not taking into account cisterns over 10k gal cap**

* Material(s) your tank(s) are made of:

**57 plastic, 14 concrete, 2 fiberglass, 2 metal, 9 ponds**

* Are they above ground  **59 (59%)**, below ground  **27 (27%)**, or semi-buried  **5 (5%)**? Pond  **9 (9%)**

*With your harvested rainwater, do you think you use less water than you would if you weren’t collecting it, the same amount, or more water?*

* Less water  **54 (55%)**
* Same amount  **18 (18%)**
* More water **14 (14%)**
* Not sure **13 (13%)**

*Do you have enough water in your barrels or cistern/water tank to last throughout the year?*

* Yes  **48 (48%)**
* No **51 (52%)**

*How satisfied are you with your system?*

* Very satisfied  **29 (28%)**
* Satisfied **47 (46%)**
* Neutral **21 (21%)**
* Disappointed  **5 (5%)**
* Very disappointed  **0 (0%)**

*Please explain:*

*How do you check the water level in your system?*

* Measuring stick  **14 (12%)**
* Gauge (either external or internal)  **6 (5%)**
* Visually  **63 (54%)**
* Tapping on the tank **25 (22%)**
* Other:  **8 (7%)**

*Please describe any hurdles or frustrations in design, installation, or use that you have experienced.*

*Please describe any pleasant surprises or successes that you are particularly pleased about.*

Do you have any recommendations, suggestions, questions, resources, or contacts that you’d like to share? (**There is more space on the back of the cover letter as well**, so please share any thoughts you have. Is there a question I’m not thinking to ask? Please share it!

**Thank you! I really appreciate your responses.**

Appendix B

**Island-wide survey for all households of Guemes, part- or full-time**

This yellow survey is an island-wide survey for every household on the island, whether you live on Guemes part-time, full-time, or have property. All your responses will be kept anonymous.

Thank you very much for your response!

*What percentage of the time do you reside on Guemes Island annually? (Please mark the answer that best applies.)*

* 0 - 25% **27 (23%)**
* 26% - 50%  **6 (5%)**
* 51% - 75%  **0 (0%)**
* 76% - 100% **83 (72%)**

*How many people live in your Guemes household (on average****)****?***\_\_2.1 average**

*Do you rent or own your residence on Guemes?*

* Rent  **2 (2%)**
* Own  **107 (91%)**
* Non-resident, owner of undeveloped property  **1 (1%)**
* Non-resident, owner of developed property  **5 (4%)**
* Other **2 (2%) 1 caretaker, 1 family home**

*How many years have you been a resident of Guemes Island?*

* None  **2 (2%)**
* Up to 5 years  **18 (16%)**
* 5 to 10 years  **12 (10%)**
* 10 to 20 years  **28 (25%)**
* More than 20 years **54 (47%)**

*What is your age group?*

* 20 or under  **0 (0%)**
* 21 to 34  **0 (0%)**
* 35 to 49  **7 (6%)**
* 50 to 64  **30 (25%)**
* 65 or older  **81 (69%)**

***Including yourself, how many generations of your family have lived on Guemes?***

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**1.6, average**

**“**We go back 5 generations in Anacortes.”

***Does your property have an existing well?***

* **Yes**  **84 (73%)**

“2 shallow, dug wells”

“surface well”

“community well Potlatch Beach”

“Community well”

* **No**  **31 (27%)**

“community reverse osmosis system managed by Skagit County PUD”

“Holiday Water Co. (wells)”

“community system, 26 lots +/-“

“it has shared wells in our Holiday Hideaway Water Company. Not on my property.”

“We are on the Holiday Hideaway water system. Our lots do not have a well.”

“Wouldn’t it be fun to know details about the wells- year it was dug or drilled, how

deep, private or public- shared by how many people. Months of usage. Is usage measured regularly, if so, # of gals, summer vs winter”

“We are on the PUD reverse osmosis system.”

“Water from a homeowner’s association well.”

“part of a community well system”

“(community well) 20 hookups”

“9 homes share a well on N. Beach”

“Holiday Hideaway water system”

* I don’t know.  **0 (0%)**

*If yes, have you experienced saltwater intrusion in your well?*

* Yes  **12 (13%)**
* No  **77 (87%)**

***Does your well water use a water softener?***

* Yes  **19 (20%)**
* No  **68 (72%)**
* **I don’t know.**  **7 (7%)**

“Community well. I don’t keep a record, but everyone on the well has an individual meter.”

***If yes, what kind? (Salt, potassium chloride,…)*** **Salt: 12, potassium chloride: 1, not sure:1**

“Use an iron filter”

*Does your water source have a meter that shows how much water is used?*

* Yes  **65 (61%)**
* No  **42 (39%)**

***If yes, do you keep a record of water used?***

* **Yes**  **36 (47%)**

“Potlatch Community Assoc. does”

“measure depth”

* **No**   **41 (53%)**

“No, but the water company does, & bills me monthly.”

“Not sure. It’s a shared well and I’ve never managed it.”

“-shown on bill”

***Do you bring water for drinking and cooking onto the island?***

* **Yes**   **28 (25%)**

“Just mineral water”

“for coffee”

* **No**  **82 (75%)**

“We used to bring drinking water but a slower pump rate and 300 gal reservoir solved problem. (2010)”

“Not anymore”

***If yes, what is the source of the water you import onto the island?***

* Store-bought bottled water **19 (66%)**
* Municipal water  **9 (31%)**

“from Anacortes”

* Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_  **1 (3%)**

“home delivery”

“Water delivered by Crystal Mntn Pure DW”

***If yes, what is your reason for not using well water? (Please mark all that apply.)***

* **My well water tastes funny**.  **12 (36%)**

“iron and manganese”

* **Health concerns with well water**  **6 (18%)**

“Too much salt for high b.p. people”

* **Other:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **15 (45%)**

“Iron content ruins cookware/ we prefer drinking bottled water”

“Well is unfiltered”

“fluoride”

“expense of chloride removal”

“supplementary”

“like the taste”

“Before we set up rain catchment, we filled jugs at Washington Park, then we had water

delivered to fill our 1500 gallon tanks.”

“Conserve island water”

“We don’t use well water, only catchment, and we prefer to not treat it for drinking potability”

“Back-up/disaster preparedness”

“Guests may be squeamish with well water.”

“Hard on coffee & tea maker”

“Drinkable and tested fine, but not the greatest taste.”

“Due to infrequent use- there can be “sand” in the water initially.”

“water bottles for quick grab & go- beach walks, hikes, car rides”

“water conservation”

*How familiar are you with the problem of saltwater intrusion into Guemes’ aquifers?*

* I am not familiar.  **3 (3%)**
* I am somewhat familiar. **45 (41%)**
* I am very familiar. **51 (46%)**
* I am very familiar and have experienced it. **11 (10%)**

***How familiar are you with rainwater catchment? (Also referred to as rainwater harvesting.)***

* I don’t know about it. **0 (0%)**
* I know of it, but am not sure how it is used**. 5 (5%)**
* I know of it and how it is used, but don’t use it. **11 (10%)**
* Very, though I don’t use it. **5 (5%)**
* **Very. I use it. (If you mark this one, please fill out the blue supplemental survey also.)**

**89 (81%)**

“Only for pond recharge”

***Have you considered rainwater catchment?***

* **Yes.**  **20 (18%)**

“Larger system”

“Catchment tank and attached to gutters. No pump so not used. Planned use for garden watering, not household use.”

* No.  **1 (1%)**
* I collect rainwater already, or have a collection system (please fill out blue survey also).

**91 (81%)**

***If yes, were you apprehensive because of any of the following? (Please check all that apply.)***

* Cost  **20 (34%)**
* Lack of familiarity  **9 (15%)**
* Reliability  **5 (8%)**
* **Code policy or permitting 16 (27%)**

“We use catchment for garden. Will be remodeling soon and want to use catchment to supplement well water for in-home use.”

* **Other:**  **9 (15%)**

“Banks will not lend on homes w/ catchment as primary water source-as of now.”

“water quality”

“copper roof”

“have no pump system installed”

“ugly”

“Old cottage- planning to remodel/rebuild, then add system.”

122. “getting materials to the island”

129. “Mosquitos breeding in rain water storage”

132. “Finding the right system for us.”

***Approximately, how old is your roof?***

* **\_\_\_\_\_\_\_\_\_\_years 12.7 years, average**

“3 years ago, we had a metal roof installed because asphalt shingles kept breaking off in wind storms.”

“shop 15, cabin 38”

* I do not know.  **3**

“(more than 15 yrs)”

“I do not know on the main house. Our new carport and shop have new asphalt shingle roofs.”

*What is your roofing type?*

* Asphalt shingle  **42 (35%)**
* Metal  **72 (61%)**
* Wood shake/shingle  **3 (3%)**
* Metal RV/trailer roof  **0 (0%)**
* Tile  **1 (1%)**
* Other:  **1 (1%)**
* I do not know  **0 (0%)**

***If you are interested in rainwater catchment, what motivates your interest? (Please check all that apply, or share a reason not listed.)***

* Cost savings, compared to well  **14 (5%)**
* Water quality considerations of saltwater intrusion in well water  **26 (10%)**
* Reducing aquifer depletion  **74 (29%)**

“!!!”

* Resilience to climate change and how it might impact freshwater supply  **42 (16%)**
* Emergency preparedness (having water stored for emergencies, power outages..)

**49 (19%)**

* Fire protection (having water available for hoses,…)  **32 (12%)**
* Other:  **21 (8%)**

“reducing how much we pump”

“water quality, esp. hardness”

“I use saved water for garden.”

“watering plants & livestock (chickens)”

“visible measurement of consumption & availability for conservation of aquifer”

“Originally to keep salt out of my garden. But I certainly used well water for garden to no ill effect. My original 55gal drums never lasted through the July Aug hot dry time.”

“I had to have my well water tested when I applied for a building permit for my starter house. It read 91ppm chlorides. I didn’t really know much in those days about chlorides but was here mostly weekends & summer. When we applied for a building permit for our current house in 2008 my chlorides level was just over the acceptable level so I had to restrict to 3gal/min pump rate. We put a 1gal/min restrictor and a 300gal reservoir tank. Since then our chlorides measure 70ppm & we’re here full time.”

“Back up source of water in future if wells went dry.”

“My catchment is to divert water away from home. Rain diverted into a pond. Presently raise ducks, previously mosquitos.”

“It just makes sense to use such an abundant resource.”

“Required by covenance for outside water usage”

“lawn/garden”

“Because it’s the right thing to do.”

“It helps fill our pond.”

“outdoor watering”

“use on plants in the yard”

“availability, doesn’t deplete other resources”

“Code prevents my use of water for plants during July-Sept.”

“garden”

“flush toilet if power is off.”

“watering plants”

“Allows you to water plants when it doesn’t rain.”

“Garden”

***Is there a question I’m not asking that you think is important? (Blank page on other side for more space.)***

“Should rainwater catchment be mandated for new construction?”

*(Note: I like this respondent, because they drew a great dog on the comment page. ☺ -Brandt)*

“Since we have not been using the well water for drinking/cooking, this past year decided to have installed a tank type filter system because the sinks and toilets were all orange and unsightly. We are glad to now have clean-looking water, but still do not use the well water for drinking or cooking because of the high salt content of the filtered water.”

“Note that we have some uncertainty about how well our shallow dug wells will perform over time. Our rainwater catchment system could be converted to provide potable water if need be in the future. (Provided we did some cleaning, upgrading, & connecting the system to water treatment.”

“What is your water source? We have a community well with large storage tank. Neighbors in adjacent property are utilizing a desalinization plant with storage capacity.

I highly recommend that all Guemes Island households have rainwater catchment systems for their outdoor water usage.”

“Need to ask residents of NW part of Guemes if they would participate in developing an aquifer recharge system.”

“We are on a community water system with about 100 users. You haven’t mentioned that in your survey.”

“We have 60 acres of land, 50 acres of which is held in open space/agricultural. This acreage is returning water to the Guemes Island aquifer.”

“I consider rainwater catchment systems to include

A) cistern type which collect roof runoff

B) Shallow ground water wells- most domestic wells are hundreds of feet deep to aquifer, but shallow ground water wells, AKA “dug wells” collect water at approx.. 6’-12’. This water is perfect for irrigation, and uses the same water a cistern would collect, and have no chance for saltwater intrusion.

I recently had a tree blow over leaving a large hole in the ground, which filled with water- which was shallow ground water.

I believe there should be no restriction on such shallow water collection systems, and there are many on the island because water systems do not have capacity to irrigate.”

“It would be interesting to me to know how other rentals impress upon renters & guests to conserve water.”

“We use our property infrequently, and are centrally located. So, 1) our well usage is minimal 2) our salt intrusion is minimal, and 3) our lot size makes us a rainwater restorer to wter table.

For us, a rainwater catchment would only be for fire department usage, emergencies, etc.”

“Because we are required to pay a monthly minimum of now $95 per month even though we have several months of NOT using any water…there is NO financial incentive to catch water for use.”

“1) How do you plan to use rain harvested?

* Potable (suitable for human consumption)
* Non potable (watering a veggie garden, etc.)
* Both

2) What type of rain catchment system are you most likely to install in the future?

* Rain barrels
* Cisterns
* \_\_\_\_\_\_\_\_\_\_\_\_

“ “Would you use a rainwater catchment system?” Likert scale 1-never, 2-doubtful, 3-maybe, 4-likely, 5-absolutely”

“Our water comes from desalinization filter for couple dozen houses on Potlatch Lane.”

***Thank you very much for filling out this survey!*** Your responses for the research will be completely anonymous. **If you have any kind of rain collection system, please fill out the blue supplemental survey also.**

**Supplemental survey; for *any* rain collection system**

**If you have any way to collect rainwater, please fill out this survey *in addition* to the yellow island-wide survey.**

This blue survey is a supplemental survey for anyone that has ***any*** rainwater collection system, *whether it is being used or not*; if you have a rain barrel for watering plants, a rain barn, a rain collection system that came with your house, a system you installed, or any other method of collecting rain, please fill out this blue supplemental survey ***as well as the yellow one.***

**Thank you very much for filling out the surveys!** Your responses will be kept anonymous and used in a social science study exploring the potential for rainwater catchment on Guemes Island.

***What was your motivation for installing the rainwater catchment system? (Please check all that apply.)***

* I don’t have a well. **4 (2%)**
* Reducing aquifer depletion  **55 (22%)**
* Saltwater intrusion  **15 (6%)**
* Backup water source  **43 (17%)**
* It was installed by the previous homeowner.  **8 (3%)**
* Collecting rainwater for outdoor use  **91 (37%)**
* I prefer rain water.  **9 (4%)**
* **Other:**   **21 (9%)**

“Our well was not a great producer.”

“less wear & tear on the well pump & less energy used”

“Didn’t want to put salt into my garden soil. Tho’ .91ppm chloride water is better than no water.”

“Fire protection”

“Fire prevention”

“Replenish pond for fish, ducks, etc.”

“1. It was a preferred alternative to drilling/fracking 2. Cost”

“Cost”

“Code precludes use of outdoor from well during July-Sep.”

“Did not have a well at the time.”

***Is the rainwater catchment system your only source for water, or is it supplemental?***

* **Only source 6 (5%)**

“When/if we run out we will have water delivered”

* **Supplemental** **91 (79%)**

“(primary- we really don’t use our well anymore)”

“irrigation"

* I have a rainwater catchment system installed, but don’t use it.  **8 (7%)**
* **Other: 10 (9%)**

“I have nearly 8000 gal. storage- it all goes to watering my garden.”

“Our gutters drain into our pond (fresh water pond).”

“The catchment system is my primary source, although my well water is of good quality.”

“I have 2x 55 gal barrels that aren’t hooked up yet.”

“We bring in potable water”

***For what do you use your collected rainwater? (Please check all that apply.)***

* **Watering plants**  **102 (52%)**

“sometimes”

* **Drinking/cooking**  **10 (5%)**

“In event of power outage.”

* **Water for animals**  **26 (13%)**
* **Fire protection**  **27 (14%)**

“…although haven’t need it for that yet. ☺”

“ponds”

* **Other:**   **29 (15%)**

“-pressure washing, car washing”

“if we do a burn pile we always have our rainwater hose handy.”

“Our house was plumbed to have our toilets flushed with rain water but we haven’t hooked that up yet.”

“The ducks use it!!!”

“emergency (eg power outages)

“filling hot tub”

“-From gutters → underground pipes → pond recharge”

“wash cars”

“hot tub fill”

“Everything a person does in their home.”

“Toilet flushing”

“pressure washing outside decks”

“Pond”

“bathing, etc”

“Catchment used for entire household.”

“Flush toilets in event of long power outage”

“Habitat”

“water plants & flush toilet when power is out”

“showering, washing hands, washing dishes”

“Disaster preparedness/back-up”

“Bathing”

“rinsing things off”

“toilet flushing during power outages”

“Maintain koi pond”

“outdoor cleaning projects”

* **I don’t use it**.  **3 (2%)**

“Note: system not yet hooked up”

***Do you use a filtration and/or sterilization system? (screens, UV light, charcoal filter,…?)***

* Yes  **21 (19%)**
* No  **88 (81%)**
* **Type(s):**

“charcoal/sand, limestone (calcite), UV

“UV light, sediment filters, carbon filter, intake screens”

“UV, charcoal filter, sediment filter, chlorine treatment”

“gutter screens, tank screens”

“screen at the top of the tank to keep out leaves and a filter on the hose when filling hot tub”

“3 filters (10 micron, 5 micron- carbon, 1 micron, UV light with safety function)”

“Berkey for drinking water. Mesh filters for everything else at the moment.” ***(note: Berkey is a brand of water filters.)***

“bleach, filtration screens”

“Charcoal?”

“screens”

***Roughly, what is the square footage of your roof catchment? (This is calculated with just a cross-section, or footprint, of your structure; for an example, if the barn you collect water from is 20’ long and 10’ wide, your catchment square footage is 20x10, or 200 square feet.)***

* **1183.6 square feet, average**

“2600 ft2 pipes to pond. 200 ft2 pipes to holding tank (500g)”

“not sure”

“Don’t use roof/ use land”

“(I only collect from half of the roof, which is ∼900ft2)”

***Who designed your system? (Please mark all that apply.)***

* Self  **75 (66%)**
* Engineer  **5 (4%)**
* Installer **19 (17%)**
* Previous owner  **8 (7%)**
* **Other:**  **6 (5%)**

“Remodel contractor/roofer

“combination plumber, excavator, & installer”

“Wife took a class and came home w/ 2 barrels.”

“Architect, installed in connection with new construction.”

***Who installed your system? (Please mark all that apply.)***

* **Self**   **71 (64%)**

“My original system was 10 55gal picle barrels under down spouts on my small cabins”

* Engineer  **2 (2%)**
* **Installer**   **25 (23%)**

“& plumber”

* **Previous owner 8 (7%)**
* **Other:**  **5 (5%)**

“System was installed when house was built.”

“Not installed.”

“contractor”

“House construction contractor.”

***If your system was installed by the previous owner, was the rain catchment system a consideration in purchasing or renting your home?***

* Yes  **2 (13%)**
* **No**   **4 (88%)**

“Glad it was there but did not influence decision to buy.”

“Nice bonus!”

***Please tell me about your barrel(s), cistern(s)/water tank(s). [If you have multiple tanks and/or types, please list them. If you need more space, the back of the cover letter/prize entry is blank.]***

* **Rain Barrel(s); how many do you have?**

“2 w/ hookups installed. 6 or 8 more out in the woods laying about. 55 gals. each”

“14 - 50gal. ea” *+* cistern”

* **Capacity of your cistern(s)/water tank(s):**

“not sure”

“3’ round x 8’ deep”

“We have a cistern (1000 gallon) and two ponds. 1 pond is for back up and emergency. The other pond is for irrigation and additional back up and emergency. We will likely add a third pond soon.”

“8 @ 50 gal? (maybe 75?)-Black pickle barrels.”

“Plastic (pickle barrels from India)”

“1000 gal for well water storage”

“Four huge water tanks which are semi-buried”

“+ above ground plastic pool”

* **Material(s) your tank(s) are made of:**

“food grade composite (Norwesco tanks)”

“corrugated steel, with liner”

“dark green “plastic” purchased from Berg Vault in Mt. Vernon”

“not sure”

“black heavy plastic pickle barrels”

* **Are they above ground**  **59 (59%)**, **below ground** **27 (27%)**, **or semi-buried 5 (5%)?** Pond  **9 (9%)**

“Pond”

“Pond, protects well from salt water”

“Have two large ponds for fire protection”

“I have 2 additional barrels that could be used.”

***With your harvested rainwater, do you think you use less water than you would if you weren’t collecting it, the same amount, or more water?***

* **Less water**  **54 (55%)**

“because we don’t use the well to fill hot tub”

“Harvesting rainwater makes you appreciate it as a precious resource.”

“less well water”

“Water to be used for garden, so less water used from aquifer. Will not have much effect on amount used for house.”

“from our well”

“Less from the well

* **Same amount**  **18 (18%)**

“Same. Without rainwater, gardens &orchard trees wouldn’t get watered.”

“Not installed. Don’t save a drop.”

* **More water** **14 (14%)**

“I use all of my rain water- grateful for the rains to return after dry July & Aug”

“Allows for 500 ft2 garden irrigation without using well water”

“N/A- without catchment pond fills with rain from sky. Often dry in summer”

“More water than when we used our well, in the fall, winter, spring-less in the summer. We have always been good stewards and use water sparingly.”

“We could not irrigate all our newly planted trees with water from our wells.”

“Wouldn’t water outside plants without it.”

* **Not sure** **13 (13%)**

“Depends on the time of year. I collect for a pond off a cabin roof.”

“Probably less for irrigation”

***Do you have enough water in your barrels or cistern/water tank to last throughout the year?***

* **Yes**   **48 (48%)**

“I’ve been here a long time and am very aware of my water usage.”

“Although I am at this house only part-time, the system could support full-time residence.”

“Do not use during the winter.”

“…with very judicious use.”

“waters my large garden during summer”

“with average rainfall.”

“if I don’t forget to direct the overflow pipe into my 3000 gal above ground tank.”

“Made it through this dry summer w 200 gal to spare”

Yes and No. “Depends on dry season. How long.”

yes,“mostly”

“garden water only”

*(pond)* “So far this year record low High/low ≈ 4’.”

“but just barely. Depends on summer rainfall.”

71. “Not likely but it’d be close.”

75. “sometimes”

87. “Don’t know”

110. “Plenty in winter. None July-Aug.”

111. “almost”

113. “Plan to install larger tanks.”

* **No** **51 (52%)**

“Not likely but it’d be close.”

“sometimes”

“Don’t know”

“Plenty in winter. None July-Aug.”

“almost”

“Plan to install larger tanks.”

***How satisfied are you with your system?***

* **Very satisfied**  **29 (28%)**
* “Love to garden- have enough to keep it going!”
* “We have beautiful outdoor plants all summer long. Even on the years that we pressure wash all the decks.”
* “No emergencies have necessitated its usage”
* “Extremely satisfied. Simple, efficient, renewable,..and tastes great!”
* “Does what it is supposed to do.”
* “I have 2 barrels that catch rainwater for the garden and power outage toilet flushing.”
* “Good alternative water for gardening.”
* **Satisfied** **47 (46%)**

“would like to enlarge”

“It works. I have ponds which collect water.”

“for what I use it”

“It’s nice not having to carry water, but we’re still building our system and have a bit of work until we can say we’re “very” satisfied.”

“Wish I had more storage in these dry summers.”

“We could use more. After we remodel, we will be more purposeful in our design and use to supplement household water.”

“As a part-time resident, I have not completely familiarized myself with the nuances of the system, e.g. changing filter, etc.”

“works for watering garden but we still run out during summer drought.”

“We collect water from a downspout. I must change the downspout to not collect water during the winter.”

“We aren’t on Guemes full time so the amount we collect (50 gallon) is sufficient for some plant watering but would not be enough if we lived full time.”

“We now run out in Aug and bring water in to cover for ∼ 2-4 weeks. This has happened for the last 3 years. We either increase storage, decrease use, or continue to transport as needed.”

“Rain barrel used to water new native planting in the summer. I have not used it for a few years now because I’ve not planted new plants.”

“Enough water most years”

“It’s enough for plants”

“Larger capacity & inner connectivity between barrels would be a smart next step…”

“It’s an elementary system but it works for watering plants.”

“At this occasionally rented house we (the owners) typically only use it for outdoor watering & cleaning.”

“Plan to install larger tanks so have more water for plants.”

* **Neutral** **21 (21%)**

“only use it in the summer. Otherwise very limited watering of plants”

“Not used yet”

* **Disappointed**  **5 (5%)**

“rain barrels are below/under house & watering needs are above house.”

“no pressure, but it is very primitive ☺”

* **Very disappointed**  **0 (0%)**

***Please explain:***

“With the summers becoming dryer I intend to add more capacity.”

“A garden uses a lot of water. 4,000 gal. doesn’t last the summer. Siting the tanks for gravity flow can be a challenge. The cost is pretty high.”

“Gross filtration can clog during times of increased pollen or detritus from roof.”

“We have to set up a vacuum pump each time we use the water.”

“Satisfied, “but not yet using to capacity.”

“Need pump fixed to use.”

“I use approx.. 2000/yr. so this cistern system is just the right size.”

“My expectations are met.”

“Need more capacity : )”

“water is accessed w/ marine sump pump.”

“I could use more capacity but it lessens the stress on our well.”

“but one can never have enough storage! My family refer to me as the water witch as I follow them around turning faucets off.”

“passive system”

“The rain barrel is used occasionally for watering plants. The 2 1500 gal tanks are not used. I stopped the project before the pump was installed because of lack of confidence with the installer. I hope to complete it some day.”

“We are concerned about using too much water from well. Having the rainwater to use means I don’t have to skimp when watering garden. The only reason I don’t use more is too lazy some summer days.”

“We like being able to fill our hot tub. We are disappointed that we don’t get enough water to last the summer.”

“The system was necessary due to loss of well to seawater intrusion. This county has done nothing to promote rainwater catchment, nor has it curtailed or restricted well drilling.”

“Plenty of water for gardens. Wouldn’t be enough for that AND household use.”

“We don’t have the capacity to get through a dry summer, but it reduces our water consumption from the well.”

“Would like to do more!”

“Currently only on 2 sm outbuildings. Wish it was on my main residence.”

“would like to dig pond deeper”

“Should help me pursue my gardening ambitions and reduce strain on well/aquifer.”

***How do you check the water level in your system?***

* **Measuring stick**  **14 (12%)**
* **Gauge (either external or internal)**  **6 (5%)**

“Simple gauge on outside. Sometimes it gets stuck.”

“Each tank (4) has a separate gauge.”

* **Visually**   **63 (54%)**

“water barrels”

* **Tapping on the tank** **25 (22%)**
* **Other:**  **8 (7%)**

“We do not check it.”

“Don’t check”

*(pond)* “Rock on bank for High. Stake to mark Low.”

“extra “septic style” overflow in ground tank also collects roof water in addn. to barrels catching out-building roof water in gardens (full about 800 gal- 3/4 + full)”

“Don’t- excess just overflows”

“Electronic monitor”

“we don’t measure it”

***Please describe any hurdles or frustrations in design, installation, or use that you have experienced.***

“Frustration that the county makes it hard to get a permit.”

“Lack of filtering before entry into tank

“I have trouble with debris clogging the inlet screen. Pressure is minimal.”

“Just gross filtration as mentioned previously.”

“Setting up and disconnecting the pump is a chore. Cannot easily do this.”

“getting the tanks situated near a roof & they are not easy to us on our flat lot- just fill watering can.”

“LOTS of water when it rains when I don’t necessarily need it and NONE when it’s very dry. (I just have a couple barrels.)

“Automatic pumps actuated by floats get tangled in cords & aren’t 100% reliable.”

“PVC ¾” pipes connecting barrels leak at entry holes. Requires continual caulking.”

“pumping in ground tank”

“bad pump, was replaced”

“Forgetting to direct overflow into my tank this year. Lost 3000 gals!!!”

“Installer was not experienced enough. Cost escalated. Not confident he knew what he was doing.”

“Still working out best distribution system from tanks to garden beds & fruit trees”

“There is sediment on bottom of underground cistern. We lost one pump due to the sediment clogging it. We elevate the pump now. One huge concern for me is making sure to pull plug after watering. If left on we would lose all water and burn up pump.”

“pump in lower tank unsatisfactory. Dirt from roof is collecting in the big tank.

“Pump failure; sump pump failure. All water had to be pumped. Gravity system would be better, but elevation isn’t adequate.”

“Barrels are on a wooden platform, so legs must be replaced, should have used treated wood.”

“I wish we had a more elaborate system for ease of use.”

“Main concern was the cost of system- which was steep (largely because we chose an expensive and large tank.”

*(pond)* “Previously it would go dry and was filled with cattails. I had it dug deeper & cattails removed. Wish would have gone much deeper.”

“Slow process due to lack of installers.”

“Water was pretty full of pine needles & leaves until we put leaf guards on gutters- a must!”

“None”

“Having someone explain how to get the system hooked up and working.”

“mosquito control. F.D. expressed unwillingness to access in ground tank in fire emergency”

“Just finding someone who would deliver the barrels was a chore. It took a lot of shopping around to get that done at a reasonable price.”

“Needed to add pressure system to even out water pressure.”

“Only issue is needing to open cistern every time I want to pump water from it.”

“Expense”

“plumbing fixtures & pumps, timers”

“Need a better fitting intake connection that eliminates light entering the inside of the tank (potentially causing algae growth). We’ve installed a low power pump for water distribution.

Will increase when we remodel.”

“Initially didn’t understand (or underestimated) the importance of clean gutters & changing filters on regular basis.”

“Time, money, and now injury.”

“Occasionally the downspout comes loose from the barrel.”

“Not knowing what I had or how it worked after buying a home. Put a new pump in & worked to water outdoor plants for a bit.”

“water level dropping unexpectedly”

“Wrong level installed, miss out on some of rain water- tanks too high”

“needs a pumping system to get water where needed. Inconvenient to carry water by bucket.”

“Connections between my barrels can clog.”

Gravity issues prevent/limit the distance from the tank I can use for watering.”

“Basic concept that was difficult to get fully operational.”

“I have an old crappy water barrel. It might be 50 gallon. I haven’t really looked into how to make it more efficient. I get no pressure.”

“PVC pipe keeps breaking”

***Please describe any pleasant surprises or successes that you are particularly pleased about.***

“It tastes great!”

“Lasts the season!”

“I calculated that I would need to gutter both sides of the roof but over 2 years I got enough water from just one side. Not sure that will always be the case though.”

“The water tastes GREAT!”

“Water tastes better than well.”

“500 gallons fills up fast!”

“I do like the satisfaction of having back up water if needed (some natural disaster for instance).”

“Generally thrilled to water young fruit trees & berries in August without guilt of using ground water.”

“the fill rate (rain) exceeds the use rate (watering) throughout the 9 month use period. (Mar-Nov).”

“gravity feed from barrels”

“How it lasts all summer for gardens”

“\*Learning 1” of rain produces ≈ 27,000 gal/acre. If only my roof & storage could keep up.”

“mosquito dunks for mosquito control.”

“Love having thriving garden during 70 day drought without using well water”

“My system is a very casual system. Water plants. Rain barrel with over flow to small low tub for critters to drink. And I fill a barrel to run my outboard motor in to get the saltwater out of it.”

“The system works so well and have plenty of water for vegetable garden, berry patch and shrubbery.”

“It is a handy, reliable source for watering our garden using gravity flow.”

“Amazed how quickly it replenishes.”

“Pleasantly surprised by how fast the barrels fill w/ not much rain- unfortunately in summer when needed it will often not rain for weeks.”

*(pond)* “When it freezes I can go ice skating (not so much lately)”

“It looks cool ☺”

“It functions”

“I can keep my garden going & hot tub full!”

“easy access near gardens when transplanting buckets, etc.”

“Until we started harvesting rainwater, I didn’t know how vulnerable I felt to be dependent on other for safe water. It’s nice to have the tanks full, in case some catastrophe did happen. Interestingly, Kitsap County recently had to tell its residents to boil their water for a week because e. coli had somehow gotten into their supply. I loved knowing I don’t have to think about things like that. Sure, I need to consider my safety, but I’m not playing a trust game with anyone.

Rain harvesting feels like the most natural thing to do.”

“Cistern pump provides greater water pressure than I had expected.”

“Having adequate water for outdoor plants and for being able to pressure wash all the decks in same year.”

“Even my small roof collects amazing quantities of water!”

“Much interest from visitors. Feelings of “smugness” that we’re being careful about water use.”

“Water is high quality, tastes great, etc.”

“periodic draining, cleaning and disinfecting of tank is minimal work.”

“My catchment tank is not much used, but some for livestock water. But the main house roof is piped to the pond which helps refill it after a long dry summer.”

“We bought the barrel from a fish processing plant and experience the smell of fish when we use the water for our plants.”

“Learning about what was set up by previous owners. Recommend a ¾ hp pump to run a sprinkler-1/2 hp is barely able to keep the flow needed.”

“Also used to flush toilet when I don’t want to use well water.”

“surprised how quickly tank & barrels fill in a good rain!”

“Great vegetables, and especially flowers year round.”

**Do you have any recommendations, suggestions, questions, resources, or contacts that you’d like to share? (There is more space on the back of the cover letter as well, so please share any thoughts you have. Is there a question I’m not thinking to ask? Please share it!**

“Make the design process easy for the homeowner. Keep county out of it as much as possible.”

“Great project! – What about community “pond” aquifer replenishment systems, plans?”

“Rain Bank, San Juan County Health Department”

“1. Berg Tanks Mt. Vernon

2. 6 gal/minute pump works well for hand watering

“Our well users are very conservative users as we are concerned about saltwater intrusion as neighbors have lost their wells.”

“Rain Bank was great. Adam Mimnaugh did a good job of installing.”

“There s/be an island-wide water coll. program, even a central tank @ high ground for gravity flow”

“Would be nice if there could be a low interest loan program that helps with the expense of installing such a system.”

“Legality of catchment systems varies from county to county, so I am never sure what to tell individuals if they ask my opinion re installing a system.”

“The island needs one or more aquifer recharge ponds totaling 5 or more acres.”

“I have been looking for an adapter to install in the downspout that would be more convenient to use when diverting water to the tank.”

“Every home should have some sort of freshwater back-up!”

“The state of Texas published rainwater catchment procedures 20+ years ago. Their direction was my guide.”

“Pretty easy to do on my scale- get a pickle barrel (feed store), add a faucet (easy- just need a hole saw or similar) and direct down spout into it (screen over the opening to prevent mosquito hatch.”

Resources

The Washington State Department of Ecology has a fantastic Rainwater Harvesting Calculator using an Excel worksheet, that calculates rainfall in your area, amount of water collected from your selected roof square footage over the year, and customizable cistern capacity and water usage. This is a very handy tool.

<https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-recovery-solutions/Rainwater-collection>

This link is for a potable rainwater catchment system template with diagrams, with great attention to detail and simplification.

<https://cpb-us-e1.wpmucdn.com/wp.wwu.edu/dist/6/4099/files/2019/08/SCP_SkagitCounty_Rainwater_FINAL-1.pdf>

Here is the link for Skagit County Planning and Development Services, if you are applying for a Rainwater Catchment system review.

https://www.skagitcounty.net/PlanningAndPermit/Documents/forms/Water/Water%20Review%20Worksheet%20fillable.pdf

<https://www.epa.gov/arc-x/climate-adaptation-and-saltwater-intrusion>

<https://www.ipcc.ch/assessment-report/ar6/>