ZEROWASTE

GREYWATER PILOT PROJECT UTILIZING PLANTER BED TREATMENT

A JOINT PROJECT OF:

CVCARE,

GHOSTS,

AND

AQUARIAN SYSTEMS INC.

ZEROWASTE PROJECT

TABLE OF CONTENTS

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Funding for this project was provided

To CVCARE

By

The Vancouver Foundation

The Endswell Foundation

The Comox Valley Community Foundation

And

To GHOSTS

By

Areas ‘A’, ‘B’, ‘C’ and ‘K’
Regional District of Comox-Strathcona

And

Environment Canada

In addition Zerowaste Project benefited from

a myriad of donations, time and services

from local community members and businesses

1. Overview

The Zerowaste project is another partnership between C.V.C.A.R.E. (Comox Valley Citizens Action for Recycling and the Environment) and G.H.O.S.T.S. (Green House Organic Sewage Treatment Society), as part of a multi-phased exploration of alternatives to traditional onsite sewage treatment to provide innovative solutions to assist in preventing pollution in Baynes Sound. CVCARE's initial involvement in the project was funded as part of the BC Health Research Foundation grant for the Sound Wastewater Solutions project and has continued thanks to the support of the Vancouver Foundation, the Endswell Foundation and the Comox Valley Community Foundation.

As a non-profit charitable society, C.V.C.A.R.E. is structured to include Management Teams for its projects, including at least 2 board members and other interested parties. This has provided not only a well-monitored and managed project, but has also provided another layer of communication with the broader public.

G.H.O.S.T.S. has brought a tremendous skill-level to the project and funding from grants-in-aid from rural Areas 'A', 'B', and 'C' of the Regional District of Comox-Strathcona, and funding from Environment Canada.

The Baynes Sound Round Table monthly meetings include representatives from the Shellfish Growers Association, various interested provincial and federal ministries, as well as many non-government organizations. They have provided a review of C.V.C.A.R.E. projects, and have been a key forum for resolving important issues, particularly to the Zerowaste project.

The greywater treatment phase of the project commenced in December 2000, with the first system being turned on in October 2001 and the final system beginning use in late March, 2002. Sample testing of the influent and effluent began for the first site in December 2001, when the effluent began entering the greywater planter boxes, and will be completed in one year's time from start-up. A review of the systems by the Ministry of Health's Innovative Technology Program (ITP) mid- 2003 will determine whether further testing or modifications are required prior to approval for general use.

2. Design

2.1 The Proposal

The following pages outline the original proposal that was submitted to the ITP for testing of the greywater planter boxes. This proposal has seen revisions through the design process.

GREYWATER TREATMENT PROPOSAL USING A PLANTER BED
(VERTICAL FLOW, SOIL BASED/ROOT ZONE FILTER)

A JOINT PROJECT OF GHOSTS AND CVCARE

PURPOSE:

To demonstrate the effectiveness of treating greywater by micro-dosing to a soil/root zone environment (vertical flow planter bed) preceded by pretreatment in a septic tank; in situations where there exists a separation in the treatment of fecal matter and household water use. Greywater in this instance refers to all household wastewater excluding the toilet.

RATIONALE:

- Many building sites on the Gulf Islands and other rural areas have a water quantity problem in the dry summer months; thus one water conservation strategy currently being employed is to use composting toilets, which require no or little water. This then requires effective treatment of the remaining household wastewater.
- Many of these same building sites have limited soil for wastewater treatment and/or disposal. By building up and containing the treatment zone above the existing grade level it is possible to provide an environment for adequate treatment before disposal. However, this is then disposed to an area adequate for disposal, but deficient in treatment capacity.
- By combining the treatment area with a landscaping feature (planterbed), it is possible to reuse the household wastewater by treating it in a garden area which would otherwise be irrigated by scarce potable water.
- The added benefit of the biochemical transmutational processes is gained by employing the rhyzosphere (root zone) in the wastewater treatment process, the rhyzosphere being rich in oxygen and microbial activity. See supporting documentation: The Value of the Rhizosphere.
- The treatment efficiency can be increased by micro dosing -thus the daily loading rate in a given area can be increased, reducing the required land base. See supporting documentation: Intermittent Sand Filters.
- If the proposed trials demonstrate treatment to be a high enough quality, combined with adequate soil conditions beneath the planter, then disposal could simply be a matter of having a permeable base on the planter allowing for soil infiltration.
- The Canadian Mortgage and Housing Corporation are strong proponents of water conservation, having done extensive research on the decreasing available potable water supplies in Canada. They have identified the use of composting toilets and separate greywater treatment systems as being one of the viable areas for a

conservation strategy and thus are encouraging research in this area. The potential applications which they cite are:

- Remote properties
- Cottages
- New environmental homes
- Upgrading existing properties
- Servicing new lots under adverse conditions

- The recent Dr. Allen groundwater study on Hornby Island has shown that wells in some populated areas are being impacted by salt water intrusion. As there seems to be a correlation between the quantity of ground water extracted and the salt water intrusion a water conservation strategy needs to be developed on the gulf islands and other coastal areas. This proposed project is one way of addressing and promoting water conservation.

SITE INTEGRATION:

For the purposes of this research proposal 3 sites have been selected which have existing permitted septic systems. In these situations the existing plumbing will be changed to allow for separating grey and black water. The blackwater will continue to be treated in the existing septic system and the greywater will be diverted to the new greywater treatment system before being discharged into the existing septic tank where it will mix with the blackwater.

PROCESS DESCRIPTION:

The greywater treatment process begins with primary treatment (2 days retention time) in the first chamber of a 2- chamber septic tank. The second chamber will house the pump, float controls and effluent filter. Secondary treatment of the filtered primary effluent will occur in the planter bed. The pump will "micro-dose" the planter bed filter up to 24 times per day (at design flow). The dose volume is very small and will maintain an unsaturated condition in the planter bed soil for optimum treatment. The hydraulic loading rate of 2.0 Igal/sq.ft./day is consistent with a high rate intermittent sand filter. The treated effluent will be collected in the underdrain of the planter bed and sent to the drainfield via the existing septic tank.

The dosing pump controller will be housed in a weatherproof outdoor panel for easy access by maintenance personnel. A combination of float switches and a programmable timer maintain pump control and operate as follows:

Fluid level will rise and activate the PUMP ON float.
The programmable timer will be activated and the pump will operate once per hour for a prescribed duration (one micro-dose).

The pump will continue to operate in this mode until the liquid level is drawn down to the LOW LEVEL PUMP OFF float. The pump and timer will remain off until the fluid level rises again to activate the PUMP ON float.

Should the liquid in the pump chamber rise to the level of the invert of the inlet pipe the HIGH WATER ALARM/EMERGERNCY OVERFLOW PUMP ON float will be activated (this mode will override the timer-controlled mode). An audible alarm will sound and the pump will come on and draw the fluid level down to prevent the overflow condition from occurring.

The EMERGENCY OVERFLOW PUMP OFF float will shut the pump off once the level has been drawn down to a prescribed level. Control will then be returned to the timer controlled micro-dose mode.

Features of the system include the following:

- 3 bedroom house as basis for design
- Separation of grey and blackwater plumbing
- 600 gallon two chamber septic tank
- Second chamber to be used as dosing chamber for pumping to planter beds
- 1/3hp effluent pump
- Simtec effluent filter
- Control panel for micro dosing
- 24 doses per day
- Concrete planter bed with impermeable base (100 sq.ft. of soil surface area)
- 3 lateral distribution lines (1” PVC Schedule 40) 1/8” orifices @ 16 o.c
- Distribution lines suspended in 6” half pipes buried to a depth of 6” to base of half pipes
- 1” or larger PVC pipe perpendicular to and under half pipes to prevent pipes from sinking into soil
- Sandy/loam soil mix to a 1’ depth
- 1# Eisenia Foetida Earth worms
- 18” C33 sand beneath soil
- 3” pea gravel beneath sand layer
- 6”drain rock beneath pea gravel layer
- 3” perforated sewer line running along the length of the bottom, draining to existing septic tank and drainfield
- Perennial plants rooted in the influent distribution zone (Plants which like moist, well drained soil).
- 3”mulch layer on top of soil
- Monitoring spigot preceding the planter bed
- Monitoring well between the planter bed and existing septic tank

Details of the system are shown on the attached drawings prepared by Aquarian Systems.

LOADING RATES:

- Maximum daily flow: 200 Igal (greywater from 3 bedroom house)

- Greywater quality: BOD(5day) 200 mg/l* (.004 lb.BOD5/ft2/day)
  TSS 42-53 mg/l*
  * from Siegrist
- Hydraulic loading rate: 2.0 Igal /sq.ft./day
- Hydraulic application rate: 0.08 Igal/sq.ft. per dose (4mm thickness over 100 sq.ft.)
- Pump flow rate: 16 Igpm (to provide minimum 2 ft. "squirt" in pressure distribution laterals (1/8 inch holes)
- Percolation rate of sandy loam: 11 to 20 minutes per inch
- Anticipated effluent quality: Between Type 2 and Type 3 as defined in the B.C. Ministry of Health Sewage Regulation (Draft 3.0)

MAINTENANCE:

- Inspection of septic tank including measurement of scum and sludge layers.
- Septic tank pump-out as required.
- Inspection of pump, floats and control panel to verify operation is within design parameters.
- Inspection and cleaning of effluent filter.
- Flushing of pressurized laterals (annually).
- Maintenance and repair of mechanical and electrical equipment as required.
- Maintenance of plants and mulch including thinning of vegetation as required.
- Provision of plant watering when residents are away on vacation by timer controlled irrigation.

MONITORING:

- Proposed greywater system sampling and testing:

  1. TSS*
  2. BOD*
  3. FECAL COLIFORM*
  4. TOTAL N**
  5. TOTAL P**
  6. TURBIDITY**
  7. FLOW MEASUREMENT*
  8. pH*
  9. TEMPERATURE*
  10. D.O.*
  11. CONDUCTIVITY**

  (* Standard parameters)
  (** As budget permits)

  - Samples be taken in monitoring wells before and after treatment in the planterbed.

- <u>MONITORING SCHEDULE</u>**:**

  -Year 1:

  Day 2: Temp, Fecal, pH, D.O, BOD5, TSS, TN, NO3, PO4, Turbidity

  Next 12 months: Quarterly

  Monitoring will take place for a minimum of 1 year.

SUPPORTING DOCUMENTATION:

1) Intermittent Sand Filters:
New Frontiers For an Ancient Art
David Venhuizen, P.E.
Austin, Texas
1996

<u>Basic Design Parameters</u>

The original concept of intermittent sand filter operation was to utilize rather fine media—in the range of 0.2 to 0.4 mm effective size—and to load the entire daily dose at one time, allowing it to drain and rest until the following day. In studies conducted at the University of Florida in the 1940's and 50's, it was noted that, all other factors remaining equal, splitting the daily load into two doses increased removal efficiencies and allowed sands of a given size to be loaded more heavily.

This finding led to further investigations of more frequent loadings. The conclusion of these studies was that, even without improving the influent quality before application to the sand filter, more frequent loadings can allow higher loading rates to be readily accommodated with no degradation in treatment and without premature clogging of the filter. In fact, for filters employing larger media, treatment actually improved with more frequent loadings even when higher hydraulic loading rates were applied.

A filter with an effective sand size of 1.04 mm demonstrated a 96% BOD5 removal efficiency when loaded at 13.8 gal/ft2/day, removal efficiency was generally in the range of 70-80% when the filter was only loaded twice per day. During the period when the filter was dosed hourly, average organic loading rate was 0.0119 lb./ft2/day, and it was above 0.005 lb/ft2/day at all loading rates except 4.02 gal/ft2/day. Two other filters, with sands of 0.44 mm and 0.46 mm effective size, demonstrated BOC5 removal efficiencies ranging from 80% to 93% when loaded twice per day at rates from 2.87 to 7.46 gal/ft2/day. With 4 loadings per day at a rate of 6.89 gal/ft2/day, removal efficiencies were elevated to 95-97%. Here again, when hydraulic loading rates were at or above 6.89 gal/ft2/day, organic loading rates were generally above the 0.005 lb./ft2/day "limit".

2) See attachment: The Value of the Rhizosphere, Dr. Alex Shigo. (Appendix 1 of this report)

3) See attachment: Aqua Test, Client – Mass. Audubon Society, Laboratory analysis of greywater effluent after filtration thru a Clivus Multrum (nylon sock) greywater filter followed by filtration thru a soil based, vertical flow, planter bed. This facility has hand washing and a small kitchen. (Appendix 2 of this report)

2.2 Design Refinement

Following a meeting on October 27, 2000 to discuss the proposal with various ministry officials from Ministry of the Environment (now Water, Land, and Air Protection). Ministry of Health and the local Environmental Health Office, the project began to take shape as details were refined. For approval for testing, the final design of the greywater planter boxes required engineered drawings to be submitted to the ITP. The local Environmental Health Office also requested the Ministry of Health engineering department to review the design. Although this review could have delayed the project further, the request was processed in a timely fashion and construction commenced in June 2001. The design will become publicly available once it is approved for general use.

It was decided that all three sites should test the same system without variation to the design. Variation would come in the water use practices and make-up of the homes being tested.

One design revision was to employ the Aquaworx control panel and "floatless" level control (liquid level in the pump chamber is monitored by a pressure transducer). It does away with the problem of float failures and the tangling of cords etc. It is a state of the art system which enhances the ability to monitor, maintain and troubleshoot the greywater system and provides a logged record of regular pump doses, emergency overflow events, high water alarm conditions and flow measurement. Pump and level control settings are operated from a palm pilot, which is in the hands of the installer and maintenance personnel. The event data is collected by the palm pilot and can be downloaded to a computer into a Microsoft Excel spreadsheet for analysis and plotting of graphs.

A plastic tube which ventilates the pressure transducer to atmospheric pressure will be replaced by Aquaworx Inc. in the near future with a more durable material.

While the engineered drawings reflect the “bones” of the system, there is another component of the greywater planter box. This could be considered the “soft tissue”, and includes the growing medium and plants.

2.3 Growing Medium

The layers of soil and aggregate in the planter box were revised from the original proposal. The final design is as follows (starting from the top and going downward):

a) 4” organic mulch layer
b) 12” sandy loam soil layer
c) 18” sand layer (ASTM C33)
d) Geotextile filter cloth (Nilex 4535 or 4545 or approved equal)
e) 6” clean drain rock layer

The ITP required the sandy loam soil layer to be clearly specified and tested via sieve analysis for conformance with the design. Accessing the appropriate soils and attaining the specified mixture locally proved to be a challenge. The soil layer was designed by specifying a gradation range from coarse to fine using a “soil banana” graph with allowable limits on percent of soil particles of a particular size. Two of the three sites received delivery of soils that fit the requirements, but one did not. The third site required modification of the soil by the addition of ASTM C33 sand to bring the soil particle size gradation within the design limits (soil banana).

Although the ITP did not require information about soil conditioning, the project employed mycelium culture and worm castings to prepare the soil for optimum performance of the planter box system.

2.4 Plants

Although the number of plants suitable for the greywater system is extensive, the Environmental Health Office requested a limited number for easy identification by field officers. The condensed list includes the following:

PERENNIALS

- Sweet Gale (Myrica gale) – aromatic, to 1.5 meter, deciduous, nitrogen fixer.
- Evergreen Huckleberry – evergreen, shade or sun, to 4 meter
- Water Iris – Japanese yellow (Pseudoacorus) or Siberian purple, 1 meter, deciduous
- Japanese Honeysuckle – 1 meter, evergreen
- Euphorbia – 1 meter, evergreen
- Columbine – 1 meter, sun to part shade

Plant 2-3 varieties of perennials, choosing at least 1 evergreen, planting 1’-2’ apart depending on size of plant at planting. As plants mature they will need to be thinned.

ANNUALS – Self Seeding

- Vetch, nitrogen fixer
- Nasturtium
- Poppies

- Snapdragons

Plant at least 1 self seeding annual or more depending on desired aesthetics. Plant on a 2' grid initially if planting starters or by seed in following years they will come up on their own.

3. Choosing Sites

The originally-chosen third site was rejected when it was decided to have all three systems conform to the same design. Another homesite was explored and was found to be unsuitable due to site constraints. The search for the elusive third site brought Denman Island, adjacent to Hornby Island, into consideration. It was thought there might be a high interest in the project with the inhabitants faced with similar physical constraints which plague Hornby Islanders – poor soils and water constraints. As well, the opportunity to have widely scattered sites might broaden the exposure of the project. However, the Denman Island option was also rejected, because of higher transportation costs and a substantial increase in the contractor's time. It was also feared that the connectivity to the community for a source of volunteers was not as strong. Eventually, a third site was confirmed on Hornby Island.

Each of the homeowners was required to sign an agreement for the product testing at their homesite. This agreement was drafted by C.V.C.A.R.E. and G.H.O.S.T.S., with additional input and requirements from the Ministry of Health. The agreement is included on the following pages.

AGREEMENT

Between

____, known hereinafter as

the householder

and

Green House Organic Sewage Treatment Society, known hereinafter as

<u>GHOSTS</u>

and

Comox Valley Citizens Action for Recycling and the Environment, known hereinafter as

CVCARE

The homeowners have offered their property as a test site for the GHOSTS/CVCARE Greywater treatment research project. GHOSTS will construct, monitor, and maintain the system for a minimum of 1 year.

The purpose of this project is to gather data for evaluating the performance of this technology with the goal of having this system being permitted by the Ministry of Health.

Because this is an ecological process, the owner/user is an integral part of the treatment process. The householders agrees to use water in a way that will optimize the treatment capability of the planter box system, such as spreading out laundry loads throughout the week, and to be judicious in their use of cleansers, products, etc. (see paragraph 18) and to not be a detriment to the optimal performance of the system.

The "planter box" greywater treatment system is installed as "product development" and is not designed to replace the existing system that serves the property.

The project is undertaken in partnership with Comox Valley Citizens Action for Recycling and the Environment (CVCARE), Green House Organic Sewage Treatment

Society (GHOSTS), the Upper Island/Central Coast Community Health Services Society, the Provincial Land Use Consultant, and with the support of the homeowners.

The parties agree to the following:

1. This agreement applies to the homeowners and tenants dwelling on the premises and are referred to in this agreement as "householders".

2. The owner shall indemnify and hold harmless the Ministry of Health, the Upper Island Central Coast Community Health Services Society and their respective employees from litigation arising from the operation or non-performance of the experimental system.

3. The owner in the event of a non-repairable failure (as determined by the EHO) replace the experimental system within 90 days with a current system.

4. The homeowner will notify any tenant dwelling on the premises of this agreement.

5. The evaluation period will start from the date of startup and continue for one year, or longer if required by the Ministry of Health.

6. The householders will not do any gardening work in the planter during the period of project monitoring.

7. GHOSTS will provide written notice when the project is completed.

8. GHOSTS undertakes to build, maintain and repair the system for the period of the research, which is a minimum of one year and may be extended by Ministry of Health requirements.

9. The homeowner is solely responsible for the ongoing care and maintenance of the pre-existing septic tank and septic field. The greywater treatment system is expected to improve the performance of the existing system. The homeowner will not hold CVCARE or GHOSTS liable for any problems that arise that are the result of pre-existing conditions of the septic system.

10. The system will be owned by GHOSTS and CVCARE until the project is completed. Ownership will then transfer to the homeowner.

11. Upon written notice of when the project is completed, responsibility for repair and maintenance will rest with the homeowner. On-going maintenance includes thinning and/or pruning of plants, maintaining the integrity of the mulch layer, ensuring the plumbing lines are not blocked, and the pump and any other working parts are in good working order.

12. The householders agree to notify GHOSTS of any modifications to any existing household plumbing that could change the quality or quantity of flows into the greywater system.
13. The householders agree not to alter the plumbing of the greywater system during the period of the research, including, but not limited to, re-directing the flow of effluent from the planter box.

14. The householders agree to maintain free and unrestricted access to the monitoring points, by not placing objects or construction on or near the monitoring points such as to restrict access.

15. The householders agree to provide access to the system for Day 1, Day 2 and weekly thereafter for performance monitoring.

16. GHOSTS agrees to inform the householders of the identification of the monitoring persons.

17. GHOSTS agrees to notify the householder at least 2 days prior to the monitoring person entering the site or, alternatively, to mutually agree upon a schedule for the monitoring.

18. The householders agree to allow the system to be shown from time to time for educational purposes, upon pre-arranged, mutually agreeable times.

19. The householders agree to immediately contact GHOSTS in the case of any detectable malfunction.

20. The Ministry of Health may request a "planned system upset" to evaluate the performance of the treatment technology in adverse conditions. The householders will be notified in advance and mutually agreeable arrangements will be made for such a "planned system upset".

21. GHOSTS and CVCARE agree not to publish the installation addresses.

22. The householders give permission for photographs to be taken of the installation, which may be published.

23. GHOSTS will supply written recommendations for household products to avoid or minimize the use of as listed in Appendix 1, attached to this agreement.

Agreed to this ____________day of ____, 2001

At ____, British Columbia

____ for GHOSTS

____ for CVCARE

____Householder

APPENDIX I TO HOUSEHOLDER AGREMENT

Recommendations for products not to use or to use in moderation

Use low sodium content cleansers and detergents
Limited use of bleach
Do not use caustic drain cleaners
Limited use of anti-bacterial soaps
No garburators (will increase load on septic tank)
No latex paint – i.e. no rinsing paint brushes

See also Appendix 2 for discussion regarding plants and products.

4. Construction and Volunteers

Following the challenge to find test homes with approved septic systems were the challenges of locating the appropriate placement of the system around a previously developed site, and then, modifying the plumbing to efficiently accommodate the greywater system.

In retrospect, low profile septic tanks (52" rather than 58") should have been used because rock prevented the complete burying of the tank; however, this is an aesthetic consideration rather than a functional one.

The great public interest in the potential use of the system attracted a healthy squad of volunteers to assist in the construction at all three sites. Work proceeded under supervision of a contractor to prepare the site, erect forms and pour concrete, lay pipe and other plumbing works, fill the boxes with soil, plant plants and apply the exterior stucco. One volunteer reported that working on the project for over 80 hours broadened her skill base for future employment prospects. The contractor, in return, gave her a glowing letter of recommendation.

The homeowners were another key component of the volunteer corps. Not only did they volunteer their homes for the "product testing" of this innovative technology, their talents in landscaping assured a creative and personal touch to the project, while under the supervision of the contractor to ensure the technical requirements were met.

Two of the planter boxes were not buried two feet into the ground, as originally intended, which resulted in some creative landscaping by the homeowners to soften the effect of a 4 foot tall box.

See Appendix 3 for details of in-kind contributions of volunteer services.

5. Maintenance

5.1 A system maintenance regime has been finalized to ensure the system is properly maintained and optimal performance is assured, as follows.

GREYWATER PILOT PROJECT ***MAINTENANCE PROGRAM***

1) Inspection and operational check of pump(s), control panel, valves, floats, piping and general system functioning (bi-annually). Visual inspection of treated effluent.
2) Change batteries annually in pump control panel, change batteries in palm pilot.
3) Check panel timer and level control settings and download data from pump control panel bi-annually.
4) Review panel data and analyze results: a) flow calculations; b) liquid levels and normal doses c) high water alarms and d) veto pump events.
5) Review and summarize effluent monitoring data. Compare actual flows with design flows.
6) Check that high-level alarms are functional.
7) Change batteries annually in supplementary irrigation control panel.
8) Ensure that supplementary irrigation is operating during drought conditions, especially in systems with split plumbing zones.
9) Check squirt at end of laterals bi-annually.
10) Flush laterals annually.
11) Thin plants as needed.
12) Fertilize plants as needed.
13) Mulch as required.
14) Check pump filter bi-annually and clean as required.
15) Have septic tank monitored annually for solids buildup and pumped as required when sludge layer reaches 12”depth.
16) Check effluent pump chamber/sampling ports for solids accumulation and clean out as required (bi-annually).
17) Keep orderly maintenance records.

5.2 Source control is an area of interest in assuring an environmentally friendly system.

The homeowner agreement recognizes the role of the homeowner in the functioning of the system and appends a list of products to avoid or minimize use of. This is to encourage reducing pollutants and chemicals that may harm the working of the system.

The former aspect responds to the quality of the influent into the system. Water conservation considers the quantity of water entering the system. Apart from the desire to create a system that can respond to water constraints in rural settings, the system itself can promote water conservation.

One site started using the greywater system in October. It wasn't until over a month later that the septic tank filled up and the pump started to dose the planter bed. This is an example of very low water usage that can occur in rural areas. Conversely another system exceeded the daily design flow for several days because of relatives from the city staying for the weekend. The high water alarm was sounded several times to draw attention to this excessive use. This shows the wide range of flows that can be expected. It also shows how the system requires built in storage capacity, warning devices and supplementary irrigation to handle extraordinary circumstances.

There is an emergency high water level alarm that is set to go off just before the emergency pump turns on. The homeowner can turn this alarm off, but it is helpful in identifying the nature of the problem. This immediate feedback can reinforce changing water usage patterns or can identify mechanical problems, like a pump that has broken down. In fact, in setting up the system at one of the test homes, the level was set so low that the alarm was sounding with very little water use. Before this was discovered, the family was working very hard to reduce their water consumption!

6. Sampling

The sampling protocol for Ministry of Health includes testing of BOD5 (5 day biochemical oxygen demand), TSS (total suspended solids), and fecal coliforms. Environmental parameters are also included, with samples collected and tested by volunteers. One sampler is a retired biologist, who performs the sampling regime at the two Hornby sites, and trained streamkeepers test the Merville site. A streamkeepers kit, on loan from Project Watershed Society, is being used by the Merville volunteers. The environmental parameters include weather conditions, air and water temperature, pH, dissolved oxygen, conductivity, turbidity and nitrates. A sample Data Collection Sheet is attached as Appendix 4.

The results are promising, with a few anomalies, and will require analysis after the product testing is completed. See Appendix 10 for preliminary results. Two of the sites will have completed a year of testing by this fall, with the final site being completed in the spring of 2003. Finally, the Ministry of Health's Innovative Technology Program (ITP) will review the results to determine whether further testing or modifications are required.

7. Publicity

On May 19, 2002, and again in early July, 2002 one homesite was on the Home and Garden Tours, sponsored by Conservation Hornby Island (CHI) and the Hornby Festival

Society. It saw 300 people viewing the garden, including the integrated greywater planter box.

The homeowner agreement includes a clause to allow for public viewing of the systems as well as for monitoring and maintenance. This is intended to continue the promote interest in the project.

In March and May 2001 advertisements were published in the Hornby Island "Grapevine" to enlist volunteers in the construction of the planter boxes on Hornby Island. An article which was published in August, 2001 in "The First Edition", a monthly newspaper publication on Hornby Island is included as Appendix 5.

The project was highlighted in the article "Saving The Salish Sea, Pulling the Plug on Pollution" in the June/July/02 edition of "The Watershed Sentinel", and the excerpt is included as Appendix 6. This publication is broadly distributed throughout British Columbia. It very recently elicited communication with a member of the Capital Region Water Advisory Committee. (See Appendix 7)

The CVCARE website stimulated communication with others interested in the greywater project. Appendix 7 provides an example of interest from the Oak and Orca Bioregional School in Victoria. This report will be posted on the CVCARE website.

Funders have been acknowledged in the CVCARE annual newsletter where the greywater project was highlighted. (See Appendix 8.) Also, the announcement for CVCARE's Annual General Meeting included recognition of our funders. (See Appendix 9)

8. Evaluation

The project is evaluated from a number of perspectives including system design, on-going system performance and integrity, interface between users and the system, and project administration, all with a view to effectively direct future endeavours to overcome site constraints for sewage management and promote water conservation.

8.1 System Design

- Preliminary testing results are excellent. The system is performing well other than higher TSS results at one of the sites, which is steadily improving.
- The cooperation and support of the local Environmental Health Office, the ITP, and Ministry of Water, Land, and Air Protection (formerly the Ministry of Environment) resulted in a design which optimized the possibility of approval.

8.2 On-going System Integrity and Performance

- Because the system is relatively complex, competent and knowledgeable personnel are required for installation of piping, pump, level control system and pump control panel and placement of the soil and aggregate layers. In the instance of the project's systems, one installer was involved with the design and therefore was very familiar with it. The second installer also had the advantage of access to the original installer's advice. Training for installers would be recommended. In addition, there is a potential that changes in the regulations for approval of construction of allowable onsite systems would require certified installers.
- Maintenance of the system also requires qualified personnel to make sure the system is operating as designed and to troubleshoot problems. Access to the software for the Aquaworx control system and understanding of the project's greywater system is currently limited to the project

8.3 User Interface

- It is important for the homeowner to be mindful of water usage and to take care of what goes down the drain. This reinforces the need to ensure proper homeowner education. A homeowner education package needs to be developed to accompany the installation of a system.
- Maintenance is a critical issue not only for this particular system, but for all on-site systems. Although property may change ownership, the systems remain. Without an entrenched monitoring and maintenance regime in place, it is up to the original property owners who install an on-site system to ensure that the required information is passed on to new owners.
- The system is designed to include a supplementary irrigation system for when household water usage drops below the requirements of the planter box (for instance, when the residents go on vacation). The homeowner would have to be responsible for turning this system on and off. Again, homeowner education is vital to ensure that this is not an issue.

8.4 Project Administration

- Homeowners, volunteers and community members were very supportive of the pilot project. Development of the project under the ITP's product testing, by non-profit groups, and with the intention of producing a non-proprietary greywater system, allowed the community where the systems are being tested to build capacity as well as contribute in cost-saving ways to the project.
- The partnerships between non-for-profit groups, community, business, and regulatory officials provided opportunities to efficiently and cost-effectively complete the project to date. Both CVCARE and GHOSTS brought their assets and attributes to the project, along with their unique sources of support, both financially and in kind.
- The project budget proved to be insufficient part way through, but the value of the project proved worthy of support, so that the building and monitoring of the intended 3 sites could proceed.

- CVCARE's original project administrator left the office in July 2001; however, current staff was introduced to the project early on, to ensure a smooth transition of administration.

9. Conclusions

a. If Ministry of Health approval is granted, an education plan will be required for the general public and health officers, as well as a training plan for installers and maintenance personnel.
b. Monitoring should continue for many years in order to watch the long term performance of the technology.
c. Research should continue to determine flexibility in dimensional details so that the system can be adapted to a wide variety of landscaping applications.
d. Research would also need to be initiated to study the system in different climates, if it is to be approvable throughout B.C.
e. Funding sources need to be identified to cover the above costs and also to provide core funding to pay office and staff costs for the monitoring, maintenance and evaluation requirements.

If approved by the Ministry of Health in B.C., greywater planter beds have potential to integrate architecture, landscaping and wastewater treatment in many different applications such as: restaurants, office buildings, apartment complexes, and single family homes both in rural and urban areas.

In areas where water use is metered there is a potential cost savings by reusing greywater for landscape irrigation as well as promoting water conservation and reducing demand on existing infrastructure.

The use of greywater treatment begins to open the door for the permitted use of composting toilets. In the Gulf Islands and other rural settings this is an important issue because of limited water availablility and/or poor soil suitability for on-site sewage treatment.

This project has proven to be an excellent example of grass roots organizing to research and develop solutions to address local needs and vision. The project fostered working relationship and communications to bring forward an unconventional concept of water use and greywater treatment, to gain recognition by authorities, as a first step to bridging the gap between regulator and rural residents.

10. Finances

10.1 Revisions to the action plan and budget

- The original budget anticipated reduced costs on a 3rd site. The action plan was altered to ensure that all three sites were similar for approval purposes, which resulted in increased costs.
- The original contractor was unavailable for a part of the project and another contractor was hired. Individual site complexities also affected the overall cost of the project.
- Waterproofing of the cement with Xypex to ensure a watertight system was not originally anticipated in the budget.
- The original design work and budget was altered somewhat when it was decided to incorporate Aquaworx's control panels. Donations and discounts resulted in this aspect of the budget being less expensive than the state of the art equipment would normally cost.
- The soil sieve testing was another expense that was not originally anticipated.
- The original sampling regime anticipated in-kind support from the Institute of Resources and the Environment and the local Environmental Health Office for laboratory testing. This was not forthcoming as it had been for the previous constructed wetland project; in particular, the provincial laboratory found itself being heavily used for water quality testing as a result of the Walkerton incident in Ontario and was unavailable for fecal coliform testing. Therefore, sampling was reduced to quarterly, to reflect a reduced budget, with Health's approval. The sampling results will be reviewed in one year, to determine the requirement for further testing.

10.2 Donations

- In the end, the tally of in-kind volunteer services during the design and build stages near $18,000.00, over and above the actual costs reported above. The quarterly sampling being conducted by volunteers at the 3 sites brings the donations to well over $18,000.00. (See Appendix 3) In addition, donations of nearly $3,000.00 are noted in the GHOSTS summary of expenses (Appendix 11)

- CVCARE's in-kind is broken down as follows:

BC Health Research Foundation project to the end of the year 2000	$10,000.
Volunteer administrative support since December 31, 2000 (150 hrs @ $20)	$ 3,000.
Monthly Board and Management Team meetings Oct. 2000-July 2002 (22 months x 5 x $20)+(22 month x 3 x $20)	$ 3,520.
	$16,520.

- The Baynes Sound Round Table peer review (6 Members x 22 months x approx. $30) $ 4,000.

All in all, the in-kind contributions add up to a very real demonstration of the passion and commitment of the community to finding alternatives to conventional liquid waste management while demonstrating resource conservation practices.