Rainwater Harvesting System Design

June Key Delta House

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Completed by *Vita Nuova LLC*

Prepared for:
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Introduction

The following report represents the product of Vita Nuova's scope of work relating to the development of a rainwater harvesting and reuse system for the June Key Delta House in Portland, Oregon. The building is a proposed renovation and conversion of a former gas station which will be used by the Delta Sorority as a community center and meeting space. Harvested rainwater will provide non-potable water for flushing toilets and irrigation on the site.

The City of Portland and the State of Oregon have extensive guidelines for the construction of rainwater harvesting systems which specifically relate to residential properties (**Ref. 1; Ref. 2**). Commercial properties require individual review by City regulators and, in some cases, are subject to additional constraints (limitations on the types of reclaimed water uses) and leniencies. The design schematic and performance specifications presented here are consistent with both the City and State guidelines.

The information presented in this report is intended to be used as a design schematic and performance specifications. These will assist in the next stage of engineering design and regulatory approval for the harvesting and reuse system. The report is not intended as a final design drawing, but must be reviewed by an Oregon licensed engineer, drawn in construction document format, and prepared with product-specific recommendations for each of the component parts. The narrative, parts list, and schematic included here should provide the proper content to meet City regulatory approval and should be used as a starting point for the next stage of engineering design.

The Delta House facility will be used as meeting and event space for as many as 20 people at a time. Reclaimed water will serve only to flush toilets and occasional irrigation of outdoor planted areas. The catchment area consists of the flat roofs and awnings of the structure, directed to an at-grade cistern for storage. Overflow from the cistern will be directed toward the site's stormwater management system and allowed to infiltrate to the groundwater. The 1,000 gallon cistern, when full, will contain enough water for approximately 600 toilet flushes, based on 1.6 gallons per flush. When near empty, the cistern will be automatically supplemented with City water. The harvesting and reuse system is also designed to minimize the need for regular maintenance and manual operations, and to perform transparently so as to provide a visible example of the potential for rainwater harvesting and reuse in the community.

In order to facilitate the process of regulatory approval, and because the guidelines provided by City and State oversight agencies are written to apply to residential properties, Vita Nuova made contact with the City's Office of Planning and Development Review (OPDR) and the commercial plumbing inspector designated to approve commercial plans for rainwater harvesting systems. The inspector, Marv Morlan, was assigned these duties only recently and was very willing to spend the necessary time to review the preliminary design schematic, hear and respond to detailed questions, and consult with other regulators regarding the specific intent and wording of the regulatory documents.

Rainwater Harvesting System Narrative

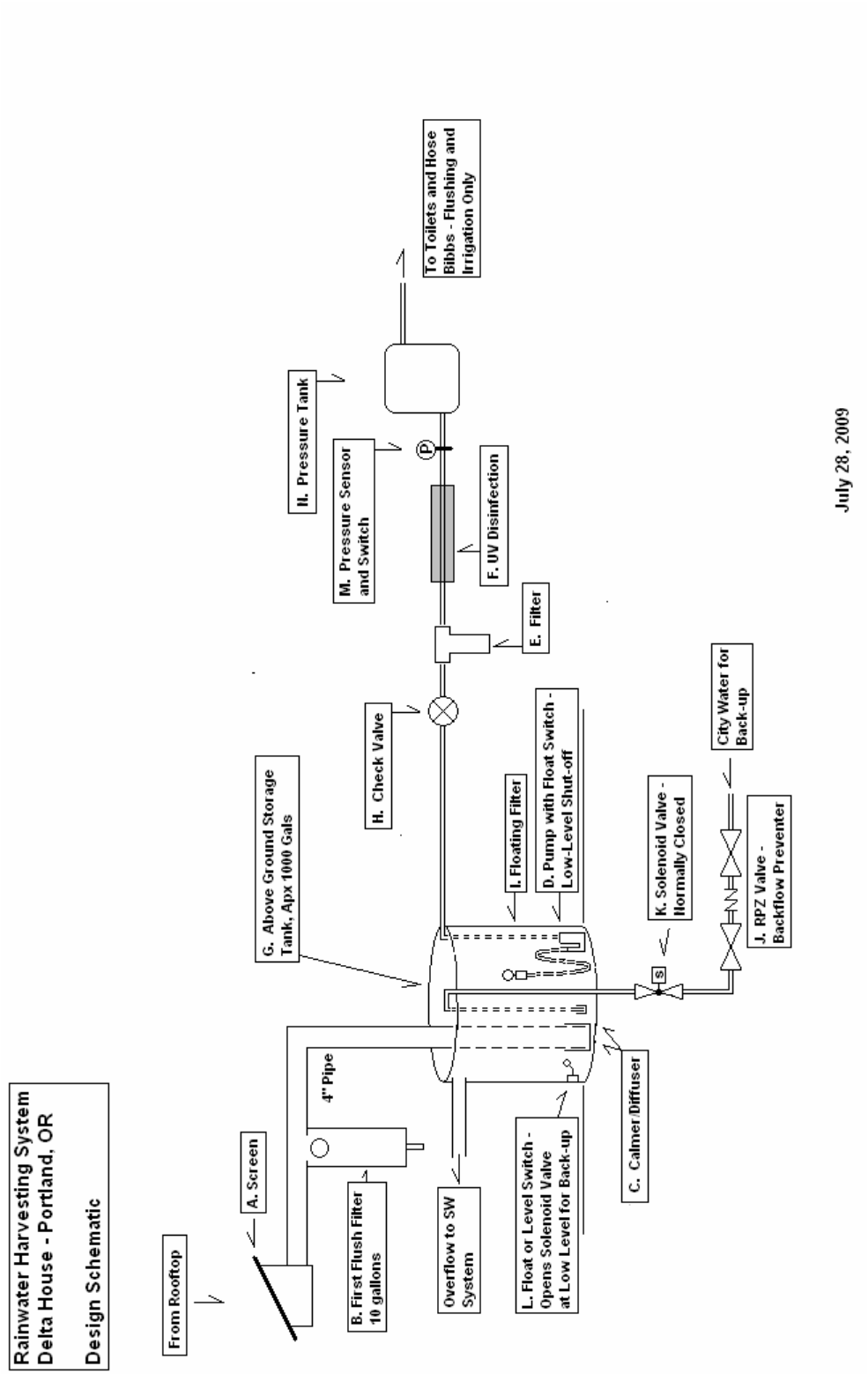
This section is intended as a brief narrative describing the flow path of rainwater falling within the catchment area and the processes involved. It should accompany the schematic design when presented for regulatory approval for explanatory purposes.

Precipitation falling within the rooftop catchment area is directed toward a single downspout and passed through a leaf screen ("A") to a 4 inch leader. The water then passes through a first flush filter ("B") which diverts the first 10 gallons away from the harvesting system and slowly drains to a suitable location within the site-wide stormwater management system. The leader directs the main flow into an at-grade cistern ("G") with approximate volume of 1,000 gallons. The cistern will be fitted with an overflow port directing excess water to the stormwater management system.

The submersible pump ("D") draws water through a floating filter ("I") connected to a vacuum hose, and is activated by a low-level shut-off switch ("pump down" type) in series with a pressure sensor/switch ("M"). The pump lifts the water from the catch basin to the pressure tank ("N"), passing the water first through a bag-type sediment filter ("E") and disinfection ("F"). The UV system would be activated by the same circuit that activates the pump. All piping from the pump and downstream will be ABS or PEX, either purple in color or wrapped in purple tape and marked "non-potable."

The cistern will be supplemented during drought periods with municipal water supplied through a backflow prevention valve ("J" – reduced pressure zone type). The municipal water supply will be activated by a float or level switch ("L" – "pump up" type) mounted in the tank approximately six inches from the tank bottom, activating a ("normally closed") solenoid valve ("K"). The switch will close the solenoid valve when the level in the tank reaches approximately 12 inches. Vita Nuova prefers a system where back-up potable water does not enter the cistern, but rather goes directly into the water reuse supply line. However, this preferred alternative is prohibited in the design guidelines.

Rainwater Harvesting System Design Schematic



Rainwater Harvesting System Parts List

The following parts list corresponds with the schematic design and is intended to provide performance specifications for each of the components included in the rainwater harvesting and reuse system for Delta House. When appropriate, the list provides references to sections in the City of Portland Code Guide (**Ref. 2**). In some cases, web-links to specific parts are provided here as guidelines to aid in subsequent design development.

A. Screen
- Collected roof runoff should pass through a screen to prevent leaf intrusion.
- Minimum mesh size should be 0.5 inches.
- Reference: City of Portland Code Guide: Rainwater Harvesting (Sec. F.2.b.)
- See: http://www.rainharvest.com/shop/shopdisplayproducts.asp?id=15&cat=Downspout+Filters

B. First Flush Filter – "Roof Washer"
- The filter should divert a minimum of 10 gallons.
- Reference: City of Portland Code Guide: Rainwater Harvesting (Sec. F.3.)
  - Sec. F.3.c.3-8 may not apply (filter components).
- See: http://www.rainharvest.com/shop/shopexd.asp?id=269

C. Inlets
- All inlets (not outlets) to the tank should be fitted with a calmer/diffuser or 180° return elbow to prevent stirring up of sediment.
- See: http://www.jrsmith.com/products/rainwater_harvesting/submittal/drh9530si.pdf

D. Pump
- The pump should be approved for use with potable water systems.
- The pump should have a built-in (or external) float or level switch for low-level shut-off (high level operation – "pump down").
  - See: http://plumbingsupply.com/alarm.html
- Connections should use flexible hose and a floating filter.
- The pump should be wired in series with the UV Disinfection unit ("F") and the Pressure Sensor/Switch ("M").
- The pump should be approximately 2-8 gpm at 30 psi.

E. Filter
- The filter should be an in-line sediment filter.
- See: http://www.waterfilters.net/Rusco-Sediment-Trapper-1-100STSS-F-Stainless-Steel_p_0-1763.html

F. UV Disinfection
- The UV system should be wired in series with the Pressure Sensor/Switch ("M") and the Pump ("D") to power up only while water is pumped from the storage tank ("G") to the pressure tank ("N").
  - See: http://www.waterfilters.net/Pentek-UV-120-1-UltraViolet-System_p_0-443.html

G. Storage Tank
- Total capacity is approximately 1,000 gallons.
- The tank should be approved for use with potable water systems.
- The tank should be no taller than it is wide.

H. Check Valve
- The valve must be compatible with ABS or PEX pipe.

I. Floating Filter

- The filter draws water from near the top of tank and filters coarse sediment and debris.
- See: http://www.rainwatermanagement.com/FloatingFilters2.pdf

J. RPZ Valve
- The back-flow preventer should be consistent with local plumbing code.

K. Solenoid Valve
- The valve permits the addition of back-up city water supply.
- Normally closed, the valve is activated by a float switch ("L") when the tank level is below 4 inches.

L. Float or Level Switch
- The switch mounts on the interior of the tank approximately 4 inches above bottom.
- The switch opens the solenoid valve (closes circuit) when the tank level is low ("pump up" type).
- See: http://www.liquidlevel.com/products_switches_standard_sp_sps-Series.asp

M. Pressure Sensor and Switch
- The sensor and switch is set to activate the pump (and UV) when pressure in the line (and in the Pressure Tank ("N") drops below approximately 30 psi.
- See: http://www.grainger.com/Grainger/items/2YCE6

N. Pressure Tank
- The tank should be installed indoors with filter and UV system.
- See: http://www.watertanks.com/products/0490-030.asp

Other Notes:

1. All open inlets and outlets to the system must be protected with debris screens to prevent intrusion by vermin.
2. All pipes carrying reclaimed water (excluding the 4 inch leader) shall be purple in color or wrapped in purple mylar tape. All outlets, toilets, and hose bibs must also be indelibly labeled. See City of Portland Code Guide: Rainwater Harvesting, Sec. F.6.
   - See: http://www.tchristy.com/catalog/09/TC.CAT.SEC.G.09.pdf

References

Ref. 1 Oregon Department of Consumer and Business Services, Building Codes Division
Oregon Smart Guide: Rainwater Harvesting
http://www.cbs.state.or.us/bcd/pdf/3660.pdf

Ref. 2 City of Portland, Oregon
Code Guide: Rainwater Harvesting
http://www.portlandonline.com/shared/cfm/image.cfm?id=68627