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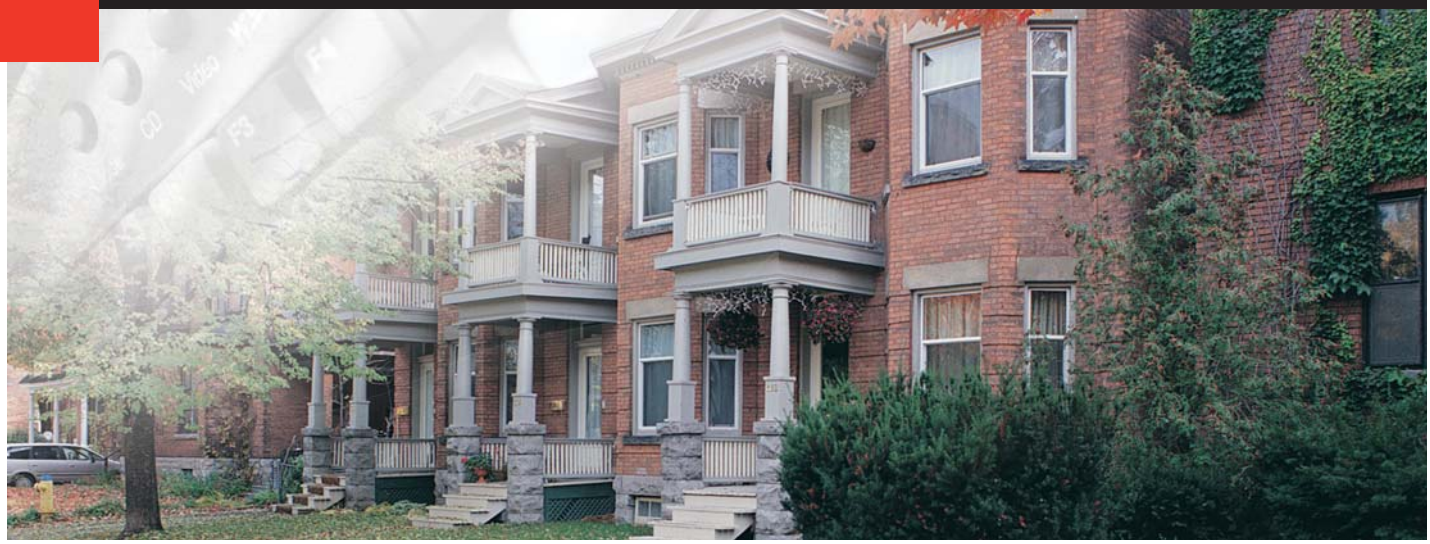

# Commissioning Guide for the Toronto Healthy Houses Water Systems

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# COMMISSIONING GUIDE FOR THE TORONTO HEALTHY HOUSES WATER SYSTEMS

# COMMISSIONING GUIDE

# FOR THE

# TORONTO HEALTHY HOUSES

# WATER SYSTEMS

CMHC CR File No: 6740-5

Prepared by:

A.R. Townshend, P.Eng.,
Blue Heron Environmental Technology
R.R.#1
Athens, Ontario
K0E 1B0
(613)924-9575

December 17, 1996

The Toronto Healthy Houses employ on-site potable water, recycled renovated water and wastewater ground disposal systems. Treated rainwater supplies potable water for drinking, food preparation and dishwashing. Reclaimed renovated wastewater through a separate plumbing system is used for toilet flushing, bathing, showering, clothes washing and hot-water heating.

Although the individual treatment processes provided are proven technologies for municipalities, the water treatment systems are considered to be innovative for single-family residences. Automatic electrical and physical shut down safeguards protect occupants against health risks.

Of necessity, residents will be involved in using water conservation devices and in ensuring high quality water treatment. Monitoring and undertaking some system operation and maintenance along with professional support will become part of the lifestyle adjustment required to live in self-sufficient, sustainable housing such as the Toronto Healthy Houses.

This Commissioning Guide is the culmination of a series of reports prepared for CMHC by Blue Heron Environmental Technology dealing with the selection, design, regulatory approval and monitoring of the potable water supply and wastewater renovation systems for the Toronto Healthy Houses. It provides a description of the water systems as they have been built including uncompleted work as of December 2, 1996; presents initial operatonal and maintenance prcedures; and offers occupant guidelines on water use, drinking water safety, and protection of the water systems from household abuse.

CMHC plans to contract for monitoring of the innovative systems incorporated into the Toronto Healthy Houses including the water systems. During the monitoring period effective procedures will be established by which future home owners can successfully operate and maintain the potable water and renovated water systems. Following completion of the monitoring program, a Homeowner's Operation and Maintenance Guide will be prepared incorporating information taken from this Commissioning Guide and the procedures developed during the monitoring period.

## RÉSUMÉ

La Maison saine de Toronto exploite ses propres réseaux d'alimentation en eau potable, de recyclage de l'eau et d'élimination des eaux usées. L'eau de pluie recueillie constitue la source d'alimentation en eau pour boire, préparer les aliments ou laver la vaisselle. Les eaux usées recyclées grâce à un système de plomberie distinct servent pour la chasse d'eau des toilettes, les bains, les douches, la lessive et le chauffage de l'eau.

Bien que les procédés de traitement individuels constituent des technologies éprouvées pour les municipalités, les systèmes de traitement de l'eau sont considérés comme innovants pour les maisons individuelles. Des dispositifs automatiques de fermeture électriques et physiques protègent les occupants contre les risques préjudiciables à la santé.

Par nécessité, les résidents seront invités à exploiter des dispositifs économiseurs d'eau et à assurer un traitement hautement qualitatif de l'eau. Contrôler et effectuer une certaine partie de l'exploitation et de l'entretien en plus de bénéficier d'un soutien de spécialistes fera partie de l'ajustement du style de vie requis pour habiter une maison écologique autonome comme la Maison saine de Toronto.

Le Guide de mise en service marque l'aboutissement d'une série de rapports rédigés à l'intention de la SCHL par Blue Heron Environmental Technology, qui traite du choix, de la conception, de l'approbation réglementaire et du contrôle de l'alimentation en eau potable et du recyclage des eaux usées pour la Maison saine de Toronto. Il fournit une description des systèmes d'eau tels qu'ils ont été réalisés, y compris les travaux inachevés en date du 2 décembre 1996; il livre les premiers mécanismes de fonctionnement et d'entretien; et offre à l'occupant des directives à propos de l'utilisation de l'eau, la consommation de l'eau en toute sécurité, et de la protection des systèmes d'eau contre les abus du ménage.

La SCHL projette d'impartir le contrôle des systèmes innovateurs intégrés à la Maison saine, y compris les systèmes d'eau. Au cours de la période de contrôle, des méthodes efficaces seront établies en fonction desquelles les futurs propriétaires pourront réussir à exploiter et à entretenir les réseaux d'alimentation en eau potable et de recyclage des eaux usées. À l'issue du programme de contrôle, on rédigera à l'intention du propriétaire-occupant un guide de fonctionnement et d'entretien qui intégrera l'information tirée du Guide de mise en service et des méthodes établies pendant la période de contrôle.


National Office
700 Montreal Road
Ottawa ON K1A 0P7
Telephone: (613) 748-2000

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# COMMISSIONING GUIDE FOR THE TORONTO HEALTHY HOUSES WATER SYSTEMS

## PREFACE

CMHC's Healthy House in the heart of the City of Toronto is one of the winners of the national Healthy Housing Design Competition which was held to promote environmentally responsible housing. The ensuing project has resulted in the building of two adjoining houses-one completely independent of municipal servicing, and the other connected only to the electrical power grid. Both houses employ completely independent, on-site potable water supply, wastewater reclamation and ground disposal systems.

The Toronto Healthy Houses are a joint project among Martin Liefhebber Architect Inc., Creative Communities Research Inc. and Canada Mortgage and Housing Corporation. The City of Toronto Public Health, the Ontario Ministry of Health, and the Ontario Ministry of Environment and Energy are major partners for the potable water and wastewater systems providing technical support on water quality and process monitoring.

Performance monitoring by CMHC is planned for a two-year period. The mutually agreed to Monitoring Program will be carried out in close collaboration with these regulatory agency partners. Following completion of the monitoring program, a Homeowners' Operation and Maintenance Guide will be prepared giving effective procedures by which future homeowners can successfully operate and maintain their potable water and renovated water systems.

Treated rainwater supplies potable water for drinking, food preparation and dishwashing. Reclaimed renovated wastewater through a separate plumbing system is used for toilet flushing, bathing, showering, clotheswashing and hot-water heating. Water and energy conservation are achieved by the use of the low-flow toilets, showerheads, taps and faucets; efficient dishwashers and clothes washers; and greywater heat utilization. Hot water is obtained from solar panels with back-up cogenerator or grid power depending on the house.

Both the potable and wastewater systems use municipal treatment technology in an innovative configuration to facilitate installation and operation in a single-family residence. Although the individual treatment processes provided are proven technologies, the water treatment systems are considered to be innovative for single-family residences. Automatic electrical and physical shut down safeguards protect occupants against health risks. Residents will of necessity become involved in ensuring high quality treatment.

Residents will monitor water quality as part of their everyday activities each time they turn on a tap or flush a toilet. They will know when the systems are not operating correctly through deteriorating aesthetic quality or through reduced flow. Resident monitoring and involvement in some system operation and maintenance along with professional support and periodic water testing will become part of the lifestyle adjustment required to live in self-sufficient, sustainable housing.

This Commissioning Guide is the culmination of a series of reports prepared for CMHC by Blue Heron Environmental Technology dealing with the selection, design, regulatory approval and monitoring of the potable water supply and wastewater renovation systems for the Toronto Healthy Houses.(1) (2) (3) (4) The objectives of the Commissioning Guide are to provide a description of the water systems as they have been built (including uncompleted work as of December 2, 1996); present initial operational and maintenance procedures as proposed by the process equipment suppliers; and offer occupant guidelines on water use, drinking water safety, and protection of the water systems from household abuse.

The Commissioning Guide is presented in three separate parts so each can be used independently of the other if desired. Part 1 provides a synopsis and detailed description with photographs of each component of the water systems in order of hydraulic flow including associated water and energy conservation features of the Toronto Healthy Houses. Part 1 concludes with a list of work items required to complete the installation.

Part 2 deals with operation and maintenance aspects as the systems are put into service. Initial operating instructions as given by the principal process equipment suppliers are presented as well as maintenance instructions taken from ancillary equipment owner guides.

Part 3 provides some guidelines for occupants of the Toronto Healthy Houses during the start-up and demonstration period with respect to water use and protection of the biological water treatment systems from user abuse. Also included is pertinent information on lifestyles appropriate for living with self-sufficient potable and reclaimed water systems.

# COMMISSIONING GUIDE

# PART 1

# DESCRIPTION OF THE TORONTO HEALTHY HOUSES WATER SYSTEMS

CMHC CR FILE NO 6740-5

Prepared by

A.R. Townshend, P.Eng.,
Blue Heron Environmental Technology
R.R.#1
Athens, Ontario K0E 1B0
(613)924-9575

December 17, 1996

# SYNOPSIS

Part One of the Commissioning Guide provides a detailed description with photographs of each component of the potable, wastewater and renovated water treatment systems in order of hydraulic flow. The description includes associated water and energy conservation features of the Toronto Healthy Houses.

The treatment systems use municipal treatment technology in an innovative configuration to facilitate installation and operation in a single-family residence. Although the individual treatment processes provided are proven technologies, the water treatment systems are considered to be innovative for single-family residences. Residents will of necessity become involved in ensuring high quality treatment.

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# PART 1
# DESCRIPTION OF TORONTO HEALTHY HOUSES WATER SYSTEMS

## 1.0 INTRODUCTION

The Toronto Healthy Houses rely on rainwater and melted snow that fall on the roof and ground patio areas of each house for fresh water. The collected runoff is used for potable water supply to the kitchen taps, dishwasher and bathroom taps.

The provision of water conservation fixtures and appliances, and extensive recycling of renovated wastewater are necessary to meet rainwater collection and storage limits. The Toronto Healthy Houses are equipped with water conservation toilets, showerheads, and faucets. Also, the dishwashers and laundry machines have been selected for their high-efficiency electrical and water usage.

Potable water treatment consists of contact in the cistern with limestone to inpart alkalinity; upflow slow-sand filtration and granular activated carbon adsorption in a single contactor; and ultra-violet disinfection before and after the treated water reservoir. (Figure 1-1)

All wastewaters from each Toronto Healthy House are treated in a septic tank for preliminary treatment, and in a recirculating Waterloo Biofilter™ for secondary treatment. Waterloo Biofilter™ effluent is discharged to a ground disposal gravel pack located in the front of each lot. (Figure 1-2)

Waterloo Biofilter™ effluent reclaimed for recycling in the Toronto Healthy Houses is renovated by means of two, parallel, combined slow-sand filters and activated carbon adsorbers located beside the similar potable water unit. These advanced treatment processes further remove particulate matter, biodegradeable constituents and refractory organics. Carbon adsorption also removes metal ions. The reclaimed renovated water is disinfected by ultra-violet irradiation before and after the renovated water reservoir. The renovated water is pumped through a separate piping system for toilet flushing, bathing, and clothes washing. The renovated water also supplies the hot water radiant heating system as required.

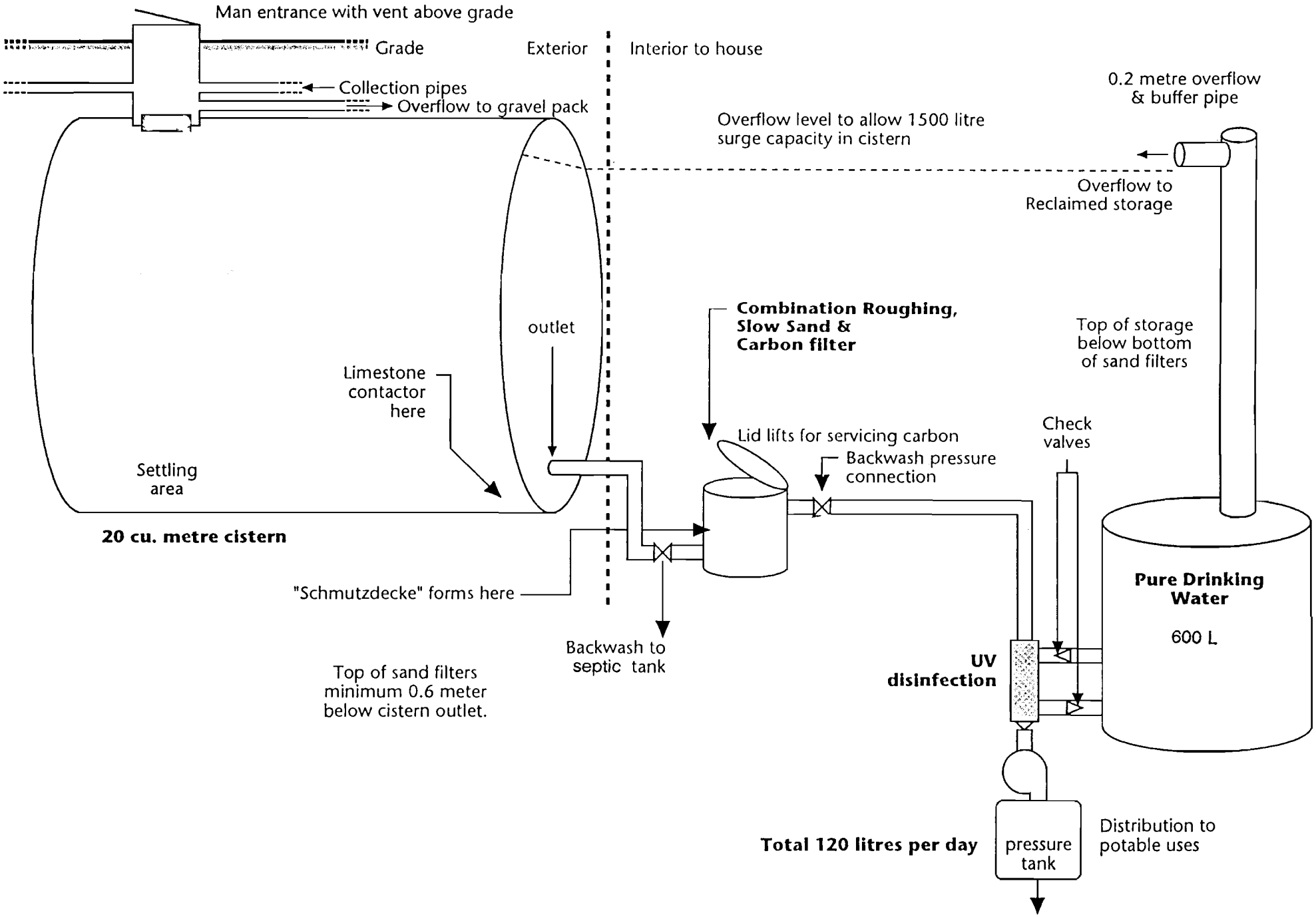


Figure 1-1

**Potable Water Supply**

**TORONTO HEALTHY HOUSE**

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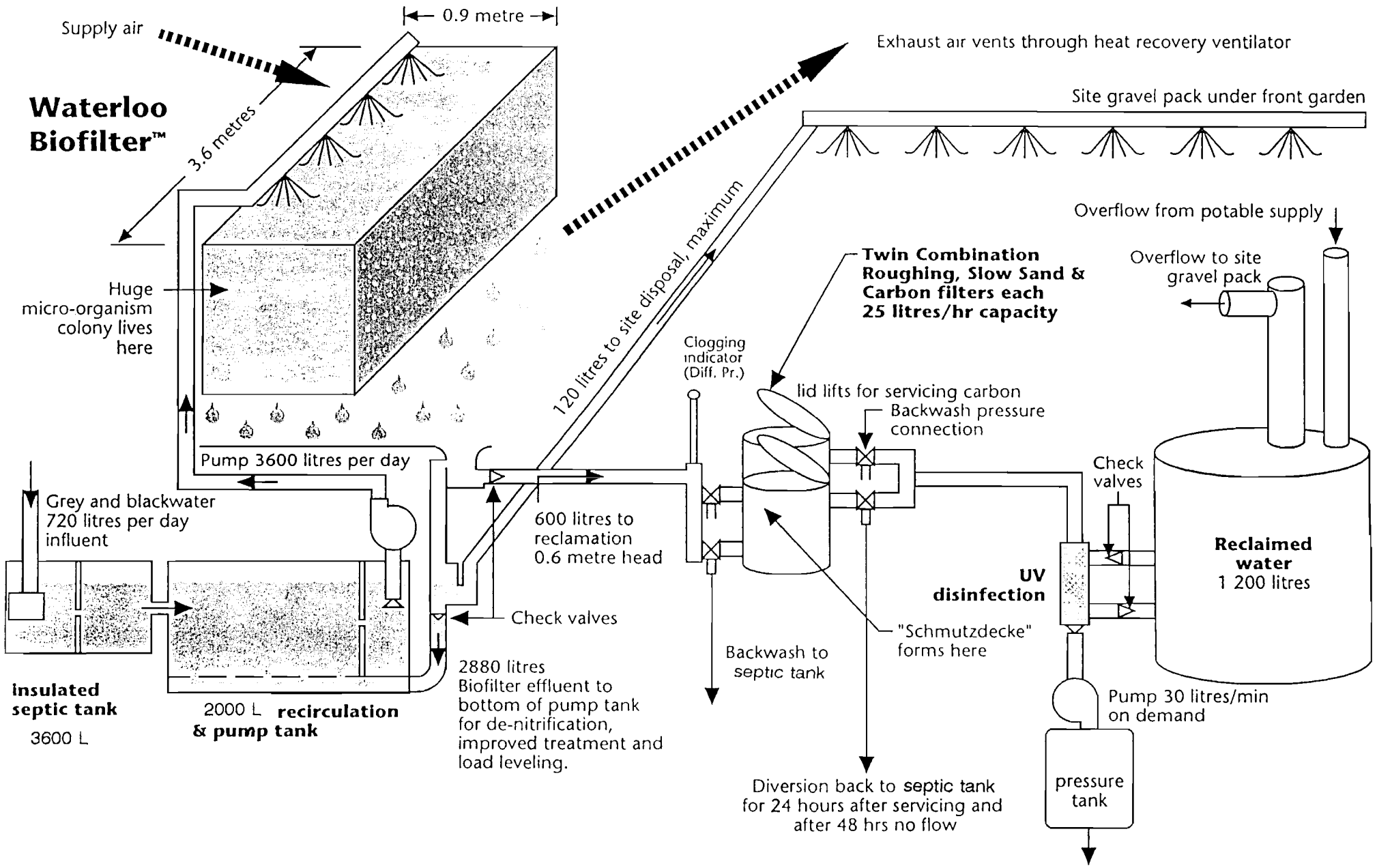


Figure 1-2

**Wastewater System & Reclamation** **TORONTO HEALTHY HOUSE**

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## 2.0 WATER CONSERVATION FIXTURES AND APPLIANCES

The Toronto Healthy Houses are equipped with water conservation devices. The master bedroom has a low flush toilet, combined shower-bath and wash basin. The second floor bathroom has a low flush toilet, shower stall and washbasin. There is also a third low flush toilet with washbasin off the front vestibule. The low flush 6 L toilets are supplied by Crane. The taps and shower heads provided by Delta feature water conserving aerators.

The Miele dishwasher in the kitchen uses two-thirds less electricity and one-half as much water as a conventional machine. The Miele clotheswasher located in the second floor bathroom also uses two-thirds less electricity and one-half as much water as a conventional clotheswasher.

## 3.0 WATER USE

The Toronto Healthy Houses are designed for a potable water use of 120 L per day (26 gal per day) and a renovated water use of 600 L per day (132 gal per day). The total water use is about one-half of the Canadian household average. Potable water is supplied to all sinks and the dishwasher. Renovated water is supplied to the toilets, bath, showers and clothes washing machine. Provision is made in the plumbing to supply potable water to the showers if necessary.

About 120 L per day of Waterloo Biofilter™ effluent is wasted to the ground disposal gravel pack. Backwash water from the combined slow-sand and activated carbon units is directed to the septic tank. Provision is also made for wasting initially filtered water after backwash to the septic tank if required.

## 4.0 POTABLE WATER SUPPLY AND STORAGE

Potable water for each house is obtained from a rainwater collection system consisting of three roof surfaces, two ground patios, collection piping and 20 cu meter (4400 gallon) concrete cistern. The total catchment area is about 80 $m^2$ (860 $ft^2$). The total roof area of approximately 55 $m^2$ (590 $ft^2$) is divided into the top flat area (24 $m^2$), the back sloping area (22 $m^2$) and the front sloping area (9 $m^2$) (Photo 1-1). Sloping roof surfaces are of Nelco polymer resin grey slate-like tiles (Photo 1-2). The lightweight material is thermally stable providing a clean surface for water collection. The flat roof is covered with a 40 mil high density polyethylene liner topped with pea gravel.

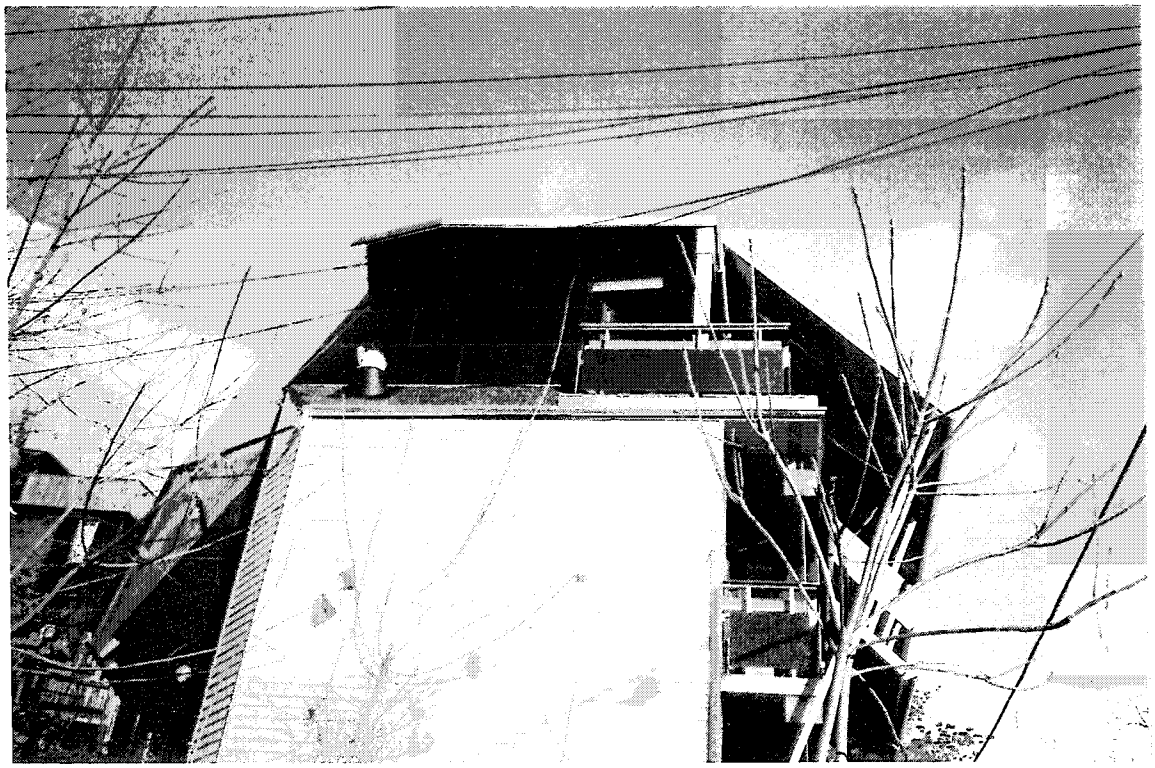

PHOTO 1-1 SIDE VIEW OF ROOFS

1-2 REAR SLOPING RAIN COLLECTION ROOF

Ground level rainwater collection is achieved by two patio areas covered with textured concrete. The top surface is created by using latex forms and adding colours to the concrete (Photo 1-13). The upper patio of each yard is approximately 5.2 m (17 ft) wide and 3.4 m (11 ft) deep (Photo 1-3).

The north side of the upper patio gunite wall is provided with a Terradrain foundation wall drainage system. Terradrain is a prefabricated drainage panel consisting of a porous geotextile bonded to a embossed polystyrene core. It directs groundwater to a 100 mm (4 in) diameter collection drain terminating in a sump in the front yard beside the car port (Photo 1-6).

Each lower patio separated by a grouted wall and plantings is about 5.2 m (17 ft) wide and 24 m (8 ft)) deep providing an area of 12.6 $m^2$ (136 $ft^2$) (Photo 1-4). The total ground collection area is therefore about 30 $m^2$ (325 $ft^2$).

The collected rainwater from the roof eavestroughs and each catch basin at the upper patios is carried by 100 mm (4 in) diameter pipes to the respective cistern inlet catch basin which also receives directly the run off from the lower patio. The catchbasins have grated covers (Photo 1-4 front).

Each precast concrete cistern under the lower patio has a storage capacity of 20 cu m (4,400 gal). An additional surge capacity of 1500 L (330 gal) will divert rainwater to the renovated water storage tank. There is also a top overflow from the cistern to the wastewater ground disposal gravel pack. The cisterns have an access entranceway (Photo 1-4 rear) for inspection and cleaning purposes. Also, limestone can be added to raise the pH of the rainwater if required.

Stored water will be directed to the combined slow sand-filter activated carbon adsorber by a small pump with pressure tank for on-and-off control depending on the water level in the cistern. The outlet pipe is above the bottom of the cistern to allow for sediment build-up.

## 5.0 SITE GROUNDWATER COLLECTION

Groundwater seeping from the high ground behind the houses and from the foundation drains is collected in separate sumps located at the front of the lots adjacent to the septic tanks (Photo 1-6). A 250 W (1/3 HP) submersible pump lifts the water to the surface for disposal in the front planted area or to the street catch basin.

PHOTO 1-3 UPPER PATIO AREA

PHOTO 1-4 LOWER PATIO AREA


PHOTO 1-5 CISTERN ACCESS CHAMBERS


PHOTO 1-6 GROUND WATER COLLECTION SUMP

Consideration is being given to utilizing this groundwater in the houses' water systems depending on its quality. Sampling of this water for its chemical and bacteriological characteristics is now to be included in the monitoring program for the Toronto Healthy Houses.

## 6.0 POTABLE WATER TREATMENT AND STORAGE

The collected rainwater is subjected to pH adjustment with added alkalinity in the storage cistern. The main treatment processes are slow sand filtration, activated carbon adsorption, and ultra-violet irradiation disinfection. The treated water is stored in a concrete tank beneath the basement floor. From there it is pumped out on demand and re-disinfected for use at the potable water taps and in the dishwasher.

### 6.1 Combined Slow Sand Filter and Activated Carbon Adsorber

Each house potable water system includes a RAL Engineering Ltd. combined upflow slow sand filter and activated carbon adsorber (5) (Photo 1-7). The blue, vertical circular unit is 300 mm (12 in) in diameter and 1.2 m (4 ft) in height. The media in the slow-sand filter is placed in four layers with the coarsest quartz material (13 to 19 mm) on the bottom and the finest silica sand (0.35 mm) on the top. The 1 mm activated carbon is suspended in a basket above the top of the sand (Photo 1-8).

The design filtration rate is 5 L per minute (1 gal per minute). A flow meter with needle valve is provided on the discharge line for controlling flow rate of the incoming pressurized water (Photo 1-7). A sampling port is provided between the sand and carbon media for determining slow-sand filter effluent quality.

The slow sand filter removes turbidity, breaks down organic matter, and reduces the number of pathogenic organisms. The activated carbon removes organic compounds including colour not in particle form, and some metals.

The unit is backwashed downflow with treated water from the house pressure system. A double check valve is installed in the backflush line to prevent backflow should the system pressure drop below the gravity head on the filter. The backwash water is directed to the septic tank. Initially filtered water after backwash can also be wasted to the septic tank if required. Air release valves on the treated water lines as they leave the top of the filter units serve to vent any accumulated air which would interrupt hydraulic flow.

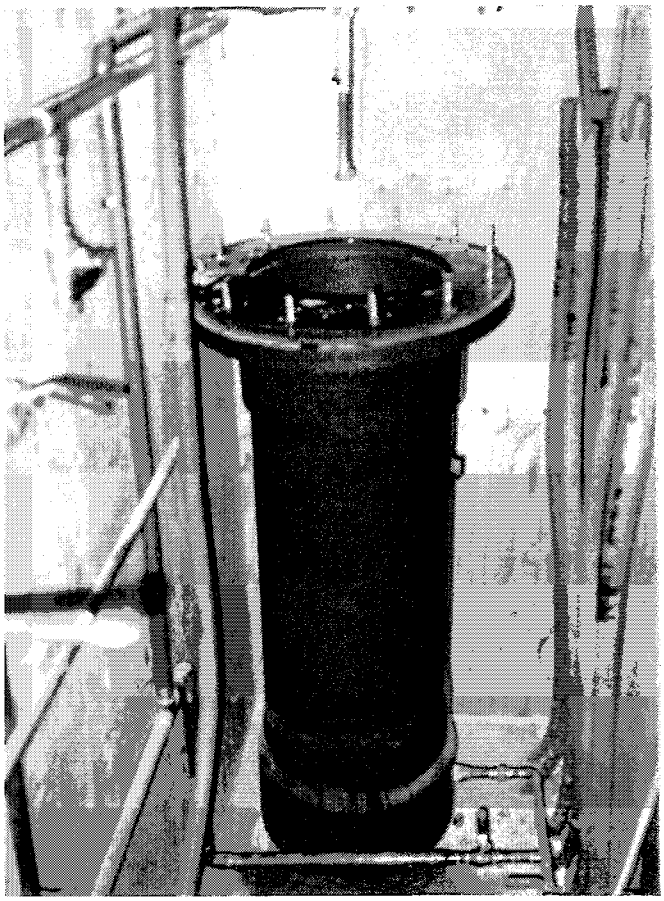

PHOTO 1-7
COMBINED POTABLE WATER SLOW SAND FILTER AND ACTIVATED CARBON ADSORBER (BLUE)

PHOTO 1-8 ACTIVATED CARBON SUSPENDED IN BASKET

## 6.2 Ultraviolet Irradiation Disinfection

Ultraviolet irradiation disinfection is provided before and after the treated water storage tank by means of a Trojan Technolgies Inc. Aqua Advantage 5 water sterilizer (Photo 1-9 Centre Top). The reaction chamber is provided with a UV sensor. The UV sensor reads the ultraviolet light intensity. The sterilizer goes into alarm mode (Monitor light turns RED and an alarm buzzes) when the measured intensity is too low.

When the system pressure pump starts on demand, it pumps water through the foot valved suction pipe in the treated water storage tank through the Aqua Advantage sterilizer. A check valve on the inlet line to the storage tank from the combined slow sand filter activated carbon adsorber beyond the UV unit prevents its use as a pump suction line. The system control boxes are wall-mounted above the sterilizer (Photo 1-10)

## 6.3 Treated Potable Water Storage Tank, Potable Water System Pressure Pumping System and Hot Water Tank

The 600 L (132 gal) treated potable water storage tank is located underneath the ground floor (Photo 1-11 rear). It provides 5 days storage.

A Grundfos "three-in-one" wall-mounted JetpaQ pumping system supplies potable water to the Toronto Healthy Houses from the treated water reservoir (Photo 1-12). The compact JetpaQ is designed to deliver constant preset discharge pressure by continuously regulating the speed of the pump to maintain the present discharge pressure. The electronic control system incorporating a frequency converter adjusts the speed of the pump so the pre-set pressure remains constant within the performance range of the pump.

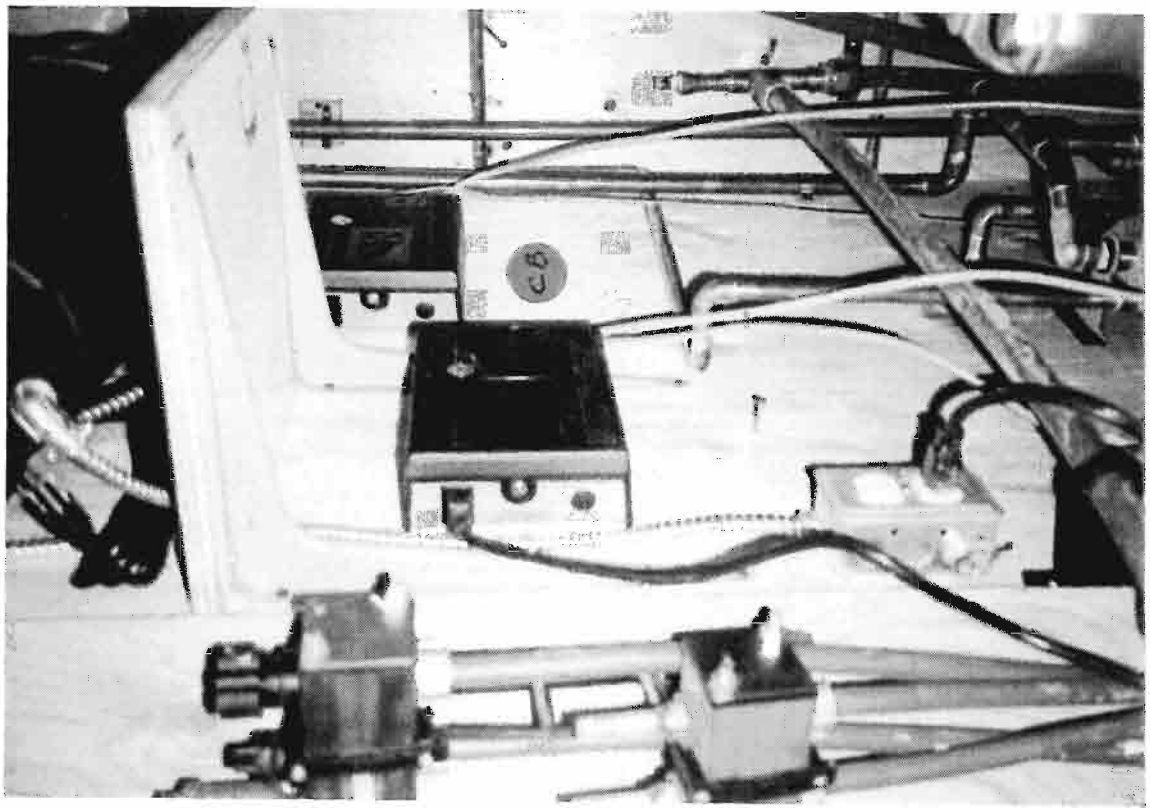

PHOTO 1-10 UV STERILIZER CONTROL BOXES

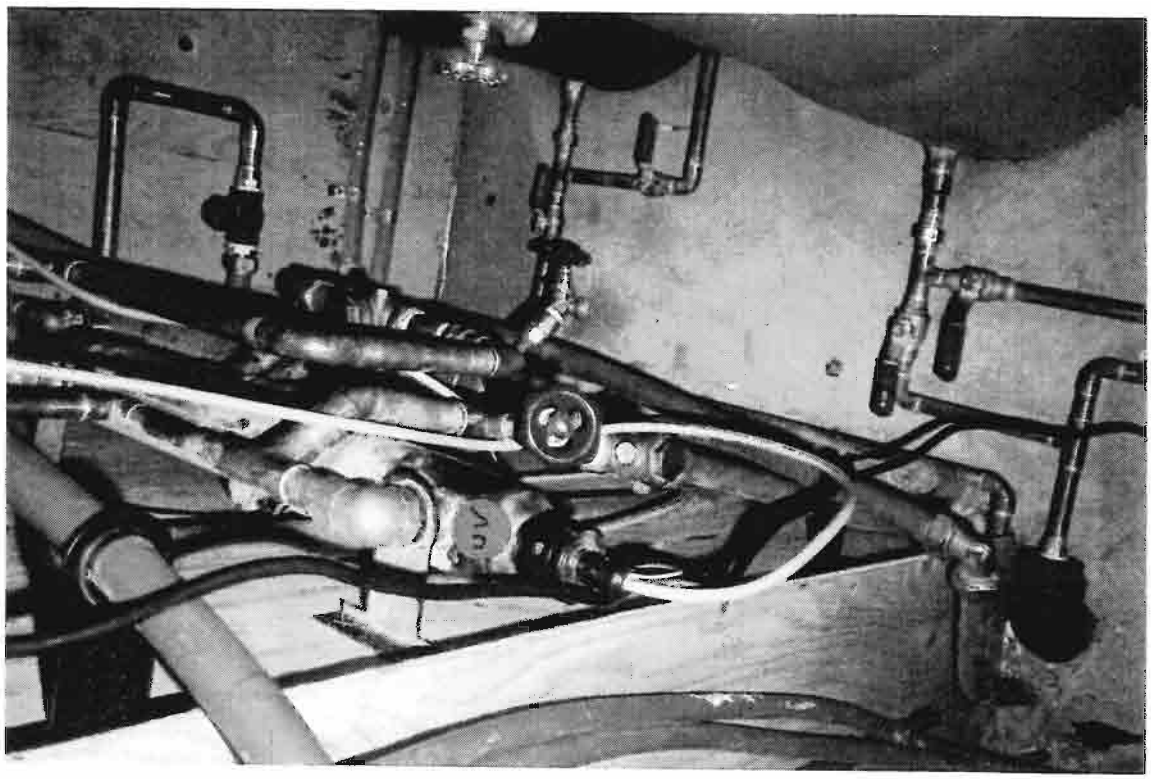

PHOTO 1-9 UV STERILIZER TUBE (CENTRE TOP)

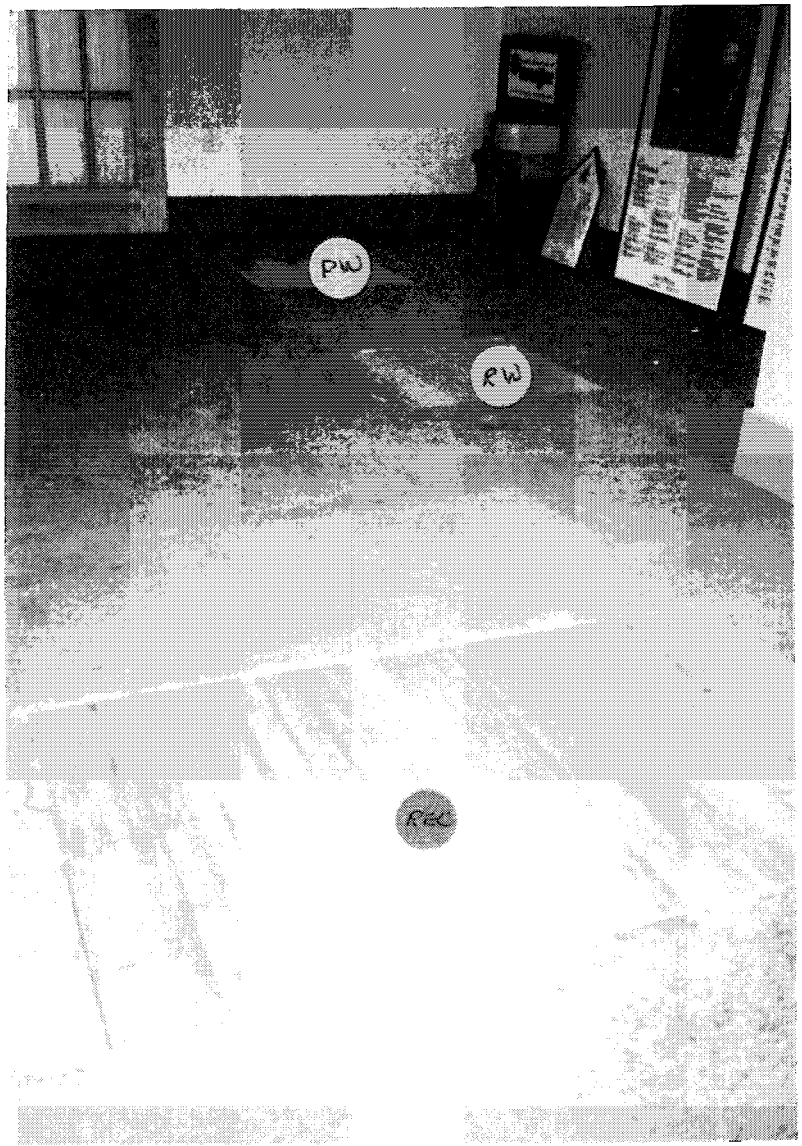


PHOTO 1-11 TREATED WASTEWATER STORAGE, WATER STORAGE AND RECIRCULATION TANK (FRONT)

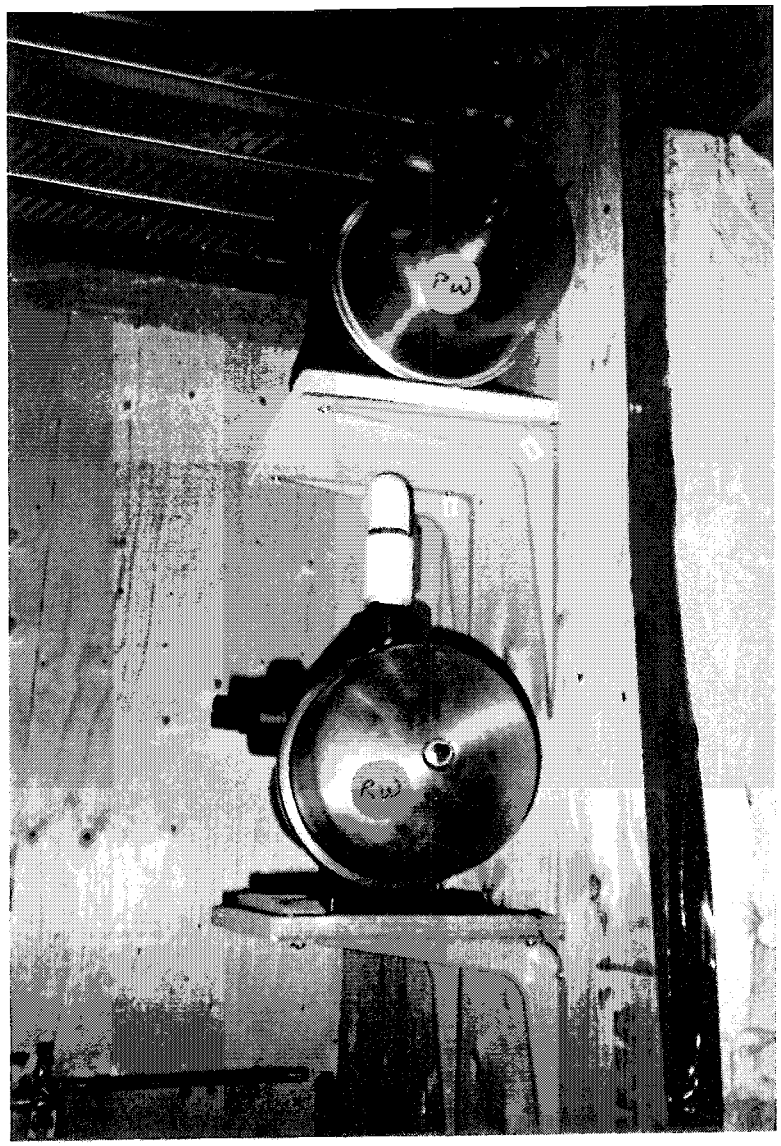


PHOTO 1-12 JETPAQ PRESSURE PUMPS

On sunny days, the hot water is heated from the two lower glycol circulating solar panels on the south side of each Toronto Healthy House (Photo 1-13). On dull days the hot water tank in the off-grid house is heated by means of a separate heat exchanger connected to the standby cogenerator. A cross over with check valves allows natural thermo-siphoning of heat from the 2200 L (484 gal) ground floor house thermal storage tank to the hot water tanks when the cogenertor is not running. For the other house, the hot water tank is heated electrically from the power grid when required.

The volume of the hot potable water tank is 150 L (33 gal). The hot water tank is located under the counter in the second floor bathroom (Photo 1-14). The tank is manufactured by Vaughan Manufacturing Corporation, Salisbury, MA.

## 7.0 GREYWATER HEAT RECOVERY

The plumbing system in each of the Toronto Healthy Houses includes two greywater heat recovery units. One recovers heat from the wastewater leaving the bathrooms (bath, shower and clotheswasher) and the second captures heat from the wastewater leaving the kitchen (sink and dishwasher) (Photo 1-15).

The GFX Greywater Heat Exchangers by Global Technologies Unlimited Inc. consist of a central copper pipe through which heated greywater travels down its inner wall and another copper pipe wrapped in a coil around it through which preheated supply water rises upwards. Up to 70% of the energy in the greywater can be transferred to the supply water further increasing its temperature.

## 8.0 WASTEWATER TREATMENT

The wastewater treatment component consists of a septic tank, recirculation tank with biofilter feed pump, Waterloo Biofilter™ and treated wastewater ground disposal gravel pack.

### 8.1 Septic Tank

The 3600 L (800 gal) precast concrete septic tank for each house is located underneath the car port (Photo 1-6 and Photo 1-16). The tanks are insulated. There is an access chamber to each of the two compartments. The dividing wall has two ports at mid elevation for the liquid to flow through. Each outlet is provided with an Orenco Biotube effluent filter to remove suspended solids (Photo 17).

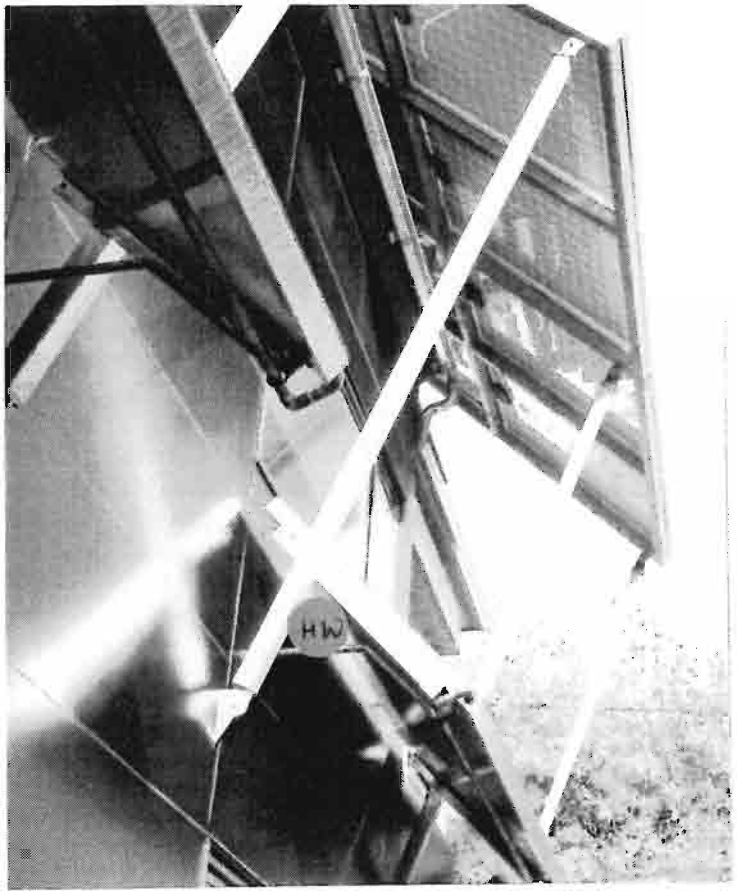


PHOTO 1-13
HOT WATER
SOLAR PANELS
(Lower)

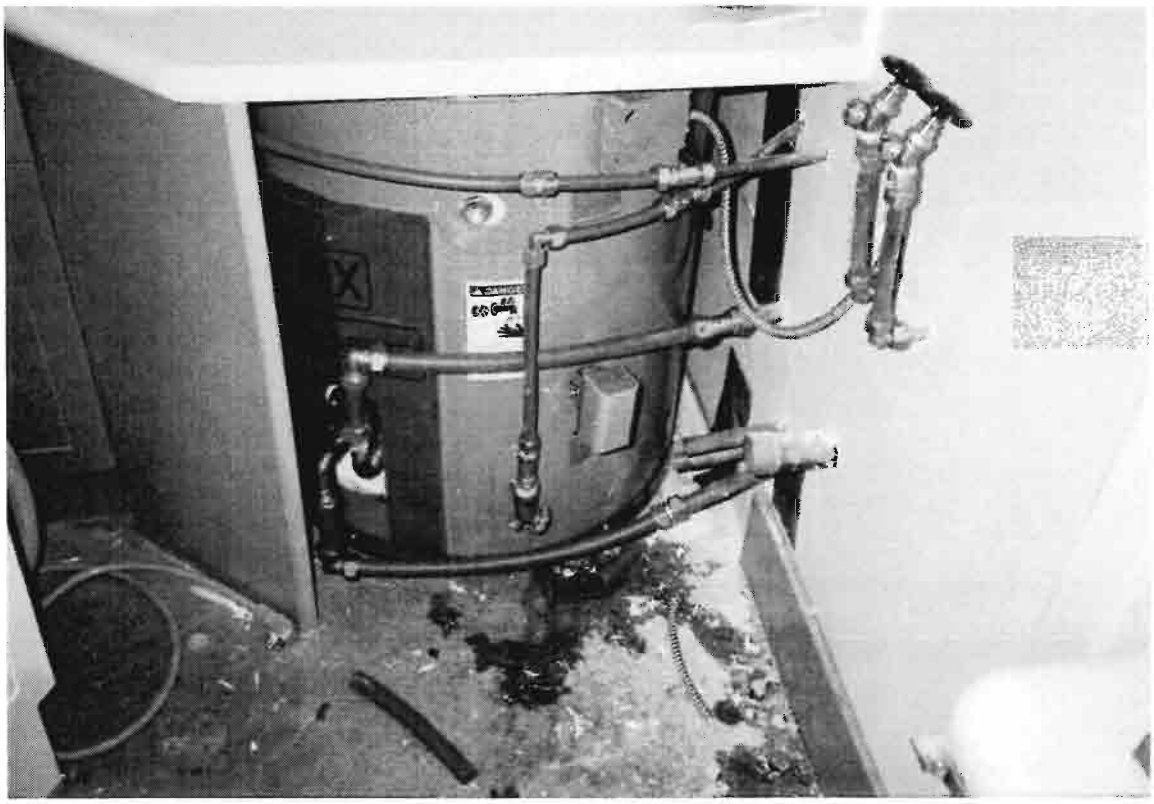

PHOTO 1-14 POTABLE HOT WATER TANK

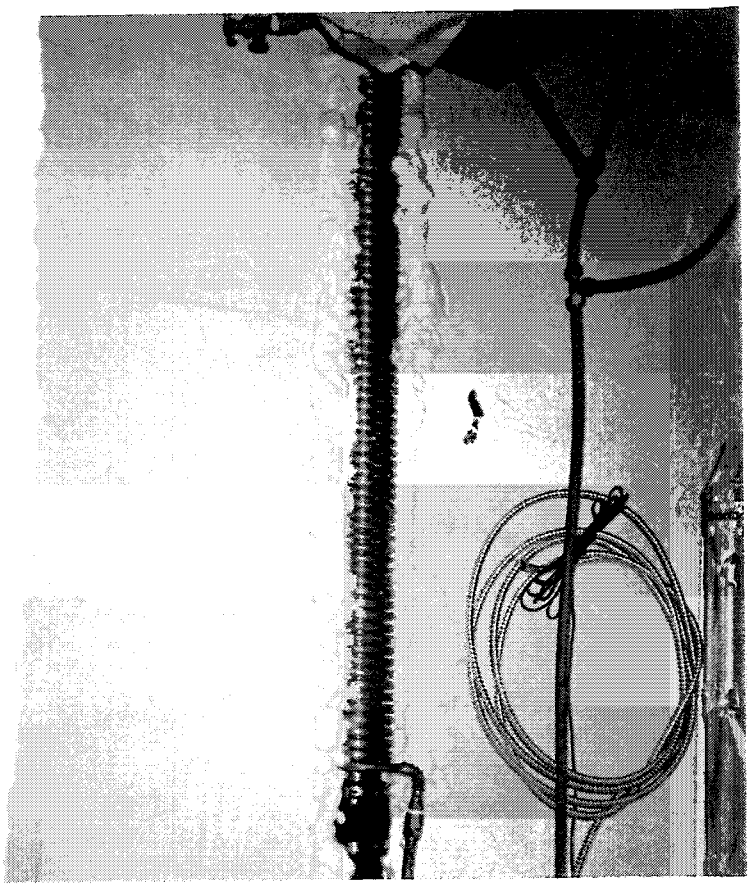

PHOTO 1-15
GREYWATER
HEAT EXCHANGER


PHOTO 1-16 SEPTIC TANK UNDER CARPORT

PHOTO 1-17 SEPTIC TANK EFFLUENT FILTER

PHOTO 1-18 SUBMERSIBLE EFFLUENT PUMP

The septic tank serves as a trash tank to retain grease, grit, oil and other objects which may otherwise clog downstream piping and equipment. The septic tank also provides primary treatment. It is a physical process to remove settleable organic and inorganic solids. The process is also effective for the removal of some organic nitrogen, organic phosphorus and heavy metals, but does little for the removal of colloidal and dissolved constituents. The septic tank further provides anaerobic digestion of the settled sludge and waste sludges from subsequent treatment processes.

8.2 Recirculation Tank

The effluent from the septic tank flows by gravity to the recirculation tank located under the ground floor (Photo 1-11 front and Photo 1-20) in the solarium/office area. The precast tank has a capacity of 2000 L (440 gal). The recirculation tank also receives Waterloo Biofilter™ effluent by means of a downward flowing valved inlet pipe (Photo 1-20 left). The mixture of septic tank effluent and Waterloo Biofilter™ effluent is pumped as feed to the Waterloo Biofilter™

The 250 Watt (1/3 HP) stainless steel Grundfos EF33 submersible pump (Photo 18) is housed in a screened pump vault which also contains three floats. There is a high level alarm float, normal on/off pump control float, and a low level float to shut off the pump if the middle float fails.

Operation of the pump is controlled through an electrical panel (Photo 1-19) which includes a timer for automatic on/off pump operation. The upper float overrides the timer if necessary. The pump is operated on an intermittent basis typically on for 30 seconds every 30 minutes to provide up to five times recycle through the Waterloo Biofilter™.

8.3 Waterloo Biofilter™

The recirculating Waterloo Biofilter™ with forced air ventilation provides secondary treatment (Photo 1-21). It is an aerobic biological process which removes organic matter and effects nitrification. Nitrification is the term given to any wastewater treatment process that biologically converts ammonia nitrogen to nitrate nitrogen.

For the Toronto Healthy Houses wastewater treatment system, denitrification will be achieved in the recirculation tank. The recirculating nitrified Waterloo Biofilter™ effluent mixes with the septic tank effluent which provides the required carbonaceous food source for the denitrifying bacteria. In an anoxic (without oxygen) environment the denitrifiers strip the oxygen from the nitrate releasing nitrogen as a gas which leaves the system through the vent piping system.

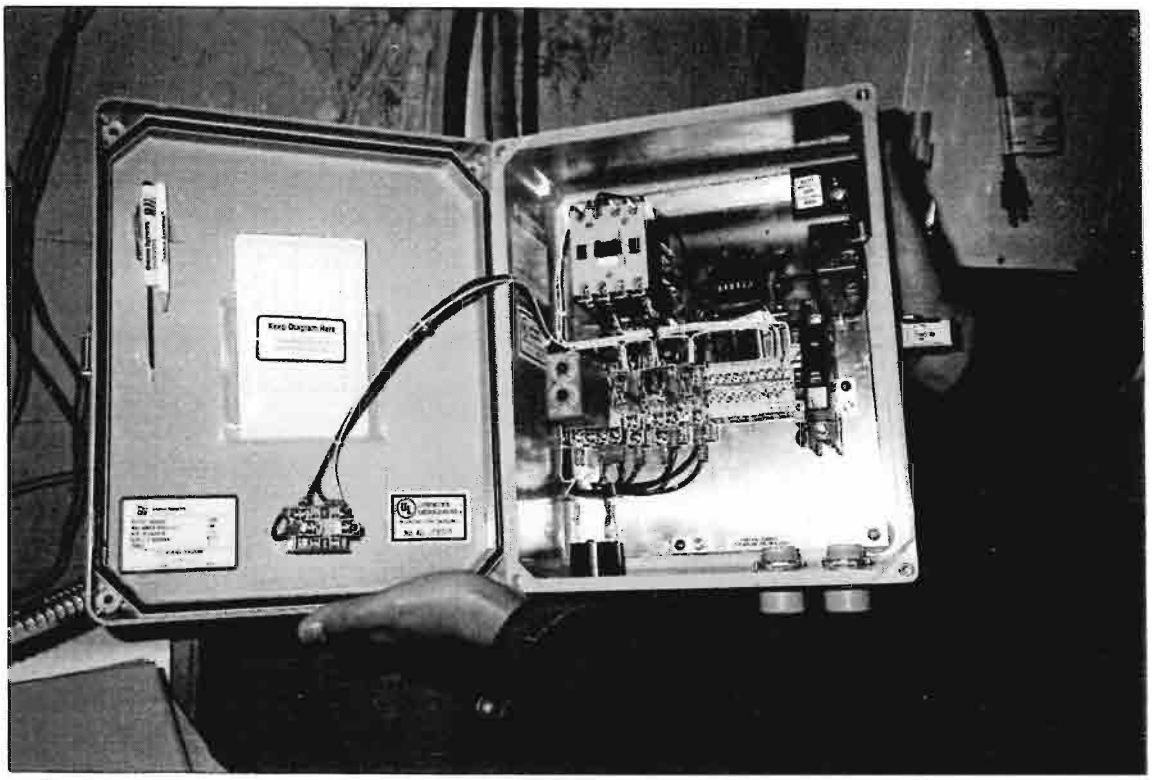

PHOTO 1-19 EFFLUENT PUMP CONTROL PANEL

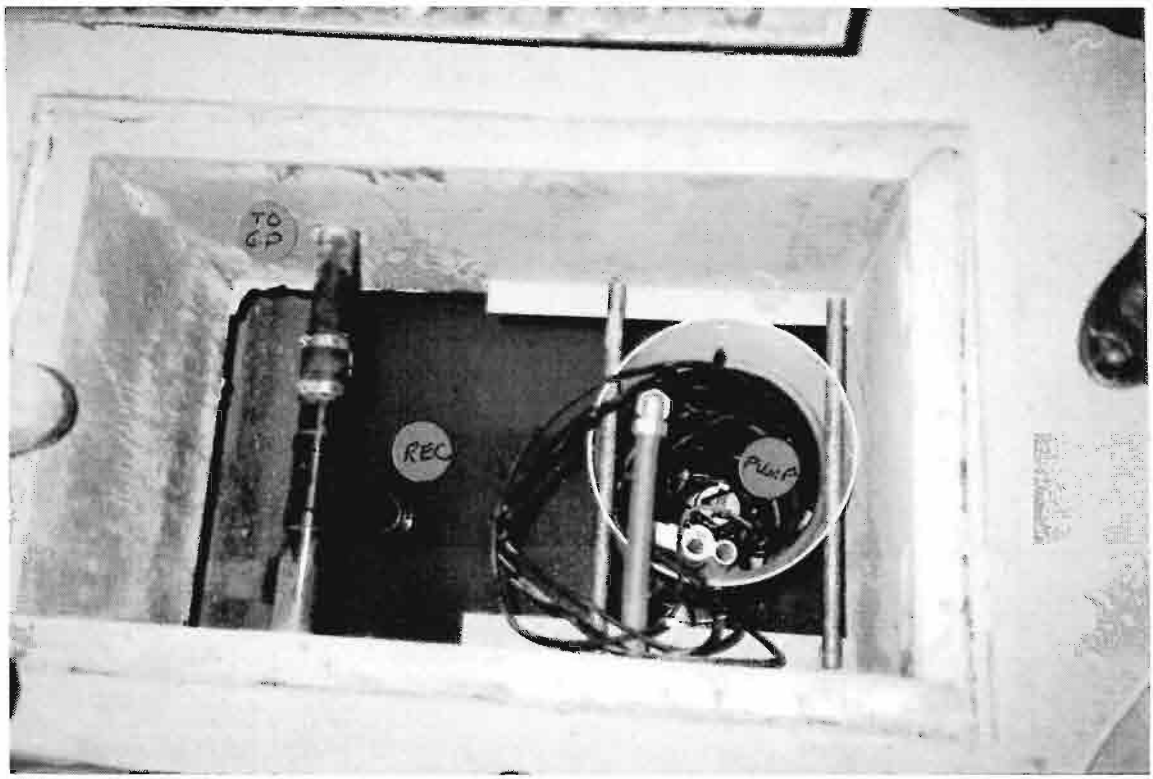


PHOTO 1-20 BIOFILTER RECIRCULATION TANK

PHOTO 1-21
WATERLOO
BIOFILTER™

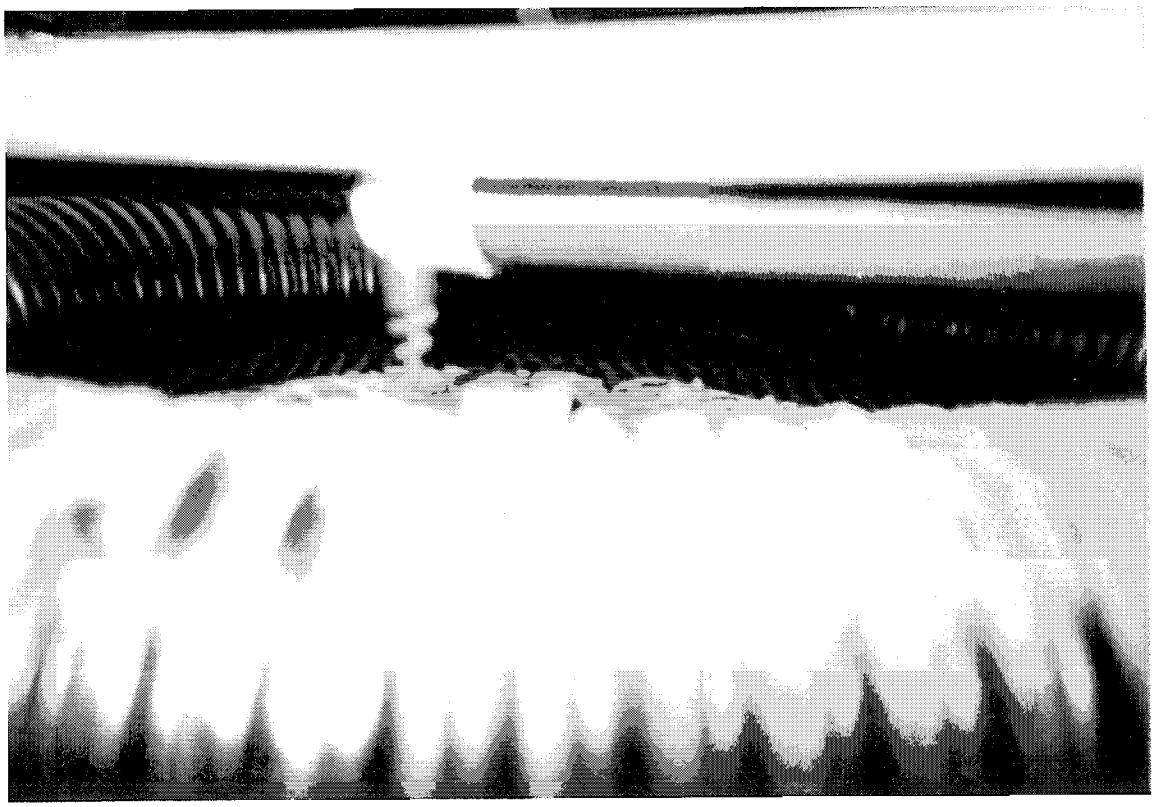

PHOTO 1-22 BIOFILTER INFLUENT DISTRIBUTION

The Waterloo Biofilter™ receives 3600 L of wastewater per day when the recirculation rate is 5:1. The filter uses synthetic foam blocks placed randomly in geodrain grid baskets (Photo 1-21) which combine high surface area and porosity, high water absorbency and retention time. The resulting free fall flow paths for wastewater and air enable design flows of 50 cm/day (10 gal/ft$^2$/day) for septic tank effluent.

The biofilter media is contained in five baskets each 760 mm (30 in) diameter and 1.2 m (4 ft) high. The baskets are housed in a waterproof stainless steel cabinet fabricated by TIBA, North York, Ontario, with sealed removable front vertical panel for access. The cabinet sits on a platform raised off the floor (Photo 1-21). The top portion of the media is contained in mesh cloth bags to facilitate removal for cleaning as may be required (Photo 1-21).

The wastewater is distributed onto the top of the filter media through a piping system with spray nozzles (Photo 1-22). The PVC 1/50° angle Beta nozzles are self draining to minimize plugging from biological slime.

Air is supplied to the biofilter above the media by a 100 mm (4 in) pipe connected to the Lifebreath® heat recovery ventilator (HRV) being part of the Toronto Healthy Houses ventilation system. The air flows around the filter baskets down to the liquid surface in the bottom tray of the cabineet. A pipe above this level will vent the air to the house plumbing vent.

The treated effluent collected in the bottom tray of the cabinet exits through the central drain. The drain is connected to a piping network under the cabinet (Photo 1-23). The 50 mm (2 in) pipe from the bottom of the vertical "T" (on the left of Photo 1-23) carries effluent to the combined slow sand, activated carbon units.

Biofilter effluent exiting the horizontal leg of the "T" flows to the recirculation tank. This is achieved by means of a looped piping system which causes flooding of the bottom tray. The adopted piping system assures a constant hydraulic head across the renovation filter units.

8.4 Treated Wastewater Ground Disposal

On a design flow balance basis, 120 L per day is wasted to the ground disposal gravel pack located outside the front wall of each house. The actual amount wasted depends on the liquid level in the recirculation tank (Photo 1-20).

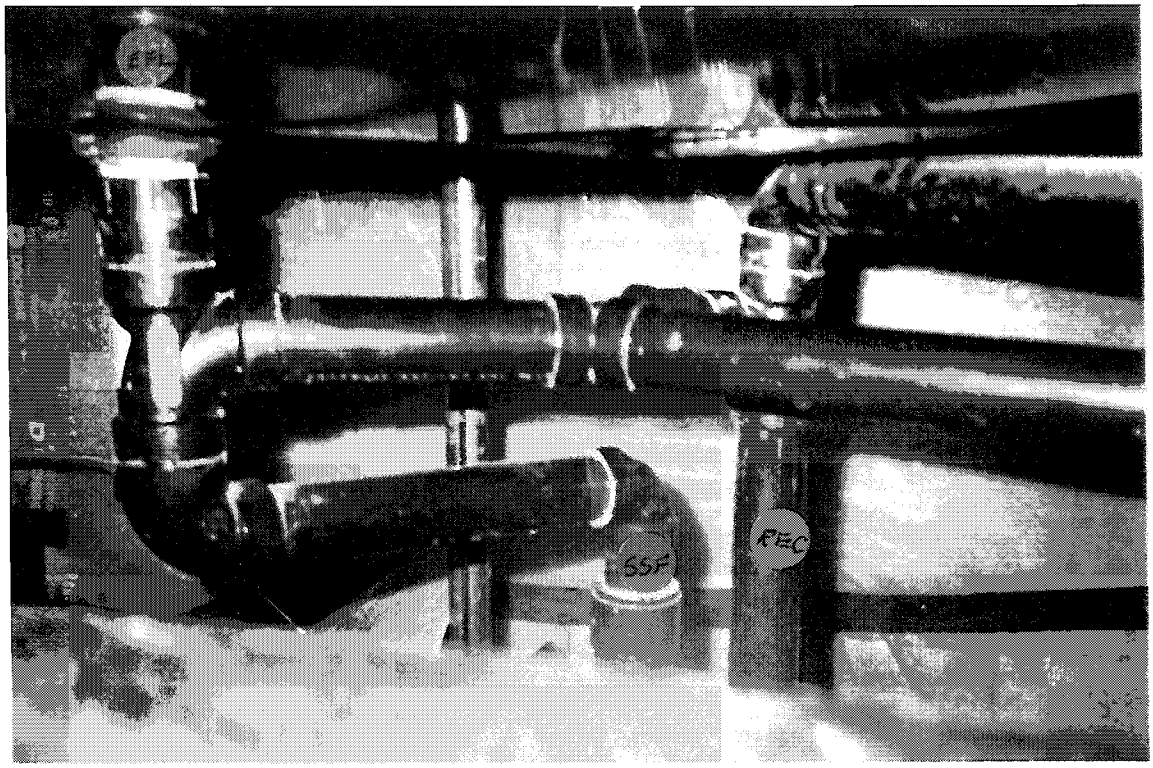


PHOTO 1-23 BIOFILTER EFFLUENT PIPING SYSTEM


PHOTO 1-24 BURIED WASTEWATER GRAVEL PACK
(UNDER THE PATIO STONES NEAREST THE FRONT WALL)

The downward pipe on the left which discharges treated Waterloo Biofilter™ effluent into the recirculation tank is equipped on its end with a weighted floating ball valve. Rising liquid in the recirculating tank causes the ball to also rise. This shuts off the flow forcing the biofilter effluent to carry on through the wall of the recirculating tank to the gravel pack beyond.

The 100 mm (4 in) diameter, 3.0 m (10 ft) long distribution pipe, parallel to the house wall and 0.4 m (16 in) from it, is above the geotextile-wrapped termite sand placed outside the wall down to the bottom of the foundation. The pipe which is about 1.2 m (4 ft) below grade is wrapped in a woven textile sock to exclude any soil particles from entering the distribution holes. The granular "A" gravel pack itself is 150 mm (6 in) deep. The top of the gravel pack is covered with a geotextile to keep out backfill material. From the surface, the gravel pack is beneath the row of patio stones closest to the front wall (Photo 1-24)

## 9.0 RENOVATED WATER TREATMENT

The renovated water treatment system consists of twin, combined slow sand filters and activated carbon adsorbers, ultraviolet irradiation disinfection, treated renovated water storage, and renovated water pressure distribution pump.

### 9.1 Combined Slow Sand Filters and Activated Carbon Adsorbers

The Waterloo Biofilter™ effluent flows by gravity upwards through twin RAL Engineering Ltd. combined slow sand filters and activated carbon adsorbers operated in parallel. Each is equal in size and media configuration to the potable water unit (Photo 1-25). The design flow rate is five times higher at 25 m (5 gal/m). They are painted grey.

They are backwashed, downflow with treated renovated water drawn from storage. One unit is backwashed at a time with the second remaining in service. The backwash water is directed to the septic tank. Also, initially filtered water can be wasted to the septic tank if found necessary.

### 9.2 Ultraviolet Irradiation Disinfection

The renovated water from the activated carbon adsorber is disinfected in the same manner as the potable water by use of a second, identical Trojan Aqua Advantage 5 Sterilizer (Photo 1-9 and 1-10). This includes the UV sensor and alarm system described previously in Section 6.2.

PHOTO 1-25 RENOVATED WATER COMBINED SAND FILTER/ ACTIVATED CARBON UNITS

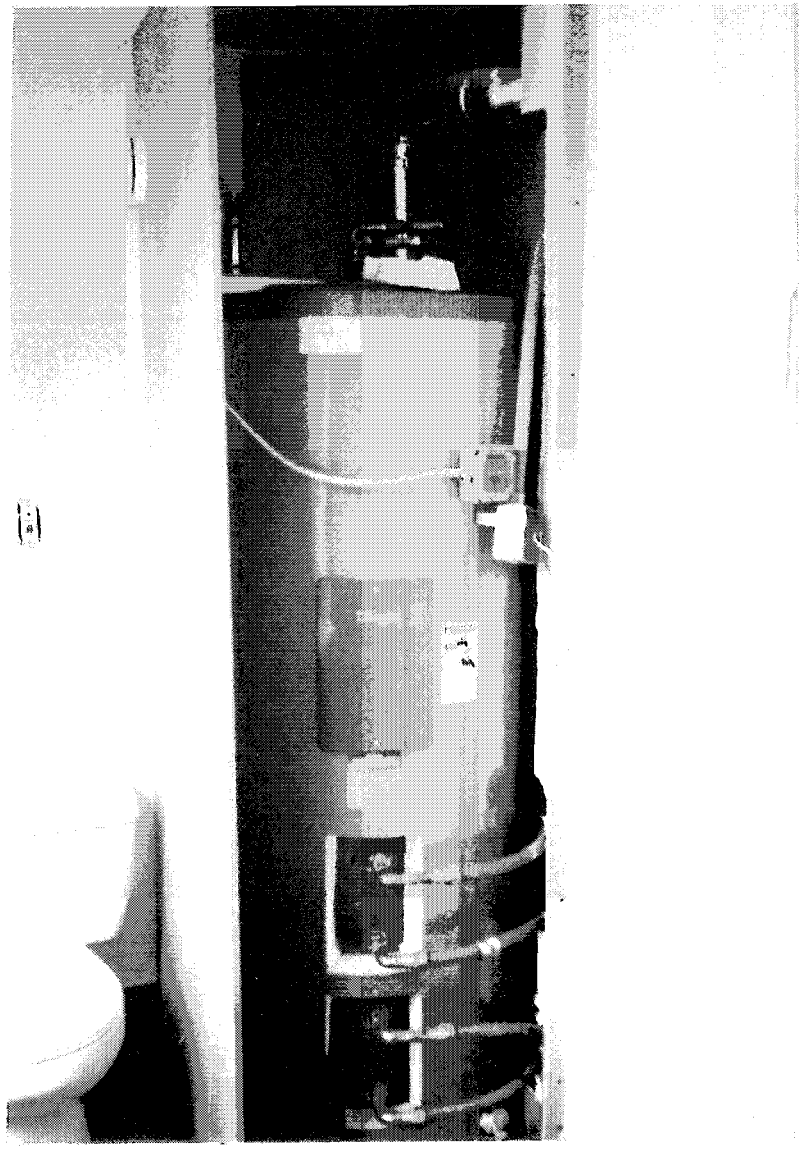

PHOTO 1-26 RENOVATED HOT WATER TANK

### 9.3 Renovated Water Storage Tank and Pressure Pump and Hot Water Tank

The 1200 L (264 gal) renovated water storage tank is located underneath the ground floor (Photo 1-11) beside the potable water storage tank. It provides two-days storage. The inlet line enters the tank near the bottom.

A second, indentical Grundfos JQ2 "three-in-one" wall mounted JetpaQ pumping system supplies renovated water to the Toronto Healthy Houses from the treated renovated water reservoir (Photo 1-12). As stated previously, in Section 6.3 this system delivers constant preset discharge pressure by continuously regulating the speed of the pump to maintain the preset discharge pressure. Under normal operating conditions the pump is maintenance free.

The 500 L (110 gal) renovated hot water tank is located in the bathroom on the third (top) floor of the house (Photo 1-26). Water is heated by the solar panels or the respective back-up system as described previously in Section 6.3. The tank is also manufactured by Vaughan Manufacturing Corporation, Salisbury, MA.

## 10.0 WORK TO BE DONE

This Commissioning Guide describes the Toronto Healthy Houses water systems as of December 2, 1996. The following action items are required to complete the installation in accordance with the previous reports (2) (3) (4).

1. For the potable supply system install a head tank with pump and sampling tap in the basement on the supply line from the cisterns to the combined slow sand filter/activated carbon adsorber. This is to avoid syphon flow.

2. Install the proposed activated carbon filter at the top of the plumbing vent stack of each house (Photo 1-1).

3. Relocate the backwash control valves for the potable water combined slow sand/activated carbon treatment units to make them conveniently accessible to operate.

4. With respect to the proposed monitoring program provide:
   (a) a means of determining the amount of rainwater supplied from each cistern,
   (b) flow meters at the potable water and renovated water service pumps to measure water usage in the houses,

(c) a means of measuring the amount of wastewater discharged to the ground disposal gravel pack.

(d) wall mounted sight glasses on the treated water discharge lines of the combined slow sand/activated carbon filters to determine the hydraulic head loss through them.

(e) tap on combined sand filter/activated carbon unit backwash drains beyond valves for sampling backwash and rewash waters.

(g) on-site process quality monitoring equipment as discussed in Section 7.3, "Monitoring Program For The Toronto Healthy Houses Water Systems".

## 10.0 REFERENCES

1. "Toronto Healthy Houses Water Supply and Wastewater Renovation - Preliminary Design," Blue Heron Technology, Athens, Ontario, April 13, 1995.
2. "Toronto Healthy Houses - Towards Final Design and Approval of the Water Supply and Wastewater Renovation Systems," Blue Heron Technology, Athens, Ontario, May 2, 1995.
3. "Regulatory Approvals and Performance Monitoring For The Toronto Healthy Houses," Blue Heron Environmental Technology, Athens, Ontario, May 3, 1995.
4. "Monitoring Program For The Toronto Healthy Houses," Blue Heron Technology, Athens, Ontario, June 28, 1996.
5. "Reusing Treated Wastewater In Domestic Housing: The Healthy House Project," R. Paloheimo, Creative Communities Research Inc., and R.A. LeCraw, RAL Engineering Ltd., University of Waterloo Conference, Waterloo, Ontario, May 13, 1996.

# APPENDICES

# TORONTO HEALTHY HOUSES WATER SYSTEMS DESIGN TEAM

## Rainwater Collection and Storage

R. Scott, P.Eng., CWRS
Technical University of Nova Scotia
1360 Barrington Street
P.O. Box 1000
Halifax, N.S., B3J 2X4
Tel. (902)420-7853 Fax (902)420-7551

## Potable Water and Renovated Water Filters and Disinfection

R.A. LeCraw, P.Eng.,
President
RAL Engineering Ltd.
482 Queen Street, E
Newmarket, ON, L3Y 2H4
Tel. (905)853-0626 Fax (905)853-8807

## Septic Tanks, Waterloo Biofilter™, and Wastewater Ground Disposal

E.C. Jowett, Ph.D, P.Eng.,
Department of Earth Sciences
University of Waterloo
Waterloo, ON, N2L 3G1
Tel. (519)885-1211, ext 3552 Fax (519)746-7484

## Project Development and Coordination for CMHC

A. Townshend, P. Eng.
Blue Heron Environmental Technology
R.R.#1 Athens, ON, K0E 1B0
Tel. (613)924-9575 Fax (613)924-9901

## Equipment Procurement and Assembly Including All Appurtenances

R. Paloheimo
Creative Communities Research Inc.
26 Garnock Avenue
Toronto, ON, M4K 1M2
Tel. (416)466-5172 Fax (416)466-5173

# APPENDIX 1-B

## PRINCIPAL SUPPLIERS OF EQUIPMENT FOR THE TORONTO HEALTHY HOUSES WATER SYSTEMS

### Concrete Water Storage and Septic Tanks

Wilkinson Heavy Precast Ltd.
588 Highway No. 5
Dundas, ON, L9H 5E2
Tel. (905)628-5611 Fax (905)628-9292

### Combined Slow Sand and Activated Carbon Filters

RAL Engineering Ltd.
482 Queen Street, East
Newmarket, ON, L3Y 2H4
Tel. (905)853-0626 Fax (905)853-8807

Septic Tank Effluent Filters
Screened Sewage Pump Vaults
Float Switch Assemblies
Effluent Pump Control Panels

Orenco Systems Inc.
814 Airway Avenue
Suthern, Oregon 97479-9012
Tel. (541)459-449 Fax (541)459-2884

### Waterloo Biofilter

Waterloo Biofilter Systems Inc.
2 Taggart Court, Unit 4
Guelph, ON N1H 6H8
Tel. (519)836-3380 Fax (519)836-3381

### Ultraviolet Light Disinfection

Trojan Technologies Inc.
845 Consortium Court
London, ON, N6E 2S8
Tel. (519)685-6660 Fax (519)681-8355

## Service Pumps

Grundfos Pumps Corp.
2555 Clovis Avenue
Clovis, CA 93612

Grundfos Canada Inc.
5647 McAdam Road
Mississauga, ON L4Z 1N9
Tel. (800)644-9599 Fax (800)265-9862

# APPENDIX 1-C

## PHOTOGRAPHS OF WATER SYSTEM COMPONENTS

# COMMISSIONING GUIDE

# PART 2

# OPERATIONAL AND MAINTENANCE

# CONSIDERATIONS FOR THE

# TORONTO HEALTHY HOUSES WATER SYSTEMS

CMHC CR File No: 6740-5

Prepared by

A.R. Townshend, P.Eng.,
Blue Heron Environmental Technology
Athens, Ontario K0E 1B0
(613)924-9575

December 17, 1996

# SYNOPSIS

The Toronto Healthy Houses employ on-site potable water, renovated water and wastewater ground disposal systems which are described in detail in Part One of the Commissioning Guide. The individual treatment processes composing these innovative systems require occupants to operate and maintain them with the assistance of professional service providers.

Part Two of the Commissioning Guide deals with operation and maintenance requirements as the systems are put into service. Initial operating instructions as given by the principal process equipment suppliers are presented as well as maintenance instructions taken from ancillary equipment owner guides.

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# PART 2

# OPERATIONAL AND MAINTENANCE CONSIDERATIONS FOR THE TORONTO HEALTHY HOUSES WATER SYSTEMS

## 1.0 INTRODUCTION

Operation and maintenance of the water systems and their ancillary equipment will ultimately be the responsiblility of the owner with the assistance of a qualified service provider on annual contract or as required. Initially, during the start-up and demonstration periods, Creative Communities Research Inc. will be responsible for operation and maintenace calling upon the equipment suppliers and installers as required.

Further, CMHC plans to contract for monitoring of the innovative systems incorporated into the Toronto Healthy Houses including the water systems during the first year of operation. Once in place, the monitoring team will work closely with Creative Communities Research Inc. to establish effective procedures by which future homeowners can successfully operate and maintain the potable water and renovated water systems provided in the Toronto Healthy Houses.

## 2.0 INITIAL OPERATING PROCEDURES

### 2.1 Potable Water System

The potable water system has five major components. Operating procedures for the water collection facilities, combined slow sand filter/activated carbon adsorber (blue), UV sterilizer, and potable water distribution system are given in the following sections.

#### 2.1.1 Water Collection

Both the roof and patio areas require some maintenance to keep them free from debris and silt. This maintenance would likely be required only during prolonged dry spells and in the fall when leaves fall from the trees.

The eavestroughs must be keep free of fallen leaves to prevent overflowing and colouring of the collected rainwater. The patio areas should be swept dry to remove any solid material from washing into the catch basins. Soiled areas should be mop washed and dried without allowing any wash water to reach the catch basins.

Access to the cisterns (Photo 1-5) for sampling purposes and for determining liquid level is by means of the capped pipes in the top of the access chambers. These pipes may also be used to deliver fresh water by truck haul should there be a shortage of collected rainwater. The liquid level should be monitored on a regular basis and more often during dry periods to assure an adequecy of water for household potable use.

Each access chamber permits entry to the cistern for inspection and cleaning purposes. Also, limestone gravel placed in the cistern for neutralization of acidity in the rainwater can be replaced through the access chamber.

2.1.2 Combined Slow Sand Filter/Activated Carbon Adsorber (blue)

Collected rainwater is pumped from the cistern to the upflow combined slow sand/activated carbon unit. The filter needs to be backflushed once every month and the activated carbon replaced every 12 months.

Normal filtering and backwash operations are controlled by valves (Photo 2-1, 2-2 and 2-3).

| Photo | Valve No. | Function |
|---|---|---|
| 2-3 | 1 | Open - Rainwater from cistern to bottom of filter during normal filtering<br>Closed - During backwash |
| 2-3 | 2 | Closed - During normal filtering<br>Open - During backwash |

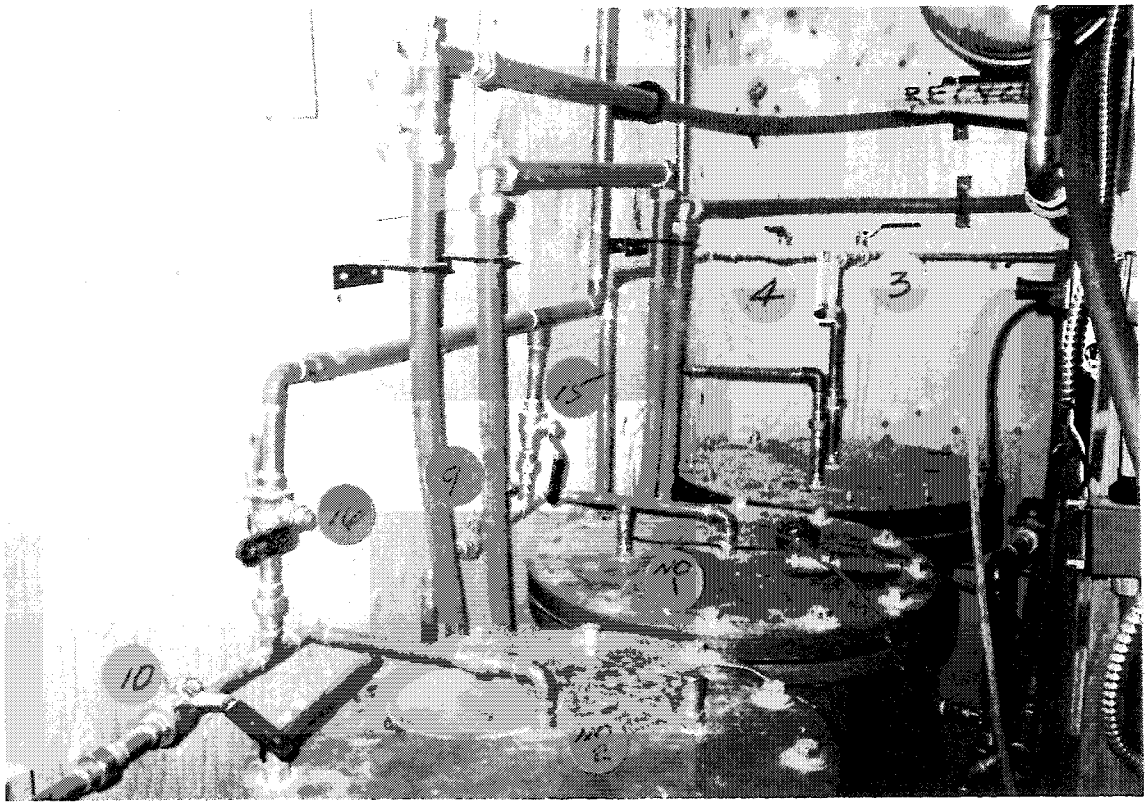


PHOTO 2-1 SLOW SAND/ACTIVATED CARBON UNIT PIPING

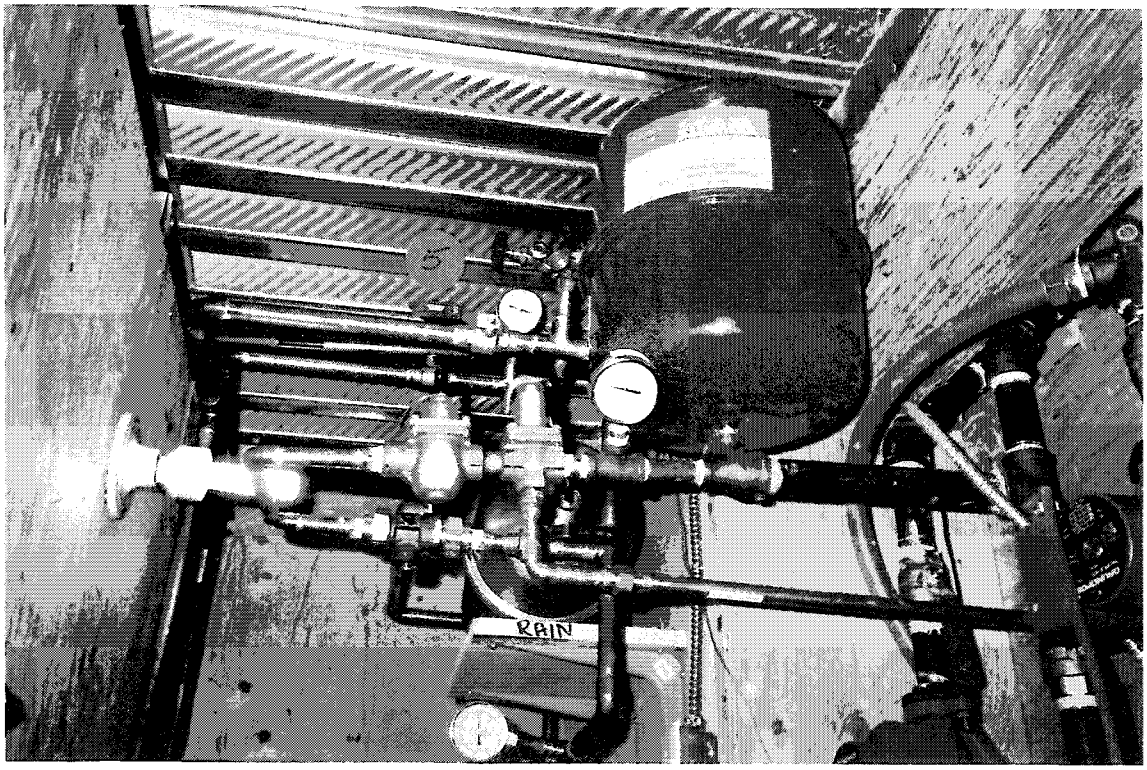


PHOTO 2-2 POTABLE WATER UNIT BACKWASH VALVE

| Photo | Valve No. | Function |
|---|---|---|
| 2-1 | 3 | Open - Treated water to UV disinfection/reservoir during normal filtering<br>Closed - During backwash or filtered water to waste |
| 2-1 | 4 | Closed - During normal filtering<br>Open - Filtered water to waste |
| 2-2 | 5 | Closed - During normal filtering<br>Open - During backwash supplies water from the house pressure system to the top of the filter for downward backwash. [Valve to be relocated for more convenient operation] |

During normal filtering operation valves 1 and 3 are open and 2, 4 and 5 are closed. Flow is up through the granular sand media and then up through the activated carbon adsorber. There is a clear area above the granular sand media and below the carbon to allow for sampling between these two treatments. The rate of flow is controlled by an adjustable needle valve in the variable orifice flow meter on the filter effluent line (Photo 2-1).

During filtering as the head loss increases the rate of flow can be maintained by further opening the flow control valve. Upon continuing head loss with the valve full open, it is time to clean the filter by backwashing. Otherwise the filter should be backwashed once a month. Failure to clean the unit will cause it to plug up reducing its treatment flow capacity. It will not, however, adversely affect water quality.

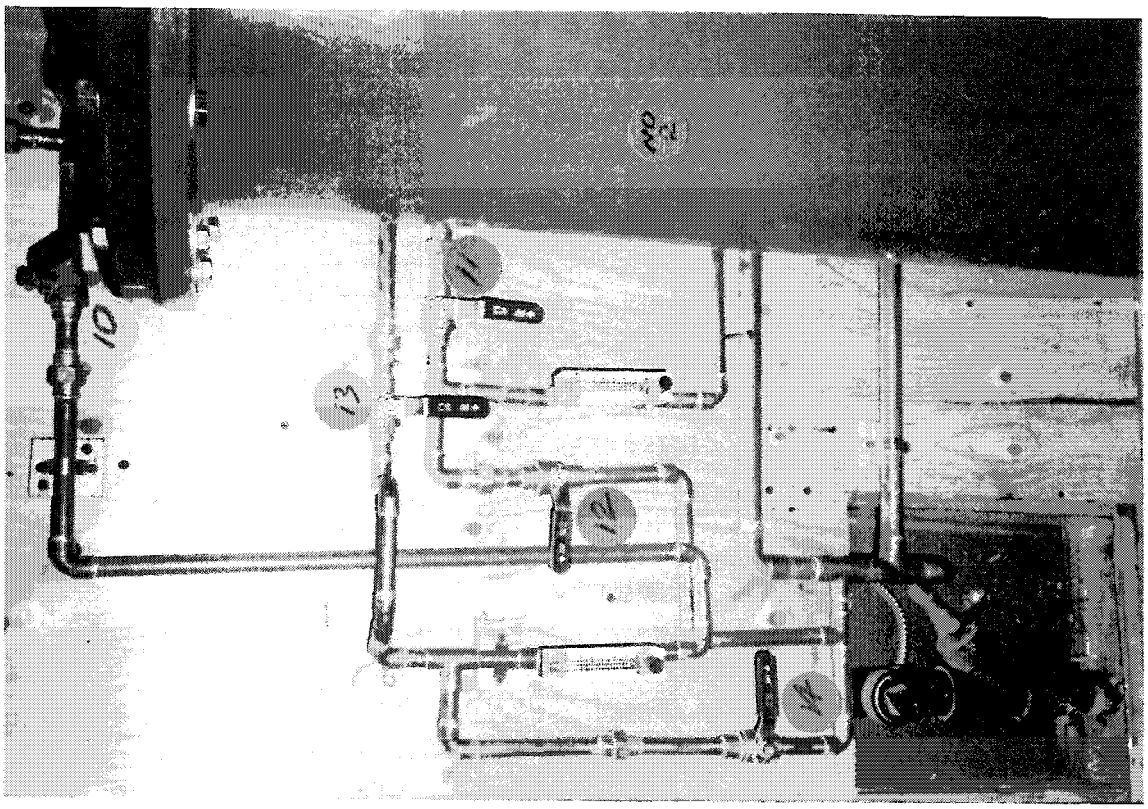

PHOTO 2-4 RENOVATED WATER UNIT PIPING

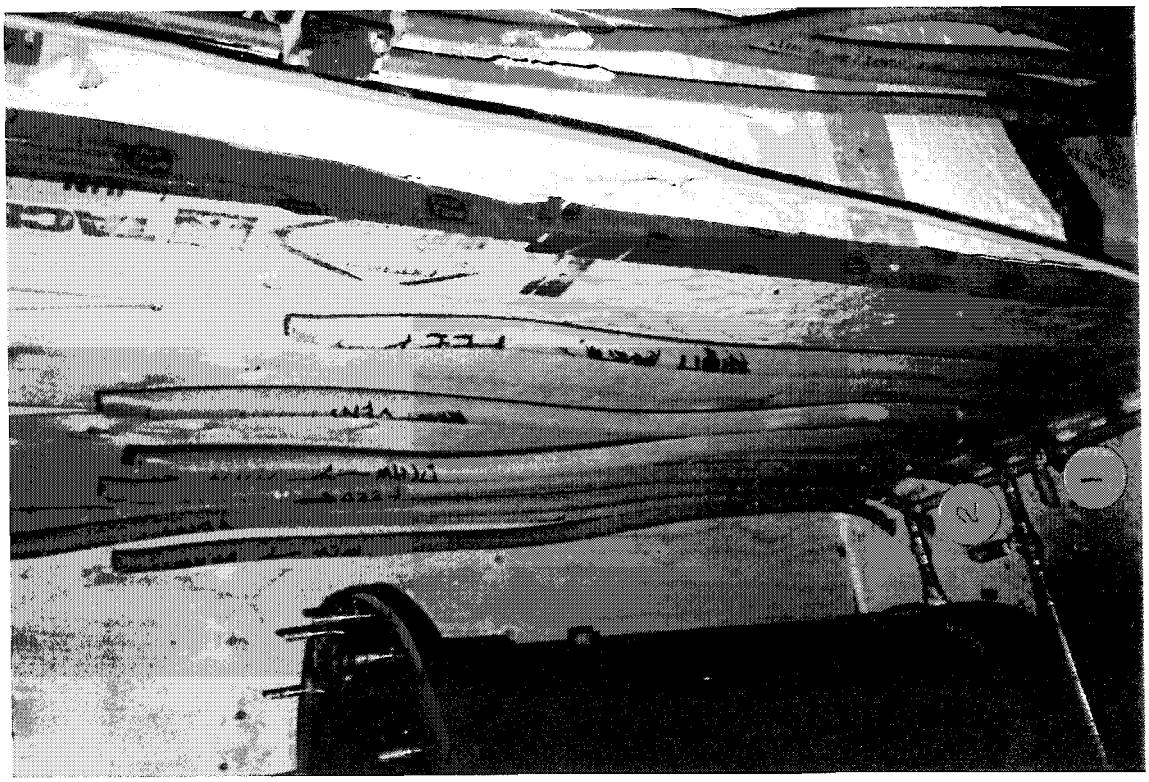

PHOTO 2-3 POTABLE WATER UNIT INLET PIPING

During backwashing valve 1, 3 and 4 are closed and valve 2 and 5 are open. Flushing is maintained for approximately 1 to 2 minutes. A check valve is installed in the backflush line to prevent backflow in the unlikely event the system pressure drops below the head pressure on the filter. At the end of the backwash the valves are reset for normal filtering operation.

Normally it is not necessary to run the filter to waste after backwashing. If fresh carbon has been added or the slow sand filter media replaced, then valve 4 can be opened and valve 3 closed to waste the freshly filtered water to the septic tank. When required, the filter effluent should be run to waste until clear for up to two hours.

### 2.1.3 UV Disinfection

The filter effluent passes through the reactor chamber of the Trojan water sterilizer before it flows to the potable water storage reservoir. There is a check valve on the effluent line from the sterilizer to the reservoir to prevent it from becoming a pump suction line when the JetpaQ pressure pump is operating.

Water from the reservoir is disinfected again through the UV sterilizer which is on the suction side of the JetpaQ supply pump. A foot valve on the pump suction line ahead of the sterilizer prevents filter effluent from entering the reservoir through the line rather than passing through the sterilizer. There is a tap on the suction line before the check valve for sampling filter effluent quality before and after the reservoir. (This is the upper red tap visible in Photo 1-9).

The sterilizers are equipped with a UV Sensor that continually monitors the intensity level of ultraviolet light within the reactor chamber. The operating condition is continuously displayed by a monitor light on the front of the electrical assembly control box mounted on the wall (Photo 2-5 left). Correct operation is indicated when the monitor light glows GREEN.

YELLOW with no audio alarm means that the ultraviolet light intensity level has been reduced. This condition generally indicates that the outer quartz sleeve and the quartz window on the end of the UV Sensor have been coated by minerals or other contaminants in the water and need to be cleaned. YELLOW may also be a result of normal aging of the lamp which has been designed for replacement every 12 months.

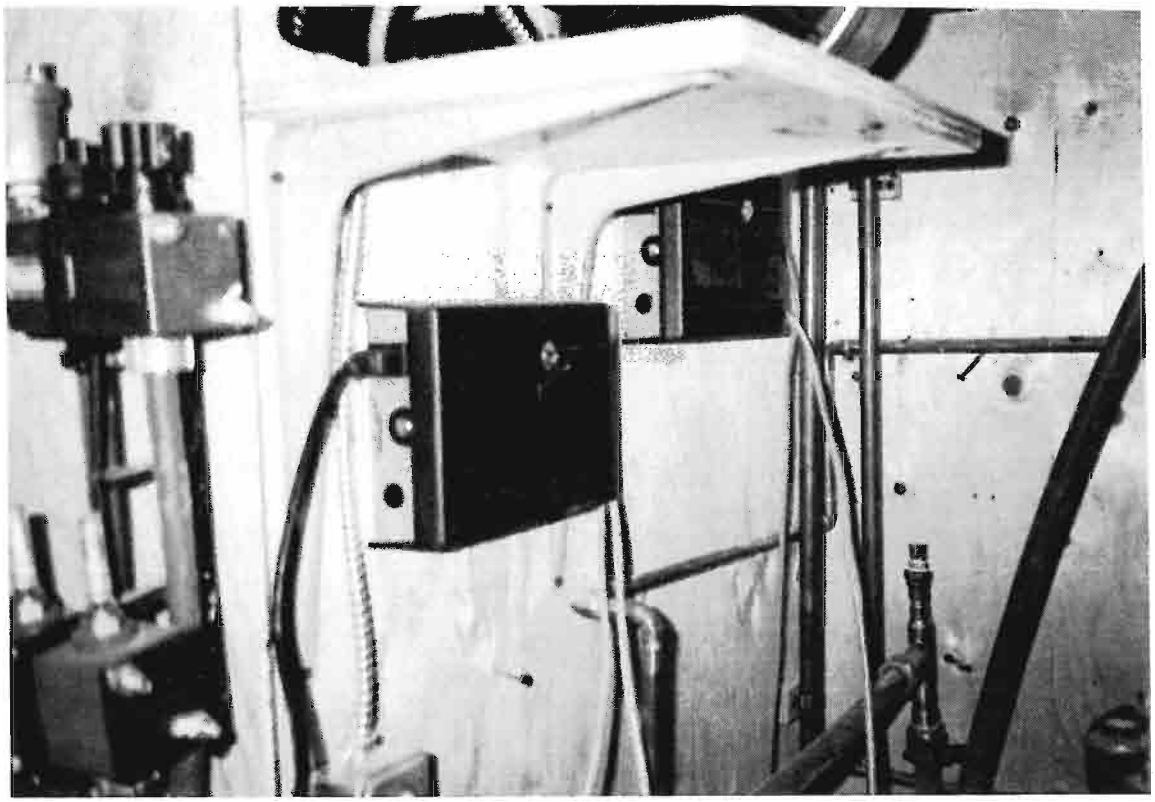

PHOTO 2-5 UV STERILIZER CONTROL BOXES

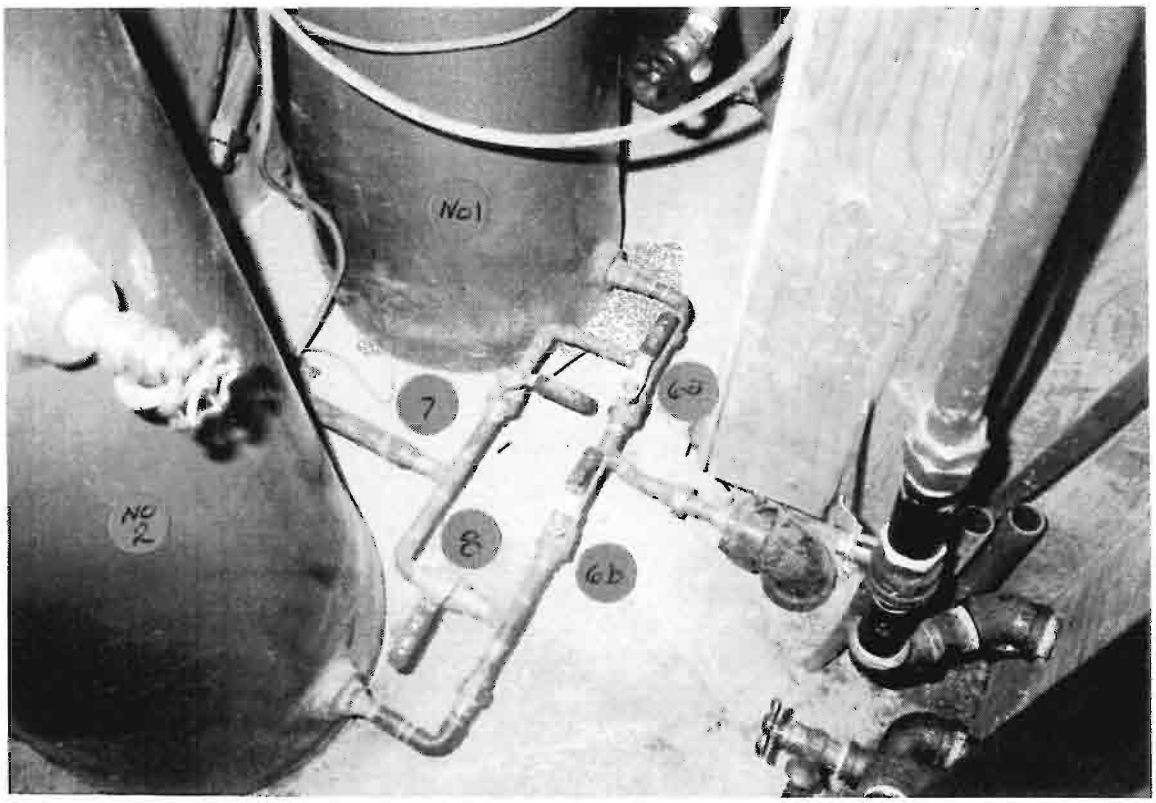


PHOTO 2-6 RENOVATED WATER UNIT INLET PIPING

An additional alarm condition is for the light to glow YELLOW while the alarm buzzes. This indicates problems with the wiring from the UV Sensor to the electrical sub-assembly. If the monitor glows RED and the alarm buzzes, it means that the ultraviolet light intensity is too low and that corrective action is required (See Section 3.4).

### 2.1.4 Potable Water Storage, Supply Pump and Hot Water Tank

When full, the 600 L (130 gal) tank located under the floor in the basement solarium/office beside the end wall next to the filters provides five days of storage (Photo 1-11). This is based on the expected average potable water use of 120 L (26 gal) per day.

Only periodically should it be necessary to access the reservoir. This would be to check the water level, to test for any buildup of solids, and to collect samples.

The potable water distribution pump is supplied by Grundfos Pumps Corporation. It is a complete pumping system with pump, diaphragm tank and frequency control all integrated into one compact unit (Photo 1-12). The precharge pressure of the diaphram tank should, however, be checked every six months.

The JetpaQ has a built-in pressure sensor which signals the pump to deliver the desired capacity at the right pressure. Built-in dry-run protection, motor overload protection, automatic reset, and soft start make the pumping system virtually maintenance free.

The JetpaQ has an automatic stop function which will stop the pump when one of the following faults occurs:

- The pump is running dry and not being cooled properly.
- There is over voltage or under voltage.
- The pump motor and frequency converter are over loaded and continue to be over loaded even after the pump reduces its performance.

After 12 restarts have failed, the pump will need to be switched off briefly and back on to reset the pump. The automatic pump stop sequence is automatically reset when the pump has been operating normally for one hour without any faults.

Instructions on priming the pump for the first time, adjusting the discharge pressure, and adjusting the precharge pressure are given in Section 3.5.

The 150 L (33 gal) potable hot water tank is located under the counter in the second floor bathroom. The input of heat from the solar panels into the hot water tank is controlled by an immersion thermostat. These automatic controls are set at the factory to maintain a water temperature of 49°C (120°F).

A periodic inspection of the operating controls, heat exchanger and wiring should be made by qualified service personnel. The temperature of the water should be tested periodically at the unit's faucet to be sure the thermostat is working properly.

## 2.2 Wastewater Treatment System

The combined greywater (sinks, dishwasher, clotheswasher, shower and bath) and blackwater (toilets) are treated in the septic tank and the Waterloo Biofilter™ before being discharged to the renovated water treatment system; to the recirculation tank; or to the gravel pack for final, ground disposal. Operation and maintenance of these components are discussed in some detail in the following sections.

### 2.2.1 Septic Tank

Access to the two-compartment septic tank buried beneath the car-port is by two, round, steel covers (Photo 1-6 and Photo 1-16). The tank should be pumped out every 3 to 5 years as required. This is to remove the accumulated surface scum and digested bottom solids. To maintain uninterrupted loading of the Waterloo Biofilter™, it will be necessary to replace with clean water whatever volume of septage is removed at the time of clean out.

The tank effluent pipe accessible from the cover closer to the street is equipped with a biotube filter. The biotube filter requires checking at least yearly and cleaned if necessary as explained in more detail in Section 3.2.

**There is no oxygen in a septic tank. Septic tanks are anaerobic digesters producing methane and ammonia which easily over whelm a person. Entering a septic tank can result in death and is best left to an experienced tank hauler.**

### 2.2.2 Recirculation Tank and Waterloo Biofilter™ Feed Pump

The septic tank effluent and biofilter effluent for recycle both discharge into the recirculation tank. The recirculation tank contains

a submersible pump with float controls housed in a screened pump vault.

Operation of the pump is controlled by means of float levels in the recirculation chamber and an electrical panel with programmable timer supplied by Orenco Systems Inc., Sutherlin, Oregon (Photo 1-21). Initially the pump has been set to operate for 30 seconds every 30 minutes 24 hours a day.

The panel has been installed by and must be serviced by a qualified electrician. Neither the pump nor any electrical wiring in the pump vault should be serviced without first disconnecting the power at the circuit breaker and fuse.

The pumping system should be inspected at least annually. If the liquid inside the screened pump vault is discernably different from the outside of the vault when the pump is running, the screen is being blinded and needs to be serviced. The procedures for removing the vault and cleaning the screen are described in Section 3.3.

The amount of recycle and Waterloo Biofilter™ effluent wasted to the ground disposal gravel pack are also controlled at the recirculation tank. This is done by a combination of the effluent pump operating level and the length of the sealed empty pipe weighting the floating ball in the down pipe (Photo 1-20 left).

When the ball is up in the fitting (seen at liquid level in Photo 1-20), the bottom leg of the "T" is flooded. The effluent from the Waterloo Biofilter™ flowing in the horizontal pipe from the bottom left passes the flooded "T" fitting and discharges beyond the tank wall to the ground disposal pack. In this manner, high liquid levels in the recirculation tank result in waste discharge to the gravel pack. The set recycle ratio ranges between 3:1 and 5:1.

### 2.2.3 Waterloo Biofilter™

The biofilter (Photo 1-21) consists of five cells filled with foam cubes. Microorganisms on and in the foam degrade the wastewater constituents. The wastewater is collected in the bottom tray of the stainless steel housing and discharges out the bottom drain (Photo 1-23).

The biofilter medium will compact with time with the weight of water. The upper media contained in removal baskets will eventually (perhaps after five years) require cleaning and/or replacement.

The distribution nozzles which spray at a 150° angle to cover the top of the filter need to be checked periodically to ensure that no plugging has occurred (Photo 1-22). The nozzles can be removed by uncoupling the pipes and removing the whole nozzle and distribution assembly.

The biofilter cells are aerobic. Air from the house HRV unit enters at the top of the filter cabinet and flows concurrent with the flow downwards to the bottom drain pipe. Air is vented to the building plumbing stack through the pipe exiting the cabinet above liquid level.

For safety when maintaining the filter, first manually shut off the effluent pump. Even though the filter is vented, there is possibility of some carbon dioxide ($CO_2$) build up as it is a by-product of aerobic oxidation. After opening the cabinet door wait a few minutes for any $CO_2$ to dissipate before getting close to the biofilter.

### 2.2.4 Wastewater Ground Disposal

The wastewater (treated biofilter effluent) ground disposal gravel pack is out of sight under the front patio (Photo 1-2) 1.2 m (4 ft) into the ground. (Section 8.4, Part 1). It should function passively without any intervention.

There are two conditions which could cause problems. To prevent compaction of the gravel and underlying native soil, heavy equipment should be kept off the front patiio.

Occupants should be on the watch for any signs of surface ponding as a result of the gravel pack flooding due to excessive groundwater infiltration. High liquid levels in the gravel pack may cause water to flow back into the recirculation tank where it will be detected by the top alarm float.

## 2.3 Renovated Water System

The components of the renovated water system are similar to the potable water system except that there are two combined slow sand filter/activated

carbon adsortion units (grey). Operating procedures for the dual filters are given in this Section. (Refer to Section 2.1 for operation of the UV sterilizer and renovated water distribution system. The equipment is identical).

Biofilter effluent to be renovated for reuse in the house flows by syphon directly downwards (Photo 1-23) under the basement floor to the filter units (Photo 2-6). The dual filters are operated in parallel during normal filtering. When it is time to backwash, one unit is kept in service while the other is backwashed.

Normal filtering and backwash operations are controlled by valves as shown in Photo 2-1, 2-4 and 2-5.

| Photo | Valve No. | Function |
|---|---|---|
| 2-5 | 6a, 6b | Open - Biofilter effluent to bottom of filters during normal filtering<br>Closed - 6a or 6b during backwash of respective filter |
| | 7, 8 | Closed - During normal filtering<br>Open - 7 or 8 during backwash of respective filter |
| 2-1 | 9 | Open - Treated effluent from Filter No 1 to flow regulator<br>Closed - During backwash of Filter No 1 |
| 2-1<br>2-4 | 10 | Open - Treated effluent from Filter No. 2 to flow regulator<br>Closed - during backwash of Filter No. 2 |
| 2-4 | 11 | Open - Treated effluent from Filter No. 1 to reservoir<br>Closed - during backwash of Filter No. 1 |
| | 12 | Closed - During normal filtering and backwashing of Filter No. 1<br>Open - Freshly filtered water from No. 1 after backwash to waste |

| Photo | Valve No. | Function |
|---|---|---|
| | 13 | Open - Treated water from Filter No. 2 to reservoir |
| | | Closed - During backwash of Filter No. 2 |
| | 14 | Closed - During normal filtering and backwashing of No. 2 |
| | | Open - During backwash of Filter No. 1 |
| | 16 | Closed - During normal filtering through Filter No. 2 and wasting after backwash |
| | | Open - During backwash of Filter No. 2 |

The frequency of backwashing is to be established by experience after start up (Section 2.1.2). Similarly, the length of the backwash will be determined after the system is operational. Further, the need to clean and/or replace activated carbon and sand filter media will also be determined from experience.

The elevation of the renovated water filter units effluent piping is above the liquid level in the discharge piping system from the biofilter. Discharge from the renovated water filters relies on a syphoning action through them. Any accumulated air should be released through the air relief valves on the discharge piping above the filters.

## 3.0 EQUIPMENT OPERATION AND MAINTENANCE

### 3.1 Introduction

The principal suppliers of equipment for the Toronto Healthy Houses Water Systems are given in Appendix 2-B. Installation was by Rolf Paloheimo, Creative Communities Research Inc. and Bert Hoerner and Son, Plumbing and Heating.

This Section of the Commissioning Guide provides useful, general information on the operation and maintenance of ancillary equipment. It has been prepared from the operation and maintenance manuals provided by the equipment suppliers themselves.

For more detailed instructions and procedures it is necessary to consult the manuals which are available at each Toronto Healthy House. Some equipment servicing is to be done only by qualified professionals and equipment representatives and should not be under taken by the homeowner.

## 3.2 Septic Tank Effluent Filter

The septic tanks serving the Toronto Healthy Houses are equipped with an Biotube effluent filter manufactured by Orenco Systems Incorporated, Sutherlin, Oregon (Photo 1-17).

The biotube effluent filter is suspended in the septic tank, supported by the 100 mm (4 in ) outlet pipe. The assembly is composed of a body that is attached to the discharge pipe and a removable cartridge that consists of the biotube screen unit, access handle, and vent.

The filter should be inspected at least yearly to ensure that it is functioning properly. A natural biological growth will occur on the filter. This growth should not be removed unless clogging sufficiently impairs the discharge rate. Like the Schmutzduke that forms on the surface of slow sand filters, the biological growth helps to trap suspended solids and remove organics from the septic tank effluent.

To clean the filter it must first be removed out of its vault by using the handle provided. The cartridge tubes should then be sprayed with a hose to remove any material sticking to them. Then spray the modulating orifices clear of any debris. The next step is to ensure that the red plugs are secure at the base of the cartridge and that the vent holes are clear. Direct all the rinse water back into the septic tank. The final step is to replace the cartridge.

## 3.3 Recirculation Tank Equipment and Waterloo Feed Pump Controls

The recirculation chamber contains a submersible pump housed in a screened pump vault for feeding wastewater to the Waterloo filter. It is a 250 Watt (1/3 HP) high-head stainless steel effluent pump model EF33 manufactured by Grundfos Pumps Corp., Clovis, California.

There are three floats. The top float activates the high-level alarm. The middle float activates the pump when the water level is high enough by being in the up position. In the bottom position it shuts off the pump when the water level is low enough. Within the normal on-off range of this float the pump can be operated independently by a timer located in the electrical panel. The bottom float is a reversed R switch ("on" in the "down" position). It turns off the pump and turns on the low level alarm when in the "down" position. This redundant off-switch protects the pump should the middle float malfunction.

The float switch assembly is mounted in the screened pump vault of the recirculation tank. The assembly is detachable without removal of the pump vault or effluent screen. If any float interferes with another, the float may be adjusted by loosening the stainless steel set screw provided in the float collar. The float stem should not be lengthened nor the float tether lengths be altered.

Plugging of the screen should be considered a good thing as the screen serves to protect the integrity of the treatment system downstream from solids carry over. For cleaning, slowly lift the screened vault out of the tank allowing the effluent in the vault to empty out the drain flap while minimizing tank disturbances. Slide the screen out of the vault and hold it over the tank opening carefully directing the buildup that has formed on the screen back into the tank. To prevent the vault from floating and the screen from being fouled by solids floating in the tank, run clear water from a hose into the vault to sink it.

The timer in the control box is programmed with an "off" dial and an "on" dial, each of which range from 0 to 10. The "off" dial is set for one hour at "10" and for 30 minutes at "5", for example. The "on" dial is set for one minute at "10" and for 30 seconds at "5" for pump dose durations.

The operating Manual provided with the pump provides a troubleshooting guide. The guide is included here for reference as Table 2-1- Troubleshooting The Effluent Pump System.

TABLE 2-1 TROUBLESHOOTING THE EFFLUENT PUMP SYSTEM

| | Problem | Possible Cause and Remedy |
|---|---|---|
| 1.0 | The pump does not run or start when water is up in tank. | 1. Check for blown fuse or tripped circuit breaker.<br>2. Check for defective level switch. |

| | |
|---|---|
| | 3. Level or control ball mechanism may be stuck inside basin.<br>4. Check to make sure pump is set at control panel for automatic operation.<br>5. Check strainer housing and discharge pipe for clogging. |
| 2.0 Pump runs but does not deliver expected flow. | 1. Check strainer housing and discharge pipe for clogging.<br>2. Check for air lock by starting and stopping several times.<br>3. Make sure discharge valve is fully open.<br>4. Insure check valve is installed properly.<br>5. Check for correct voltage. |
| 3.0 Pump will not shut off. | 1. Defective or stuck float switch. Check to make sure it is not mechanically bound to the sides of the basin.<br>2. Then check for out of adjustment. |
| 4.0 Pump starts and stops too often. | 1. Float switch set too "tight".<br>2. Check valve is stuck.<br>3. Sump pit is too small.<br>4. Overload is tripping in hot motor. Pump may be clogged or fluid too low. |

3.4 Trojan Aqua UV Water Sterilizer

Both the potable water and renovated water are disinfected using separate Advantage 5/8/12 plus water sterilizers. Unless a situation is encountered that is explicitly addressed by the provided Owners Manual, repairs should only be made by an authorized service provider.

The Owner's Manual provides guidelines for recognizing situations and solving problems that may occur during normal operations. The Troubleshooting Guide is reproduced from the Owner's Manual in Table 2-2.

Cleaning of the ultraviolet lamp/sleeve referred to in the Guide first requires its removal from the reactor chamber in accordance with the given instructions. Cleaning itself is achieved by the use of a commercial scale remover (such as Lime-Away or CLR). Vinegar and isopropyl alcohol are not recommended because they can leave behind a residue that can block the ultraviolet rays.

## TROUBLESHOOTING OF THE ADVANTAGE 5/8/12 PLUS WATER STERILIZERS

Table 2-2

Note the following guidelines are offered as suggestions for recognizing situations and solving problems that may be detected during normal operation. Read through the instructions before taking action. If the symptoms described do not relate to the problem or if the suggested corrective actions are ineffective contact your dealer or installer.

| | PROBLEM | PROBABLE CAUSES | POSSIBLE SOLUTIONS |
|---|---|---|---|
| 1 | Monitor light does not glow, the alarm does not buzz. | Sterilizer is unplugged. | Plug sterilizer into AC power outlet. |
| | | No power at AC outlet. | Replace fuse or reset breaker. |
| | | Power supply cord damaged. | Replace power supply cord. |
| | | Power surge caused damage to Electrical Sub-Assembly. | Contact installer/dealer for repair or service. Install surge protector. |
| 2 | Monitor light glows RED and the alarm buzzes. | Lamp/Sleeve not operating because of burnout, damage to electrical pins, or general damage. | Replace Lamp/Sleeve. Follow instructions in Lamp/Sleeve Cleaning and Replacement section. |
| | | Lamp/Sleeve not operating because Lamp Harness not connected properly. | Inspect Lamp Harness and reconnect. |
| | | Lamp/Sleeve has operated beyond useful design life. Design life is 12 months of continuous usage. | Replace Lamp/Sleeve. Follow instructions in "Replacement of the Ultraviolet Lamp/Sleeve" section |
| | | Outer glass sleeve of Lamp/Sleeve has a coating on it. | Coating must be removed for correct operation. Follow procedure in "Cleaning of the Ultraviolet Lamp/Sleeve" section. |
| | | The UV Sensor quartz window is coated with unfiltered water contaminants or minerals. | Any coating must be removed for correct operation. Follow procedure in "Cleaning of the UV Sensor" section. |
| 3 | Monitor light changes from GREEN to YELLOW. | Detected ultraviolet intensity level has been reduced by coating on the Lamp/Sleeve, coating on the UV Sensor, and by aging of the lamp as it operates continually. | Refer to above solutions for each of these possible causes Note that deterioration of the ultraviolet intensity level is progressive. If no action is taken, a full alarm condition will occur soon after |
| 4 | Monitor light case glows RED and the alarm buzzes occasionally when water is not being used (such as at night or after vacation). | The temperature monitor on the side of reactor chamber has come loose from the securing clip, or has slipped free of the clear plastic holder under the clip. (Confirm this is the cause by running water through the sterilizer - the alarm should go silent.) | Inspect the temperature monitor position. If loose, re-attach securely under the retaining clip. If the temperature monitor has come out of the clear plastic holder under the clip, secure it back into place. |
| 5 | Monitor light glows YELLOW and the alarm buzzes. | Caused by damage or pinching of the electrical cord between the UV Sensor and the electrical sub-assembly. | Inspect the electrical cord for pinching or damage such as a cut or tear in the cord protective jacket. |
| 6 | Fuse keeps blowing or breaker keeps tripping | Lamp Harness is wet. | Clean and dry the Lamp Harness. Check the sterilizer for leaks |
| | | Short circuit in electrical assembly | Contact dealer or installer for repair/service |
| 7 | Leak at inlet/outlet. | Threaded metal pipe fittings are leaking. | Clean threads, reseal with Teflon tape and tighten. |
| | | Adaptor kit not tight. | Check sealing rings and washers. |

If the lamp/sleeve requires cleaning, the UV Sensor probe will likely require cleaning as well using commercial de-scaler and lint-free wipes after its removal. The UV Sensor is fragile and must be handled carefully. Care must also be taken not to pull on the attached cord.

**The light given off by the ultraviolet lamp/sleeve can cause serious burns to unprotected eyes and skin. One should never look at the lamp/sleeve when it is operating. Do not plug the unit into an electrical outlet without having the lamp/sleeve properly secured into the stainless steel reactor chamber.**

All Aqua UV Advantage structural, hardware and electrical systems are guaranteed to be free of material defects for five years on a pro-rated basis. Lamps and sensor probes are guaranteed to be free of material defects for one year. The warranty will be void if the product is altered or misused in any way.

3.5 Potable Water and Renovated Water Distribution Pumps

The Toronto Healthy Houses are equipped with JQ2 model JetPaQ pumping units having a maximum power consumption of 730 watts. Each unit is 457 mm (18 in) long overall, 146 mm (5-3/4 in) wide and 286 mm (11- 1/4 in) high.

The maximum working pressure is 6.3 kg/sq. cm (90 psi) with a maximum inlet pressure of 4.6 kg/sq. cm (65 psi). The preset factory default pressures are 2.1 kg/sq. cm (30 psi) for the diaphragm tank and 3.0 kg/sq. cm (43 psi) for the discharge pressure.

When starting the pump for the first time, it must be primed as it is drawing water from the storage tank below. All of the air in the suction pipe must be expelled before the discharge pressure becomes constant corresponding to the preset valve.

If the pump flow is less than 3.4 L/M (0.75 gal/m) the pump will start and stop itself intermittently to maintain the constant pressure that has been specified. If the water consumption exceeds the pump's ability to deliver that flow, the pump will not be able to meet the pre-set discharge pressure. When the water usage drops to a level that the pump can deliver, the pump will change back to normal operation and once again deliver the required pre-set discharge pressure.

If the discharge pressure at the tap at the highest location in the piping system is unsatisfactory, it should be adjusted. However, it is recommended not to set the pressure higher than necessary to minimize power consumption.

The pressure is adjusted by removing the motor cover and changing the coding switches. The procedure for accomplishing this is given on page 10 and page 11 of the Operating Instructions supplied by Grundfos.

To ensure satisfactory pump operation, the tank precharge pressure must also be changed. To do this requires a pressure gauge and an ordinary hand or foot airpump. The procedure to be followed is given on page 11 of the Operating Instructions.

If the pump experiences occasional pressure loss during on/off control, the setting of the tank pre-charge pressure is too high in relation to the discharge pressure. If the pump is running constantly, the pressure of the diaphragm tank is too low or too high. Other operating problems can be identified from Troubleshooting Guide (Table 2-3) as contained in the Operating Manual.

Troubleshooting

| Problem | Possible Cause | Remedy |
|---|---|---|
| The pump does not start | A. Overheating due to insufficient water at the pump suction port (dry-running).<br>B. Overheating due to excessive liquid temperature (above + 104°F).<br>C. Overheating due to blocked pump.<br>D. Too low or too high supply voltage.<br>E. No electrical power to the pump.<br>F. The discharge pressure is higher than the pre-set value. | • Disconnect the pump from the power supply Check the water supply/suction pipe for blockage, leaking, or non-submergence (out of the water).<br>• Supply cold liquid to the pump.<br>• Contact the pump supplier/dealer.<br>• Check the supply voltage and correct the fault, if possible.<br>• Check fuses before the pump and/or connect the pump to the power supply.<br>• Turn on a tap. With all taps closed the tank pressure should be 7% higher than the pre-set value. |
| The pump does not stop | A. Air pockets in the pipe between non-return valve and pump<br>B. The suction pipe is too elastic.<br>C. The inlet pressure is too low in relation to the pre-set discharge pressure.<br>D. The tank pre-charge pressure is too high or too low.<br>E. The system piping is defective or leaking.<br>F. A check valve is fitted in the discharge port (the pump gives no water). | • Disconnect the pump from the power supply Vent or prime the suction pipe.<br>• Fit a non-return valve in the pump suction port.<br>• Bring the operating conditions into accordance with the table on page 10.<br>• Adjust the pressure, as explained on pages 10-11.<br>• Repair or replace the piping.<br>• Interchange the suction and discharge adapters or remove the check valve from the discharge of the pump. |
| The pump cuts out during operation | A. Overheating due to insufficient water at the pump suction port (dry-running).<br>B. Overheating due to excessive liquid temperature (above + 40°C).<br>C. Overheating due to blocked pump.<br>D. Too low or too high supply voltage.<br>E. The discharge pressure has fallen below 7 psi (dry-running or defective discharge pipe). | • Check the water supply/suction pipe for blockage.<br>• Supply cold liquid to the pump.<br>• Contact the pump supplier/dealer<br>• Check the supply voltage and correct the fault, if possible.<br>• Check the water supply/suction pipe or the system piping. |
| The pressure varies too much | A. Leakage in suction pipe or air in the water<br>B. The inlet pressure varies more than 0.73 psi per second.<br>C. The pump is defective. | • Check the water supply/suction pipe for blockage.<br>• Make a reservoir to supply the pump with water<br>• Contact the pump supplier/dealer |
| The pump does not change to frequency converter operation | A. The pressure boosting is lower than 10 psi.<br>B. The water consumption is lower than 0.9 GPM. | • Set a higher discharge pressure, as explained on pages 10-11.<br>• Increase the water consumption. |
| The pump gives electric shocks | A. Defective ground connection. | • Connect the ground connection to the pump in accordance with local regulations. |

Table 2-3 TROUBLESHOOTING THE JETPAQS

If the pump does not start when the fault has been corrected, it is defective and should be repaired or replaced. For further information, please contact GRUNDFOS.

# PART 2 APPENDICES

Page

# APPENDIX 2-A

## PHOTOGRAPHS OF WATER SYSTEM COMPONENTS

Page

# APPENDIX 2-B

## PRINCIPAL SUPPLIERS OF EQUIPMENT FOR THE TORONTO HEALTHY HOUSES WATER SYSTEMS

### Concrete Water Storage and Septic Tanks

Wilkinson Heavy Precast Ltd.
588 Highway No. 5
Dundas, ON, L9H 5E2
Tel. (905)628-5611 Fax (905)628-9292

### Combined Slow Sand and Activated Carbon Filters

RAL Engineering Ltd.
482 Queen Street, East
Newmarket, ON, L3Y 2H4
Tel. (905)853-0626 Fax (905)853-8807

### Septic Tank Effluent Filters<br>Screened Sewage Pump Vaults<br>Float Switch Assemblies<br>Effluent Pump Control Panels

Orenco Systems Inc.
814 Airway Avenue
Suthern, Oregon 97479-9012
Tel. (541)459-449 Fax (541)459-2884

### Waterloo Biofilter

Waterloo Biofilter Systems Inc.
2 Taggart Court, Unit 4
Guelph, ON N1H 6H8
Tel. (519)836-3380 Fax (519)836-3381

### Ultraviolet Light Disinfection

Trojan Technologies Inc.
845 Consortium Court
London, ON, N6E 2S8
Tel. (519)685-6660 Fax (519)681-8355

Service Pumps

Grundfos Pumps Corp.
2555 Clovis Avenue
Clovis, CA 93612

Grundfos Canada Inc.
5647 McAdam Road
Mississauga, ON L4Z 1N9
Tel. (800)644-9599 Fax (800)265-9862

# COMMISSIONING GUIDE

# PART 3

# TORONTO HEALTHY HOUSES
# OCCUPANTS GUIDELINES

CMHC CR File No. 6740-5

Prepared by:

A.R. Townshend, P. Eng.,
Blue Heron Environmental Technology
R.R.#1
Athens, Ontario K0E 1B0
(613)924-9575

December 17, 1996

# SYNOPSIS

Of necessity, residents will be involved in using water conservation devices and in ensuring high quality water treatment. Monitoring and undertaking some system operation and maintenance along with professional support will become part of the lifestyle adjustment required to live in self-sufficient, sustainable housing such as the Toronto Healthy Houses.

Part Three of the Commissioning Guide offers occupants guidelines on water use, biological treatment systems, drinking water safety and protecting the water treatment systems from abuse. Included are suggestions for conserving water and instructions for making and using homemade cleaners.

PART 3
TORONTO HEALTHY HOUSES
OCCUPANT GUIDELINES

Page



PHOTOGRAPHS

# PART 3.0
# TORONTO HEALTHY HOUSES
# OCCUPANT GUIDELINES

## 1.0 INTRODUCTION

This part of the Commissioning Guide provides assistance the occupants of the Toronto Healthy Houses (Photo 3-1) during the start-up and demonstration period with respect to water use and protection of the biological water treatment systems from user abuse. The aim is to provide pertinent information on lifestyles appropriate for living with self-sufficient potable and reclaimed water systems.

Both the potable water and renovated water treatment systems rely on beneficial living microorganisms to attain required water quality. Moderate use of household commercial cleaners, disinfectants, and solvents should not interfere with the operation of the treatment systems. However, indiscriminate use could cause problems by killing the necessary microorganisms in the treatment units. To avoid this from occurring in the Toronto Healthy Houses systems, these guidelines advocate that such potentially damaging commercial products not be used in the Toronto Healthy Houses.

When required to make fundamental changes in lifestyle, the best approach is to start with small changes that have a good chance for success. Changes in wasteful attitudes and behavioral practices combined with knowledge of simple water conservation hints, and an awareness of the need for water conservation, can in themselves produce a significant reduction in total water demand. In making the transition using non-toxic compounds occupants should resolve that concern for good health and well being is strong enough to change habits and procedures.

PHOTO 3-1 TORONTO HEALTHY HOUSES EXTERIOR

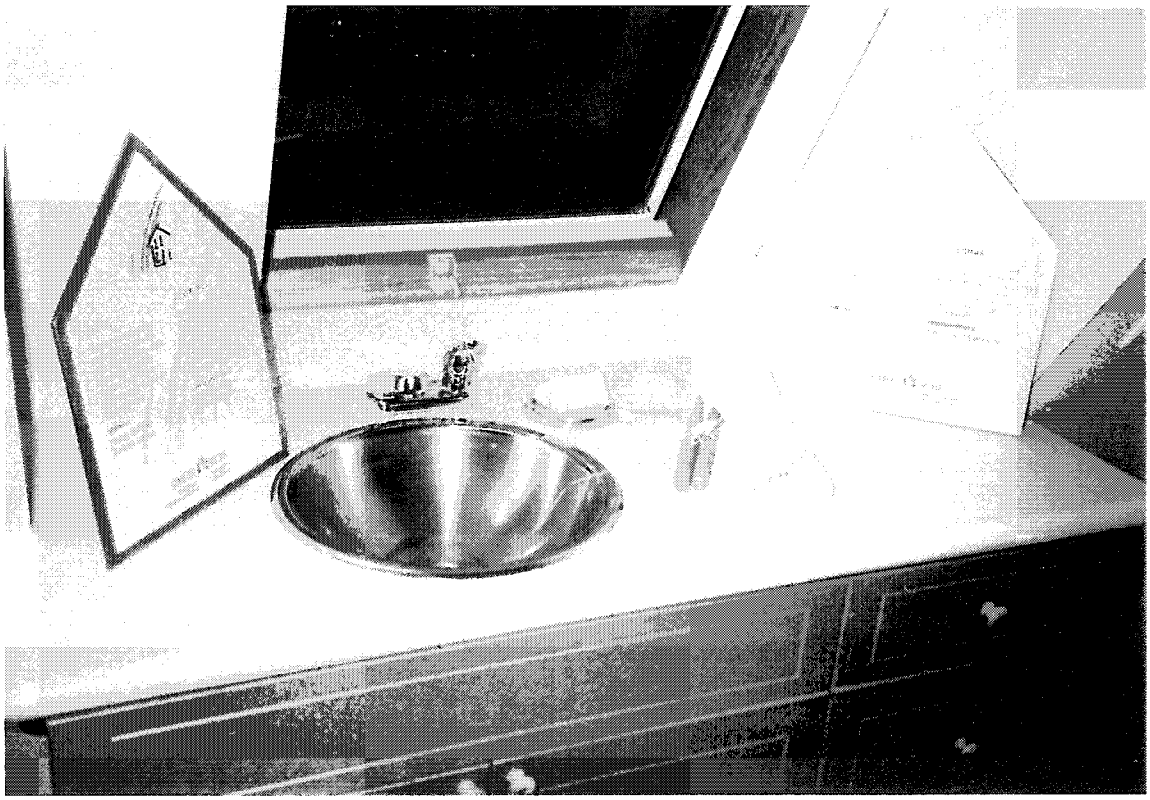

PHOTO 3-2 WATER CONSERVATION FIXTURES

## 2.0 WATER USE

For the general population the desire for water conservation may be philosophical and/or economically based. For occupants of the Toronto Healthy Houses good water conservation practices are essential for successful living. They will need to adjust their present water use and appliance practices to the water conservation devices they find in the houses and to the reality of a limited water supply (Photo 3-2).

Many people believe the changes involved with water conservation will somehow diminish their life-style. Conserving water is easy and painless when the need for it is fully understood. Water conservation reduces the total and peak hydraulic demands on the Healthy Houses potable water and reclaimed water systems. Reduced hot water consumption also means lower energy requirements.

For the Toronto Healthy Houses the amount of potable water available is limited to what is collected from the roof and garden catchment areas during periods of precipitation and the ability of the 20 cubic meter (4,400 gallon) cisterns to meet the water demand between precipitation events. The design average daily potable water use for each house based on four occupants is 120 L pd (26 gpd) and a reclaimed water use of 600 L pd (132 gpd). This is about one half the Canadian household average.

Residents need to become familiar with how the potable water and wastewater treatment systems function and the way they look, sound, and smell when they are working correctly. With this knowledge and experience, residents should be able to identify problems before they become serious. Any leaky faucets, toilets or piping should be repaired. If unable to correct a problem, the service provider should be called. Further instruction and advice should be sought from the service provider on proper operation, maintenance and troubleshooting.

### 2.1 Fixtures and Appliances

The Toronto Healthy Houses are equipped with water conserving 6 Litre flush toilets, showerheads and faucets. Conventional showerheads use between 15 and 30 litres of water every minute. Water conserving showerheads are designed to have a maximum flow rate of 9.5 litres per minute.

The houses are equipped with front-loading clothes washers which use about one third less water than conventional top-loaders. The supplied European dishwashers use about forty percent less water than North American dishwashers.

## 2.2 Water Conservation Practices

Small changes in water use habits both indoors and out doors will help to keep water consumption within the available supply. Outdoor conservation activities usually will require more time and involvement.

The following suggestions are easy to do and call for no sacrifice. An adjustment period should be expected for these conservation practices to become second nature.

### 2.2.1 Indoors

- Always turn off taps so they do not drip.
- Do not let taps run continuously while washing dishes, rinsing fruits, and vegetables, brushing your teeth or shaving. To rinse, use a partially filled sink.
- Keep a bottle of potable water in the refrigerator for cold drinking water. Rinse the container and change the water every few days.
- When boiling vegetables, use only enough water to cover them, and use a tight fitting lid. Steaming uses even less water while conserving more nutrients.
- For the automatic dishwasher, wash only full loads. Use the energy server or shortest cycle settings.
- Similarly, for the automatic clothes washer run only when there are full loads. Learn to postpone some loads until there is enough for a full load. Try to spread clothes washing over several days.
- Take short showers - five minutes or less.
- When bathing do not overfill the tub.

### 2.2 Outdoors

- Use a broom to clean off the driveway (carport), walkways and the ground water collection patios.
- Mulch around the base of trees, shrubs, and plants to reduce water loss from evaporation while retarding weed growth.
- Adjust sprinkler times and duration according to the demands of different seasons and weather conditions.
- Use a sprinkler that delivers large flat droplets. For trees and bushes use prolonged drip irrigation so water reaches deep down to their roots.
- Dethatch or aerate lawn areas annually to allow water to penetrate down to the roots.

- Mow lawn areas frequently cutting less than 25 mm (10 in) of grass each time. Maintain the height of grass at 50 to 64 mm (2 to 2.5 in) for better root structure.
- For car washing use a bucket and sponge. For rinsing use a trigger nozzle on the hose.

## 3.0 BIOLOGICAL TREATMENT SYSTEMS

The Toronto Healthy Houses potable water treatment and renovated water systems both use biological filtration processes to break down organic matter and reduce the number of pathogenic organisms. The renovated water system also incorporates a septic tank ahead of the filters for solids removal and some organic reduction.

The vertical circular filters combine slow sand filtration and activated carbon treatment. The slow sand filter removes turbidity, breaks down organic matter and reduces the number of pathogenic organisms. The granular activated carbon is used to remove by adsorption organic compounds including colour not in particle form.

The sand bed develops a surface layer of biologically active microorganisms called "schmutzdecke". Schmutzdecke is a sticky mat of microorganisms cultivated on the fine sand surface of the slow sand filter. It serves to remove turbidity without the addition of chemicals. For a schmutzdecke to form flow rates must be kept very low. If a slow sand filter clogs, it will slow down and eventually stop filtering water. It is less likely to foul the water system with a break through of microorganisms or chemicals than a conventional filter system.

## 4.0 DRINKING WATER SAFETY

If at any time there is any doubt about the safety of the potable water, the ultra-violet light disinfection unit is suspect or the turbidity of the water is excessive, boil it!

Occupants can protect themselves against microbial disease causing agents that may be present by boiling. Bacteria in water can be destroyed by heating to a rolling boil for three minutes. Allow the water to cool before consumption. Such boiled water may have a flat taste as the gases dissolved in the water are driven out. The taste can be restored by pouring the water back and forth from one clean container to another or by letting the water sit covered for a few hours.

All major waterborne bacterial pathogens are inactivated by bringing water to a rolling boil (100°C) for one minute. Bacterial spores that are highly heat-resistant are know to exist, but they are not known to cause waterborne disease.

Just seconds of contact with boiling water at 100°C kills waterborne protozoa. Cryptosporidium and Giardia lamblia, which are resistant to chlorination and require filtration treatment, are killed by boiling .

The hepatitis A virus which is considered one of the most heat-resistant viruses is also rendered noninfectious after one minute of boiling water. Therefore, boiling water for three minutes provides additional time to inactivate any other waterborne viruses that may be present.

## 5.0 PROTECTING THE WATER SYSTEMS FROM OCCUPANT ABUSE

### 5.1 General

A surprising number of chemical products used in the house and garden are toxic. These include household cleaners, household hazardous chemicals, herbicides and pesticides. It is imperative that none of these products in sufficient quantity enter the Toronto Healthy Houses wastewater treatment systems to adversely affect the microorganisms upon which they depend. These chemical products are discussed in separate sub sections.

Guidelines on other items of concern follow:

- As many kitchen wastes as possible should be directed to a composter or to the garbage rather than being ground or otherwise washed down the kitchen sink. ie coffee grounds, tea leaves and eggshells. While vegetable, fruit, meat and fish scraps are biodegradable, they will add to the solids build-up in the septic tank. The amount of grease, fat, and oil washed off dishes or discharged directly down the drain should be minimized by pouring the liquid into a waste container (can or jar) and wiping the remainder off with a paper towel for disposal in the garbage.
- Non-biodegradable substances or objects such as cigarette butts, paper towels, disposable diapers, gauze bandages, dental floss, condoms or feminine products should also not be disposed of down any drains.
- Beauty aids and expired medicines are acceptable in normal amounts but again the safest course of action is not to put them in the sink or toilet.
- Only moderates amount of white toilet paper should be used. Toilet paper should break up easily in water. Some dyes used for toilet paper are difficult for bacteria to break down, but generally it is the composition of the paper that determines biodegradability. Biodegradability depends

on the different types of material added to the tissue to give it its properties such as wet strength and softness; not if it is thick or thin. NSF International has a test program for certifying the acceptability of toilet paper products. Consumers should look for the NSF registered mark on toilet paper packaging.

- Adding commercially available enhancers on start-up of the wastewater treatment units or on a regular basis should not be necessary. System users should not be misled by direct mail and telephone promotions. Chemical additives, which are primarily oxidizing agents, can damage concrete tanks and destroy soil structure beyond the ground disposal gravel pack disposal field. Biological additives, containing bacterial and enzymatic formulations, are designed to enhance biological activity resulting in improved effluent quality and reduced odours.

  Unless there has been a major killing of the microorganisms in a biological system treating domestic wastewater, there should be sufficient bacteria and enzymes naturally present without the need for additives. The following further guidance to the occupants of the Toronto Healthy Houses is to prevent such an occurance caused by the inadvertent addition of destructive chemicals.

## 5.2 Household Cleaners

Toilet, drain, and other commercial cleaning products that are used every day have significant health and environment impacts. Commercial dishwashing detergents contain surfactants, germicides, complex phosphates, and sodium nitrites which are extremely toxic. Commercial laundry detergent may contain toxic organic compounds such as sodium aluminosilicate. Commercial disinfectants may contain naphtha, chlorinated germicides, sodium hypochlorite, and sodium nitrite.

Specialized cleaners may contain chlorinated phosphates, chlorine bleach, ammonia, chlorinated phenols, and sodium acid oxalate. The last two are highly toxic being considered hazardous waste.

None of these products should be poured down the drain or thrown into regular trash. Occupants of the Toronto Healthy Houses should be careful in their use of standard commercially available cleaners, embrace newer environmentally safe products, and/or use homemade cleaners containing natural ingredients.

### 5.2.1 Using Commercial Cleaners

Commercial bleaches should be used sparingly. Bleach is a disinfectant which in sufficient quantity will kill the microorganisms in the wastewater/renovated water treatment units which effect much of the organic constituent removal that takes place. Only a small amount of diluted bleach should be discharged to the household drains at any one time to minimize upsetting the biological wastewater treatment processes taking place.

Laundry detergents contain phosphates which are not harmful in themselves, but are nutrients for microorganisms and plant life. Only a small amount of phosphate will be removed by the Toronto Healthy Houses wastewater treatment system. Commercial detergents may contain other persistent chemical agents which may build up their concentrations in the recycled renovated water system. These include NTA (nitro-tri-acetic acid) and EDTA (ethylene diamino-tetra-acetate) which are considered to be environmentally harmful.

Phosphate-free commercial laundry detergents are available from supermarkets under their house labels. Amway's Koolwash is a biodegradable, phosphate-free detergent for fine fabrics. The Soap Factory has a full line of environment-friendly products such as laundry soaps, dish detergents, automatic dishwasher powder, bathroom cleaners and all purpose cleaner.

Earthly Goods, at 372 Danforth Avenue, west of Chester Avenue immediately north of the Toronto Healthy Houses, has available Soap Factory, and other cleaners, made with readily bio-degradable ingredients. The store also carries an automatic dishwasher powder with all vegetable derived surfactants that is free of phosphates.

### 5.2.2 Using Homemade Cleaners

The basic cleaning agents that have served for generations provide all the sanitation needed to-day. Homemade cleaners can be substituted for almost all commercial products. They can be made from six major ingredients, all readily available in supermarkets or hardware stores.

Baking Soda (Bicarbonate of soda) is an effective mineral cleaning agent. It cleans, deodorizes, scours, polishes, removes stains and softens fabrics.

Borax is a mineral of natural origin consisting of water, oxygen, sodium, and boron. In large doses, borax is toxic if consumed orally. The lethal dose for a 150 pound person is between one ounce and one pound. Borax has antiseptic, antifungal, and antibacterial properties. It cleans, wallpaper, painted walls, and floors. It also deodorizes, and removes stains.

Washing Soda (Soda ash) is the mineral sodium carbonate. It is a very effective cleaner of grease, oil, dirt, and many petroleum products. It is moderately toxic so should be used with gloves in well-ventilated areas.

Vinegar is a liquid derived from the fermentation of fruits or grains. Its acid content makes it useful for cutting grease and dissolving mineral deposits. It removes mildew, stains, and wax build up.

Natural soaps contain lye and vegetable oil. They clean everything from dishes to cars.

Sodium percarbonate is a natural bleach alternative to chlorine made from washing soda and hydrogen peroxide. Sodium perborate is also a natural bleach alternative to chlorine made from borax and hydrogen peroxide.

Cleaning with these natural materials takes on the simplicity of making up appropriate cleaners from canisters of these natural materials that are available from supermarkets and hardware stores. With some adjustment, Toronto Healthy Houses occupants can utilize their own safe products.

Books and guides are available with home recipes using these ingredients for almost every conceivable cleaning chore: an example is "Clean and Green" by Annie Berthold-Bond published by Ceres Press, Woodstock, New York, 1990. By buying in bulk and following such recipes, safe cleaning products will cost pennies in comparison to the many dollars spent on highly advertised commercial products.

Some examples of environmentally friendly, inexpensive, do-it-yourself alternatives to commercial household cleaners are:

> Abrasive cleaner - Combine two parts borax and one part baking soda or washing soda. Store in a container with holes punched in the top to create a shaker and label it accordingly. Sprinkle on soiled surface and scrub with a damp cloth. Wipe dry.

Liquid cleaner - Stir to melt 15 ml of soap flakes, 30 ml of borax and 5 ml of lemon juice or white vinegar in 1 L of hot water. Apply to soiled surface and rinse.

Laundry soap - Mix 250 ml of soap flakes, 125 ml of washing soda, and 125 ml of borax. Store in a properly labelled container. Measure 125 ml of the mixture, and add to water in the washing machine before adding clothes. Rinse load in cold water. Add 125 ml to 250 ml of vinegar to your rinse cycle to help remove soap residue, and to soften clothes.

In switching from commercial laundry detergents for the first time, detergent residues now on clothing should be removed by rinsing in water and 50 ml washing soda for each load.

Abrasive Powder - Use lemon dipped in borax.

Bathroom Tile Cleaner - Mix baking soda and water

Bleach for White Clothes - Add 1 to 3 tablespoons of sodium percarbonate per load.

Disinfectant - Mix 125 ml of borax to 4.5 L of water.

Ammonia-Based Cleaner Substitute - Mix vinegar in salt and water.

Drain Declogger - Allow a handful of baking soda and 125 ml of borax to sit for an hour before flushing.

Toronto Healthy House occupants should utilize their own or manufactured environmentally safe biodegradable products, rejecting the market places's potentially hazardous waste producing products. Their own chosen life style depends upon it.

## 5.3 Household Hazardous Wastes

Household hazardous wastes including paints, solvents, cleaners, oil and grease are sufficiently strong enough to overwhelm and disable the biological treatment activity in the septic tank, Waterloo Biofilter™ and slow-sand wastewater renovation filter. Even an occasional improper discharge can result in an extended period of unsatisfactory treatment.

These items should, therefore, never be disposed of by flushing them down the drain.

The following materials should either be returned to their producer or disposed of by controlled means such as an organized community hazardous waste collection day.

- household waste paints, varsol, and paint thinners,
- waste petroleum products (e.g. antifreeze, crankcase oils, and lubricants),
- halogenated pesticides and herbicides (e.g. DDT, Raid, Black Flag),
- organic non-halogenated pesticides and herbicide wastes, and
- photographic solutions.

5.4 Patio Rainwater Collection Areas

Pesticides, herbicides and artificial fertilizers must be kept off the ground level rainwater collection patio areas. Surrounding garden and lawn areas can be satisfactorily maintained without chemicals by a combination of mulching, weeding, cultivation, and symbiotic companion planting.

There are several ways to control pests without resorting to chemical pesticides. On the small scale of the yards and gardens of the Toronto Healthy Houses, non-chemical pest control can be a feasible alternative.

Any or all of the following techniques may be used to protect trees and shrubs:

- Pick off infested leaves by hand and dispose of them. This will control moderate infestations of such as pests as the lilac leaf miner, leaf rollers, and spruce budworm.
- In late fall or early spring, prune off branches containing the greyish egg bands of the forest tent caterpillar. Use a knife to scrape the egg bands off limbs too large to prune.
- If forest tent caterpillar eggs have hatched, pick off larvae by hand when they cluster together in late evening or on cool days.

If all else fails the following products are the least dangerous commercially available pesticides:

Bacillus thuringiensis (BT) is a biological product that can be used to control cabbage worms, cutworms, gypsy moth, caterpillars, potato beetles, and the larva of blackfly and mosquito. Rain washes it away so applications must be repeated after each rainfall.

Diatomaceous earth is a natural product when crushed consists of very sharp splinters which punch holes in the waxy shells of insects. It is best used indoors against ear wigs, ants, and cockroaches.

Rotenone and pyrethrum are both "broad spectrum" insecticides that kill all the insects in their path. Extracted from plants, they are considered non-poisonous to people and pets when used as directed.

Vegetables and flowers have different odours and root secretions that affect the activity of insects and the growth of nearby plants. The following suggestions are know to be effective:

- Plant marigolds and other members of the chrysanthemum family throughout the garden to protect tomatoes, beans, and other plants from a variety of insects.
- Place aromatic plants at intervals throughout the garden to ward off pests. Chives, dill, nasturtiums, geraniums, thyme, basil, celery, mint, garlic, and onions are examples of aromatic plants often grown for their own value anyway.
- Basil is said to keep tomatoes free from infestation, and savory to protect beans. Onions or garlic placed next to carrots will foil the carrot fly.
- Plant horseradish at the corners of a potato patch, and plant beans near potatoes to repel the Colorado potato beetle.

Overhanding trees and bird feeders should not be installed in the vicinity of the rain collection patio's so not to encourage birds and their droppings. There should be no sand areas for cats to relieve themselves.

## 5.5 Wastewater Ground Disposal Gravel Pack

The ground disposal pack is located across the front of each lot beyond the south foundation wall. Waterloo Biofilter™ effluent is disposed of into the ground by means of this buried gravel pack.

It is important that no heavy objects or vehicles be permitted to crush the distribution pipe which is below the ground surface. Watering of the grass over the trench should be minimized. Although protected by a geotextile cover, any foundation planting should be selected to avoid root systems which may damage or plug the distribution pipe.

## 6.0 REFERENCES

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