Field Report

On

Best Practices for Improving Water Quality in Rainwater Harvesting Systems

under the project

Promoting Rainwater Harvesting in the Caribbean Region - Phase 2

A collaborative effort between the

Caribbean Environmental Health Institute (CEHI), the Antigua Public Utilities Authority (APUA), and the United Nations Environment Programme (UNEP)

October 2009

CEHI CARICOM

ANTIGUA PUBLIC UTILITIES AUTHORITY

UNEP

Preamble

This Technical Seminar series on Best Practices Rainwater Harvesting held over the 21st and 22nd October 2009 was designed to raise awareness of the critical issues associated with water safety associated with eth practice of rainwater harvesting in Antigua and Barbuda. The seminars familiarized participants on the importance of integrating water safety measures in conventional Rainwater Harvesting (RWH) systems and measures that can be taken to maximize rainwater capture. The seminars showcased special demonstration models for rainwater harvesting for small commercial enterprises and households using a special first-flush diverter designed under resources provided from the United Nations Environment Programme (UNEP) under a collaborative initiative with the Caribbean Environmental Health Institute to promote the practice of rainwater harvesting in the Caribbean. The following is a summary of the CEHI-UNEP project.

CEHI, with support from UNEP is implementing a demonstration initiative in Antigua and Barbuda to promote the practice of Rainwater Harvesting (RWH) in the Caribbean. This support is follow-up to a first phase of a UNEP-assisted effort to raise the profile of the practice of RWH in the region. During that first phase Grenada was used as a pilot to develop a National Programme to promote RWH. The lessons learned and strategic directions that emerged from the national pilot were used to develop a Regional RWH Programme for the Caribbean. The project also funded the production of public awareness material that included posters, radio public service announcements, a feature-length video and a technical brochure.

In the second (current) phase, the emphasis is on the development of demonstration models that showcase best practices in rainwater harvesting to the Caribbean. Antigua and Barbuda was selected as the candidate country given the fact that the practice is well established in the majority of households and business enterprises. Two candidate models were initially selected; a typical household, and a small business enterprise (likely an agricultural enterprise). This was subsequently expanded to include a second business enterprise and a school. The project financed upgrades and retro-fitting of the existing RWH systems to bring them to recommended standard so that they represent best practice and serve as training resources for householders, contractors, business operators in Antigua and Barbuda, and the rest of the Caribbean. The project supported the hosting of a national symposium (held in January 2008), sensitization activities, the development of a handbook on implementing RWH practices in Caribbean States including provision of mapping RWH harvesting potentials across landscapes.

Information on the RWH collaboration between CEHI and UNEP is posted at the CEHI website at http://cehi.org.lc/rainwaterharvest.htm.

The local collaborator in the hosting of the seminars was the Antigua Public Utilities Authority (APUA).

The Demonstration Component – Summary

Activity description (initial concept): *Develop and implement two field demonstration models of RWH best practices that can be used as standards for promotion and replication. One model will be a lower-income household, and the other a small-scale commercial enterprise (farm, manufacturer, hotel, other).*

The Water Division of Antigua Public Utilities Authority (APUA) was local contact point for the initiative which fell under the office of the Water Services Manager. The Planning Department was the given the responsibility for technological development and installation of the models.

The selection of the demonstration models was informed by an assessment exercise. To aid in the assessment, an evaluation instrument was developed that assessed the relative suitability (through a weighted criteria scoring system) of the candidate building for consideration. The criteria weighted attributes such as roof integrity, household economic status, reliance on rainwater as the primary source of drinking water. A total of nine household candidates were evaluated. The selection of the agro-processing demonstration model was done in consultation with the Ministry of Agriculture.

The first two demonstration models were installed; the lower-income household and the small agro-processing facility. Given the fact that the overall cost for the interventions were below the available budget, it was decided to include the two additional demo models; a second agro-processor and a school on Barbuda. The choice of the school on Barbuda was to extend the reach of the project to that island, and to demonstrate a larger-scale institutional application of best-practice RWH. The central focus of the demonstration models was the development of a special first-flush diverter (FFD) system that enhances of the quality of water prior to entry into the storage facility. This FFD uses a different method for isolation of contaminants as compared to the conventional diverters.

The field component concluded with the convening of two technical seminars; one held on Antigua and the other on Barbuda. The major objectives of these seminars were to:

- Familiarize participants with the project inputs and outcomes.
- Raise awareness on the risks associated with poor practices in rainwater harvesting;
- Present technical options towards improvement in water quality in RWH systems;
- Gather feedback from stakeholders on the practicality of the technical solutions as presented in the demonstration models;
- Gain testimonials from the project beneficiaries on the application of the improvements to the RWH systems.

A key recommendation that emerged from the technical seminars was to adapt the first-flush diverter technology to utilize 4-inch pipes and fittings that are more readily available than the pipes and fittings used for the demo models. This will be the case particularly for the household applications.

The demonstration models will remain as an educational resource for persons interested in implementing best practices in RWH in Antigua and Barbuda and for uptake at the regional level across the Caribbean.

About CEHI

The Caribbean Environmental Health Institute (CEHI), an agency under CARICOM, was established in 1989 with the broad mandate to provide technical assistance on matters of environmental management to Member States. The Institute is headquartered in St. Lucia. For more information on the Institute please visit www.cehi.org.lc.

1 Demonstration model selection

Over the course of approximately two months from January 2008, candidate demonstration models were selected under the direction of a Technical Steering Committee established for the project. A two-man assessment team comprising of Hastin Barnes (Planning Engineer with the APUA) and Randell Pyle (a private sector contractor), appraised a total of nine short-listed households in various neighbourhoods that included Ottos, Yorks, New Winthropes, Potters, Cassada Gardens and Lightfoot West.

A special evaluation instrument was developed based on weighted criteria in that favoured selection based on attributes of the candidate. However there were two prerequisite criteria that had to be met before consideration for evaluation; (1) the household and enterprise must be already engaged in the practice of RWH and (2) there must be evidence that the participants have the capacity to sustain participation in the demonstration initiative. Ten (10) specific criteria were applied in guiding selection of the demo. In the analysis, evaluators were instructed to assign the value of one (1) at the appropriate criteria condition, one of three that could describe the candidate site (see table below). A tally was then made for each column and the total multiplied by a weighting factor to derive the score for each condition. The weighting factors were applied to favour smaller households where there may less ability to invest in RWH. The score was then added to yield an overall score that was used to rank and ultimately select the candidate demos. The score derived was out of a possible 10; the closer the score to 10 the more favoured the demo was for selection. Annex 1 contains a worked example of the evaluation sheet.

	Qualifying Criteria	Categories		
		Less favoured ▶▶▶▶▶▶▶▶ More favoured		
1	House size or enterprise size	Large	Medium	Small
2	Financial affluence	Affluent	Middle-income	Lower-income
3	Occupancy	Low (<3 persons)	Middle (3 - 6 persons)	High (> 6 persons)
4	Roofing material condition	poor condition	fair condition	good condition
5	Storage type	underground cistern	above ground cistern	black tanks
6	Conveyance system	poor condition	fair condition	good condition
7	Access to potable supply - water availability	100% of time (reliable)	50% of time (variable)	no access
8	Durability of building structure	Low	Moderate	High
9	Existence of water quality protection measures	no measures	some measures	well developed
10	Is RW used in internal plumbing system?	No		Yes

The household that ranked number one with a score of 7 was approached and invited to commitment to the project but after an initial acceptance, opted to no longer participate. The second ranked household was then selected. This household belonged to Beatrice Joseph. The evaluation score sheet is presented below.

The agro processing candidate demonstration model was selected using a different process as the evaluators found it challenging to assess the various commercial enterprises using the assessment instrument. The alternative was to consult with the Ministry of Agriculture to determine the most suitable candidate that would not only benefit from participation but also

be an advocate for improved RWH practices. The final selection was the enterprise Suzie's Hotsauce, operated by Rosie McMaster.

Condition assessments on both structures to appropriately configure them for best-practice RWH were carried out by the APUA. The initial plan under the project was to tender out the RWH improvement works to private contractors. However, based on preliminary scoping of contractors' interest and costs to carry out the installations, in addition to the need for continual engagement at a technical level on the project it was decided to rely on APUA's water department civil works crew, given their familiarity with the subject area and the ease of supervisory control over the project. Engagement of APUA in this manner was deemed strategic in that learning and capacity could be built within this agency that could then be transferred to the wider public.

Participant agreements (see template in Annex 2) for the two demos were drafted. These agreements stipulated the terms and conditions of participation in the programme, obligating the participants to offer the installed RWH systems for public display and capacity-building efforts over one year following completion of the work.

Rainwater Harvesting Antigua Demonstration Initiative

This spreadsheet is designed to assist in selection of the demonstration candidate for RWH infrastructure upgrade
It is anticipated that at least 5 potential demos (household) and 3 potential enterprise demos will be short-listed for evaluation using this instrument.

The following are the prerequisite criteria

1 The household and enterprise must be already engaged in the practice of RWH
2 There must be evidence that the participants have the capacity to sustain participation

The following are the qualifying criteria

Overall, the assessment gives highest favour (through weighting factors) to less affluent 'typical' households or small enterprises that use RWH and are affected by lack of access to a ready supply of potable water. The weighting factors can be adjusted.
NOTE: In the case of homes; **'Large'** is regarded as >2,000 sq.ft; **'Small'** is <1,500 sq.ft.

To use (and explainatory notes):

1 Insert values of **'1'** in the respective rows (entry columns shaded yellow) that best describe the relative rating assigned to the attribute.
NOTE: If more than one '1' is inserted on any given row the numerical outcome will not be valid.
2 The weightings are intended to favour selection of candidate demos that meet the **typical small to medium home or buisiness enterprise profile**
3 The weigthings also favour housholders and business owners who do have a reliable potable water supply and who have existing RWH systems that can be relatively easily upgraded
4 These weights can be changed by the evaluators if felt necessary, but must maintain the selection objective as outlined above

NOTE: only enter data in the yellow cells

	Qualifying Criteria	Categories					
1	House size or enterprise size	Large		Medium	1	Small	
2	Financial affluence	Affluent		Middle-income		Lower-income	1
3	Occupancy	Low (<3 persons)		Middle (3 - 6 persons)	1	High (> 6 persons)	
4	Roofing material condition	poor condition		fair condition	1	good condition	
5	Storage type	underground cistern		above ground cistern		black tanks	1
6	Conveyance system	poor condition		fair condition		good condition	1
7	Access to potable supply - water availability	100% of time (reliable)	1	50% of time (variable)		no access	
8	Durability of building structure	Low		Moderate		High	1
9	Existence of water quality protection measures	no measures		some measures	1	well developed	
10	Is RW used in internal plumbing system?	No	1	<<<<<<<do not fill in>>>>>>>>>		Yes	

Sum	2	4	4
Weighting	.25	.1	.1
Score	0.5	2	4

OVERALL SCORE 6.5

Beatrice Joseph
Tindale Road 560 6871

Based on the installation costs of the two demonstration models and the amount available for this component under the project, a decision was made to include two more demonstration models. A second agro-processing facility was added, Granma Aki, and a school on Barbuda, the Sir McChesney George Secondary School. Bringing the project to Barbuda was considered a good way to span both islands where the example of the school shows a RWH application for larger-volume institutional purposes.

RWH system enhancement

The RWH designs and scope of works for the demos were supplied by Hastin Barnes (APUA). All the demos involved the reconfiguration of the conveyance system to a specially-designed first-flush diverter. Given the varying conditions of the demos, work ranged from cleaning catchment surfaces (pressure washing) to installation of facial boards to receive new guttering, installation of down-pipes and installation of storage tanks and pumps.

A key aspect of the demonstration project however was the development of a first-flush diverter that requires reduced maintenance and that makes an improvement on the existing available recommended first-flush devices. This particular device works by routing water from the roof catchment upwards in a vertical column past a simple cloth filter that screens out small particulate matter before the water enters the tank. The difference with the mechanism developed for this project and the other first flush diverters is that the as the water layers itself with the cleanest water in the column on top, it is further subjected to screening as it is forces through the filter. The fact that a filter is combined with the first flush makes this a rather novel approach as compared with the other first-flush designs that have been proposed or available on the market.

The filter is supported by a rigid metal gauze cut into a circle with cloth wrapped over the edges of the gauze on both sides. The filter is inserted between the points where the two pipes join. The coupling holds both pipes and filter in place

Figure 1 shows how the upflow first flush diverter mechanism works and installation of the coupling that holds the cloth filter.

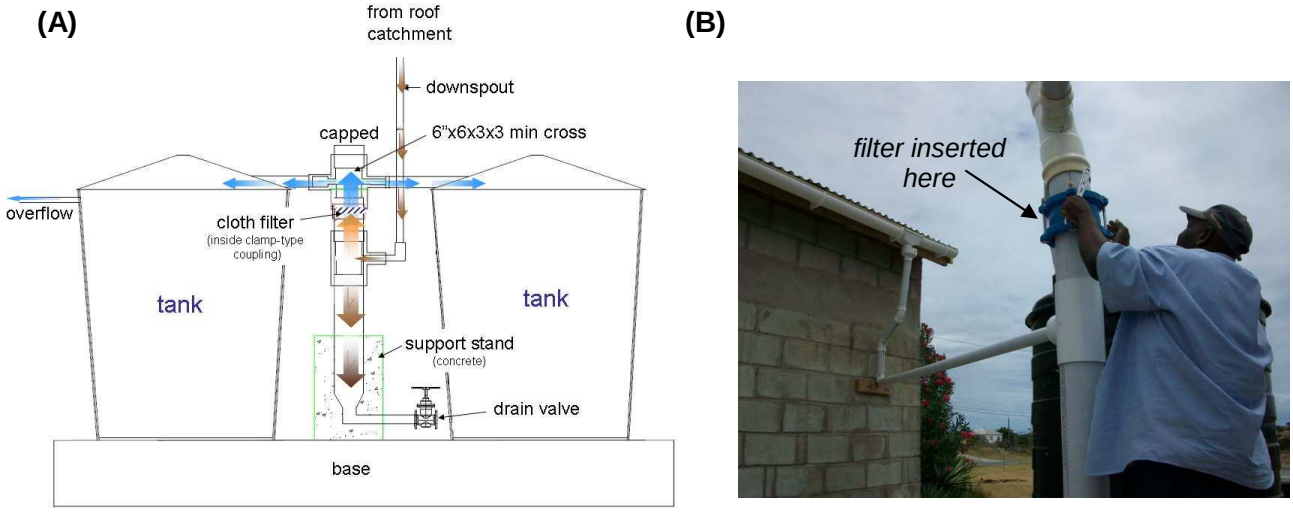

Figure 1 *(A) schematic of dual-tank first-flush filter arrangement; (B) Installing the coupling on the first-flush diverter*

Figure 2 *RWH demonstration models with new storage and first-flush diverters*

Demonstration model profiles

The following is a profile of the demonstration models. The description is provided of the location, building structure, purpose and water needs. The technical specifications on the catchment, conveyance and storage systems are provided before the project intervention with a description of the enhancements delivered under the project.

1. Household Model – Private residence

General: The household is a 3-bedroom 2-bathroom occupying 96m^2 of floor space. It is a single-storey, single family dwelling with 4 residents. The house has a connection to the potable municipal supply but the residents have traditionally relied on rainwater for potable needs. The estimated daily water consumption is 0.5 m^3/day. The household is owned by Beatrice Joseph.

Location: The house is situated at Tindale Road in Ottos, St. John's (Figure 3).

Figure 3 *Demo site*

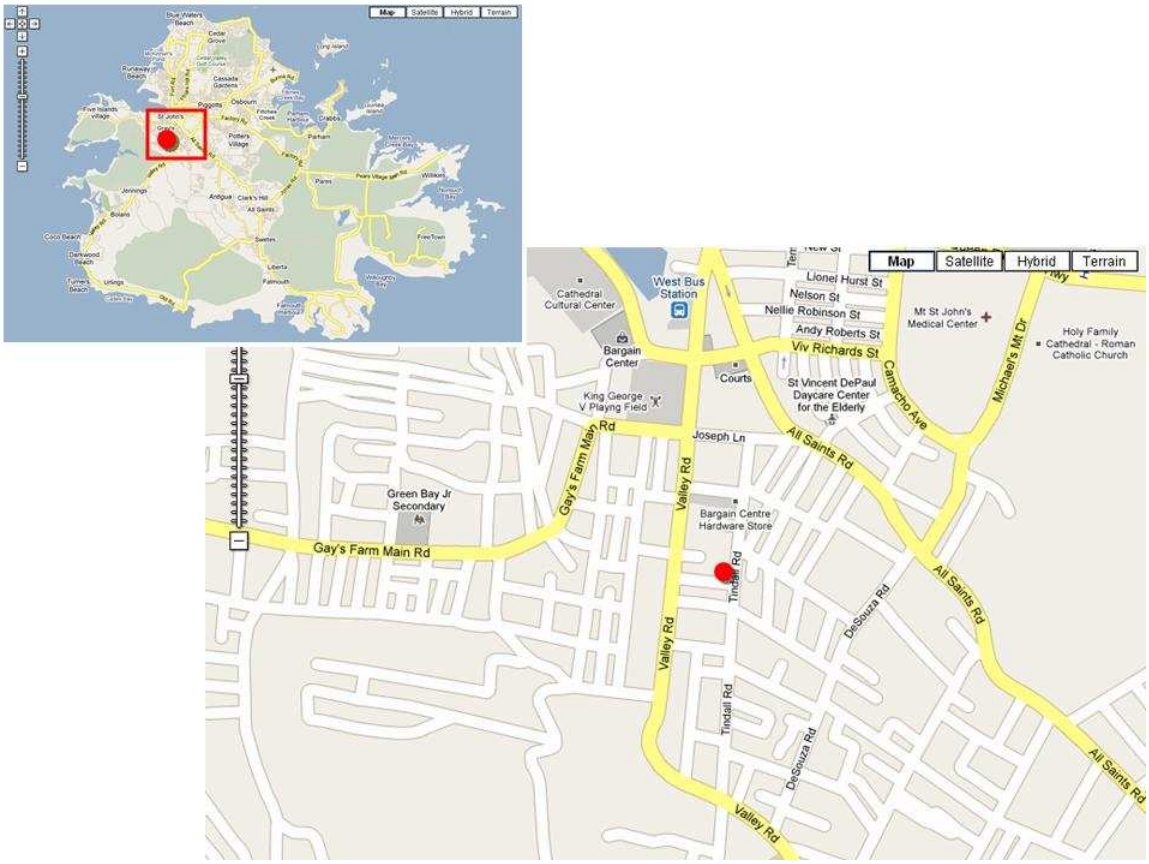

Figure 4 *Location map for household demonstration model*

Technical specifications of RWH system:
The following are the technical specifications of the RWH prior to the intervention.

- Catchment (roof) area: 96 m^2
- Roof catchment: galvanized sheet
- Overhanging trees: Yes
- First-flush diverter exists: No
- Storage tank capacity: 4.5m^3 (1,000 gallons)
- Storage tank material: 2 plastic tanks
- Access to water: Drawn from tap cistern tap into containers

Figure 5 *Installation of the support base for the first-flush diverter*

Enhancements made under project (date of installation: March 2009

- Supply and installation of 1 metres PVC down pipes
- Supply and installation of a first-flush diverter
- Construction of concrete base 2 feet above grade for first flush diverter
- Existing 400-gallon tank integrated within the system
- Clean up area surrounding the storage tanks

2. Agro-processor Model – Suzie's Hotsauce

General: The site is the production facility for Suzie's Hotsauce, a well-known agro-processor who has received international awards for the quality of the condiments produced, most notably the hot pepper sauce. The operation is run by Rosie McMaster. Rainwater is used almost exclusively in the manufacture of the products which is harvested and stored on-site. The water from the storage also supplies the rest of the household's needs.

Location: The operation is in the personal dwelling of Rosie McMaster situated at Marble Hill (Figure 7).

Figure 6 *Demo site*

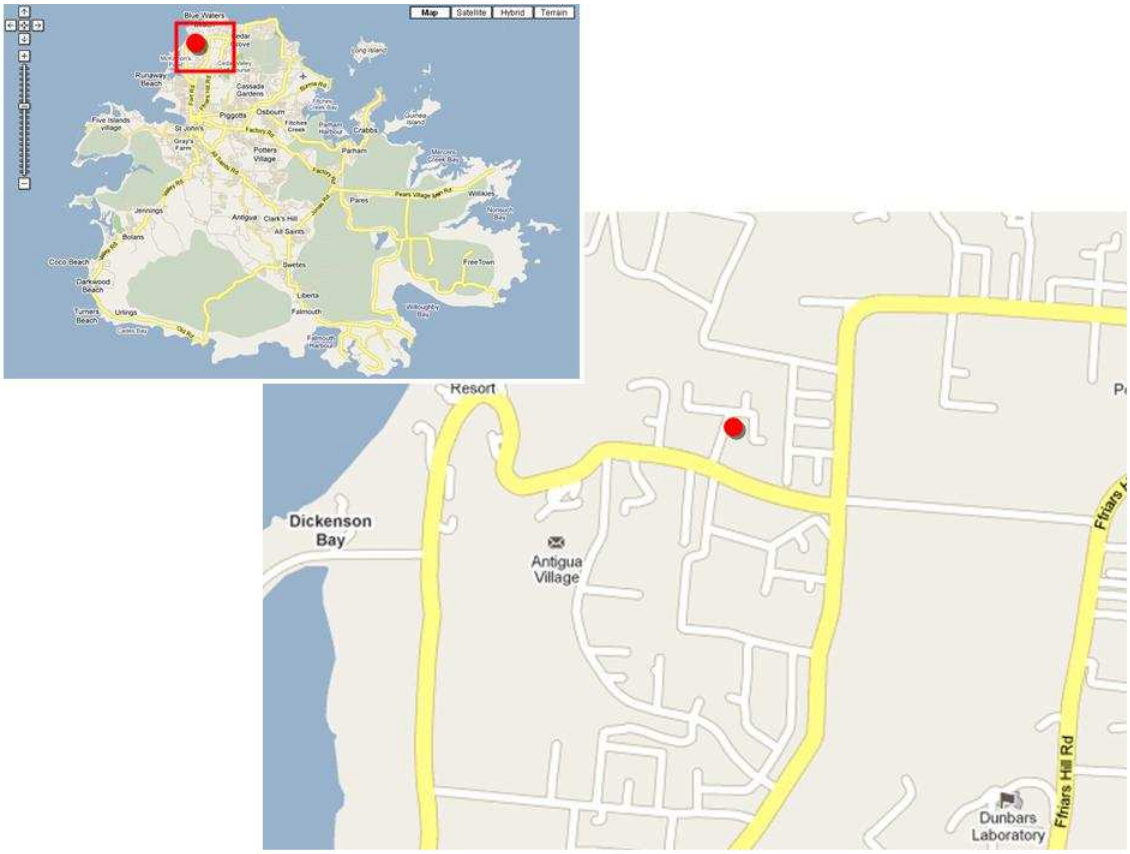

Figure 7 *Location map for Suzie's Hotsauce demo model*

Technical specifications of RWH system:
The following are the technical specifications of the RWH prior to the intervention.

- Catchment (roof) area: 185 m^2
- Roof catchment: tar shingles
- Overhanging trees: Few around south side of the building, although not overhanging the roof
- First-flush diverter exists: No
- Storage tank capacity: 3 m^3 (600 gallons each)
- Storage tank material: underground concrete cistern; 1 plastic tanks
- Access to water: pumped into building by 1/2 horsepower pump

Figure 8 *Site before installation*

Enhancements made under project (October – November 2008)

- Supply and installation of 10 metres of new 4" PVC guttering to fascia boards and down pipes
- Supply and installation of 5 metres of PVC down pipes
- Supply and installation of a PVC first-flush diverter unit
- Construction of a concrete base 2 feet above grade for storage tank support
- Supply and installation of two 1,000-gallon storage tanks
- Relocation of the existing 400-gallon tank and integration within the overall RWH system
    - Upgraded total storage capacity of 25 m3 including cistern
- Plumbing of the new installation and integration into existing facility infrastructure
- Supply and installation of a water meter after water tanks as per design specifications
- Refurbishment of the pumphouse shed
- Clean up of the general area surrounding the storage tanks
- Painting of the section of the backwall of the building in the vicinity of the storage tanks

Figure 10 *First-flush diverter and new storage tanks*

Figure 9 *Construction of the concrete tank platform*

3. Agro-processor Model – Granma Aki

General: The site is the production facility for Granma Aki, another local agro-processor who produces a range of processed foods including condiments and herbal teas. The operation is run by Novella Payne. Rainwater is used almost exclusively in the manufacture of the products which is harvested and stored on-site.

Location: The operation is a small purpose-built facility on Glanville's main Road at Carty's Hill (Figure 12).

Figure 11 *Demo site before installation (note the rotten facia board and missing gutter section)*

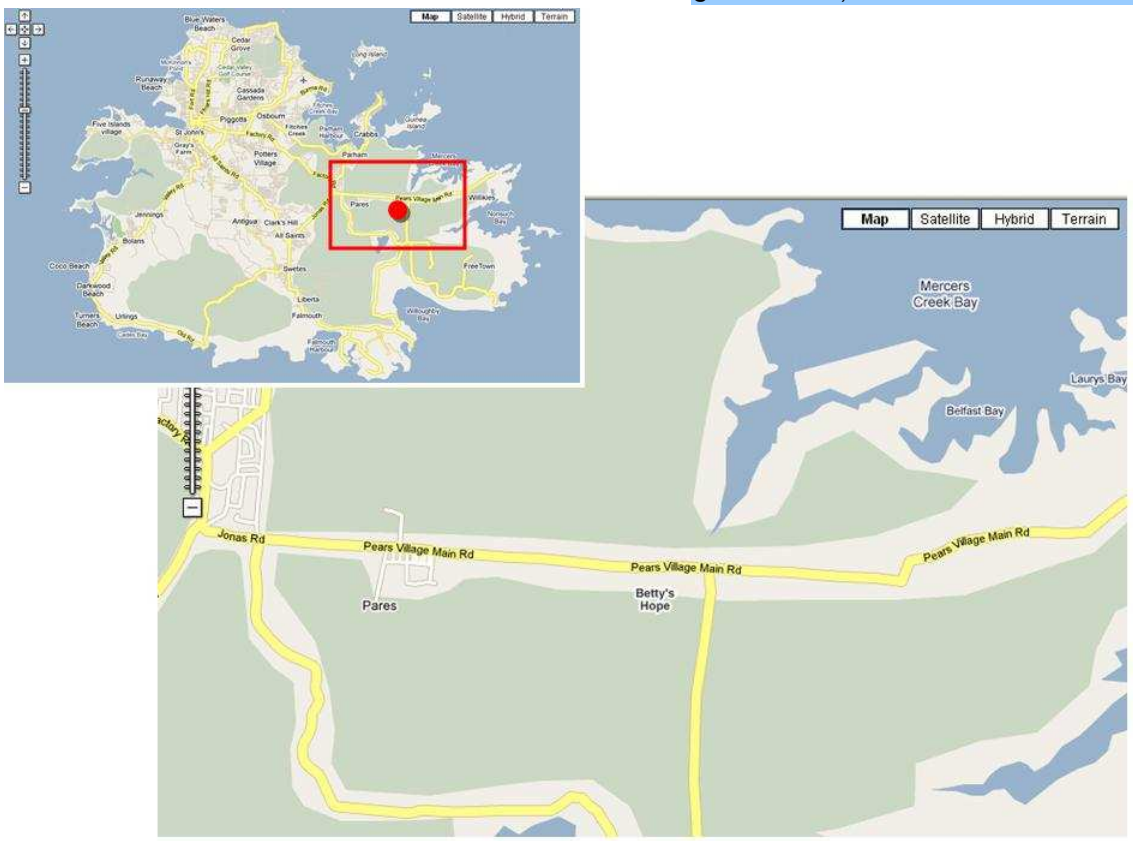

Figure 12 *Location map for Granma Aki demo model*

Technical specifications of RWH system:
The following are the technical specifications of the RWH prior to the intervention.

- Catchment (roof) area: 45 m^2
- Roof catchment: galvanized sheeting
- Overhanging trees: None
- First-flush diverter exists: No
- Storage tank capacity: 2.72 m^3 (600 gallons)
- Storage tank material: 1 plastic tank
- Access to water: Gravity feed

Enhancements made under project (November 2008 - January 2009)**:**

- Installation of 7.5 metres for new 4" guttering and 3.5 metres of down-pipe
- Installation of 1 plastic tank for combined added capacity of 2.72 m^3
- Installation of upflow first-flush diverter

Figure 13 *Installed storage capacity and first-flush diverter*

4. Institutional (school) Model – McChesney George Secondary School

General: This is the only secondary school on Barbuda with a student population of 93 students, along with 13 teachers and 16 support staff. The water is used for drinking and non-potable purposes including cleaning, washing and irrigation. The estimated daily water demand is 4.54 m^3/day.

Location: The school is located at Indigo (east of Cordrington) (Figure 14).

Figure 14 *Location map for the Sir McChesney George School demo model*

Technical specifications of RWH system:
The following are the technical specifications of the RWH prior to the intervention.

- Combined catchment (roof) area: 450 m^2 (estimated)
- Roof catchment: galvanized sheeting
- Overhanging trees: None
- First-flush diverter exists: No
- Storage tank capacity: 273 m^3 (60,000 gallons)
- Storage tank material: underground concrete cistern

- Access to water: pumped into building by 1 horsepower pump & 2 120 gallons pressure tanks

Enhancements made under project (date of installation: June, 2009):

- Removal of old inlet piping and replacement with upflow first-flush diverter

Figure 15 *Demo site*

Figure 16 *Inlet pipes from roof catchments into cistern before installation*

Figure 17 *Upflow first-flush diverter (left) and new inflow pipe configuration to cistern (INSET: discharge pipe from the first-flush)*

Lessons learnt

- **Ease of system operation:** The operation of the system, specifically the servicing of the filter within the first-flush device is slightly complicated. It was found that removing the bolts to open the coupling that secured the connecting pipes and the filter could be challenging. This may however be more related to operators getting used to performing the task.

- **Availability of components:** The use of 6" diameter piping and fittings may be more useful for large-scale water harvesters, such as schools, hospitals, industries and other institutional buildings as compared to households. These facilities tend to be larger and RWH applications will invariably entail handling of greater water volumes necessitating use of larger pipes and fittings. Further, these facilities and support infrastructure are purpose-built and provisions tend to be made for specialized maintenance programmes, hence procurement of supplies and materials may be less of an issue. For smaller structures and homes these 6" components will likely not be a favoured option as they are not readily available. The main concern as was revealed in the technical seminars was the availability of the coupling that is used to house the filter in the first-flush diverter. An alternative design for smaller facilities and households is recommended.

- **Filter use and maintenance:** The cloth filter in the FFD was found to restrict the flow of the water at the school and at the household demo sites. This was particularly the case with the school where it was found that the filter caused a back-up of water within the conveyance system given the large volume of water being channelled off the roofs; inflow exceeded transmission across the filter. Following a particular storm when water back-up was observed, the cloth was removed allowing the supporting gaze to remain (installed within the coupling). This permitted unimpeded water flow into the storage. However, not using the cloth filter reduces the utility of the first-flush diverter to screen out smaller particles that contribute to sludge accumulation in the tank. Another finding was that the elevation of the roof catchment relative to the elevation of the filter in the FFD (difference in hydraulic head) will influence the transmission rate across the filter. With sufficient difference in elevation the water pressure causes more rapid transmission upward through the cloth filter. Where there is a relatively small difference the pressure of the water may not be sufficient to drive transmission at a quick enough rate to deal with the inflow off the roof. The choice of the filter media in terms of porosity will therefore be a factor that needs to be considered.

Figure 18 *Contamination residue on the first-flush cloth filter*

- **Catchment contamination based on location:** Of all the demos, the household demo at Ottos was found to be most exposed to airborne contaminants. Within a month of installation of the cloth filter, it was found to be clogged with black residues (Figure 18), a consequence of the site's location relative to high volumes of vehicular traffic. The All Saints Road, a major road that enters St. John's runs approximately 300 metres from the location and the vehicular exhaust coats the catchment surfaces in areas in close proximity to this and other main roadways in the area. By comparison, inspections of the filter at Granma Aki's facility, located in a relatively rural area, revealed little

fouling of the filter. This means that the servicing regimen for the filter needs to be more frequent in the urban areas as compared to the rural areas.

- **Water quality enhancement:** The recipients all claimed that the new first flush diverter seemed to improve the quality if the water. This claim however is unsubstantiated as no systematic testing of the water was carried out prior to and after the installations. Additionally, in the case of the systems where new 'black tanks' were purchased it would be expected that microbial contamination would be low. The water quality will need to be systematically monitored over time to observe evidence of contamination and where practical, sample RWH systems in close proximity that use similar catchment, conveyance and storage systems.
- **Operation of the first-flush diverter:** A common issue raised during the technical seminars was the operation of the first-flush mechanism to release the dirty water. The effectiveness of the initial rainfall in removing hardened-on deposits on the roof depends on the nature of the material on the roof (depth of the deposits and its cohesiveness, which in turn is related to the duration of the rainless period), the intensity and duration of the rainfall. Animal droppings and resins from trees for example can be difficult to dislodge and the volume of first flush that will be required to satisfactorily remove these deposits will depend based on these factors. It was recommended that in cases where the roof has remain unwashed for a long period that the first flush diverter remains in a open position for the first several minutes of rainfall before being manually closed off. It may be desirous, if the tank has sufficient water that the first-flush remain disengaged for these rain events (in other words left open for all the water to be diverted away from the storage).
- In the case of the Barbuda school, the first-flush outflow needs to be routed to the back of the tank so as to minimize ponding when the first flush ions released.
- **Installation costs:** In the technical seminars the issue of cost for installation of the systems was raised. The cost varied depending on the condition of the catchment and whether new gutters, down-pipes and storage were needed. The cost for installation of the first flush diverters and the associated components under this project were as follows ($US):

Demo	Materials cost	Labour cost	Total cost
Household	$407	$185	$593
Suzie's Hotsauce	$2,778	$2,074	$4,852
Granma Aki	$1,352	$741	$2,093
Secondary school	$1,111	$1,037	$2,148
Promotions	$1,150	$296	$1,446

- **Institutional roles:** The APUA (Water Services Division) as the lead agency with the mandate for water resources management in Antigua and Barbuda was ideally-suited to lead the technical contributions to the project. The Authority leads the efforts at the national level to urge water conservation and improved management and is engaged at the moment with the formulation of a national policy on integrated water resources management, an effort that is being financed under the Global Environment Facility-funded Integrating Eater shed and Coastal Areas Management (GEF-IWCAM) Project (www.iwcam.org). However, it has been noted that there is some level of policy and institutional/operational disconnect between the Authority and the Ministry of Agriculture in management of water resources as it concerns agricultural production.

While the demos did not consider RWH in primary agricultural production, there was focus on value-added agricultural production, and the role of the Ministry of Agriculture could be expanded in advocating for best practices in RWH in this area.

Recommendations

- **Re-design for smaller RWH applications:** The use of the 6" PVC pipes and fittings may be best suited for commercial, municipal and industrial applications where there generally is need to handle large water volumes. For domestic applications 4" pipes and fittings will be more appropriate as they are cheaper and more readily available in hardware stores. In addition the coupling used has the disadvantage of being held together by bolts that need to be removed to service the filter. The alternative design therefore calls for the use of 4-inch fittings that are more readily available. Figure 19 illustrates the proposed re-design. In addition, filters of varying porosity could be experimented with so as to minimize the extent of clogging but users need to be aware that the cloth should be removed and cleaned as part of routine maintenance.

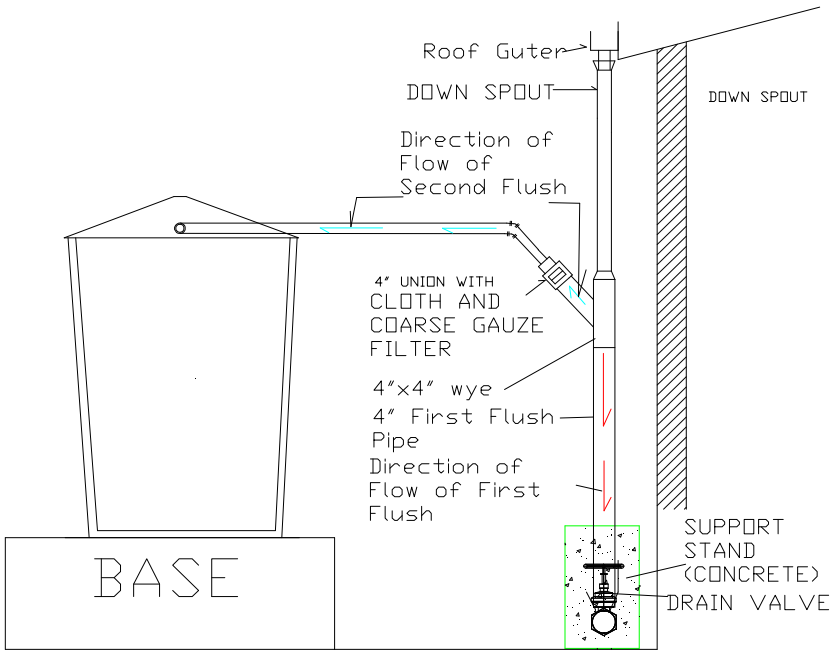

Figure 19 *Alternative design for up-flow filter and first flush diverter (using 4" fittings)*

- **Monitoring quality of harvested water:** The implementation of a monitoring system to test routinely the quality of the water over time. It is recommended that in as far as possible water quality should be tested at a site in the immediate vicinity where 'unimproved' RWH is practices where the storage method (tank type) and catchment (surface type) is similar. This will aid in a comparative analysis.
- **Technical partnerships:** There are several agencies that could be integrated as part of a national partnership grouping. The Central Board of Health will need to be key stakeholders in testing RWH systems as part of an on-going process to monitor health and raise awareness amongst the population on the health impacts of poor practices. This effort will be supported in the short to medium term by the Caribbean EcoHealth Project (CEHP). The CEHP is a multi-agency collaborative regional-level initiative comprising research partners from various universities in Canada and the Caribbean

(UWI and St. George's University) with funding from the Canadian government to study environmental health impacts of particular pollutants in the environment and burden of illness. There is a RWH cistern-testing component as part of the CEHP which is being led by CEHI. The intention is to conduct household surveys to assess knowledge, attitudes and practices by RWH practitioners and test the cisterns to determine the nature of contamination and potential health effects. This project will run into 2011. Antigua is one of the test countries. The Ministry of Agriculture should be another major partner in supporting the promotion of RWH for agricultural production at both primary and secondary production levels. From a policy stand-point the Development Control Authority (DCA) should continue to remain engaged as they have the statutory mandate in ensuring that adequate storage capacity is provided for in dwellings, public buildings and other facilities. The RWH technologies developed across the globe and under this project can be greatly promoted through application by local engineers, architects, plumbers and contractors. Organizations such as the Antigua and Barbuda Plumbing Association, Antigua and Barbuda Institute of Architects and the Antigua and Barbuda Contractor's Association should remain engaged in this initiative so as to transfer the technology to new projects. The Antigua Chapter of the Caribbean Water and Wastewater Association can also play a role in advocacy.

- **Raising awareness:** The level of awareness on the need for regular maintenance of catchment, conveyance systems, cisterns and tanks needs to be raised given the potential for health hazards. The Central Board of Health should consider the implementation of a more systematic and wide-reaching public awareness programme. It is recognized that the CBH may have resource challenges in launching a comprehensive programme for public awareness in improving safe rainwater harvesting practices. The development of a specific costed programme may be considered for solicitation of donor support.

Annexes

Annex 1: Demo selection evaluation instrument (worked example)

Rainwater Harvesting Antigua Demonstration Initiative

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It is anticipated that at least 5 potential demos (household) and 3 potential enterprise demos will be short-listed for evaluation using this instrument.

The following are the prerequisite criteria

1 The household and enterprise must be already engaged in the practice of RWH
2 There must be evidence that the participants have the capacity to sustain participation

The following are the qualifying criteria

Overall, the assessment gives highest favour (through weighting factors) to less affluent 'typical' households or small enterprises that use RWH and are affected by lack of access to a ready supply of potable water. The weighting factors can be adjusted.
NOTE: In the case of homes; **'Large'** is regarded as <2,000 sq.ft; **'Small'** is >1,500 sq.ft.

To use (and explainatory notes):

1 Insert values of **'1'** in the respective rows (entry columns shaded yellow) that best describe the relative rating assigned to the attribute.
NOTE: If more than one '1' is inserted on any given row the numerical outcome will not be valid.
2 The weightings are intended to favour selection of candidate demos that meet the **typical small to medium home or buisiness enterprise profile**
3 The weigthings also favour housholders and business owners who do have a reliable potable water supply and who have existing RWH systems that can be relatively easily upgraded
4 These weights can be changed by the evaluators if felt necessary, but must maintain the selection objective as outlined above

NOTE: only enter data in the yellow cells

	Qualifying Criteria	Categories					
1	House size or enterprise size	Large		Medium	1	Small	
2	Financial affluence	Affluent		Middle-income		Lower-income	1
3	Occupancy	Low (<3 persons)		Middle (3 - 6 persons)	1	High (> 6 persons)	
4	Roofing material condition	poor condition		fair condition		good condition	1
5	Storage type	underground cistern		above ground cistern		black tanks	1
6	Conveyance system	poor condition		fair condition		good condition	1
7	Access to potable supply - water availability	100% of time (reliable)	1	50% of time (variable)		no access	
8	Durability of building structure	Low		Moderate		High	1
9	Existence of water quality protection measures	no measures		some measures	1	well developed	
10	Is RW used in internal plumbing system?	No	1	<<<<<<<do not fill in>>>>>>>>>		Yes	

Sum	2	Sum	3	Sum	5
Weighting	0.25	Weighting	0.5	Weighting	1
Score	0.5	Score	1.5	Score	5

OVERALL SCORE 7

Annex 2: Participant Agreement (template)

Participant Agreement

Promoting Rainwater Harvesting in the Caribbean Region
Phase 2

Installation of Rainwater Harvesting fittings and equipment for Demonstration Model purpose

An initiative financed by the
United Nations Environment Programme (UNEP)
Division of Environmental Policy Implementation (DEPI)
P.O. Box 30552, Nairobi, Kenya

Implemented by the
Caribbean Environmental Health Institute (CEHI)
P.O. Box 1111
The Morne, Castries
St. Lucia

In partnership with the
Antigua Public Utilities Authority (APUA)
Cassada Gardens
St. John's, Antigua

September 2008

Participant Agreement

Promoting Rainwater Harvesting in the Caribbean Region (Phase 2)

Installation of Rainwater Harvesting fittings and equipment on for Demonstration Model purpose

Between
The Caribbean Environmental Health Institute
hereinafter referred to as the "CEHI"

and
Mrs. Rosemarie MacMaster
of Susie's Hot Sauce
Marble Hill, St. John's, Antigua
hereinafter referred to as the "Participant"

Terms of Agreement

A. THIS AGREEMENT is made and entered into for a term beginning the ___ day of _____ 2009, and ending the ____ day of _____ 2010, between the **Caribbean Environmental Health Institute** (hereinafter referred to as **"CEHI"**) having its principal place of business at the Morne, Castries, St. Lucia. W.I., and **Rosemarie MacMaster** (hereinafter referred to as the **"the Participant"**) of Susie's Hot Sauce, Marble Hill, St. John's, Antigua.

B. The purpose of this Agreement between CEHI and the Participant is to demonstrate best-practices in the design, installation and operation of low-cost Rainwater Harvesting (RWH) technologies that will be used as part of a suite of training resources for RWH practitioners across the Caribbean region.

C. The **Antigua Public Utilities Authority** (hereinafter referred to as the **"APUA"**) will serve as the local supervisory collaborator for the project.

CEHI and the Participant hereby agree as follows:

1. SCOPE OF WORK

I. CEHI, through local sub-contracting arrangements will recruit a Contractor to implement the work (hereinafter referred to as the "Rainwater Harvesting system" or "the Project"), described in the Scope of Works attached as Appendix A.

II. The Participant agrees (i) to provide CEHI, the APUA and their associates, access to the Rainwater Harvesting system and (ii) to cooperate and participate in water use and supply studies, and capacity building (training) activities relevant to the Project during the term as specified in Clause A above.

2. LIAISON

I. The APUA's Water Division will be responsible for local implementation of the Project on behalf of CEHI and will maintain contact between the Participant, the Contractor and CEHI to facilitate successful completion.

3. LIMITATION

I. CEHI is not obliged to perform any work beyond the Scope of Work described in Appendix A.

II. The Participant agrees not to transfer, sell or modify the Rainwater harvesting system or any of its components without the expressed prior approval by CEHI during the term as specified in Clause A above.

III. CEHI accepts no liability for any and all claims, losses, costs, damages of any nature whatsoever or claims of expenses from any cause or causes related to the Project.

4. CONFIDENTIALITY

I. CEHI and the Participant may disclose confidential information to each other to facilitate work under this Agreement. Such information shall be safeguarded and not disclosed to third parties without prior agreement by the two parties.

II. The obligation to keep information confidential shall however not apply to information which:

(a) Is already known to the party to which it is disclosed;
(b) Becomes part of the public domain without breach of this Agreement, or;
(c) Is obtained from third parties who have no confidentiality obligations to the contracting parties.

5. PUBLICITY

I. The Project will not use the name of the Participant in any publicity without the prior approval of the Participant.

II. The parties agree that it is part of Project's function to disseminate information and make it available for the purpose of Project.

III. The Participant will permit visitation of the property by interested parties through the APUA for term specified in Clause A following commissioning of the Rainwater Harvesting system. Visitation by interested parties beyond the term specified in Clause A will be at the discretion of the Participant.

6. OWNERSHIP OF PROPERTY

I. The Rainwater Harvesting system and all of its newly installed components will remain the property of CEHI during the term specified in Clause A. Thereafter, ownership becomes that of the Participant.

7. TERMINATION

I. Either party may terminate this Agreement thirty (30) days after notice is given to the other party.

8. ENTIRE AGREEMENT

I. This Agreement constitutes the entire agreement between the parties with respect to the subject matter hereof and supersedes all prior agreements, understandings, negotiations and discussions, whether written or oral.

IN WITNESS WHEREOF, the duly authorized officers of the parties have executed this Agreement as of the day and year first written above.

..... Date .....

Patricia Aquing
Executive Director
Caribbean Environmental Health Institute

..... Date.....

Rosemarie MacMaster
Susie's Hot Sauce

APPENDIX A
Scope of Works

Item	Description
1	To supply and install PVC guttering to fascia boards and down pipes
2	To supply and install PVC down pipes
3	To supply and install PVC pipe First Flush Diverters
4	To construct concrete base 2 feet above grade for storage tank support
5	To supply and install two 1000-gallon storage tanks
6	To relocate existing 400-gallon tank and integrate within the system
7	Allow for plumbing of system and integration into existing facility plumbing
8	To supply and install a water meter after water tanks as per design specifications
9	Refurbish the pumphouse shed
10	Clean up area surrounding the storage tanks
11	Paint the section of the backwall of the building in the vicinity of the storage tanks
12	Pressure washing of the roof section

n/a – not applicable