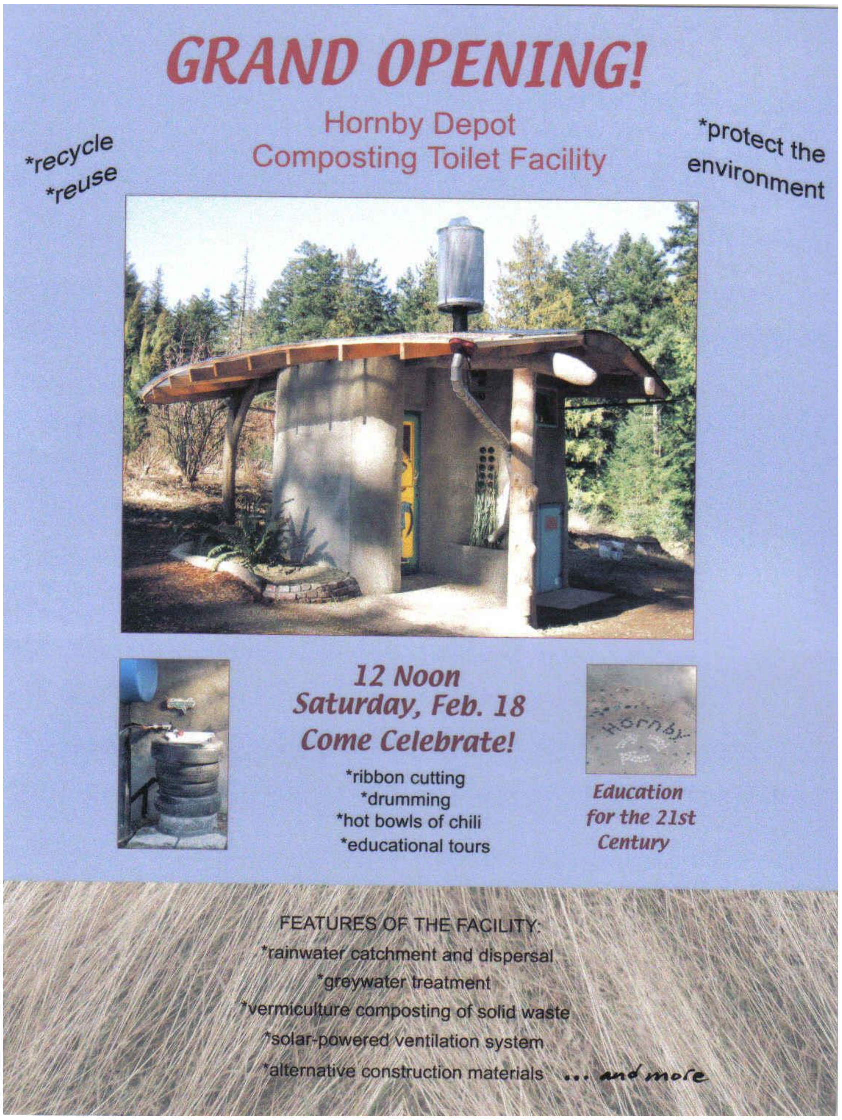
HORNBY ISLAND RECYCLING DEPOT COMPOSTING TOILET FACILITY



AN EXAMPLE OF

<u>HYDRO-LODGE-ICAL DESIGN</u>

In Feb, 2006 Hornby Island celebrated the opening of the composting toilet facility at the Hornby Island Recycling Depot. There was live music and bowels of chili offered up. The raffle winner made first use of the biffy, while the band played on. We were celebrating not just an outhouse but a state of the art facility that integrates structural and landscape architecture with innovative wastewater treatment, stormwater management, roof water catchment, composting toilet, solar energy, reuse of waste materials, education, art, and an evolution in the island's recycling story and local building techniques.

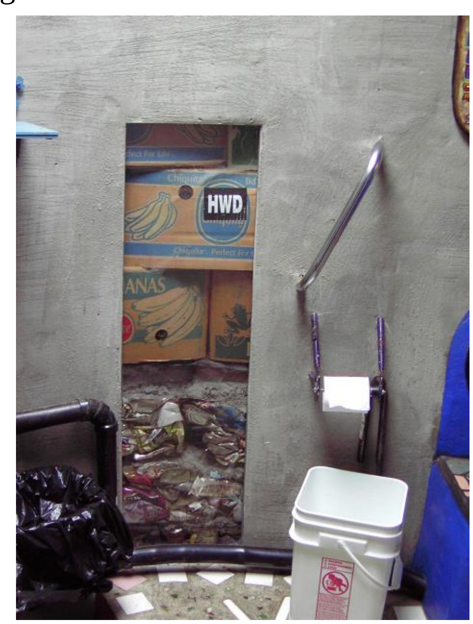
The Recycling Depot composting toilet facility is a prototype ecologically sensitive example of effective management of water, liquid waste, human waste, and solid waste. The various functions combined and demonstrated in this facility are:

- Rain water harvesting
- Rain water storage
- Rain water use for hand basins and urinal flushing
- Use of roof water for irrigation of creative architectural landscaping
- Soil infiltration of stormwater
- Re-use of greywater from hand basins, urinal, and compost leachate, for landscape irrigation and fertilization (bio-resource retrieval)
- Treatment of greywater in an environmentally sustainable manner
- Growing of gourds as a resource for craftwork material (bio-resource retrieval)
- The use of worms for treatment and transformation of human waste for use as a soil amendment (bio-resource retrieval)
- Creative architectural design
- Passive solar powered venting
- The reusing and recycling of solid waste for building construction, design, and artistic embellishment

1. STRUCTURE

The design for the structure of the facility was determined by the function (composting toilet) of the building, the materials at hand, and the design/build approach. This design/build process of being flexible with the design during the building process is common on these islands, often involving using the materials at hand such as beach logs.

Built like a straw bale post and beam structure the walls of the spiral shaped building are comprised of crushed bales of tin cans, newspaper filled banana boxes, old red bricks, computer printers, toasters, glass bottles, VCR's, etc. Stucco covers all of this giving a finished adobe look. A Plexiglas window shows the inner wall materials.



Discarded hot water tanks inside the walls shape the wall ends. These give a pillar effect and visual flow to the structure that nicely complements the spiraling wall. Car windows are used in the wall above the toilet and broken tile and glass are inlaid to various surfaces for finishing touches. Visitors leave with their imaginations inspired by the possibilities presented by building with previously used materials destined for land fill or reprocessing for recycling.

Initially the plan was to use straw bales for wall materials. Not having straw bales available but having a recycling depot full of almost everything made by humans we looked around at the materials available. Tin cans are brought to the depot for recycling. These are compacted into bales in the baler shown in the picture on the lower right in preparation for shipping off island.

The bales are about the same width as a straw bale and can be stacked like bricks. We cast a concrete footing the same width as the bales of cans and tied down the bottom row of tin bricks with steel strapping embedded in the footing. Mortar was used to hold it all in place. Places where there were odd shaped spaces to fill were filled with whatever the depot had to offer up such as old gas tanks, pumps, vcr's, etc. Scott Hardy, one of the co-builders, was an employee of the depot and always had just the thing when we were structurally or design challenged.

Half way up the walls we ran out of tin can bales and cast around for other suitable materials to complete the walls with. Banana boxes, which were filled with newspapers and magazines, proved to be the same width as the tin can bales, were stackable, and available in quantity. These were used to fill in to the underside of the beach log roof beams. How to stucco over cardboard? Once again Scott channeled the depot in the form of discarded galvanized roofing sheets. These we screwed to cleats on the underside of the roof and the top row of cans to cover the cardboard boxes inside and out. This, along with stucco wire, provided a suitable substrate for the stucco.

As of the writing of this article the building is four years old and the truth window on the inside wall shows no signs of rusting of the tin cans, nor of molding of the banana boxes. The insulative value of the walls is not an issue as this is not a heated building. Definitely the R-value of the tin cans would not equal that of straw bales but possibly of cob. The cement mortar layer connecting between outside and inside walls would be the weak link in the r-value if it were used on a heated building. Perhaps mica or perlite added to the mortar mix would increase the r-value.

One of the structural design elements when building a vermicomposting toilet is to create a space so that the toilet is above the compost bins but to also have the bins easily accessible for maintenance and management from outside ground level. Ideally the perfect terraced topography is available to provide for a split level building and easy access to the lower bin level. Otherwise, for a free standing structure you have to incorporate the required height in the structure. If one builds conventional stairs and a landing to get the user above compost bin height, this can result in an awkwardly tall building out of proportion to its environment.

In our situation we had only a slight drop in elevation at the chosen site so we created large pie-shaped steps/landings winding up to the toilet inside the building. This served to keep the building low in its surroundings and created a pleasing spiral shape upon which one ascends to the throne.

To build up the landings, various “waste” were used such as: broken glass, toaster, vcr’s, bricks, small propane bottles, etc., and then a top coat of cement to create a flat solid surface. Recycled tiles and glass were then used for aesthetics on the floor surface.

Stair way to relief.

2. COMPOSTING PROCESS

The core function of the building is the recycling of human waste by way of composting. The particular process used is known as vermicomposting, which means using worms to undertake the composting process. The toilet chute leads to a pair of worm bins that are exchanged as required. The organic waste material including paper are digested by the worms and rendered virtually pathogen free. Some of the alder planer shavings, used as a bulking agent, are still present after composting. When the active bin has been filled, it is replaced and moved to the side and left to further vermicompost while the new bin fills. The bins are used plastic barrels, a waste product from the food industry. The resultant compost, worm castings, have been shown to be a very beneficial soil amendment promoting vigorous plant growth.

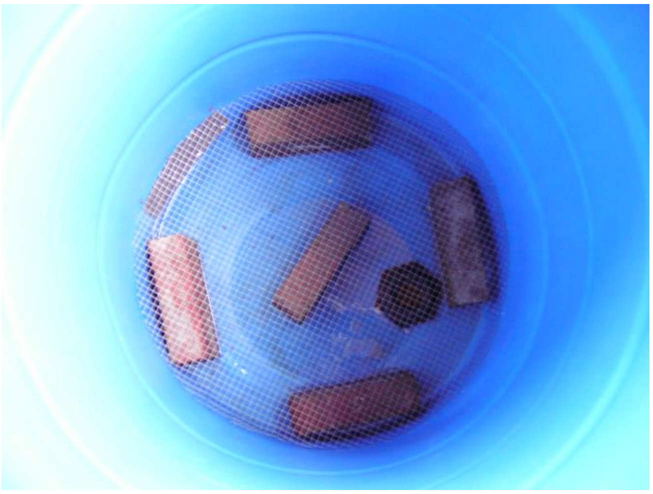
The doors normally are kept fastened with bolts to prevent easy access by children or the public in general. Doors and vents are sealed to prevent fly intrusion.

When designing a vermicomposting system, ease of system management and the needs of the worms define the design parameters.

Placing the composting bins on platforms with castors allows one the ability to exchange barrels easily or to pull barrels from the chamber onto the concrete apron for compost management. A union fitting on the drain line is easily disconnected to facilitate this process.

Worms

Worms are oxygen breathers and this must be provided for in system design. The first requirement in this regard is to provide good drainage for urine and embodied liquid in the compost solids because there is not much oxygen available in a saturated environment. This was done by placing mesh and hardware cloth on top of bricks so as to elevate the compost pile above the floor of the barrel allowing for effective drainage. A drain pipe in the barrel bottom carries the liquid out to an evapotranspiration garden adjacent to the building.



Screened vents fastened to the side of the barrel and below the compost mass in the area of the bricks allow for air flow into the barrel bottom. Oxygen is then available to then be ducted into the compost pile by the tunneling action of the worms. Puck vents both inside the building and in the access doors allow air to flow into the chamber and a 6” vent stack creates a positive air draw up through the roof of the building. The vent stack also serves to move odours up and out of the chamber rather than into the toilet area. Venting is assisted by a solar heated poly greenhouse built around the vent pipe thus creating a positive upward draw.

Compost Management

Prior to initial use of the compost barrels, a 6" starter bed of compost containing red wiggler worms and planer shavings (non-Cedar) was placed on top of the bottom screen. This barrel is then left in place until it fills. A container of planer shavings is placed by the toilet so that each user can sprinkle a cup of bulking agent down the toilet after each use. The bulking agent provides a carbon source for effective composting and also helps to keep the composting pile somewhat fluffy for good drainage and oxygen penetration. As part of the maintenance, the cone that develops on top of the pile as the barrel gets close to full should be flattened as needed.

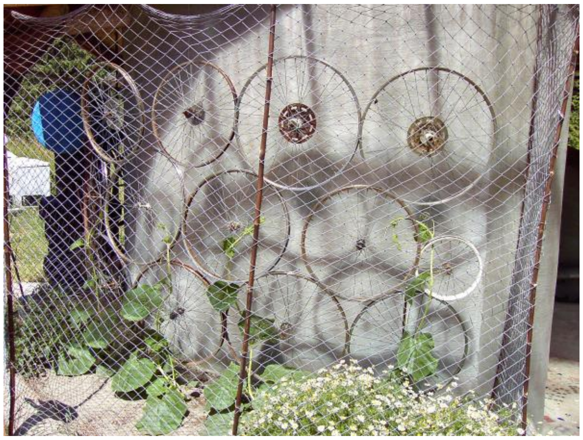
When the first barrel is full it is disconnected from the drain pipe and replaced with an empty barrel. There is enough room in the compartment to put the full barrel to the side for composting as the second barrel is filling. The worms will then work their magic with their gourmet feast. Worm castings, the resulting end product is virtually pathogen free and very microbially and nutrient rich. The beneficial properties of castings and use as a soil amendment are a study in itself. The barrel in the photo shows the vermicompost filling the container as well as coating the inside walls. As the fecal matter and toilet paper break down there is a substantial reduction in volume due to the high moisture content of the solids separating out. Since opening day four years ago there has only been one barrel of finished compost removed this past fall. This in spite of year round and heavy summer and Christmas season use.

This is actually a three barrel process. When the second barrel has filled, the compost/castings from the first barrel filled are removed by shovel into a third barrel for finishing. This third barrel is stored in a nearby locked shed. A drain spigot allows for draining by hand into a container from time to time. This liquid is a good fertilizer for non-food crops and should be diluted 10:1 with fresh water. A compost sample taken from this third barrel was sent to the lab in 2008 and tested for fecal coliform. The test result was a fecal coliform count of 170 per 100 grams of compost. The lab tech said that this was lower than the allowable limit in commercial shellfish and that "if you cooked it you could eat it". The limit for swimming water is 200 fecal colony forming units per 100 ml.

The B.C. Organic Matter Recycling Regulation specifies the regulations governing the application of composted organic matter to the soil. It does not contain protocols concerning vermicomposting. At this point the vermicomposting process does not allow one to legally apply this compost to land. Technically it should be taken to a sewage treatment plant and disposed of. Put simply, the approved processes basically specify the number of times a pile should be turned either in a chamber or in windrows by a trained and certified operator in order to achieve full pathogen reduction. It is hoped that with further research, development, and data collection in B.C., vermicomposting will demonstrate its viability and be included in the regulation.

3. WASTEWATER TREATMENT

The so called "wastewater" is treated by way of vegetated evapotranspiration gardens. All of the water flowing into these contained gardens is either evaporated from the soil surface, reached by way of capillary action, or transpired by plant uptake and respiration. To date there has been no indication of excess water draining from the containment area into the surrounding soils.



There are two gardens, one for the water from the hand basins and urinal and the other receiving leachate from the composting bins. Same principles in each garden but differing interpretation and design based on site conditions, topography, function, and aesthetics.

The garden at the south facing front of the building adjacent to the wall is based on a sub-surface horizontal flow wetland model. It is a basin roughly 2' x 13' x 1.3' deep that is lined with an EPDM rubber membrane. The bottom half of the basin is filled with a course aggregate, in this case broken glass because that was what was available at the depot. On top of this is sand to ground level. There is an inlet at one end and an outlet at the far end with a drain pipe going to the second garden behind the building. Suitable plants are transplanted into the sand layer.

In this case gourds were planted because they are fast growing and transpire a lot of water through their large, soft tissue leaves. Also, they have a wonderful aesthetic and produce a value added harvestable product. Gourds are used around the world for their utilitarian and artistic value. Bicycle rims, again from the depot, were used as a trellis for the vines to grow on. They added an attractive visual until they were soon covered by lush vegetation. The vegetation also helps to cool the building in the summer. The leachate from the second compost bin, which initially was drained manually, was added to this garden for nutrient.

Rainwater from the roof also can be directed into the garden to supplement water supply and also to dilute the salts in the urine.

Waste to wealth

The first season's gourd fruit was used to make the shakers and finger drum/shaker shown in the photo at right. The point is that life is a creative process and that by integrating our "waste stream" into our resource stream we can achieve

more than the sum of our parts and do more with less, locally.

The second garden, which evapotranspires the leachate from the composting toilet, is built on a slope behind the toilet facility.

Discarded tires were terraced and filled with sand. Between each layer of sand is a strip of rubber membrane channeling liquid flow from the upper row of tires to the center of the row below. Native plants from the site were then transplanted into the sand medium.

Again, the leachate diluted with rainwater from the roof, is either evaporated from the sand surface or transpired by the plant leaves. If any water is left at the bottom row of tires it infiltrates into the native soil for dispersal. A capped standpipe situated slightly down slope from the garden is used to monitor for drainage into the adjacent soils. Thus far there has been no indication of excess liquid draining to surrounding soils. This system was engineered to comply with the current B.C. Sewerage System Regulation and follows Standard Practice requirements. Based on a site assessment of local soils and anticipated flow rates, the surrounding soils would constitute an adequate treatment/drainfield area assuming no evapotranspiration took place. It is always satisfying to integrate art, science, and regulation in an aesthetic, functional, and environmental package.

4. RAINWATER COLLECTION

Water for the hand basins comes from rainwater collected from the building's roof. Two 50 gallon barrels identical to the composting barrels store the water and gravity feed it to the hand basins, one inside the building and one outside as a general hand washing station for the depot.

As this water is not for potable use, a torch-on roof membrane was used. Initially both sides of the roof were used for collection until sod was installed on the front half. Water quality was impacted by the soil and so the system was modified so as not to collect from the sod area.

The used water from the inside sink drains to the urinal in order to flush the drain line and prevent the build up of salts. From there the water drains directly into the evapotranspiration garden through a trap and a five gallon clean out chamber. Overflow from the rain barrels can be directed either to a soil infiltration trench or into the garden for irrigation and dilution.

The recycling depot is owned by the Comox Valley Regional District and managed by the Hornby Island Residents and Ratepayers Association. The regional district requested that use of the rainwater for the hand basins be discontinued because of health concerns from possible pathogens in the water even though there were signs posted stating to not drink the water.

In order to address the health concerns the water collection pipe was retrofitted to act as a filter.

The 2” diameter pipe was replaced with a 6” pipe and filled with filter sand and then capped with hardware mesh and a pond filter for filtering out particulate matter. Sand is a conventional medium for facilitating pathogen reduction in septic systems. The health inspector then issued a letter stating that he had no grievous concerns as per the use of this water for hand washing. The regional district then relented and allowed for this use as long as we had appropriate warning signs for the public stating not to drink.

Roof water is the only water supply for the facility. Most years it is adequate to the need. The prolonged drought during the summer of 2009 did leave us without water for a period of time.

The rainwater from the opposite roof corner drains into a planter in the entrance way. A whimsical use of used materials carries the water to the planter from the roof. This demonstrates the passive use of rainwater for landscape irrigation. The planter drains into an infiltration trench in the adjacent soil.

All water in excess of hand washing or direct irrigation is absorbed into the nearby soils in infiltration trenches. These are comprised of 4” perforated pipes in trenches lined with broken glass to facilitate infiltration to the soil. This keeps “stormwater” onsite and hydrates the local soils as well as eliminating soil erosion. Chemicals released from the roofing membrane have a better chance of being broken down in the soil root zone than if they are drained to the surface and allowed to migrate from the site during rain events.

5. COMMUNITY PROCESS

Evolution of the Recycling Depot

The Hornby Island Recycling Depot was started as a community initiative in 1978. Not only was it a sorting and transfer station to send chosen materials to their markets, it was a place where people could go and find a used car part, book, washing machine hose, or a new wardrobe from the freestore all for the leaving and taking. Building a composting toilet to replace the aging outhouse was a natural step to take in recycling. The process of decay in the cycle of life is the basis of the life process of our organic world. Problems arise from treating it as waste.

It was also evolutionary in the variety of “waste materials” used in its construction. Much of the materials used were drawn from the “waste” supply yard or the beach as the need arose. During the building process a group of people from Nunavut, in the far north of Canada, toured the site. They were quite enthralled to see the variety of previously used materials being reused for construction. They said that they had had a recycling depot where recyclables were gathered for transport to distant places. Transport had become too costly to continue so they now had a growing mountain of garbage collecting on the nearby melting permafrost. They left excited at the new potential that they saw for their community.

Regulatory oversight

Hornby and some of the other gulf islands have no building inspection or building permitting process. By law everyone in Canada is obliged to build to building code standards but you know what they say: when the cats away the people will play, and build from their art. People here are used to building with scavenged materials, especially from off the beach. This coupled with a creative building process that involves having a basic design in mind but being flexible with the process and allowing it to morph with the interrelationship of experiencing the building as it grows coupled with so called “mistakes” or materials that present themselves serendipitously. This process played itself out nicely with the rich treasure of materials at hand at the recycling depot along with posts and beams hauled from the beach, locally sawn boards, aided by miscellaneous materials purchased from town. There is no doubt that regulatory oversight has its value but the lack of it also has inherent value along with greater personal responsibility.

Finances

Finances were a controversial issue with this building in part because it cost a lot more than was originally estimated. There were a number of reasons for this. Suffice it to say that the enthusiastic support for the project regardless of cost was matched by loud objections on the other hand. The funds that were thought to be available from the local regional district for the building turned out not to be forthcoming after the building was substantially finished. The local Residents and Ratepayers Society was then on the hook for it.

In response to this situation many people came forward to support the building by organizing fundraisers to pay back the funds to the society. This took the form of direct donations, community quilt raffle, T-shirt sales, partial proceeds from a recycling depot DVD (still available), bags of bark mulch, photo cards, and musical performances. $8,860 was raised the first year and has been added to every year since.

At left is a photo of an avante-guard musical performance fund raiser in the metals recycling area.

Volunteerism

As well as these sales and events, there was much contribution to the building itself in terms of building materials and labour. People dug, planted, bricked, tiled, plastered, encouraged, informed, engineered, signed, roofed, solar vented, created, administered, photo and video documented, and generally supported.

Visitors

People visiting during the building process always left with a smile on their faces as they do now that it is complete and in use.

Cultural Amenity

The Hornby Festival takes place every summer. During the 10 day event there are spot concerts at a variety of venues around the island. The toilet facility was chosen as one of the spots the first summer it was open. A classical trio played with the gourd vines as a back drop. It was a beautiful sunny afternoon and the crowd was enchanted.

One of the members had played Carnegie Hall the week before playing on Hornby. The building had set a new standard for visiting musicians. The important thing is that a toilet not only does not have to be tucked out of the way, it can be an enjoyable focal point.

Island neighbors often take their visiting guests to see the recycling depot and make a point of showing them the toilet.

6. SUMMARY

Integration of functions, form, knowledge, available materials, location, topography, and aesthetics give this building character and functionality that people seem to really respond to. Integration of architecture, landscape, and water management practices work together here in a cohesive whole. The end products being a satisfying experience, worm castings for the soil, and gourds harvested for craft work.

The fact that we have little building regulation on the islands and need to provide for our own functions, unlike urban living, creates a self sufficient environment that forces one to draw on one's own resources as well as nourishes the creative spirit. We are free to create. Sometimes this works and sometimes it doesn't. If one sticks around they see after awhile what is not working and can adjust accordingly. Success is the child of failure.

The building could not have been created on paper beyond the concept and basic footprint. It was the synthesis of all of the people involved and the experience and knowledge that each brought to the project, the spirit of being in the process at each moment and utilizing the resources at hand where ever possible. The end result is a building that uses no electricity, all of the water functions are integrated in such a way that no water aside from rainwater is used and there is no discharge of "wastewater" to local soils.

Thanks go to Annie for initiating and encouraging the process, Scott for sharing the work and creativity, Della for her endless enthusiasm and support, Ron for the engineering, Shakti for the great mosaics, Elizabeth for the funky signs and t-shirts, John for years of water quality monitoring, and everyone else who contributed physically, creatively, and administratively. ……And let us not forget the worms……

Photos and text: Ed Hoeppner, Opening Day poster: Della McCreary