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NEW YORK CITY SOIL AND WATER CONSERVATION DISTRICT | EVERGREEN EXCHANGE | eDESIGN DYNAMICS

BROOKLYN, NY MARCH 2018

APPENDIX five

NYC DOT REVOCABLE CONSENT RULES

New York City

Department of Transportation

REVOCABLE CONSENT RULES

Title 34
Chapter 7
Rules of the City of New York

March 7, 2016

Due to recent legislative changes, certain cross references to the Administrative Code contained in these Rules may be inaccurate.

Title 34 **3/7/2016**
Department of Transportation
Chapter 7
Revocable Consent Rules

CONTENTS

Section 7-01
Definitions

Administrative Code. "Administrative Code" means the Administrative Code of the City of New York.

Charter. "Charter" means the New York City Charter.

Commissioner. "Commissioner" means the Commissioner of the Department of Transportation of the City of New York or his or her designee.

Department. "Department" means the Department of Transportation of the City of New York.

DCP. "DCP" means the Department of City Planning of the City of New York.

DoITT. "DoITT" means the Department of Information Technology and Telecommunications of the City of New York.

Improvement. "Improvement" means a tangible thing or object which may be installed on, over or under a street, or any private use of a street.

Public Service Corporation. "Public Service Corporation" means an entity subject to the jurisdiction of the Public Service Commission under the Public Service Law.

Revocable Consent. "Revocable consent" means a grant of a right, revocable at will, (1) to any person to construct and use for private use pipes, conduits and tunnels under, railroad tracks upon, and connecting bridges over inalienable property, (2) to an owner of real property or, with the consent of the owner, to a tenant of real property to use adjacent inalienable property for the purposes stated in section 7-04 hereof or as may be permitted by rules of DoITT, or (3) to a public service corporation for facilities ancillary to, but not within, a franchise granted prior to July 1, 1990.

ULURP. "ULURP" means the Uniform Land Use Review Procedure as set out in sections 197-c and 197-d of the Charter.

Section 7-02
Requirement to Obtain a Revocable Consent

With the exception of the city of New York and/or its agents, no person or entity shall install or maintain any of the improvements listed in section 7-04 of these rules without first obtaining a revocable consent from the Department. The Department shall not issue a revocable consent for any improvement which, in the judgment of DCP, has land use impacts or implications, unless such revocable consent has been reviewed and approved pursuant to ULURP. Revocable consents may not be assigned, transferred or otherwise conveyed without the prior written approval of the Commissioner.

Section 7-03
DCP Review

(a) The Department shall submit to DCP petitions for those improvements listed in §7-04(a) of these rules that do not meet the locational or dimensional standards in such section 7-04(a). The Department shall also submit to DCP all petitions for the following improvements: bridge, above-ground cable, guard booth, information sign/kiosk, parking area for private use, and above-ground pipe/fuel line.

(b) DCP shall review each petition submitted by the Department to determine whether or not a proposed revocable consent has land use impacts or implications and whether, as a result, ULURP applies, and shall notify the Department of its determination. The Department shall notify the petitioner of the determination by DCP regarding the applicability of ULURP and shall stay its final decision pending ULURP approval.

(c) If ULURP is required, the petitioner shall obtain information and application forms pertaining to ULURP from DCP and file a ULURP application with DCP in accordance with the rules governing ULURP.

(d) No revocable consent shall be granted by the Department if the application for such consent has been disapproved pursuant to ULURP. A revocable consent may be granted by the Department if the application for such consent has been approved pursuant to ULURP or if DCP determines the proposed improvement has no land use impacts.

(e) The Department shall submit to DCP for review any petition for a renewal or amendment for an improvement listed in section 7-04(a) of these rules where:

(1) such renewal or amendment includes a modification that does not meet a locational or dimensional standard in section 7-04(a) or increases the degree of non-compliance with such locational or dimensional standard; or

(2) such petition is for a bridge, above-ground cable, guard booth, information sign/kiosk, parking area for private use, above-ground pipe/fuel line, and the renewal or amendment includes a modification to the location or an increase in the dimension of such improvement; or

(3) such petition is for a renewal or amendment of a consent that was approved by the City Planning Commission for a specific term, and the renewal or amendment would extend the consent beyond the term approved by the Commission.

Section 7-04
Eligible Improvements; Standards; Annual Rates.

(a) The Commissioner may, in his or her discretion, grant, renew, modify, or rescind revocable consents for any of the improvements listed in this subdivision to be constructed or maintained on, over, or under City streets, in accordance with the requirements set forth in section 364 of the Charter. Except as otherwise provided, annual compensation for the improvements listed in this subdivision shall be as set forth herein and, unless otherwise provided, shall not increase during the term of the revocable consent.

(1) **Accessibility Lift to Provide Access for People with Disabilities**

(i) Standard.
The lift shall be stored at the building end of its run and shall include appropriate safety devices. The lift shall not extend more than five and one half feet in the direction of the curb from the base of the steps when in use. In no instance shall the lift or any portion thereof extend beyond the curbline when in use.

(ii) Annual rate. $25. The annual fee for an accessibility lift shall be in addition to the normal fee for a stoop or stairway.

(2) **Bench**

(i) Standard.
No bench shall be greater than six feet in length. Benches greater than four feet in length shall be designed to discourage people from reclining. Benches adjacent and parallel to the building shall be installed no more than six inches from the building face and, if multiple benches are installed, they shall be at least three feet apart. A bench which is not anchored to the sidewalk shall be placed against the building face during hours that the benefited property is open to the public and shall be stored inside the building when the building is closed.

(ii) Annual rate. $150

(3) **Bridge**

(i) To be referred to DCP to determine whether the improvement has land use impacts.

(ii) Annual rate. See section 7-10. If the structure is not in use, the rate shall be 10% of the rate in effect pursuant to the formulas described in section 7-10.

(4) **Cable, above-ground**

(i) To be referred to DCP to determine whether the improvement has land use

impacts.

(ii) Annual rate. See section 7-10.

(5) **Cellar door, including stair**

(i) Standard. All cellar doors required by section 27-292(b) (4) of the Administrative Code shall be constructed pursuant to the requirements of the Administrative Code.

(ii) Annual rate. See section 7-10.

(6) **Clock**

(i) Standard. The base shall be no more than 18 inches in diameter. The lowest portion of the clock face shall be at least eight feet above the sidewalk. The overall height of the clock shall not exceed 15 feet. The clockface shall be no more than two feet in diameter. Time shall be maintained accurately. The name or logo and address of the adjacent premises may be displayed on the clockface; however, the total display space shall be no greater than one third of the square footage of the clockface.

(ii) Annual rate. $300

(7) **Conduit and underground cable**

(i) Standard. All conduits shall be underground.

(ii) Annual rate. See section 7-10.

(8) **Electrical socket**

(i) Standard. All electrical sockets shall be installed pursuant to the requirements of the New York City Department of Buildings.

(ii) Annual rate. $25

(9) **Enclosure for trash receptacle, adjoining a building, for private use**

(i) Standard. The enclosure shall be of non-flammable construction and shall be rodent proof. The enclosure shall be between three feet and five feet high, except in areas in the Bronx, Queens, Brooklyn and Staten Island zoned for manufacturing, mixed-use (MX), special purpose districts which allow manufacturing, or for automotive or other heavy commercial uses (C8), where the enclosure shall be between three feet and ten feet high, and shall be securely

affixed to the sidewalk, fence, building, or other appropriate fixture.

(ii) Annual rate. The greater of $5 per square foot of area, as projected onto a horizontal plane or $25, except in areas zoned for manufacturing, where the annual rate shall be $1 per square foot of area, as projected onto a horizontal plane.

(10) **Fenced or walled-in area, including the enclosing structure, not used for planting or parking, including a fenced or walled-in area containing a drainage basin or a shopping cart storage area.**

An area enclosed by a privately installed guard rail shall be deemed a fenced-in area and shall be subject to the standards below. Fences may be approved for no more than one year pursuant to the provisions in section 2-10(j) of Chapter 2 of this Title 34, provided the placement of such fences is for temporary security purposes.

(i) Standard.

(A) The fence shall be no fewer than three and no greater than four feet high in residential and commercial zoning districts and shall be no fewer than three and no greater than ten feet high in manufacturing zoning districts, as such zoning districts are set forth in the Zoning Resolution, except that athletic play field fences may extend as high as 15 feet. Smooth edged finials may be attached to fence posts up to a maximum height of four feet, six inches in residential or commercial zoning districts. No chisel points or spikes shall be included on fences shorter than eight feet, except as approved by the Landmarks Preservation Commission.

(B) The fence shall be constructed of non-flammable, non-wood material. The use of opaque material (such as masonry) is limited to the base of the fence up to 21 inches in height and to vertical columns spaced at least five feet apart. Solid or opaque materials may comprise no more than 35 percent of the total vertical area of the fence above any opaque base. For metal fences, picket interspaces shall measure between four and five and three quarters inches, and picket width may measure up to one inch wide. Chain-link, where approved, shall have a two inch mesh and shall not include screening. Barbed wire is permitted in manufacturing zoning districts only. Razor wire is prohibited.

(C) No sign shall be attached to a fence.

(ii) Annual rate.

(A) Except as provided in section 7-04(a)(10)(ii)(B), below, the first year's annual rate shall be the greater of $1,500 or (C x L x 0.16 x A), as defined in section 7-10(a) of these rules, and subsequent years' rates shall be determined in accordance with section 7-10(c) of these rules.

(B) For non-commercial use connected to a residential building of six or fewer units, the greater of $100 or (C x L x 0.01 x A), as defined in section 7-10(a) of these rules.

(11) **Flagpole**

(i) Standard. The base shall be no larger than 18 inches in diameter and no fewer than 30 inches in height.

(ii) Annual rate. None (pursuant to section 19-125(e) of the Administrative Code).

(12) **Guard booth**

(i) To be referred to DCP to determine whether the improvement has land use impacts.

(ii) Annual rate. See section 7-10.

(13) **Information sign or kiosk**

(i) To be referred to DCP to determine whether the improvement has land use impacts.

(ii) Annual rate. See section 7-10.

(14) **Litter receptacle for public use**

(i) Standard. The litter receptacle shall be constructed of non-flammable, non-wood material and shall be securely affixed to the sidewalk or sufficiently heavy to prevent movement without considerable force. The minimum height of the receptacle shall be two feet, six inches, the maximum height shall be four feet and the maximum width shall be three feet, with an overall area not to exceed nine square feet. No side of the receptacle shall exceed three feet in width. The litter receptacle may include the grantee's logo and/or building or institution name no greater than one square foot in size, if the receptacle is adjacent to the named property.

(ii) Annual rate. $25

(15) **Overhead Building Projection in excess of that allowed by the Administrative Code**

(i) Standard. Overhead building projections shall be permitted over the street provided the minimum height above the sidewalk is ten feet and the depth of the projection does not exceed three feet, ten inches, inclusive of any depth permitted by section 27-313(a) of the Administrative Code, to a height 30 feet above the sidewalk. Above 30 vertical feet the permitted depth shall be four feet ten inches, inclusive of any depth permitted by the Administrative Code. Except for architectural details such as cornices, brackets and belt courses, which may extend

across the full street frontage of a building, projections shall not have an aggregate width at any level of the building greater than 50 percent of the building frontage. Projections containing floor area shall be referred to DCP.

(ii) Annual rate. See section 7-10.

(16) **Parking area for private use for non-residential property (if there is no charge to vehicle operator)**

(i) To be referred to DCP to determine whether the improvement has land use impacts.

(ii) Annual rate. The first year's annual rate shall be the greater of $600 or (C x L x 0.36 x A), as defined in section 7-10(a) of these rules, and subsequent years' rates shall be determined in accordance with section 7-10(c).

(17) **Pipe or fuel pipeline, above-ground**

(i) To be referred to DCP to determine whether the improvement has land use impacts.

(ii) Annual rate. See section 7-10. If the grantee is not using the structure, the Department may set rates without reference to the formulas described in section 7-10.

(18) **Planted area, including any surrounding fence or wall**

(i) Standard. Live vegetation shall occupy 80 percent of the area. No vegetation may overhang a sidewalk beyond the boundary of the planted area, including any fence, unless the overhanging vegetation is at least eight feet above the adjacent sidewalk area. No rocks, timbers, wickets (hoops) or other trip hazards shall serve as a border. Any surrounding fence or wall shall conform to the standards provided in item (10), above.

(ii) Annual rate. The greater of $2 per square foot of area, as projected onto a horizontal plane, or $25

(19) **Planters.**

(i) Standard.

(A) The planter shall be no fewer than 18 and no greater than 48 inches high. The maximum area, measured at the planter's widest point, shall be 25 square feet, and the maximum dimension of the planter shall be five feet along the side which is perpendicular to the curb or eight feet along the side which is parallel to the curb. (Planters installed against the building face may be continuous.)

(B) If a planter is proposed to be placed above a sidewalk vault, a professional engineer shall certify that the sidewalk can support a 600-pound per square foot live load.

(C) No planter shall be constructed of wood. Wood cladding of other planter types is permitted if such cladding is fireproof and graffiti resistant. Concrete tubs, two inches thick, are recommended.

(D) The Department recommends the planting of small shrubs and flowers as they require less maintenance and are hardier than small trees. No woody growth shall overhang the edge of the planter. Suggested tree species for planters are: Crab Apples - (Florida Snow Drift); Euonymus Pateris (Shrub); Taxus O. Densifornius (Japanese Yew); Scotch Pine; Austrian Pine; Ilex Meserva; Cornus Mass (Corneliean Dogwood); Syringia Reticulata (Japanese Tree Lilac); Prunus Sargentii (Columnaris); Acer Ginnala (Amur Maple); Acer Truncatum; Viburnum Sieboldii (Tree Form Viburnum).

(E) Planters shall be maintained, shall contain live plants at all times and shall be kept free of debris and graffiti.

(ii) Annual rate. The greater of $2 per square foot of area as projected onto a horizontal plane, or $25 per planter.

(20) **Post, pole or bollard not otherwise governed by permit procedures contained in section 19-125 of the Administrative Code**

(i) Standard. The post, pole or bollard shall be no fewer than 30 inches high, no greater than 48 inches high, and no greater than 18 inches in diameter. If more than one post, pole or bollard is to be installed, they shall be at least four feet apart and shall not be joined with horizontal members. If a concrete-filled pipe design is used, it shall be capped or smoothed.

(ii) Annual rate.

(A) $125 each, minimum of $500 per consent.

(B) Post, pole or bollard adjacent to a building containing a marquee pursuant to a permit granted by the Department of Buildings, $25 each, minimum of $100 per consent.

(21) **Public service corporation facility ancillary to, but not within, a franchise granted prior to July 1, 1990**

(i) Standard. Refer to standards in this section for individual structures.

(ii) Annual rate. See section 7-10. When calculating the annual rate pursuant to this paragraph, “E” will be reduced by 15%. This rate shall not apply to revocable consents approved as provided in subdivision (b) of this section.

(22) **Railroad tracks for private use**

(i) Standard. Railroad tracks shall be located in an M or C8 zoning district outside any area improved for vehicular or pedestrian use, except that tracks may cross an existing or future driveway with the permission of the property owner served by such driveway.

(ii) Annual rate. The first year's annual rate shall be the greater of $500 or (C x L x 0.04 x A), as defined in section 7-10(a) of these rules, and subsequent years' rates shall be determined in accordance with section 7-10(c).

(23) **Ramp intended to provide access for people with disabilities**

(i) Standard.

(A) The Department may grant a revocable consent for a ramp which extends more than 44 inches from the building line for buildings erected prior to December 6, 1969, including any additional steps attached or ancillary to the ramp structure made necessary by the creation of the ramp. (Section 27-308 of the Administrative Code permits ramps to extend up to 44 inches from the building line for such buildings.) (Buildings erected after December 6, 1969 must contain ramps within the property line.)

(B) In the case of buildings erected between December 6, 1969 and September 5, 1987, the Department may grant a revocable consent for a ramp which extends more than 44 inches from the building line if the ramp will make a primary entrance to the building accessible.

(C) The ramp shall conform to the standards of the Americans with Disabilities Act, 36 CFR Part 1191, and section 27-308 of the Administrative Code. A canopy may be erected above the ramp provided such canopy does not fully enclose the ramp and provided such ramp is adequately illuminated and complies with all other applicable regulations.

(ii) Annual rate. $25

(24) **Retaining Walls**

(i) Standard. Retaining walls may be constructed only where warranted by existing grade or by a change in grade undertaken with prior approval by the Department of Buildings.

(ii) Annual rate. See section 7-10.

(25) **Sidewalk plaque or logo**

(i) Standard. The size of the logo or plaque shall not exceed nine square feet with a maximum dimension of three feet along any side. The plaque or logo shall be limited in design and content to a symbol or other element referring to or naming the adjoining property owner, a district organization, the district/neighborhood character, or consistent with an area-wide way-finding

graphic design system. The plaque or logo shall consist of material that provides a stable, firm and slip-resistant surface and shall be installed flush with the sidewalk surface.

(ii) Annual rate. $300 per plaque or logo.

(26) **Socket with removable poles, posts, or similar devices, including any connecting devices such as ropes, ribbons, horizontal poles, and the area thereby enclosed**

(i) Standard. Sockets shall be flush with the sidewalk and fitted with spring-mounted flush covers. Posts or poles shall be no fewer than 30 inches and no greater than 48 inches high, including any connecting devices.

(ii) Annual rate. The first year's annual rate shall be the greater of $750 or (C x L x 0.16 x A), as defined in Section 7-10(a) of these rules, where A is the area of the enclosed area, and subsequent years' rates shall be determined in accordance with section 7-10(c).

(27) **Stoop, step, ramp, vestibule or other entrance detail extending beyond limits set in Articles 8 and 9 of Subchapter 4 of Chapter 1 of Title 27 of the Administrative Code, other than a ramp described in section 7-04(a)(23) hereof or a stoop or other improvement described in section 7-04(a)(29) hereof**

(i) Standard. Such structures shall be constructed pursuant to the requirements of the New York City Department of Buildings and shall have a maximum width of eight feet and shall extend as far as such structures on adjacent buildings.

(ii) Annual rate. See section 7-10.

(28) **Stoop or any other improvement eligible for a revocable consent pursuant to these rules and adjacent to a building which is located within a designated New York City historic district or which is a designated New York City Landmark.**

(i) Standard. No revocable consent shall be granted for such a structure located in a designated New York City historic district or attached to a designated New York City landmark building without the prior written approval of the Landmarks Preservation Commission pursuant to Chapter 3 of Title 25 of the Administrative Code. Refer to standards in this section for individual structures.

(ii) Annual rate. $25 for residential buildings with fewer than six units. For all other buildings, see the appropriate paragraph of this subdivision.

(29) **Street lamp or light fixture**

(i) Standard. Street lamps or light fixtures which replace or augment existing lighting shall be placed and illuminated as approved by the Department's Division of Street Lighting. The base shall be no greater than 18 inches in diameter. Hours of illumination shall coincide with those of the City's street lights.

(ii) Annual rate. $150

(30) **Tunnel**

(i) Standard. All tunnels and related structures shall be constructed underground or within the adjacent building pursuant to the requirements of the New York City Department of Buildings.

(ii) Annual rate. See section 7-10. If the structure is not in use, the rate shall be 10% of the rate in effect pursuant to the formulas described in section 7-10.

(31) **Vault extending beyond the curbline or underground improvement not otherwise governed by license procedures contained in section 19-117 of the Administrative Code**

(i) Standard. All vaults shall be constructed underground pursuant to the requirements of the New York City Department of Buildings.

(ii) Annual rate. See section 7-10.

(32) **Any improvement listed in section 7-04 for which a consent is proposed to be granted where the grantee has filed an application concerning the subject property pursuant to section 4-105 of the Administrative Code, or any improvement listed in section 7-04 of these rules where the construction of such improvement was funded 50 percent or more by a City agency.**

(i) Standard. Refer to standards listed above for individual structures.

(ii) Annual rate. The Department may set rates for such consents without reference to the formulas described in § 7-10; such rates shall be set forth in the agreements memorializing the consents.

(33) **Any improvement listed in section 7-04 which has been approved for use for security purposes by the New York City Police Department.**

(i) Standard. Refer to standards listed above for individual structures.

(ii) Annual rate. None.

(iii) This paragraph shall not be construed to apply to any improvement(s) listed in paragraph 35 of subdivision (a) of Section 7-04 of Title 34 of these

Rules.

(34) **Upon approval by the Public Design Commission, any work of art that is fully integrated into an improvement listed in section 7-04.**

(i) Standard. Such an improvement with an integrated art element must adhere to the standards listed in this section for individual structures.

(ii) Annual rate. 50% reduction to the annual rate listed in this section for individual structures.

(35) **Portions of the street used in connection with loading docks, bays or other like facilities for loading and unloading of goods and materials of or for the use of foreign, domestic or multinational governmental entities, where, in the judgment of the New York City Police Department, the location of such facility is necessary due to security concerns applicable to such entity.**

(i) To be referred to DCP to determine whether the improvement has land use impacts.

(ii) Annual rate. An amount determined by the Department to be adequate compensation.

(36) **Bicycle racks.**

(i) Standard. All bicycle racks shall be installed in compliance with the general conditions in Section 7-06 of this title. A request that adheres to minimum clearances may nonetheless be denied by the department if the bicycle rack would interfere with the safe passage of pedestrians.

(ii) Annual rate. $25

(37) **Any improvement that has been certified by a New York State Licensed Professional Engineer as a component of a flood mitigation system as defined in Section 2-10 of this title.**

(i) Standard.

(A) The Department may grant a revocable consent for flood mitigation system components. Except in the case of a public service corporation facility, a revocable consent will only be granted to a petitioner:

(a) for the protection of a building or portion of a building under this paragraph where such building or portion of a building was erected prior to January 8, 2015 or where a lawful building permit was issued by the Department of Buildings for the erection of such

building prior to January 8, 2016; or
(b) for the protection of a building or portion of a building located within an area of special flood hazard, as such term is defined in section G201.2 of Appendix G of the New York City Building Code.

(B) Such improvements shall be designed and constructed in compliance with the requirements of the New York City Department of Buildings and any other applicable requirements of or terms and conditions of approvals issued by other City entities. The Department will consult with the New York City Department of Environmental Protection and any other agency the Department deems necessary or desirable regarding an application for a revocable consent for flood mitigation system components prior to its approval of such application.

(ii)Fee. $2,000. This fee shall apply to the initial revocable consent application and shall not apply to renewal applications so long as the design of the improvement has not changed.

(b) Other improvements approved by the Board of Estimate. Revocable consents that were granted by the Board of Estimate prior to July 1, 1990 for private improvements which are not listed in subdivision (a) above may be renewed, amended, or revoked by the Commissioner in his or her sole discretion, provided that any renewal or amendment shall be submitted to DCP when required pursuant to section 7-03 of these rules. In each year of such consent, the annual rate shall increase by the average of the Consumer Price Index for All Urban Consumers in New York and New Jersey published by the U.S. Department of Labor's Bureau of Labor Statistics ("CPI") increase for the ten years prior to the date of the renewal of the consent. For consents granted pursuant to this subdivision to public service corporations, their annual rate increase shall be reduced by 15%.

(c) Compliance with requirements. All improvements for which a revocable consent is granted shall comply with the general conditions in section 7-06 of these rules.

Section 7-05

Revocable Consents for Telecommunications Purposes

Petitions for revocable consents for telecommunications purposes shall be reviewed and may be granted by DoITT, subject to approval by the Department and review by DCP, where appropriate. Petitions for such consents shall be filed with the Department and shall be forwarded by the Department to DoITT for processing. Petitioners shall submit any additional information which may be required by DoITT.

Section 7-06

General Conditions

(a) Advertising Prohibited. No advertising shall appear on any improvement which is the subject of a revocable consent agreement.

(b) Maintenance. Graffiti shall be removed within seven days of appearance. Art Commission approved colors shall be used and maintained. Sidewalks fronting the entire property must be in good condition, without violations or illegal encroachments.

(c) Clearances for Above-Ground Structures.

(1) Corner Clearance Policy. No revocable consent will be granted for above-ground structures located within the corner quadrant (the area ten feet from either side of the area created by extending the building line to the curb) pursuant to Executive Order #22 of 4/13/95, as amended.

(2) Improvements shall be at least 18 inches from the curb line (front face of curb).

(3) Clear path. A straight unobstructed path ("clear path") for pedestrian circulation on the sidewalk shall remain after the installation of the improvement. The minimum width of the clear path shall be the greater of eight feet or one-half of the sidewalk width. The minimum width of the clear path shall be the greater of ten and one-half feet or one-half of the sidewalk width where a bench, information kiosk or bicycle rack with bicycles parallel to the curb or a queuing area enclosed by poles abuts the clear path. The minimum width of the clear path shall be the greater of 12 1/2 feet or one-half of the sidewalk width where a bicycle rack with bicycles perpendicular to the curb abuts the clear path. The clear path shall be maintained for 15 feet to either side of the improvement. When possible, the improvement shall abut, be aligned with, or be located between other major obstructions such as subway entrances, bus stop shelters, newsstands, and sidewalk cafés.

(4) Improvements shall not be located under fire escapes.

(5) (i) The following minimum distances shall be required between the revocable consent improvement and the specified element or object, except as otherwise specified herein:

Subway Entrance (open side)	15'
Sidewalk Cafés	15'
Newsstand	15'
Bus Stop (with/without shelter)	15'

Fire Hydrant/Standpipe	10'
Driveway	10'
Bicycle Rack (including all bicycles)	8'
Street Tree	5'
Bench	5'
Principal Building Entrance	5'
Ramp intended to provide access for people with disabilities	5'
Subway Entrance (closed end or side)	5'
Public Telephone	5'
Planters on the sidewalk not adjacent to the building façade	5'
Mail Box	4'
Street Lights	4'
Parking Meters	4'
Edge of Tree Pit	3'
Street Signs	3'
Utility Hole Covers, Cellar Doors, Areaways	3'
Transformer Vault, Sidewalk Grates	3'
All Other Legal Street Furniture	5'

(ii) Benches, information kiosks, litter receptacles, mail boxes, planters and public telephones may be located in an aligned grouping with a reduced minimum clearance between them of three feet. Other structures may be incorporated into such groupings provided the minimum clearances in subparagraph (i) above are provided. In no case shall such groupings extend for a length greater than 30 feet along the sidewalk. The listed elements may also be combined, without separation, into a single structure provided the overall length of such unitary structure and any other of the listed elements outside the grouping or unitary structure shall be no more than 15 feet. In no case shall a grouping or unitary structure be less than 15 feet from another grouping or unitary structure.

(d) Waiver.

(1) Where strict compliance with these rules shall create undue hardship, the Commissioner may waive or modify these rules, in specific cases, except where prohibited by law, if in his/her opinion, the public health, safety and general welfare will not be endangered thereby. The petitioner shall request such waiver in writing and shall provide any information requested by the Department which may assist the Commissioner in his or her determination.

(2) Notwithstanding the above provisions, prior to waiving the standards rules related to the location or dimensions of improvements, the Department shall refer the proposed change to DCP for review.

Section 7-07

Application Requirements

(a) Petition form. An application for a new revocable consent or for a renewal, modification, assignment or rescission of an existing revocable consent shall be made on a petition form obtained from the Department, and shall be signed by the petitioner or a person authorized to enter into binding agreements on behalf of the petitioner. In the case of a new consent, the petitioner shall submit the original plus ten copies of the completed form; in the case of a renewal, modification, assignment or rescission, petitioner shall submit the original plus five copies.

(b) Business Certificates. The petitioner shall submit a copy of any applicable business certificate, such as a certificate of incorporation or partnership certificate. With respect to petitions for an assignment or transfer of a revocable consent, the petitioner shall submit a copy of the business certificate of the assignee or transferee.

(c) Plans.

(1) Paper or mylar prints of a plan shall be submitted in the equivalent number of prints as are required for the petition form. Each plan print shall measure 18 by 24 inches unless otherwise authorized by the Department.

(2) The plan shall bear the seal of a Professional Engineer or Registered Architect licensed by the State of New York.

(3) The plan shall be drawn to scale and shall indicate the block and lot number of the property of the petitioner. The plan shall indicate in detail the method of construction, applicable technical information, and the materials to be used. A title box shall be placed on the right hand side of each sheet containing the words “Plan Showing Location of Proposed (structure type) to be Constructed in (name of street), Borough of (borough), to Accompany Application of (petitioner’s name), dated (petition date), to the Department of Transportation of the City of New York” and shall indicate the date it was prepared and any subsequent revisions.

(4) All details of existing structures shall be shown in standard line thickness. All proposed new construction and existing structures which are the subject of the petition shall be plainly shown in red. Proposed removals or relocations, if any, of existing conduits, pipes lines, or other structures shall be clearly indicated by red dashed lines.

(5) The plan shall show the building lines and curb lines, railroad tracks, and, if applicable, any electrical conduits, sewers and other substructures in the street which may be affected in any manner by the proposed construction. All such information shall be obtained and verified by the petitioner. The location, character and dimensions of all such structures and substructures shall be accurately shown and indicated by dimensions on the plan.

(6) The plan shall include longitudinal and transverse sections to show the relative position of the existing structures in the street and the proposed new construction.

(7) The applicant shall provide photographs of the existing conditions and may be required to provide photo simulations of the proposed structure and its surroundings as they would appear after installation.

(8) The plan shall also include the Professional Engineer's or Registered Architect's estimate of the current cost to remove or deactivate the proposed improvement and restore all sidewalks and pavements to current Department standards for new construction. Alternatively, the cost of removal may be provided on a separate sheet of paper provided that it is signed and sealed by a Professional Engineer or Registered Architect.

(9) Following the installation of any improvement for which a consent has been granted, the petitioner shall submit to the Department two copies of a plan indicating the "as built" condition. Such plan shall include any changes approved by the Department, with any deviations from the original plan shown by a double red line. Such plan shall be signed, sealed and dated by a Professional Engineer, Registered Architect or a Licensed Land Surveyor and shall include a certification which reads: "This drawing represents the as-built condition and shows the actual location of all subsurface conditions uncovered during this installation."

(d) Pedestrian Congestion. The Department may require a petitioner to submit additional information concerning pedestrian density and volume as well as the width of the usable pedestrian path at the site of a proposed revocable consent structure. The Department may require that such information include a pedestrian flow analysis conducted according to the performance standards described in the Transportation Research Board's Highway Capacity Manual chapter on pedestrian flow.

(e) Additional Copies and Information. Upon the request of the Department, the petitioner shall provide additional copies of the petition and/or plan. The petitioner shall also provide any additional supporting information requested by the Department or by DCP, where referral has been made to DCP.

(f) Waiver of Plan Requirements. For petitions concerning minor improvements, such as planters, trash and litter receptacles, or benches, the Department may waive the requirement that the plan be prepared by a Professional Engineer or Registered Architect where such submission is not otherwise required by law, and where the petitioner has requested a waiver in writing.

(g) Exception. The requirements of this section shall not apply to revocable consents for public service corporation facilities ancillary to, but not within, a franchise, if the revocable consent covers multiple structures whose locations are not known at the time of the granting of the consent. Plans for each such structure shall be submitted prior to construction and shall meet the requirements of Chapter 2 of Title 34 of the Rules of the City of New York.

Section 7-08

Filing Fees

(a) General Information. Filing fees for petitions shall be submitted with the petition form and any required plans or supporting documents. Filing fees shall be non-refundable.

(b) Specified Improvements. The filing fees listed in this paragraph shall apply to petitions for the following specified types of improvement: accessibility lift; bench; enclosure for trash receptacle; litter receptacle; planted area; planter; ramp intended to provide access for people with disabilities; stoop or step; or any improvement which has been approved by the Landmarks Preservation Commission:

(1) initial petition	$100.00
(2) renewal	100.00
(3) modification	100.00
(4) assignment or transfer	100.00
(5) rescission	100.00

(c) All other improvements, except for improvements approved for use for security purposes by the New York City Police Department.

(1)	initial petition	750.00
(i)	initial petition with a Special Street Plan Type F application with proof of payment of a fee in excess of $650.00	100.00
(2)	renewal	500.00
(3)	modification	
(i)	contractual	375.00
(ii)	structural	550.00
(4)	assignment or transfer	200.00
(5)	rescission	375.00

(d) Improvements approved for use for security purposes by the New York City Police Department. Filing fees shall not apply to any improvements approved for use for security purposes by the New York City Police Department.

Section 7-09

Action by the Department

(a) The Department shall, within 30 calendar days of receipt of a complete petition for a revocable consent, forward a copy of such petition to: the Borough President for the borough in which the proposed improvement is to be located; all Community Boards in whose districts the proposed improvement is to be located; DCP, if required to do so pursuant to section 7-03; and all other City agencies affected by the proposed consent. The Department shall allow 30 calendar days for the Borough President, Community Board, and other affected agencies to comment on the petition.

(b) The Department shall inform the petitioner in writing of all objections. Review of the petition shall be stayed until all objections are resolved. The petitioner shall be given the opportunity to revise the petition or plan in order to resolve the objection(s). If any objection has not been resolved within 90 days from the date the petitioner was informed of the latest objection, such petition may, in the discretion of the Department, be deemed to have been withdrawn.

(c) Prior to granting any revocable consent or renewal or modification to the location or an increase in the dimension of an improvement, the Department shall hold a public hearing on the terms and conditions of the proposed revocable consent agreement. Notice of such hearing shall be published by the Department at the expense of the petitioner in accordance with section 371 of the Charter.

(d) Notwithstanding the foregoing, the Department may deny a petition for a revocable consent without a hearing if, in the sole judgment of the Commissioner, the grant of such consent would interfere with the use of the inalienable property of the City (including streets and sidewalks) for public purpose or would otherwise not be in the best interest of the City.

(e) The revocable consent agreement shall be filed by the Department with the appropriate County Clerk.

Section 7-10

Annual Rate Schedule for Revocable Consent Improvements

For all improvements that do not have an annual rate set forth in section 7-04(a), the annual rate of compensation for the first year of the term of each revocable consent shall be calculated in accordance with the following:

(a) Definitions and Variables.

"A" means the maximum area of the improvement for which a consent has been or is proposed to be granted, as projected onto a horizontal plane (the "footprint").

"Benefited Property" means the real property which is adjacent to the improvement for which a revocable consent has been or is proposed to be granted, and which is benefited by the improvement.

"C" means 100 percent plus the percent change (plus or minus) in the Consumer Price Index for All Urban Consumers in New York and New Jersey published by the U.S. Department of Labor's Bureau of Labor Statistics ("CPI") on July 1 of the year for which the revocable consent annual rate is being calculated, compared to the CPI on July 1, 2003.

"E" means the standard escalating factor, which shall be a percentage equal to the average annual percentage increase in the CPI for the ten years immediately preceding the year for which the standard escalating factor is being determined; the Department shall determine the standard escalating factor on July 1 of the year to be applied to all consents granted or renewed between that July 1 and the next succeeding June 30, inclusive.

"L" means the Current Transitional Assessed Value[1] or the Actual Assessed Value, whichever is lower, of the Benefited Property, in its unimproved state (in dollars and cents per square foot); provided, however, that if there is more than one Benefited Property, "L" shall be equal to the average of the Current Transitional Assessed Values of all the Benefited Properties in their unimproved states (in dollars and cents per square foot). Note: For cables contained within conduit owned by another entity, L=0.

"M" means the applicable multiplier. For pipes and conduits with up to 25 square feet in cross-sectional area, the applicable multiplier is 0.04. For all other improvements, the applicable multiplier is 0.08.

"Minimum Annual Charge" shall be assessed as follows: For improvements having a maximum cross-sectional area greater than four square feet, the Minimum Annual Charge shall be $3,000. For improvements having a maximum cross-sectional area of four square feet or less, the Minimum Annual Charge is $1,500, except that pipes and conduits having an outside diameter of

[1] Current Actual or Transitional Value, whichever is less.

three inches or less (inclusive of any protective sheath or casing) shall be assessed a Minimum Annual Charge of $750.

"R1" means the rate of compensation for the first year of the revocable consent agreement which shall be determined in accordance with section 7-10(b), below.

"V" means the rate (in dollars and cents) obtained from Table A relating to the volume occupied by the improvement. For improvements exceeding nine feet in height, the computation will be made in units up to nine feet in height and then added together.

(b) Rate for First Year. R1 shall equal C [V + (L x M x A)], or the Minimum Annual Charge, whichever is greater.

(c) Rate for Each Subsequent Year.

second year = R1 + (E x R1)

third year = R1 + (2E x R1)

fourth year = R1 + (3E x R1)

fifth year = R1 + (4E x R1)

sixth year = R1 + (5E x R1)

seventh year = R1 + (6E x R1)

eighth year = R1 + (7E x R1)

ninth year = R1 + (8E x R1)

tenth year = R1 + (9E x R1)

(d) Consents granted on or prior to June 30, 1991. For those consents granted on or before June 30, 1991 which provide for annual fees to be computed based upon the rate schedule currently in effect, annual compensation shall equal R1 as calculated pursuant to section 7-10(b).

(e) Revenue. All revocable consent revenue shall be collected by the Department.

Table A

Length in Feet	Cross-Section Area						
	Up to 1.4 Sq. ft.	1.4 to 4 Sq. ft.	4 to 20 Sq. ft.	20 to 81 Sq. ft.	81 to 162 Sq. ft.	162 to 243 Sq. ft.	Smaller Pipes up to 3"
Up to 100'	$13.90 Per Ft.	$27.83 Per Ft.	$34.78 Per Ft.	$41.72 Per Ft.	$69.56 Per Ft.	$83.48 Per Ft.	$7.26 Per Ft.
100' - 150'	$1,390 + $8.17 Per Ft. Over 100 ft.	$2,783 + $16.35 Per Ft. Over 100 ft.	$3,478 + $20.43 Per Ft. Over 100 ft.	$4,172 + $24.51 Per Ft. Over 100 ft.	$6,956 + $40.87 Per Ft. Over 100 ft.	$8,348 + $49.04 Per Ft. Over 100 ft.	$726 + $4.26 Per Ft. Over 100 ft.
150' - 200'	$1,799 + $7.72 Per Ft. Over 150 ft.	$3,600 + $15.45 Per Ft. Over 150 ft.	$4,499 + $19.30 Per Ft. Over 150 ft.	$5,397 + $23.16 Per Ft. Over 150 ft.	$9,000 + $38.62 Per Ft. Over 150 ft.	$10,800 + $46.34 Per Ft. Over 150 ft.	$939 + $4.03 Per Ft. Over 150 ft.
200' - 250'	$2,185 + $7.29 Per Ft. Over 200 ft.	$4,373 + $14.59 Per Ft. Over 200 ft.	$5,464 + $18.23 Per Ft. Over 200 ft.	$6,555 + $21.87 Per Ft. Over 200 ft.	$10,931 + $36.46 Per Ft. Over 200 ft.	$13,117 + $43.76 Per Ft. Over 200 ft.	$1,140 + $3.80 Per Ft. Over 200 ft.
250' - 300'	$2,549 + $6.83 Per Ft. Over 250 ft.	$5,102 + $13.67 Per Ft. Over 250 ft.	$6,376 + $17.08 Per Ft. Over 250 ft.	$7,649 + $20.49 Per Ft. Over 250 ft.	$12,754 + $34.16 Per Ft. Over 250 ft.	$15,305 + $41.00 Per Ft. Over 250 ft.	$1,330 + $3.56 Per Ft. Over 250 ft.
300' - 350'	$2,891 + $6.40 Per Ft. Over 300 ft.	$5,786 + $12.81 Per Ft. Over 300 ft.	$7,230 + $16.00 Per Ft. Over 300 ft.	$8,673 + $19.20 Per Ft. Over 300 ft.	$14,462 + $32.01 Per Ft. Over 300 ft.	$17,355 + $38.42 Per Ft. Over 300 ft.	$1,508 + $3.34 Per Ft. Over 300 ft.
350' - 400'	$3,211 + $5.94 Per Ft. Over 350 ft.	$6,426 + $11.89 Per Ft. Over 350 ft.	$8,030 + $14.85 Per Ft. Over 350 ft.	$9,633 + $17.82 Per Ft. Over 350 ft.	$16,062 + $29.71 Per Ft. Over 350 ft.	$19,276 + $35.66 Per Ft. Over 350 ft.	$1,675 + $3.10 Per Ft. Over 350 ft.
400' - 450'	$3,508 + $5.70 Per Ft. Over 400 ft.	$7,021 + $11.41 Per Ft. Over 400 ft.	$8,772 + $14.25 Per Ft. Over 400 ft.	$10,524 + $17.10 Per Ft. Over 400 ft.	$17,548 + $28.51 Per Ft. Over 400 ft.	$21,059 + $34.22 Per Ft. Over 400 ft.	$1,830 + $2.97 Per Ft. Over 400
450' - 525'	$3,793 + $5.21 Per Ft. Over 450 ft.	$7,591 + $10.43 Per Ft. Over 450 ft.	$9,485 + $13.03 Per Ft. Over 450 ft.	$11,379 + $15.63 Per Ft. Over 450 ft.	$18,973 + $26.06 Per Ft. Over 450 ft.	$22,770 + $31.28 Per Ft. Over 450 ft.	$1,979 + $2.72 Per Ft. Over 450 ft.
525' - 600'	$4,183 + $4.75 Per Ft. Over 525 ft.	$8,373 + $9.48 Per Ft. Over 525 ft.	$10,462 + $11.85 Per Ft. Over 525 ft.	$12,551 + $14.22 Per Ft. Over 525 ft.	$20,928 + $23.71 Per Ft. Over 525 ft.	$25,116 + $28.45 Per Ft. Over 525 ft.	$2,183 + $2.47 Per Ft. Over 525 ft.
600' - 30,000'	$4,540 + $4.33 Per Ft. Over 600 ft.	$9,084 + $8.66 Per Ft. Over 600 ft.	$11,351 + $10.83 Per Ft. Over 600 ft.	$13,618 + $12.99 Per Ft. Over 600 ft.	$22,706 + $21.66 Per Ft. Over 600 ft.	$27,249 + $25.99 Per Ft. Over 600 ft.	$2,368 + $2.26 Per Ft. Over 600 ft.
For More Than 30,000'	$134,440 + $2.82 Per Ft. Over 30,000 ft.	$268,884 + $5.64 Per Ft. Over 30,000 ft.	$336,251 + $7.05 Per Ft. Over 30,000 ft.	$403,318 + $8.46 Per Ft. Over 30,000 ft.	$672,506 + $14.11 Per Ft. Over 30,000 ft.	$806,949 + $16.93 Per Ft. Over 30,000 ft.	$70,168 + $1.47 Per Ft. Over 30,000 ft.

APPENDIX SIX

NYS RAINWATER HARVESTING GUIDELINES

New York State
Rainwater Harvesting Guide

2015

Environmental
Finance
Center
Syracuse University

New York State Rainwater Harvesting Guide 2015

Information for the development of this guide was primarily sourced, with permission, from “Rainwater Harvesting” by Dana O. Porter, Russell A Persyn, and Valeen A. Silvy of Texas A&M AgriLife Extension Service Information presented in this guide is from the Texas A&M publication unless otherwise cited.

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What is Rainwater Harvesting?

According to the National Conference of State Legislatures, rainwater harvesting is “the act of utilizing a collection system to use rainwater for outdoor uses, plumbing, and in some cases, consumption” (NCSL 2013). While there are laws pertaining to rainwater harvesting in some states, New York is not one of them. Rainwater harvesting captures, diverts, and stores rainwater for later use. The method of harvesting rainwater is an innovative approach to use water more efficiently, resulting in monetary savings.

Why Participate in Rainwater Harvesting?

Even with low rainfall averages, one can save money by efficiently collecting and storing rainwater for irrigation for many aspects of the landscape. Rainwater harvesting can also be an easy solution to minimize harmful environmental effects that could be occurring on a property.

Benefits of Rainwater Harvesting

- Decreased erosion from rainwater runoff, which can decrease agricultural productivity.
- Reduced charges on utility bills.
- Reduced runoff that could be carrying harmful contaminants such as fertilizer, sediments, or pesticides. This becomes especially important when on a farm or near a body of water.
- Rainwater can be used to clean machinery, provide drinking water for animals, wash out of pens and parlors, and supply water to irrigation systems.

Did you know? Many areas of New York State use salt to keep roads safe in the winter. However, this salt can infiltrate soil on a property and inhibit vegetation growth. Rainwater, however, is free of salts and minerals. When rainwater percolates into the soil it pushes the salt away from the root zones, promoting healthy root growth.

Rainwater harvesting systems can be very easy to create. This guide helps homeowners, farmers, and other users design and utilize a rainwater harvesting system that is right for them and their property.

Water Use and Supply Nationwide and in NYS

Water uses such as irrigation, public supply, and thermoelectric power account for 90 percent of the nation’s total water consumption (USGS,

2015). According to the U.S. Geological Survey, the estimated total water use for New York State in 2010 was 10.6 billion gallons per day.

New York State is rich in freshwater sources, as normal annual precipitation in most of state ranges from 30 to 50 inches (NOAA 2015). These sources provide drinking water, flood protection, and support "recreation, tourism, agriculture, fishing, power generation, and manufacturing" (NYSDEC, 2015). However, freshwater is not an unlimited resource, and water users are only increasing in New York (NYSDEC, 2015). Since water is so valuable, water conservation efforts and conservation programs have been developed throughout the state.

Before Installation

There are many factors to consider when choosing the right rainwater harvesting system that caters to a property owner's demands. Determining the right system in the beginning will save money and increase efficiency.

What Is the Primary Use of the Rainwater Harvesting System?

Collected rainwater may serve in various applications, including landscaping, in-home use, livestock, fire protection, stormwater management, and facility/equipment washing. Identifying water applications will guide system size and installation needs.

Consider the Following:

- Will the harvested rainwater be used immediately, or stored for later use?
- Will the system need to have high pressure to spray crops, or will a low pressure, dripping system be used to water the crops?
- Are the crops for consumption? If so, what water treatment system options are available?

How Much Rainwater Is Required?

Knowing how much water is currently used to water plants, clean, or provide drinking water for animals is important. Based on of a farm's water needs, a property owner can build an appropriate system. Annual water needs can be difficult to determine. However, the Penn State College of Agricultural Sciences has designed a guide that will assist in this analysis. The guide focuses on water uses for animals, irrigation systems, milk houses, and parlor and holding areas (Penn State Extension 2015).

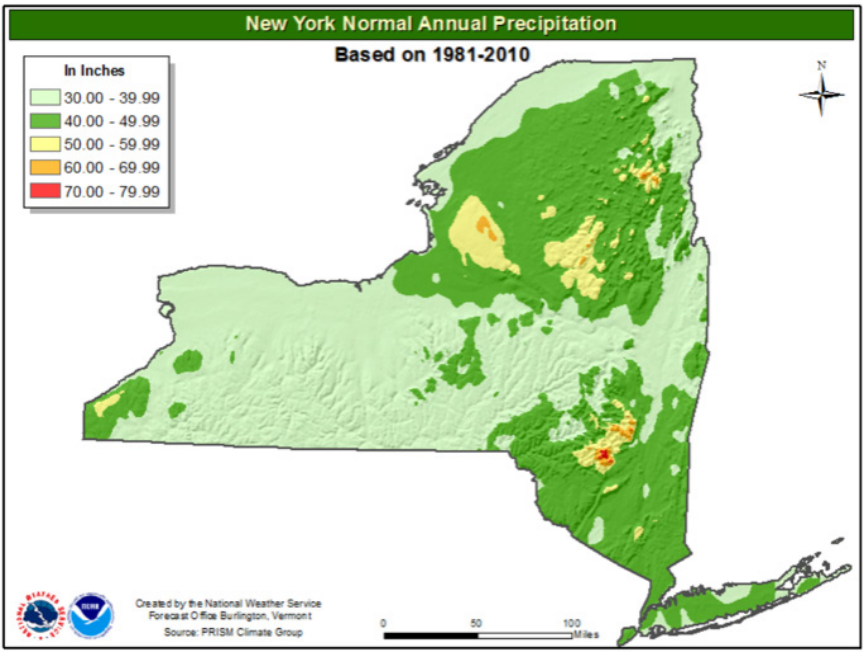
Estimated on-farm water use: _____ gallons

How Much Rainwater Can Be Collected?

Determining how much rainwater can be collected will give the user an idea of how to utilize it. The amount of rainwater that is available for use may affect the type and size of the system that a homeowner or farmer puts in place. Following these easy steps can help determine the amount of rainwater available for use in gallons.

Step 1

Locate the property where the rainwater harvesting system will be installed on the map below, created by the National Weather Service. Use the key to determine annual precipitation levels in that area.



Step 2

Next, determine the property's catchment area. For example, a roof with 30ft by 40ft dimensions will yield a catchment area of 1,200 square feet.

Step 3

Determine the runoff coefficient. Different types of materials allow for better runoff than others. If there are multiple locations on the property, different roof types will have an affect on the system. The roof's coefficient can be found in the table below.

Runoff Coefficients*		
Surface Type	**High**	**Low**
Roof		
Metal, gravel, asphalt shingle	0.95	0.75
Paving		
Concrete, ashpalt	0.95	0.70
Brick	0.85	0.70
Gravel	0.70	0.25
Soil		
Flat (2% or less), bare	0.75	0.20
Flat (2% or less), with vegetation	0.60	0.10
Lawns, Sandy Soil		
Flat (2% or less)	0.10	0.05
Average (2% to 7%)	0.15	0.10
Lawns, Heavy Soil		
Flat (2% or less)	0.17	0.13
Average (2% to 7%)	0.22	0.18

*Data obtained from: Haan, C.T., B.J. Barfield and J.C. Hayes, *Design Hydrology and Sedimentology for Small Catchments*, Academic Press; and Waterfall, P.H., 1998, *Harvesting Rainwater for Landscape Use*, Arizona Department of Water Resources.

Step 4

Calculate how much rainwater can be harvested on the property.

Rainwater Harvested (Gallons)	=	Average Inches of Rainfall Annually	x	0.623 Constant	x	Catchment Area (Square Feet)	x	Runoff Coefficient

Annual rainwater harvesting potential: _____ gallons

Efficiently Using Rainwater:

Investing in a rainwater harvesting system may not provide returns if there are leaking faucets and pipes. Leaks will result in unnecessary costs as homeowners end up buying or pumping more water. Homeowners and farmers should take precautions to prevent any water collected through the harvesting system from being wasted.

Follow These Steps to Increase Efficiency:

- Replace leaking hoses and faucets.
- Water crops in the morning or at night to reduce evaporation.
- When washing equipment or pens, use only as much as needed.
- Improve irrigation water use efficiency.

Components of a Rainwater Harvesting System

Source: Texas A&M Agrilife Extension Service

There are many parts that are crucial to a rainwater harvesting system. It is important that each part is constructed and placed appropriately to get the most out of the system. All rainwater harvesting systems need a catchment area, conveyance system, filter, storage, and distribution system (Innovative Water Solutions 2015).

Catchments

The catchment system makes first contact with the rainwater and directs it to the conveyance system. Catchments are most commonly roofs as they have a large surface area available with an adequate pitch to provide runoff. The catchment system will provide a "yield," or an amount of water per rainfall. Using materials that have a high yield will increase the system's ability to harvest.

Materials: Roofs are made from various materials, which affects the properties of the catchment area. Considering the material of the roof is most important when the rainwater harvesting system will be used for potable water. Metal roofs are best for this application as they easily shed contaminants. Additionally, metal roofs have one of the highest yields due to high runoff coefficient and low permeability. Less debris will build up, keeping the water cleaner (Pickett 2015).

*Important: Make sure to avoid wood shingles or metal flashing that contains lead. Harvest rainwater in this application can be harmful to crops and inappropriate as a potable water source.

Slope: A steeper slope on the roof will allow water to run off more quickly, cleaning the roof of containments. Less steep roofs will allow contaminants to sit on the roof longer, possibly causing problems for the

system (Texas A&M Agrilife Extension 2015a).

Conveyance Systems

From the catchment area, the water needs to make its way to the storage tank. This is done through the conveyance part of the rainwater harvesting system. The conveyance system is usually made up of a series of downspouts and gutters that divert the rainwater to the storage tank. There are two types of conveyance systems, dry and wet. Both dry and wet systems have two main factors to take into consideration, sizing and proper installation of gutters and downspouts.

Dry Systems: These systems are designed for the water to run directly from the catchment to the conveyance system, and then into the storage tank. The only time there is water in the dry conveyance system is when it is raining, avoiding the problem of stagnant water (Rain Harvesting 2015a).

Wet Systems: Wet systems have piping that runs from the catchment to below ground. The piping resurfaces when it reaches the storage tank above ground. This is a more popular solution in applications where the storage tank is not located next to the catchment area and/or the catchment area is relatively large. Farmers or property owners that wish to irrigate land that isn't adjacent to the catchment area would benefit from using this option. Stagnant water in the piping between rainfall occurrences is one disadvantage of this system (Rain Harvesting 2015b).

The Fix for Wet Systems

An in ground water diverter makes sure that the water is flushed out of the underground wet system, therefore converting the wet system to a dry system. This improves water quality by not allowing water to sit, and reduces the possibility of contaminates from entering the tank. Diverters are built underground and are out of sight. http://rainharvesting.com.au/product/in-ground-diverters/

Sizing: According to the Texas A&M Agrilife Extension, gutters should be sized to be able to handle a 100-year storm event, meaning that a storm of that magnitude will have a one percent chance of happening every year. A gutter used as part of a conveyance system should be no smaller than five inches wide. Downspout size must be calculated. One square inch of a downspout should be provided for every hundred feet of catchment area supplying that downspout. The formula to calculate downspout size is below (Texas A&M Agrilife Extension 2015).

Downspout Size = (Length (feet) x Width (feet) of catchment area)/100

Proper Installation: This is important in order to make sure that the conveyance system is safe and functions properly.

Take the following steps to ensure that the conveyence system functions properly (Texas A&M Agrilife Extension 2015a):
- Paint PVC pipe to avoid UV breakdown. This can improve to the aesthetic of the system if this is a concern.
- Make sure the gutters are sloped at least 1/16" per foot to allow for proper drainage. This is especially important during freezing New York winters to avoid ice buildup.
- Provide gutter hangers every foot to help resist snow weight.
- Use rounded gutter outlets to reduce the amount of debris buildup.
- The front of the gutter should be a ½ inch lower than the back. When collecting rainwater, there is a possibility for debris to splash against the building.

Filtration

Debris is likely to enter the conveyance system as a result of rainwater collection. There are ways to help prevent this, resulting in a cleaner, more efficient system. The first step is to install a leaf screen over the top of the downspout, preventing any large debris from entering. After the leaf filter is installed, the rainwater should pass through a device called a first flush diverter. The diverter stops contaminants from entering the rainwater tank. One 10-gallon diverter should be installed for every 1,000 square feet of catchment area. An inline sediment filter removes any sediment after the water exits the tank and before it reaches the outlet. Inline sediment filters are important when using drip line irrigation systems. If not removed, the sediment will clog the holes in the drip line (Rain Harvesting 2015c).

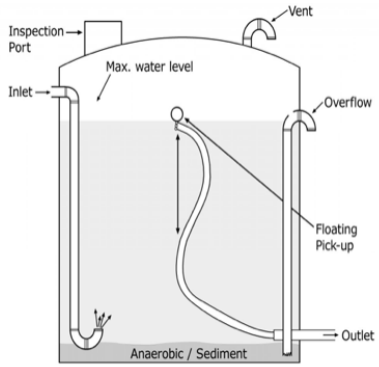
Storage

This is one of the most complicated but important steps when building a rainwater harvesting system. There are many factors to consider, such as safety, connections, above or below-ground, and tank material. Storage can be the most expensive part of a system, and so it is important to consider potential problems beforehand.

Safety: The goal of rainwater harvesting is to collect quality water that can be used for a multitude of agricultural practices and potentially for potable water. While the tank is holding water waiting to be used, steps should be taken to retain the quality of that water. The tank should not allow for light penetration, which will cause the growth of algae, thus tainting the water supply. The tank should be sealed except for any necessary inlets or outlets. This is important in keeping any insects or animals from entering the storage tank.

Connections: Every storage tank requires inlets and outlets in order to take in water, discharge water, and breathe (Texas A&M Agrilife Extension 2015b).

Inlet: The inlet is where rainwater enters the tank. It is important to have a calming inlet connected to the end of the inlet inside the tank. This is done to avoid any disruption of possible sediments on the bottom of the tank.



Source: Texas A&M Agrilife Extension Service

Outlet: The outlet is where the water drains from the tank. The outlet is connected to a floating object attached to a flexible tube off of the bottom of the tank. The bottom four inches of the tank should not be drained to avoid sediment drainage.

Overflow: Overflow releases excess water during a heavy rain.

Vent: The vent is important to stop a vacuum effect from occurring inside of the storage tank. Cover any openings with mesh so insects and other contaminants cannot enter the tank.

Inspection Port: Located at the top of the tank, the port allows for maintenance and inspection by the user.

Tank Materials: There are many different types of materials that can be used in tank construction. Each material has its advantages and disadvantages in cost, construction, and durability.

Above-Ground or Below-Ground: There is much to consider when deciding to place a tank above or below-ground. The advantages and disadvantages of each installation should be considered case-by-case based on the user's goals for rainwater harvesting.

Above-Ground: On a farm, there is usually not a problem with restricted space allowing for the placement of large storage tanks on the property. Many farms have multi-story buildings in the form of barns, garages, and holding areas. This allows for large tanks to be gravity fed to the tank from the catchment area. However, it is important to remember that in New York's winter climate, above-ground tanks need to be insulated and often drained for several months.

Advantages:
- Installation is less expensive.
- Maintenance and repair are much easier because of accessibility.
- It is easy to add another tank if necessary.
- Gravity fed tank.

Disadvantages:
- Subject to freeze-thaw cycles that make the system possibly unusable in the winter months.
- Heavy equipment, which can easily damage an above-ground tank.
- Sunlight can cause algal growth.
- May be considered an eyesore.

Below-Ground: This type of tank installation is often more common in large-scale operations. Underground tanks will be able to better handle the freeze-thaw cycles that New York experiences every year, thus allowing for possible year round use. An underground tank requires installment of pumps to get the water in the storage tank.

Advantages:
- Algal growth will not occur due to the absence of sunlight.
- The tank avoids weather conditions including freezing, as long as the tank is below the frost line.
- The ground temperature has a stable, cool temperature throughout the year, limiting bacterial growth.

Disadvantages:
- More expensive.
- Less accessible for maintenance.
- Soil shifts may cause a fracture to occur.
- The system will require a pump to move the water into the tank.

Distribution
The distribution system depends entirely on what the user wants to do with the water. Common applications for the rainwater include irrigation, washing of machinery and pens, drinking water for livestock, as well as any other application for water on the property. Distribution systems are designed case-by-case, as each farm will need the system to fulfill different requirements. Pumps, pressurized tanks, and control boxes are all optional, but will make the rainwater harvesting system more useful.

Pumps
When deciding on the type of distribution, pressure is an important factor to consider. Most rainwater harvesting systems present on farms need to be pressurized in order to perform at the level needed. Gravity

flow systems will not suffice for farming applications, unless only low pressure is needed for all water demands that have to be located at a lower level than the tank. Pumps will pressurize the system, expanding the potential rainwater usage, but for an increased price. When a system is pressurized, hoses, faucets, and irrigation systems can be used at any location on the farm, at any point. Pumps can either be located in-line with the discharge pipe, or submersed within the tank. Determining the size of the pump is based on the pressure and volume a user wants from the system. A good reference is that a typical indoor showerhead operates at 30psi and 2.5 gallons. A pump technician can advise users on the type of pump needed to meet agricultural needs.

Pressurized Tank

A pressurized tank is used to relieve the pump of a constant on/off cycle when using pressurized water from the system. Having a pump turn on and off repeatedly will reduce the lifespan of the pump. Pressurized tanks store water at pressure, and are refilled when depleted. These are useful when using only small amounts of water for jobs on the farm or at a residence.

Control Panels

The use of control panels will help monitor the system. There are many companies that sell control panels for rainwater harvesting (Texas A&M Agrilife Extension 2015b).

Making Rainwater Safe to Consume

If a user wants to use the system for drinking water or watering ready-to-eat crops, then ultraviolet (UV) sterilization is required. A UV unit will kill bacteria, pathogens, and viruses that could harm the consumer. Modern units work by allowing water to flow in between a UV light and a stainless steel tube. The UV light is wrapped in a quartz sleeve to protect the bulb from water, but still allows all of the UV energy to be transferred to the water. The water has to be free of sediments so shadowing of the UV light can be avoided. Shadowing could potentially cause the UV light to miss some of the contaminants. Using a carbon filter before the UV treatment will get rid of unfavorable smells and tastes. Using UV is only necessary if the water is going to be used for consumption or irrigation of ready-to-eat crops. There are many of applications for rainwater harvesting that don't require the use of a UV light (Conservation Technology 2015).

Freezing Conditions and Rainwater Harvesting

New York State has a wide range of temperatures throughout its four seasons. Even during the freezing winter months, rainwater harvesting systems still collect enough water to benefit system owners. When freezing temperatures do occur, certain precautions need to be taken in order to protect the system (The Watershed 2015).

Tanks: The tank should be emptied unless it is installed in a way to stop freezing from occurring. The tank can be placed underground below the frost line, reducing the risk of freezing. An aerator can be added to the tank to make sure there is movement in the water, preventing the water from settling or freezing. A heat pump can also be used to deter freezing as well.

Conveyance System: Make sure that the conveyance system has the proper slope to ensure there is never any sitting water in the gutters. This will cause a buildup of ice and place strain on the system.

Pump: Like the tank, the pump must either be winterized or placed below the frost line like the tank. Having an in-tank, submersible pump, is an advantage when freezing occurs. The water in the tank should not freeze, thus acting as protection for the pump.

Distribution: All distribution systems need to be insulated from freezing temperatures if not placed underground and below the frost line. If this is not possible, the distribution system should be drained during the freezing months to avoid damage.

Maintenance

It is important to take care of the rainwater harvesting system to maintain its efficiency and effectiveness. This is easy to do, and should be done before each rain season and after periods of heavy rainfall. Proper maintenance will ensure that the user is harvesting the most rain per rainfall.

Maintenance List

- Removal of any debris build up in the gutters and downspouts.
- Clean out all of filters periodically. This is important for systems using drip irrigation and/or rainwater for potable water.
- Flushing of the storage tank bottom to get rid of sediment buildup.
- Checking for leaks throughout the system and repair accordingly.

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APPENDIX
seven

GROWNYC RAINWATER HARVESTING 101

Rainwater Harvesting 101

GARDEN • TEACH • RECYCLE • GREENMARKET

grow NYC

RAINWATER HARVESTING 101

GROWNYC

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PREFACE

GrowNYC is a hands-on non-profit that has been improving New York City's environment for over thirty years. GrowNYC's dedicated staff green our neighborhoods, create the environmental leaders of the future, promote waste prevention and recycling, and run the largest farmers market program in the country. GrowNYC achieves its mission through the following projects and programs: The Open Space Greening Program, Greenmarket, The New Farmer Development Project, Environmental Education Training Student Organizers, Learn It, Grow It, Eat It and Office of Recycling Outreach and Education.

The Open Space Greening Program (OSG) empowers people in neighborhoods throughout the city to create, manage and sustain community gardens and park/playgrounds. OSG provides best practices workshops, services, tools, donated plant material, and open space planning/mapping information and other services. Grow Truck provides tools, donated supplies, plants and horticultural advice and assistance to gardening groups all over New York City. The Plant-A-Lot Project gives substantial material and technical assistance to several new gardens each year and helps the 45 existing gardens created in prior years.

Since 2002, OSG staff has taken the lead in building and maintaining rainwater harvesting systems in community gardens across the five boroughs, leading educational workshops, assisting community gardeners in identifying alternate water resources and building low cost systems. GrowNYC is an active member of the Water Resources Group, a network of NYC greening and environmental organizations promoting sustainable water conservation practices in NYC. The New York State Department of Environmental Conservation (DEC) recognized GrowNYC's efforts with The Environmental Excellence Award in 2006. This manual was created to disseminate to a wide audience the design parameters and building techniques used by GrowNYC staff.

Summer intern was able to prepare this document thanks to a grant from The New York State Department of Environmental Conservation in 2008 for Pollution Prevention. Ms. Leung provided many of the photos, charts, and drawings used. OSG staff, Lars Chellberg, and Lenny Librizzi provided invaluable guidance, advice, and editing of the manual. GrowNYC Executive Director Marcel Van Ooyen and Assistant Executive Director Julie Walsh edited the text. Additional information and assistance was provided by NYC community gardeners and members of the Water Resources Group.

Table of Contents

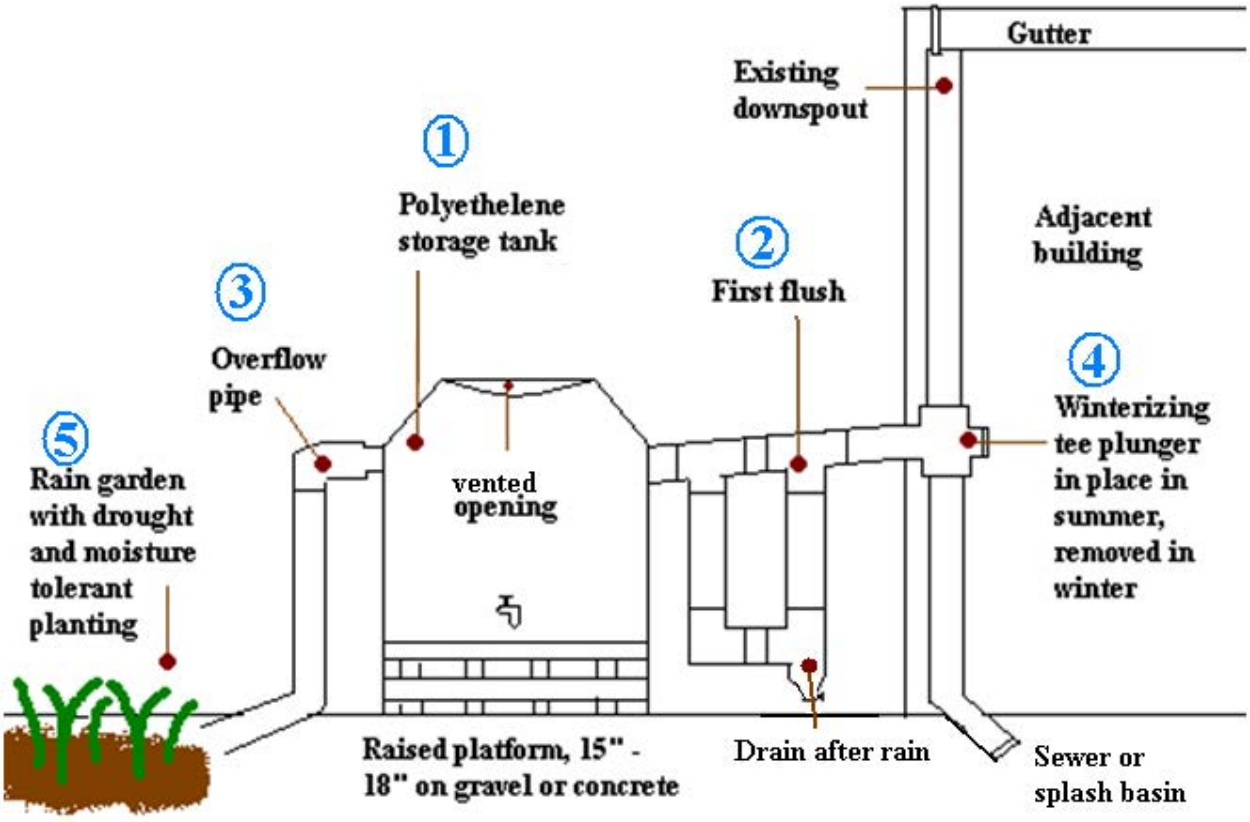
Introduction

"It isn't easy to come up with 'one size fits all' instructions for building rainwater harvesting systems because of variations in styles of roofs, downspouts, storage tanks, and garden layouts. You have to use a combination of research, common sense, ingenuity, and dumb luck to design and build your system."

-Lenny Librizzi, Assistant Director of Open Space Greening at GrowNYC

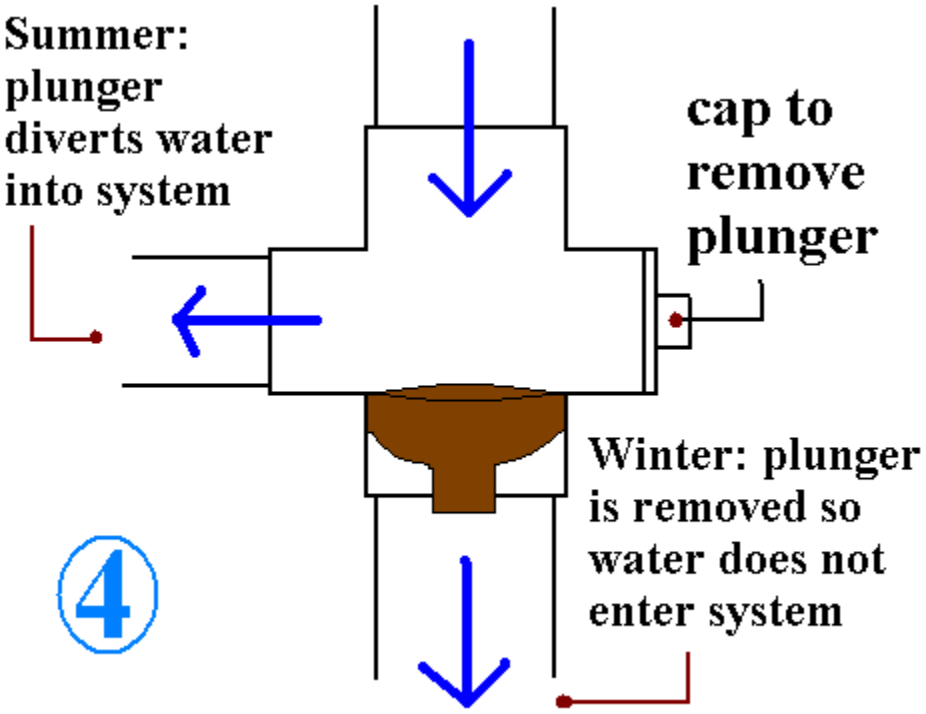
Rain water harvesting (RWH) is the means of collecting and storing rain water in large, durable containers, usually, collecting from rooftop gutters. RWH systems come in a variety of shapes and sizes (see pictures below).

Rain water harvesting systems are fairly easy to construct. Tanks in NYC community gardens range in size from 300 to 1000 gallons but can be as small as 55 gallons and as big as 10,000 gallons. Rain water collected from the downspout of an adjacent building or shed in the garden is redirected to the water storage area in the garden. The RWH system includes 3 parts (see drawing): the tank **(1),** the first flush **(2)** and the overflow pipe **(3).**



During a rainfall event water from the gutter flows into the downspout. Instead of the water going into the sewer system, the rainwater harvesting system diverts the water into pipes. This diverter consists of a 3 way tee with a plunger in place during the summer. This plunger keeps the water from entering the downspout and forces it to flow into the harvesting system. It is taken out in the winter when rainwater is no longer collected **(4).**

Here is a closer view of how the plunger works.



The pipes lead to a roof washer system which is a containment area for the first few gallons of water. Since the initial flushes of water contain rooftop debris and leaves, the roof washer acts as a filtering system by separating the dirty water from the cleaner water. Once the roof washer is full, the cleaner water enters the rain tank. As soon as the tank is full, excess water flows into the overflow pipe which leads to an adjacent rain garden **(5),** is directed back to where it originally flowed or piped underground. A rain garden is a plot containing hardy plants that can survive with both saturated and dry soil.

History of rainwater harvesting

Rainwater harvesting is an ancient practice. Many different cultures have used this technology for agricultural purposes. The Philippines have been using rain water for rice terraces for thousands of years now. Indian history indicates that rain water systems have been in use since 3000 BC. Usage can also be traced back 2000 years ago in Thailand and other parts of Southeast Asia, where simple gutters were used to fill jars and pots. The earth dams of ancient Egypt were used to control runoff. Ancient rain water cisterns can still be seen on the islands of Capri and Malta.

In addition to rainwater harvesting, the Romans also used their systems as air conditioners. When the water evaporated, it created a cooling effect in the microclimate. As their populations started to increase, the Romans developed underground cisterns. This way, less water would be lost due to evaporation. They connected these cisterns to above ground pools as a means of water filtration. When these pools overflowed, the cleaner water would enter the cisterns. This design was an inspiration for modern day rain barrels. The Roman's shallow pool mirrors the modern day roof washer or first flush system.

The world's largest cistern is the Yerebatan Sarayi, built by Caesar Justinian in 527 AD. It is located in modern day Turkey and is a popular tourist attraction. It is 140 meters by 70 meters big and can store up to 80,000 meters^3 of water. This huge structure is completely underground and involves a series of intersecting vaults. Binbirdik is another cistern in Istanbul, created by Caesar Constantine in 389 AD that can store 80,000 meters^3. However construction of these cisterns stopped due to the difficulty of building underground and the outbreak of human fecal contamination in large cities. [1]

In the 1970's, a new technology of rain water harvesting was developed where storm water was stored in well storage tanks in the form of different sized ponds. A thin layer of red clay was used to line the bottom of the pond to prevent seepage and trees were planted around the pond to prevent excessive evaporation. Over 40,000 of these systems were built in the Loess Plateaus of China. [2]

Although rain water harvesting was a significant and successful design in the past, its popularity has declined over the centuries. Urbanization demanded a more centralized water supply system. Watersheds and pipelines came into use and running water became one of the world's greatest inventions. However, due to modern day water pollution and drought, rainwater harvesting techniques have come back into practice again.

Benefits of rainwater harvesting in urban areas

By keeping storm water out of the sewage system, gardeners help keep their local water bodies clean. Because most of NYC is paved over, rainwater can't be absorbed by the ground. Instead, it runs across the pavement, picking up oil, street debris, animal feces and other waste as it moves. This runoff then enters the sewer system.

Unfortunately, not all runoff makes it to a treatment plant before entering the city's rivers and harbor. This is because most of NYC is on a combined sewer system, whereby the same pipes are used to transport both storm water runoff and household waste to sewage treatment plants. If these treatment plants overflow, the contaminated water then enters the water bodies surrounding NYC.

During dry weather the sewage treatment system generally works well, but these treatment plants can only handle about twice their dry weather volume. This means that heavy rains often result in combined sewer overflows (CSOs), which release untreated wastewater, storm water and street debris into local waterways. Untreated sewage can carry disease causing pathogens and nutrient rich organic material, which can choke the Harbor's ecosystem.

Not only can rainwater harvesting prevent water pollution, it also conserves water. Typical systems can store up to 1000 gallons of water. Harvesting during rainy days in spring and summer provides a source of water for the dry spells between rain events. Instead of running the hose to water your garden, you can use the rainwater stored in your tank. This will relieve the strain on our reservoirs and also save you money on your water bill. Forty percent of household water consumption is used on domestic irrigation! [3]

Rainwater harvesting has proven to be successful. The 35 rain water harvesting systems working in NYC's community gardens collect 422,900 gallons of water every year. That's enough for 264,313 toilet flushes!

Of course small scale construction of rainwater systems is not enough to significantly impact our environment. However, if rain barrels were used more extensively and rain gardens became a larger part of city landscape planning, water conservation would have a greater environmental impact. We would experience cleaner water bodies, less flooding and lower water costs.

Rain water harvesting has great potential to reduce rainwater flow into storm drains by collecting rainwater in gardens and can reduce the dependence on the NYC watershed. Every drop of water counts and conservation is the most sustainable, cost-effective source of water supply for our region.

Current efforts

Community gardeners across North America and around the world have revived the practice of using rain barrels in their gardens out of necessity.

In **Seattle**, budget constraints and rising water prices spawned the construction of rainwater harvesting systems. Some of Seattle's rainwater harvesting systems are works of art. Here gate pillars support the flow of rainwater from the building on the right into the cistern on the left. Seattle Public Utilities have recommended changes to the land use and building codes that encourage water conservation. SPU has also sponsored some wildly successful sales of rain barrels to Seattle residents.

The special curves on this gate represent the monthly rain fall in Seattle and the amount of water collected year round.

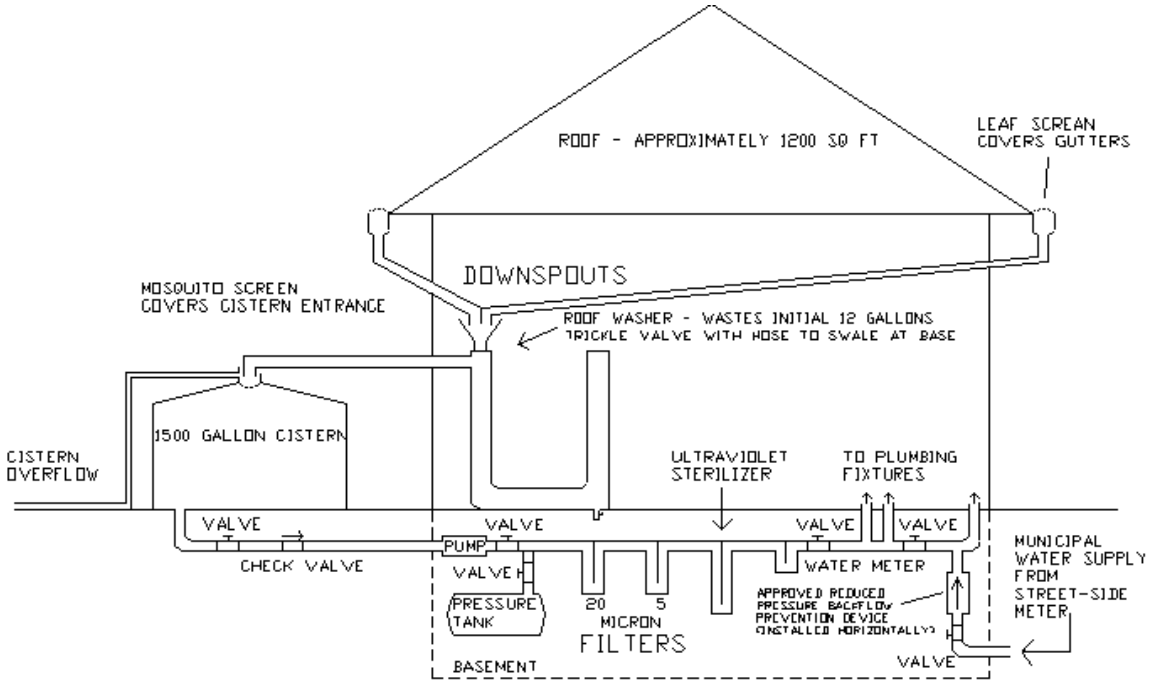
The overflow pipe of this Seattle cistern creates a mini waterfall.

A cat enjoying the rain garden in Kansas City.

The 10,000 Rain Gardens Program in **Kansas City** is an example of regional efforts to educate and introduce water conservation to the Kansas City community. Rain gardens are areas of vegetation on porous ground that can filter and drain excess storm water. Kansas City officials encourage their residents to plant these gardens on their own property.

The City of **Vancouver** designs and manufactures rain barrels for residents to use for irrigation (see picture on right). Vancouver subsidizes the cost of the rain barrels by 50%. Over 2000 barrels have already been sold.

Portland, Oregon, granted a permit for a household to harvest rainwater for use indoors during all but the dry summer months (see sketch and picture below). The water undergoes enough filtering to meet EPA's standards for drinking water. In 1998 this system cost less than $1,500 to install.



Maplewood, Minnesota has forged a coalition between its water and sanitation departments and residential landowners to plant large-scale curbside rain gardens that reduce storm-water sewage (see picture on left).

The Minnesota Arboretum uses its parking lots to demonstrate best landscape practices such as planting rain gardens and using permeable pavers to reduce contamination caused by storm water runoff (see picture on right).

The City of **Toronto** Downspout Disconnection Program offers a free service to homeowners to disconnect downspouts from the sewer system and install rain barrels which are available at a discount.

Chicago also encourages its citizens to disconnect downspouts. In addition, Chicago's Water Agenda 2003 included a rooftop garden initiative, a pilot program for permeable alleys, and rain gardens planted in the City's rights-of-way.

Austin offers rebates of up to $30 for newly installed rain barrels and of up to $500 for installation of rainwater harvesting systems, following design approval by the City.

In 2001, the first Drought Emergency to be announced since 1989 was declared in **New York City**. The reservoir levels were 40% below normal which resulted in mandatory water use restrictions. The Water Resources Group (WRG) was founded as a response to this single drought year. Since then WRG and GrowNYC have built 35 rainwater harvesting systems in New York City, collecting over 422, 900 gallons of storm water per year.

"New York City currently lags behind other cities like Boston and Chicago, which capture 90% of their combined sewage overflow; New York City only captures about 70%, according to the city"[4]

Materials

Every rain water harvesting system is different but they do have similarities. Here is a comprehensive list of tools and supplies. Your system will use many of these but may not require all of them.

Tools:

- Drill
- Hole saw attachment or jigsaw
- Screw drivers
- Hammer
- Level
- PVC saw (see top saw in picture) and metal hacksaw (bottom saw)
- Tin snips or sheet metal shears
- Crimping tool (see picture on right) and cable cutting tools

Gutters:

- Gutter lengths
- Leaders and bends
- Pre-fabricated gutter hangers
- Plumbing strap (for securing pipes to wall)
- Flexible, accordion style expandable plastic pipe
- Tube of gutter sealant and caulk gun to apply it
- PVC cleaner and cement
- Teflon tape (for creating a water tight seal on threaded bushings)

Barrel storage system:

- Tanks and PVC parts or other materials to construct the manifold. Here we have a capped 4 way tee (see leftmost picture) and a 90° and 45° elbow respectively (see rightmost picture)
- Window screen or screened vents for mosquito proof vent
- Bulk head fittings (An elongated compression fitting, which will allow pipe, to run through a bulkhead)
- Platform material such as treated lumber, plastic lumber or concrete blocks
- Eyebolts (for securing tank)
- Spigot
- Metal flanges of corresponding size to spigot and hardware
- Rope or cabling supplies to secure the tank

Where to obtain supplies

Polyethylene tanks are best purchased locally because of high shipping costs. Search online for local suppliers. You can personally ship smaller tanks and save on extra expenses. Here are some websites that sell tanks:

- http://www.liquidlogictanks.com/index.html
- http://www.tank-depot.com/
- http://www.rainbarrelsource.com/
- http://www.rainbarrelsandmore.com/
- http://www.aquabarrel.com/

Drip irrigation suppliers include:

- http://www.dripdepot.com/
- http://www.dripirrigation.com/
- http://www.rainbird.com/drip/index.htm
- http://www.dripworksusa.com/
- http://www.netafim.com/
- http://www.chapindrip.com/
- http://www.farmtek.com

Downspout filters and a variety of other specialized parts for systems can be purchased from:

- http://www.starkenvironmental.com/a-1-filtration.html
- http://www.braewater.com/
- http://www.rainharvesting.com.au/default.asp
- http://downspoutfilter.com/index.php
- http://rainharvest.com/shop/default.asp

Tools and PVC gutter pieces can be purchased at your local hardware stores. Lowes or Home Depot also sells these items. For locations near you, visit their websites at http://www.lowes.com/ or http://www.homedepot.com.

Cost Estimates

Note that the prices listed indicate the values in 2008. Adjust for a 15% – 20% annual increase.

Polyethylene tanks: Generally, tanks cost $1 per gallon but it can sometimes be too big to transport on your own. Shipping costs are about an additional $1 per gallon.

Leaders and Gutters: The number of leaders and gutters needed per site will vary depending on the roof configuration. A 10-foot long gutter is $15.00, a 10 foot long 2”x 3” leader is $9.00, and a 10 foot long 3”x 4” leader is $16.00. Connecting parts, corners and bends are anywhere from $2.00 to $10.00.

Platforms: Platforms for containers can be made out of cinder blocks, plywood or any other sturdy material. While the tank is light when it is empty, remember that a full tank of water can weigh thousands of pounds. A small 55 gallon tank weighs over 400 pounds when full! Be sure that your platform is strong enough to withstand large weights. Cement blocks can be scavenged from construction sites. Should you have to purchase them, 8” x16” cement blocks are $ 1.50 each. The lumber prices are $16.00 for a pressure treated 8 foot long 2”x 10” piece or $13.00 for a pine or fir 8-foot long 2”x 10” piece. An 8 foot long 4” x 4” piece costs $12.00. 4” x 4” lumber laid lengthwise in alternating directions placed on a gravel base makes a sturdy platform (see picture on page 25). Using poured concrete pilings and a built wooden deck for a platform may cost about $500.

Miscellaneous Hardware and specialized parts: This category includes accordion connector pieces, screens, sealants, sheet metal, screws, nuts, bolts, gravel, filtering parts and supplies, roof washers, weed fabric and other specialized parts. These parts will vary by site and type of barrel.

Plumbing Supplies: The amount of plumbing you need varies depending on the system you are making. This category includes overflow pieces, PVC pipes, connector pieces, rubber fittings, spigots, bulkhead fittings and the piping needed to draw the water away from the system. Upgrades will include soaker hoses or other type of overflow disperser and roof washers. A sophisticated drip irrigation system could add $500 – 1000 to the cost.

Tool Kit: Some specialty tools are needed such as drill bits, screw bits, hacksaw blades, tin snips, hole saws, caulk gun, caulking or silicon, jig saw, pliers and tape measures.

Cost analysis for a 300 gallon rainwater system in 2008

Tank	$300
Shipping of Tank	$300
Leaders and Gutters	$100
Platform	$300
Hardware	$100
Plumbing	$100
Tool Kit	$50
Total Cost	$1250

Cost analysis for a 1000 gallon rainwater system in 2008

Tank	$1000
Shipping of Tank	$1000
Leaders and Gutters	$200
Platform	$600
Hardware	$200
Plumbing	$200
Tool Kit	$50
Total Cost	$3250

If there is not already an existing roof or shed nearby, a shade structure can be constructed. One possible design is the winged structure seen here:

Cost analysis for a 300 gallon rainwater system with winged structure in 2008

Tank	$300
Shipping of Tank	$300
Leaders and Gutters	$100
Platform	$300
Hardware	$100
Plumbing	$100
Tool Kit	$50
Materials for Shade Structure	$2500
Total Cost	$3750

PVC Applications

Up to now PVC or polyvinyl chloride has been the key piping material in the rainwater harvesting systems in NYC community gardens. This hard plastic is inexpensive, durable, easy to use and readily available. Tees, elbows, bushings and couplings are all made out of PVC. Although PVC is fairly stable, there are environmental hazards in manufacturing and burning PVC. We are currently looking for other sources that are more environmentally benign but also having the same flexibility with parts as PVC does. Although metal can be an alternative, it can be costly. If there is a material that you think can be a replacement for PVC, please add your information or comment to this wiki: http://www.waterresourcesgroup.org/wiki/index.php?title=Main_Page.

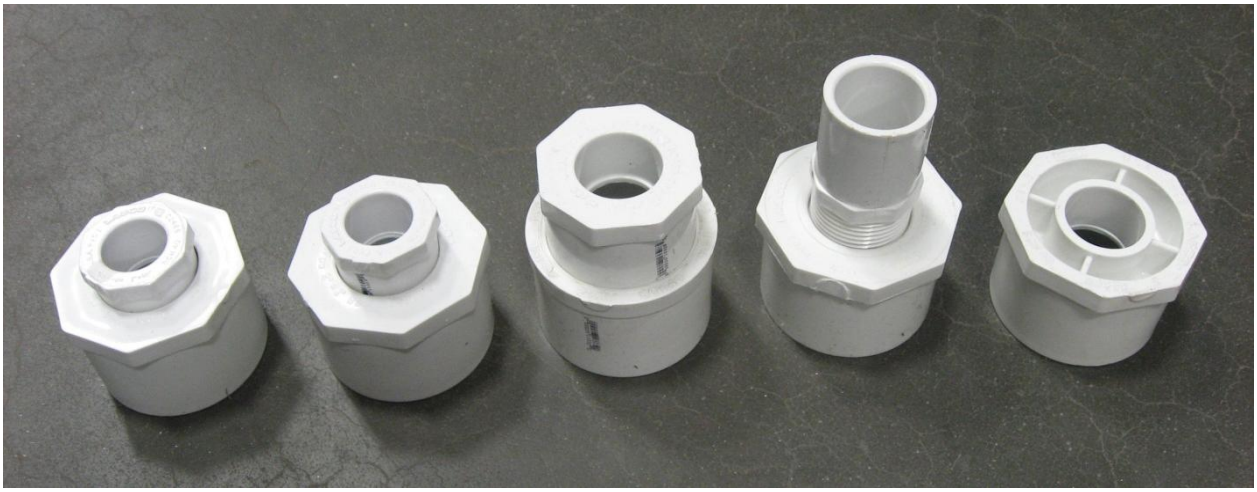
In order to join PVC pipes together, use PVC specific cleaner primer and cement. PVC cleaner primer removes dirt and melts the surface for ultimate adhesion. After the pipe is clean, you can use cement to join the two pieces together. Only apply cleaner and cement to the outside part of the male piece (see picture on left) and the inside part of the female piece (see picture on right). It is important to hold the two pieces together for 20 seconds after applying the cement because they may move apart. After 20 seconds, the two pieces are permanently joined (see bottommost picture). Wipe off excess glue.

Use bushings and reducer fittings when it is necessary to change the size of your pipes. These come in a wide variety of glue (slip) and threaded designs.

This 2”x 1 ¼” slip bushing connects a 2” (diameter) piece of pipe with a 1 ¼ “pipe. Slip bushings can be adhered using the cleaner and cement method mentioned above.

This 2”x 1” slip and thread bushing connects a 2” slip pipe with a 1” threaded pipe. Thread bushings can be adhered tightly using Teflon tape. Roll the tape starting at the end of the male thread bushing towards the middle. Two or three wraps are sufficient.

PVC parts are very versatile since no two rainwater harvesting systems are alike. Many different combinations of PVC parts can be used for the same function. Here are 5 different ways to connect a 2” pipe with a ¾ “pipe.



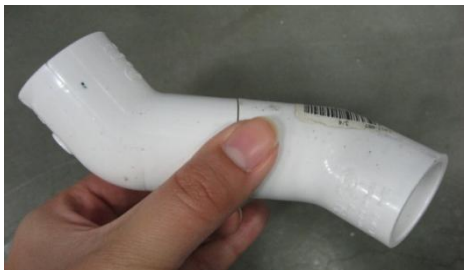
It is very important to align adjacent pipes. The two tees in the first picture (see picture below) must align exactly in order to connect to the same wall. Careless glueing will lead to problems. Use a hard, level surface such as a concrete floor to help you align pipes.

The pipes in the second picture (see picture on left) must be exactly perpendicular to each other. The tee on the left will connect to the barrel. The tee on the right will connect to existing pipes. Use a marker to indicate the points where the one pipe must meet the other.

The pictures above also point out the use of piping. Notice how the two tees are joined in each picture. In the second picture, the two tees are joined by using a small piece of pipe in between them, called a sleeve. The interior coupling is too short to be seen in this picture. In a situation where you want the tees to be further apart, such as in the first picture, just extend the size of the pipe to the desired length.

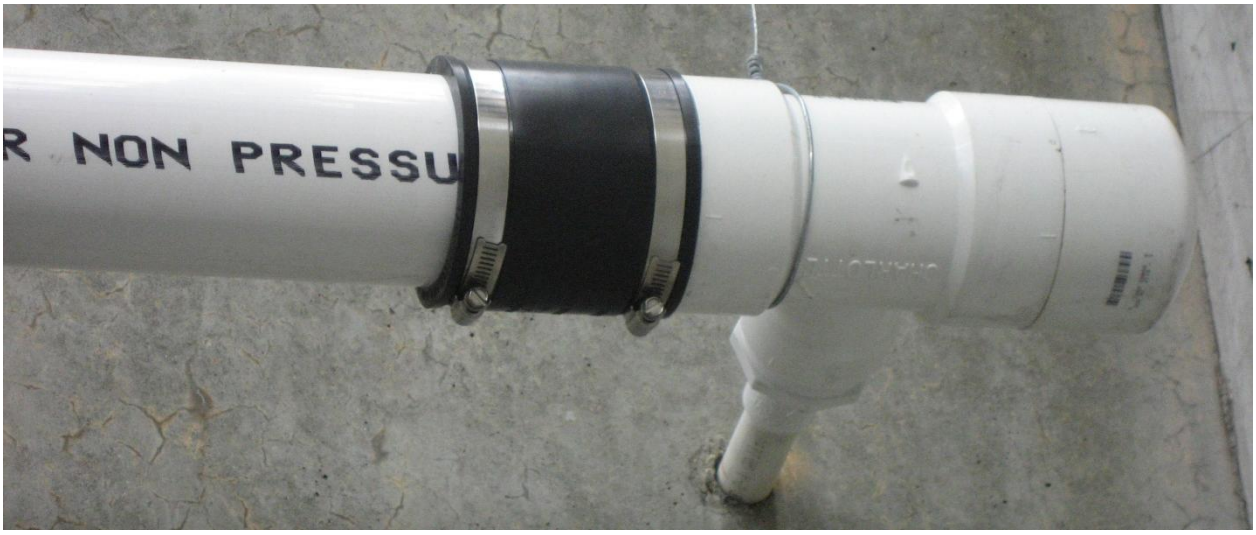
Although every rainwater system must be carefully planned before actual construction begins, it is very easy to miscalculate or measure incorrectly. Often times, errors are not realized at first. To fix a measurement or connection problem where the 2 pipes that were intended to connect do not match up, use two 45° degree elbows. A combination of two 45° elbows will produce almost any twist or angle desired.

Two 45° elbows can make a 90° degree twist or a 180° degree twist.



Two pipes that did not connect before can now be connected with the help of two 45° elbows.

It is also possible to shorten the PVC pipe by cutting and reconnecting it with a rubber coupling. Notice that the pipe below is too long to connect with the smaller pipes attached to the wall (see top picture). It was shortened and reconnected using a rubber coupling (see bottom picture).



Sizing of the tank and roof washer

A variety of rainwater systems can be constructed for the same downspout and roof. Here are two different systems that have been installed over the years at the 1100 Block Bergen Garden in Brooklyn. It is generally better to have a single barrel rather than multiple barrels because of possible leakage from the numerous connections. The 9 barrels in the original system had 17 connections. There were 17 locations where leakage could occur as opposed to 1 location in the current system.

The capacity of the system should be determined by two factors: the size of the roof, which determines how much water can be collected and the size of the garden, which measures how

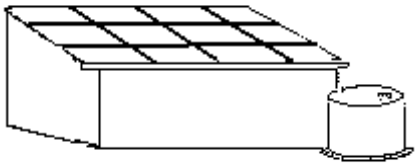
much water is needed. A 300 gallon vertical cylindrical storage tank is approximately 42 inches in diameter and 51 inches tall. A 1000 gallon polyethylene tank is approximately 92 inches in diameter by 60 inches tall or 61 inches in diameter by 100 inches tall.

The amount of water you can harvest varies depending on the size of your roof. You will be surprised how much water you will be able to collect from even the smallest roof. **The rule of thumb is 600 gallons of water per inch of rain per thousand square feet of catchment area.** Not all the rain that falls can actually be collected. Efficiency is usually presumed to be 75% depending on system design and capacity. Here is the basic formula for calculating the potential amount that can be collected:

$$\frac{\textit{(Catchment area) x (inches of rain) x (600 gallons) x (.75)}}{\textit{1000 square feet}}$$

Remember that a roof can have several downspouts. Your catchment area only consists of the region where the downspout that is connected to the rain barrel collects from. Pay attention to the gutter and slope of the roof to determine which part is your catchment area. In order to calculate the catchment area, use measuring tape to determine the width and length of your roof in square feet. Multiply the length and width of your catchment area for the area of your roof.

The sample roof shown below (see picture below[5]) has a catchment area that is 40 feet wide and 30 feet long. Hence, it has a 1200 square feet roof (40 feet wide x 30 feet long). Assume that it rains 2 inches. We can now plug this information into our general formula (see equation above).



Catchment Area = 1200 square feet
Amount of Rain = 2 inches
Gallons of water collected per inch of rain per 1000 square feet = 600 gallons
Percent Efficiency = 75% or .75

$$\frac{\textit{(1200 square feet) x (2 inches of rain) x (600 gallons) x (.75)}}{\textit{1000 square feet}} = \textit{1080 gallons}$$

Therefore a 1200 square foot roof will collect 1080 gallons of water on a day with 2 inches of rainfall. Using this formula and your region's average rainfall numbers combined with an estimated water need, you should be able to calculate the approximate size of your tank or barrel system.

Roof washer sizes also differ according to the size of the roof. **The rule of thumb is one to two gallons of roof washer capacity for every 100 square feet of catchment area.** A 1 foot length of 6 inch diameter PVC pipe holds 1.5 gallons. A 1 foot length of 4 inch diameter PVC pipe holds .66 gallons.

We will use the same 1200 square foot roof shown above as an example. Since the rule of thumb suggests one gallon of roof washer capacity for every 100 square feet of catchment area, the sample roof will need 12 gallons of roof washer capacity.

If you are using 6 inch diameter pipe, use the following formula:

$$\frac{\textit{Number of gallons of roof washer capacity}}{\textit{1.5 gallons/ feet}}$$

The size of our roof washer on our sample roof can be calculated by:

$$\frac{\textit{12 gallons of roof washer capacity}}{\textit{1.5 gallons / feet}} = \textit{8 feet of 6" pipe}$$

If you are using 4 inch diameter pipe, use the following formula:

$$\frac{\textit{Number of gallons of roof washer capacity}}{\textit{.66 gallons / feet}} = \frac{\textit{12 gallons}}{\textit{.66 gallons/ feet}} = \textit{18 feet of 4" pipe}$$

Therefore a 1200 square foot roof will need 8 feet of 6" diameter pipe or 18 feet of 4" diameter pipe. Remember it is possible to separate long lengths of roof washers into several, continuous pipes instead of just one long pipe.

Construction

The first step of the construction project is to make a plan drawing. The plan drawing considers the location of the downspout and the amount of space available. Each system must include the tank, the first flush and the overflow. Here are some issues that should be considered in your planning:

• The most stable place to position your barrel is against a stable wall on level ground as close to the downspout as possible.
• Gravity moves water downhill. Be sure there is available space for a downward pitch in all pipes.
• The barrel on its platform is the highest point of the garden but the lowest point of the system.
• The overflow pipe should be directed toward a rain garden not toward pathways or structures.
• The overflow pipe should flow from the barrel's highest point.
• The spigot should be at the barrel's lowest point.


overflow pipe
roof washer
system


roof washer
system
overflow pipe

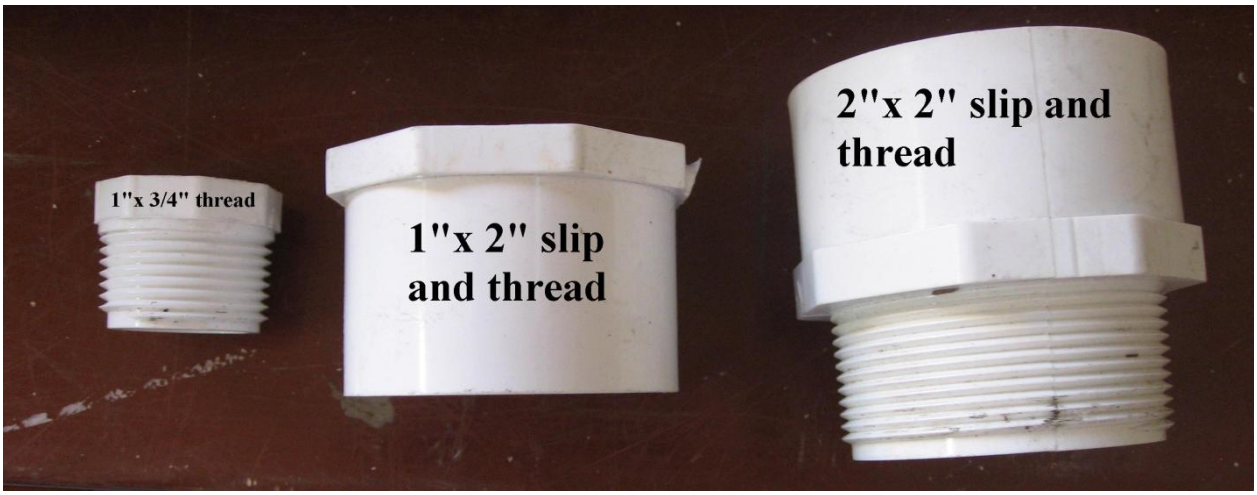
Tanks

Tanks can be made from all sorts of materials such as cement (see picture on left[6]), metal, ceramic and wood (see picture on right[7]). In tropical countries, a terra cotta tank can be used. No wintering tee is necessary for these tanks because there is no danger of freezing.

For design purposes, bladders can also be used to store water instead of tanks. Bladders are large, flexible bags functioning in a way similar to the water balloon (see picture on left[8]). This way, engineers can create storage tanks in a variety of shapes instead of the traditional cylinder.

The tank system includes the spigot, the inflow pipe, the overflow pipe, the lid and the platform it rests on.

Spigot: A variety of bushings can be used to connect the spigot. It is preferable to use a single reducer bushing but that is often not possible. For example, the tank's spigot hole is 2 inches in diameter. The spigot pictured here is a ¾ "ball valve hose bib. In order to reduce the 2" opening to the ¾"spigot, the following 3 bushings were used:



Lid: The lid should remain closed at all times. Still water is a haven for mosquito larvae. Inspect the lid and any vents annually and clean as necessary

Inflow and Overflow pipes: Some tanks come with bulkhead fittings installed for the inflow and overflow pipes. For those that don't, a hole saw is used to drill a large hole in the barrel. Two bushing pieces, like the ones pictured below, are used to fashion a bulkhead fitting.

Use a marker to trace the hole you will cut for the threaded bushings. Make the hole tight to the threads. Once the hole is prepared, thread the first piece in from the outside.

Thread the second piece from the inside of the tank using a flexible wrench. Use gutter sealant to create a watertight seal.

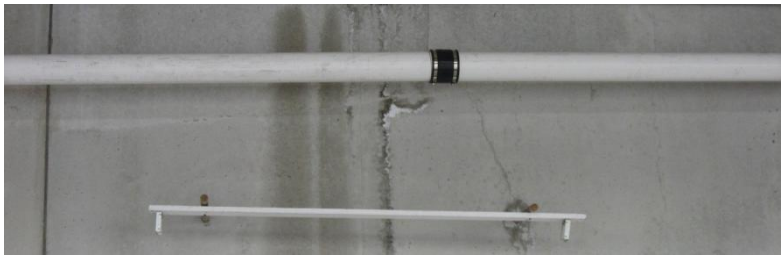
Platform: The purpose of the platform is to raise the tank enough to get your watering can under the spigot and to create pressure flow for a hose. Spread a thick gravel base over an area slightly larger than the platform. This will promote good drainage and allow for final leveling once the platform is built.

A stable arrangement of cement cinder blocks, like this one, makes a great platform for small 55 gallon tanks but is not ideal for larger tanks. Since the blocks easily shift, rot resistant 4”X 4” or 6”X 6” lumber laid out in alternating rows is the best option for a platform. Steel platforms are also a possibility but are more costly. Be sure to level and compact the ground well where the tank will sit.

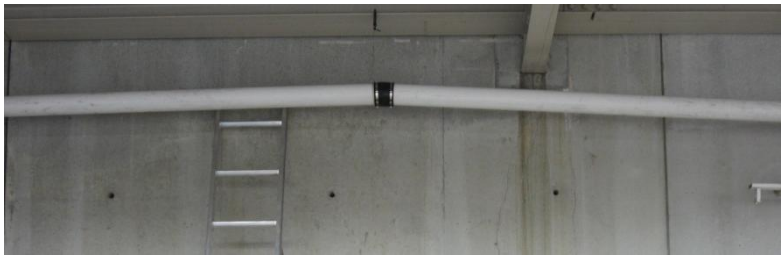
Warning Signs: Do not drink the water collected. Only use it to irrigate your garden. Installed PVC is inert and it is used as a water supply pipe for house trailers and other homes. The possible contamination is almost exclusively from harmful bacteria. For water to meet drinking water standards it must be treated, usually with chlorine, often filtered and sometimes treated with ultraviolet light. A warning sticker or sign should be placed on your rain barrel to avoid the possibility of anyone mistakenly drinking the water.

Leaders

The leaders of the rain water harvesting system refer to the series of pipes that lead to the tank. This includes the pipe that connects the downspout, the wintering tee, the roof washer system and the pipe that connects the barrel. Gravity keeps the water flowing. Remember to put a downward pitch on all pipes. A quarter inch down for every linear foot will create an adequate pitch. Use a level (see picture below). It may be useful for someone to stand back to visually check the pitch and help you adjust the pipes as you are pitching them.



Keep pipes pitched downward.



DO NOT pitch pipes upward.

Keep the pitch of your pipes even and downhill. The picture on top is correct. The picture on the bottom has an upward pitch and will create problems.

Connecting the downspout: Our intent with rain water harvesting is to divert storm water, store it for future use and keep it out of the sewers. There are several options to divert the rain water: insert a 3 way tee into the downspout (see picture on left) or connect the existing downspout directly to the rain barrel (see picture on right). You can design your own custom diverter as well.

Another possibility is to replace the downspout entirely with pipes leading to your rain water harvesing system (see picture below and on the next page).

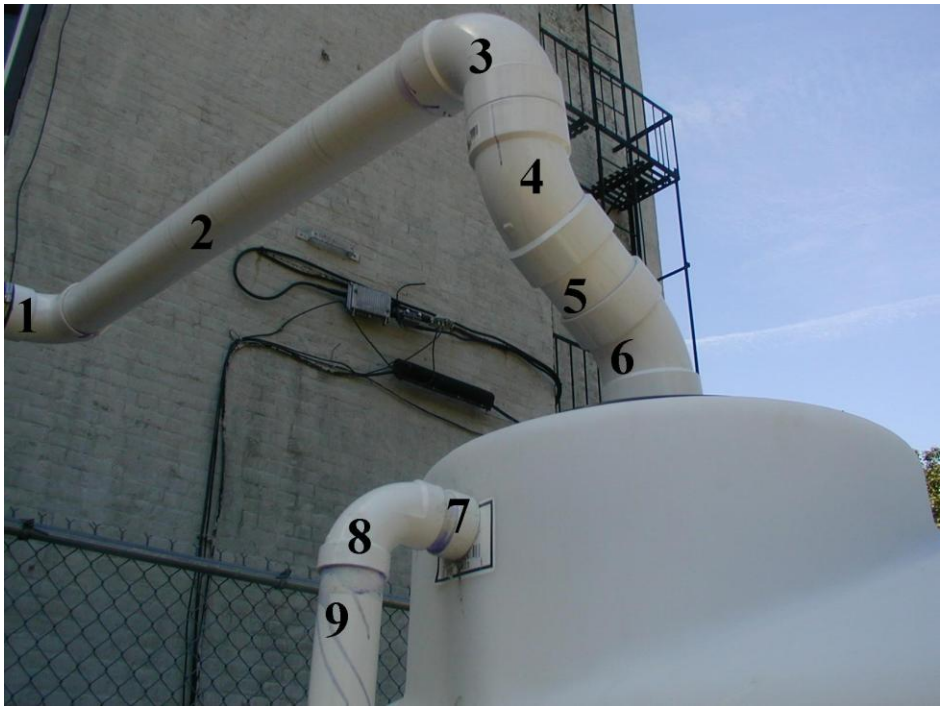
Connecting to the downspout is one of the last steps in construction of your system. You do not want to disconnect your downspout and start collecting rainwater with an unfinished system.

Wintering tee: The purpose of the wintering tee is to allow the water to be directed back into the sewers during freezing temperatures. Rain water should not be collected at that time because it may freeze and cause breaks in the system. A simple wintering tee utilizes a removable plunger head. The plunger head blocks water flow into the sewer and forces it to enter the system. It is removed during the winter and rain water will just flow straight down into the sewer (see picture on left and diagram on page 4). Complicated wintering tees include a filtering system. It operates with the same principle but instead of a removable plunger head, there is a removable filter which catches debris (see picture on right).

Roof washer system: Refer to ‘Roof washers’ on page 30.

Connecting the barrel: Refer to ‘Tanks’ on page 23.

Here are some ideas to help you with the design of your leader.



INFLOW
1: 90° elbow
2: 4"pipe
3: 90° elbow
4: 45° elbow
5: 4"pipe
6: 45° elbow

OVERFLOW
7: 2"bushing
8: 90° elbow
9: 2"pipe

This design uses a separate inflow and overflow pipe.

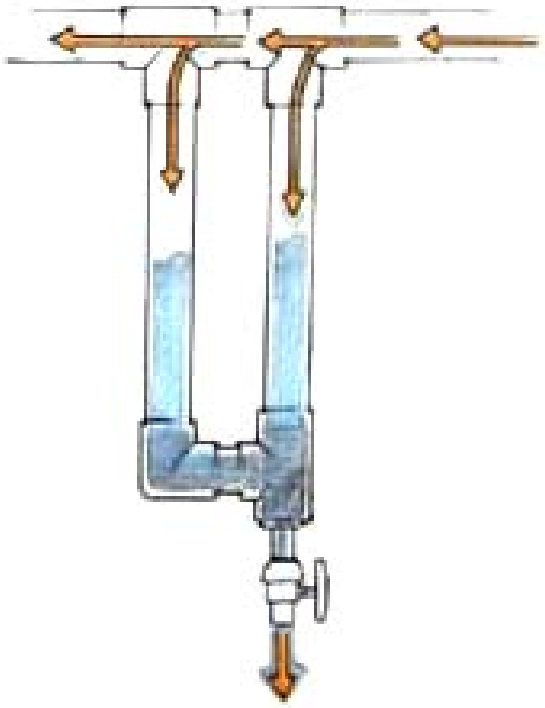
INFLOW
1: downspout
2: 4"rubber coupling
3: cap
4: 4 way tee
5: rubber coupling
6: 90° elbow
7: 4"sleeve
8: 4"rubber coupling
9: 3 way tee

OVERFLOW
10: 45° elbow
11: 90° elbow
12: 4"pipe

This design uses the same tank opening for both the inflow and overflow.

Roof Washers

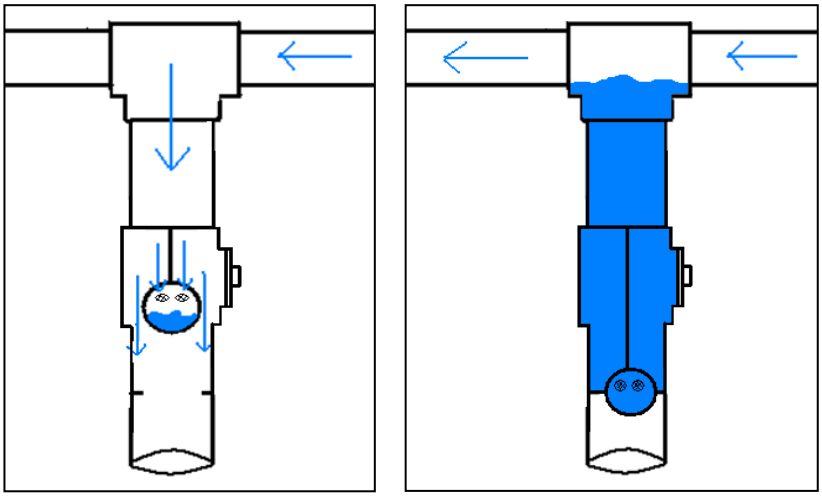
Roof tops are prone to collect leaves and dirt. The rain carries all this debris with it as it enters the gutter and downspout. The roof washer or first flush system is a simple way to filter the water you collect. It is a series of pipes that storm water flows into before entering the rain barrel. Once the roof washer is full, water will begin to fill the rain barrel without mixing with the dirty water contained in the first flush. The appropriate size of the roof washer varies depending on the size of the roof. Refer to 'Sizing of the tank and roof washer system' on page 18 for details on how to calculate roof washer size. Small first flush systems can be a single downward pipe. However, to accommodate larger roofs, first flush systems can be constructed of multiple downward pipes.



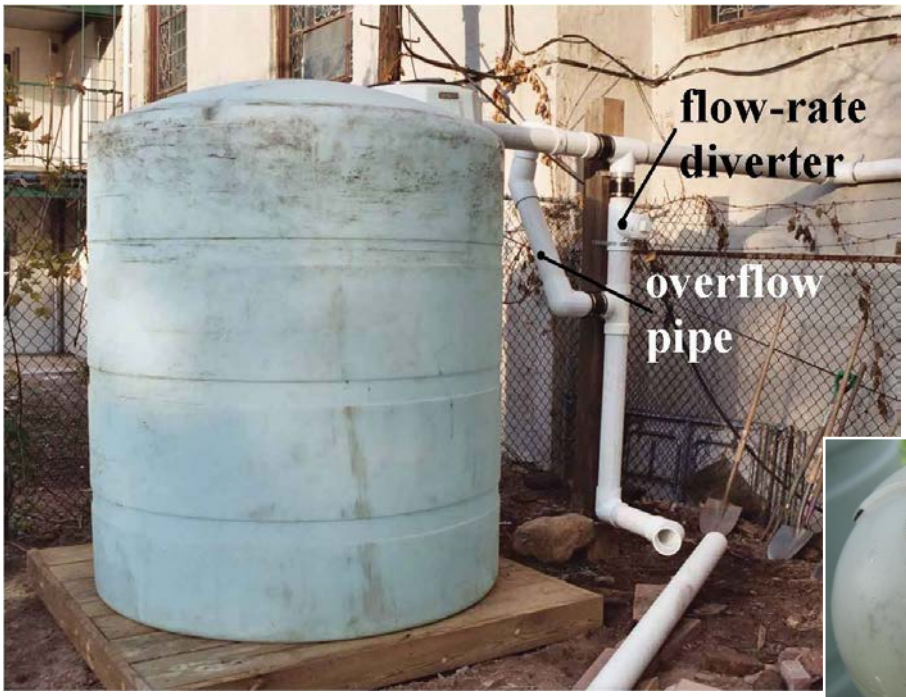
The roof washer must be emptied promptly after a rain event and valve reset in the closed position to be ready for the next rain. Drain the roof washer to a safe location. Include another spigot or valve in your design to drain the first flush.

An alternative to the container method of the roof washer is a device like the Flow-Rate Diverter by Safe Rain. It consists of a plastic ball attached to a spring. The top of the ball contains a screen and a movable tab. During a rainfall event, water that enters the pipe will either flow into the ball or on its sides (see picture on left). The purpose of the screen on top is to gradually allow water to enter the ball. Once the ball is filled, it will sink down and block the drain (see picture on right). Water can then start filling up the pipe and start entering the tank. The moveable tab controls the amount of water that enters the ball by covering or exposing the screen as desired. For example, larger barrels that require larger roof washers require a screen that is less exposed. Larger amounts of water will have to pass through the pipe before the ball can be filled. The ball will have a small drip hole to slowly empty once the rain has ended to then return to its original position to be ready for the next rainfall.

Entering rainwater will flow into this pipe. Some will enter the ball, making it heavier and some will flow past the ball and out of the pipe.



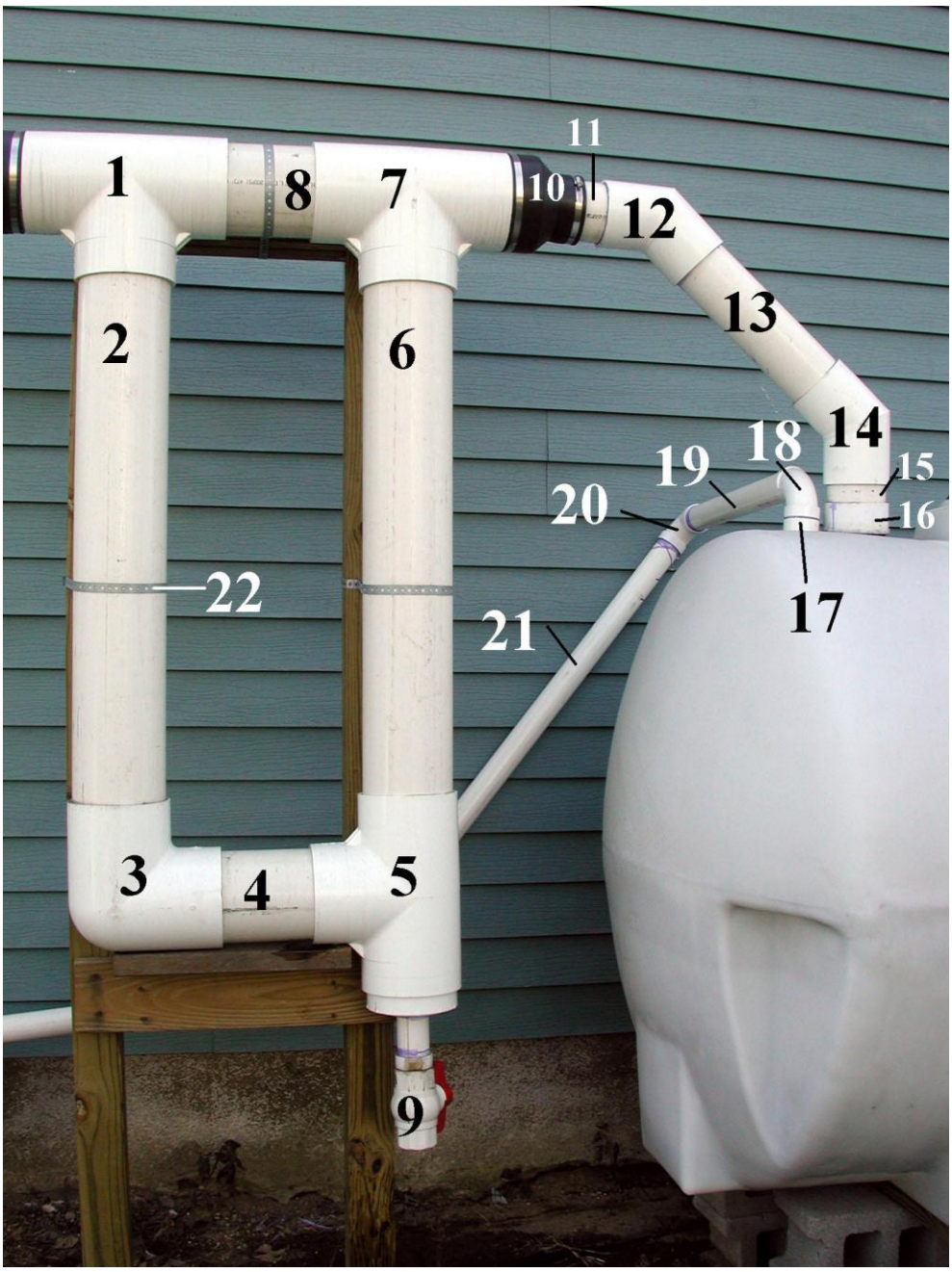
Once the ball is saturated with water, it will sink down and block the pipe. Water will fill up the pipe and finally enter the tank.



This device allows the overflow pipe to be connected to the roof washer pipe.

Water gradually enters the ball through this screen.

Here is an idea to help you design a roof washer of your own.



ROOF WASHER
1: 3 way tee
2: 6”pipe
3: 90° elbow
4: 6”pipe
5: 3 way tee
6: 6”pipe
7: 3 way tee
8: 6” pipe
9: drain valve

INFLOW
10: 6”x4” rubber coupling
11: 4” pipe
12: 45° elbow
13: 4”pipe
14: 45° elbow
15: 4”pipe
16: bushing

OVERFLOW
17: bushing
18: 90° elbow
19: 2”pipe
20: 90° elbow
21: 2” pipe

ANCHORING
22: plumber’s strap

Although this rainwater harvesting system has a good roof washer design, it does not have a good overflow design. Excess water will back up into the inflow pipe before the overflow pipe starts working. The overflow pipe should also be the same diameter as the inflow pipe to avoid a bottleneck situation.

Overflow pipes

When the rain barrel reaches its capacity, the overflow pipe discharges the excess water so that water won't start spilling out from around the lid. Cut a hole near the top of the barrel and connect an overflow pipe there. Be sure that the overflow pipe is not directed toward water-sensitive structures or areas where water can collect and do damage. The overflow pipe should be the same size as the inflow pipe so that a bottleneck situation is avoided during heavy rainfalls.

Here are some ideas to help you design an overflow pipe of your own.

OVERFLOW
1: bushing
2: 2"pipe
3: 45° elbow
4: 45° elbow
5: 2" pipe

The overflow pipe is connected back to the sewer. Building systems close to the downspout requires less piping.

OVERFLOW
1: 2” pipe
2: 90° elbow
3: 2” pipe

Instead of directing water back into the sewer, you can direct the water into a rain garden, gravel filled trench or connect it to a drip irrigation system. Overflow can be turned into works of art. Here the overflow is turned into a small water course (see picture on below), which ultimately ends in a rain garden.

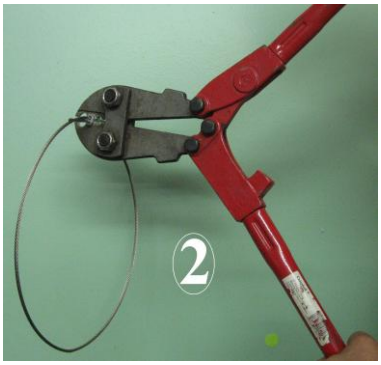
Rain gardens are depressed plots of land (see pictures below). It should be at the lowest point in the garden so that water can flow there easily. Dig a deep trench and fill it with 5 inches of gravel for seepage. Cover this area with burlap netting so that the soil will not sink down into the gravel. Place a couple of inches of soil on top and start planting. Only plants able to survive both dry and saturated soil should be grown. Native plants are also encouraged because they are more tolerant of local climate and soil conditions. These plants include wildflowers, ferns, shrubs and small trees. [9] Brooklyn Botanic Garden provides a thorough list of rain garden plants for different regions on their website at:
http://www.bbg.org/gar2/topics/design/2004sp_raingardens.html

Bioswales are alternatives to rain gardens. They are depressions in the landscape with collections of rock, gravel and vegetation that act as a filter for water. They effectively strain silt, inorganic contaminants, organic chemicals and pathogens. The longer the water is trapped inside the bioswale, the easier it is for pollutants to be trapped. They are most commonly found surrounding a parking lot so that oil runoff can be filtered before entering the sewer system.[10]

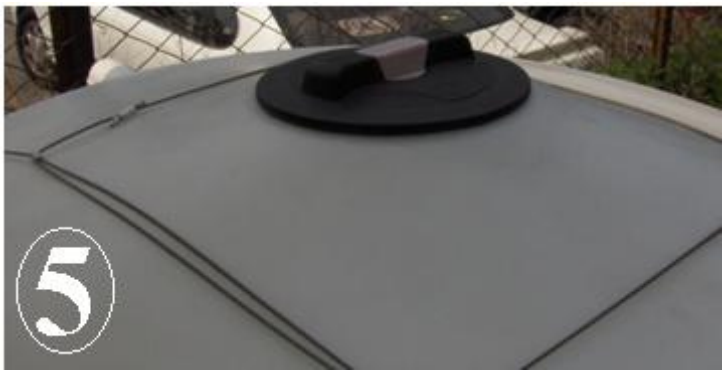
Anchoring

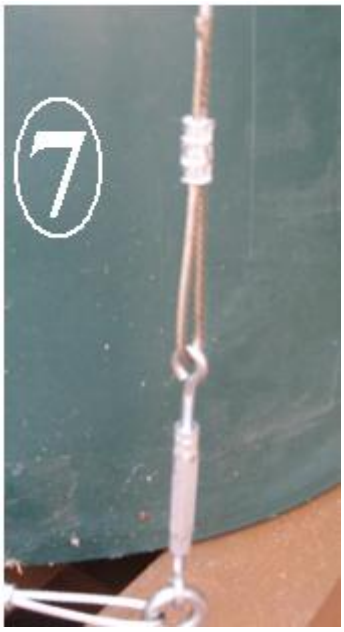
Because the rain barrel is fairly light and may tip or fall when it is empty, it is important to anchor the system to the platform or a structure. The easiest method to tie down your system is to use nylon rope. Steel cable is also a solution. Since cabling is more complicated, we will illustrate these steps.

Cut a piece of steel aircraft cable and slip 5 cable swedges in it Use the first piece of cable swedge **(see picture 1)** and a crimping tool to connect it into a circle **(2).** Its circumference should be a less than the circumference of the rain barrel but more than that of the lid. Cut two more long pieces of steel cable. They should be at least twice the height of the rain barrel. Use one cable and slip it through two of the metal cable swedges that are already on the circle. Making sure both lengths of cable are even; use the crimping tool to secure the metal swedges in place. Do the same with the other cable and two metal swedges **(3).**



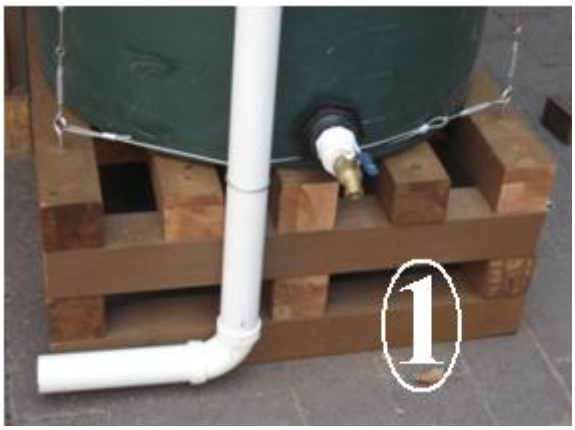
Screw a metal eyebolt into each of the four corners of your platform. Connect a turn buckle to each metal eyebolt **(4).** Place the series of cables onto your rain barrel. The circle should be on top of the rain barrel **(5).** The four hanging ends should be facing each corner of the platform. Loop the ends of the cables into the turn buckle **(6).** Use a metal swedge to secure the loop. Do this for all four corners. Finally, twist the turn buckles until the metal cables are taut **(7)** to finish securing your rain barrel **(8).**



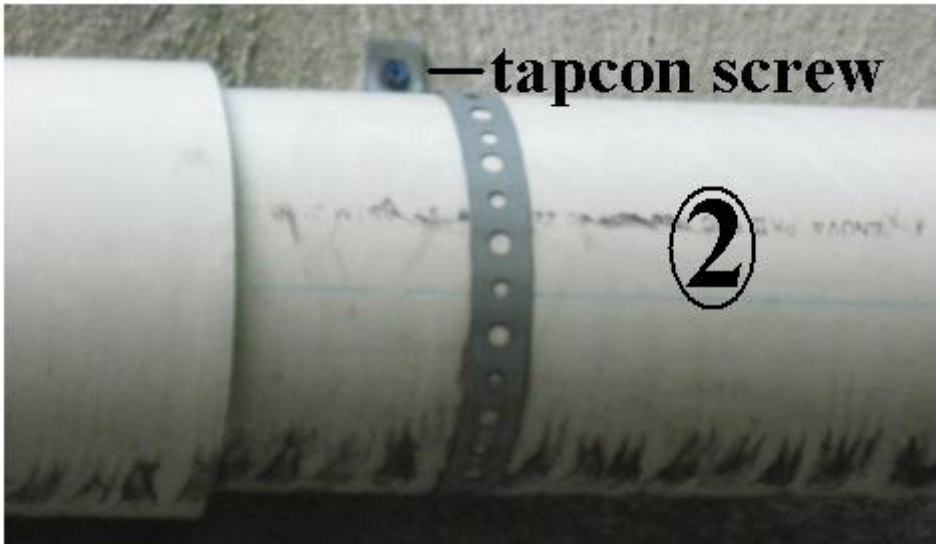


For cinder block platforms, nail a thick wooden plank on top and use the eyebolt method mentioned above.
Pre-fabricated steel brackets are generally used to anchor horizontal tanks.

It is a good idea to anchor pipes as well. If the pipe is hugging the rain barrel, anchor the pipe to that platform using cable **(see picture 1),** perforated plumber's strap **(2)** or other methods.



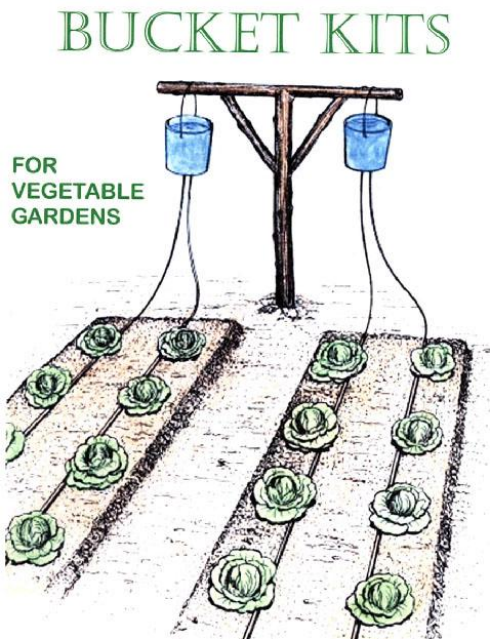
Pipes that are directly against the wall of a building can be secured to the wall using plumber's strap attached with tapcon screws, which seal the hole drilled in the wall to avoid leaks **(2).**

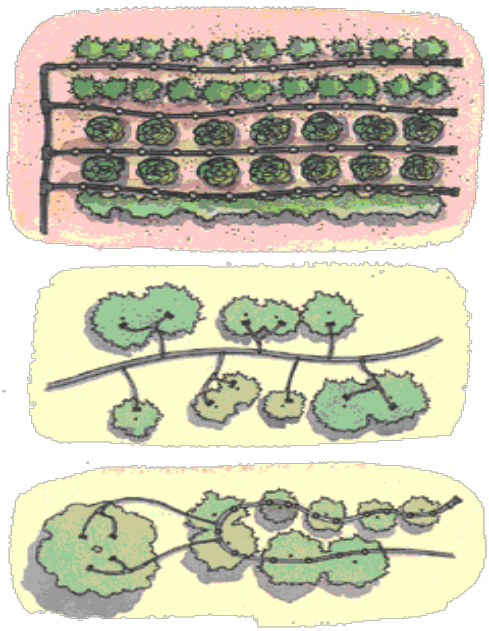


Drip Irrigation

Drip irrigation systems reduce water use. Small amounts of water are supplied to the base of plants. Since the water is applied directly to the soil, rather than onto the plant, evaporation from leaf surfaces is eliminated. The water is also placed where it is needed rather than sprayed over the entire garden.

With a drip system, water flows into a series of thin flexible hose lines. These irrigation hoses have tiny holes at even intervals. These hoses are placed on the surface or beneath a layer of mulch. When water enters the system, it slowly trickles out of these holes and waters the roots of plants (see pictures below[11]). The overflow of rain water harvesting systems is sometimes connected to these smaller pipes.





Tubing comes in many sizes (see pictures below[12]). It is used to get the water from the source to the garden. A variety of fittings are available to go around corners and to connect pieces.

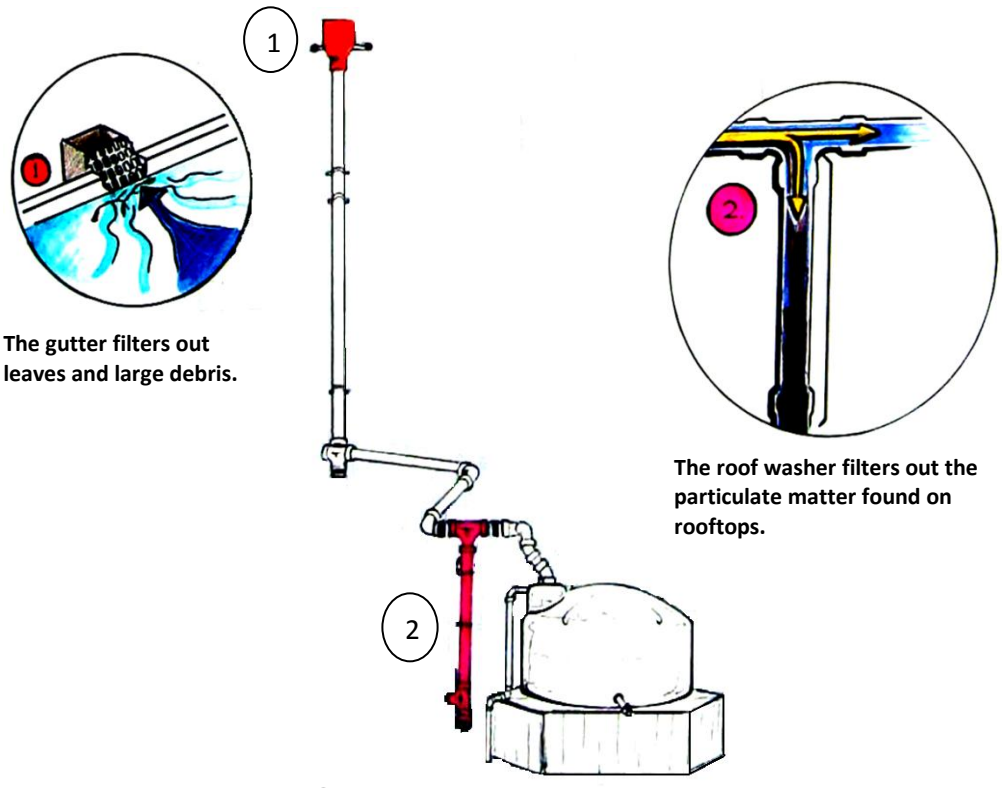
In most cases, no special tools or skills are needed. Plastic pipe is punched with an inexpensive tube punch that assures the proper hole size. Spaghetti tubes snap into the hole. No gluing is required. Because the holes are small, they can easily be plugged if you put one in the wrong place.

Gravity Feed Drip Irrigation Kits are used to connect to rain barrels and rainwater harvesting systems where the water pressure is low (see picture below[13]). This system uses small ¼ inch valves instead of emitters to avoid the problem of clogged emitters

Drip Irrigation systems need planning, but are neither expensive nor difficult to install. Most drip irrigation suppliers will help you design a system to best meet your gardening needs. Drip systems require periodic maintenance. Check regularly for leaks and broken connections.

Filtration Systems

This rain water harvesting system already has two means of filtration, one at the gutter **(see picture 1)** and the other at the roof washer **(2).**



The gutter filters out leaves and large debris.

The roof washer filters out the particulate matter found on rooftops.

This gutter screen that is put at the mouth of the downspout (see picture on right) prevents leaves and other large debris from entering the system. If you want to buy a filter, two choices are Rain Keeper Downspout filter for smaller roofs and the Rain Keeper Downspout collection filter for smaller systems. Refer to “Where to obtain supplies” on page 11 for more information.

Treatment

During warm weather, bacteria may grow inside the storage tank. Organic matter also poses a problem as algae or other contaminants may grow in storage tanks.WRG recommends adding a small amount of chlorine, in the form of unscented household bleach, to your water storage tank. Do not use bleach with any additives like fragrances or softeners. A log should be kept to ensure the proper addition of the chemical. Store log with bleach container. Please remember to wear gloves when handling bleach, to store bleach in a cool, dry place and to label bottle clearly to avoid improper use. On the 1st of each month, add a small amount of bleach to *each* water storage container. If the tank is emptied and refilled in less than one month's time, an application of bleach should be added to the tank when it refills

Tank Size	Amount of Bleach to Add
1000 gallons	1/3 cup
750 gallons	1/4 cup
500 gallons	3 tablespoons
50 gallons	2 teaspoons

Regularly emptying the roof washer and the addition of a small amount of bleach to your tank will ensure the water is safe for watering vegetables. The water stored in the tanks is for ***irrigation purposes only*****.** It is safe to use on vegetables and other plants in the garden, but it is not safe to drink. The quality of this water does not comply with local and national drinking water standards.

Aesthetics

“The most beautiful system is carefully constructed and incorporates a carefully thought out, well designed and installed plumbing system.”

-Lars Chellberg, GrowNYC staff member

Although a rain barrel is considered by some to be unsightly, it is easy to beautify your rain water harvesting system. PVC pipes and tanks can be covered by plants or painted (see pictures below).

A gazebo at this Seattle community garden covers an underground cistern that stores 5,000 gallons of collected rainwater (see picture below).

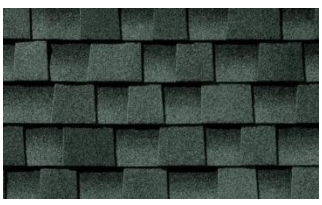
Promoting the sustainable practice of rain water harvesting is also important. For example, NYC community gardens use a “This garden harvests rain water” sign (see picture on right), a good idea to put in front of your system. Have printed information for people to learn more about rain water harvesting like this Water Resources Group brochure (see picture on left).

Sometimes it is necessary to break some basic RWH rules for aesthetic reasons. This rain water harvesting system has an inflow pipe that is pitched upward which means that it must rain enough for the water to fill up the roof washer and the inflow pipe before it can enter the tank. This was done so that the roof washer could be positioned below the brick wall and not interfere with the tree limb or the neighbor’s views.

Roofing Material

Roof tops are essential to any rain water harvesting system. Popular types of roofing include corrugated metal decking, shingles, rolled asphalt and cedar shake.

Corrugated metal decking can come in two forms- zinc coated or hot dipped galvanized. Because, zinc coated roofs rust easily, hot dipped galvanized roofs are more popular. These roofs are constructed simply by nailing down with sealing washers to your structure or screwing. Apply gutter sealant on any nail or screw to make sure water doesn't leak from these spots. Metal roofs provide great structural support for long amounts of time. It has the highest efficiency rate when it comes to rain water harvesting because of its waterproof surface. Its only downfall is the noise factor. It gets very loud when rain water clashes with the rooftop. It is an ideal roofing material for non residential structures.



Shingles are small pieces of overlapping wood or slate. Place a ½ inch wide piece of plywood on top of the structure. Start nailing shingles in a horizontal, overlapping fashion starting from the gutter line.

Work your way up to the top of your roof, making sure your next row overlaps the previous row (see picture on left[14]).

Rolled asphalt or modified bitumen roofs occur most commonly on flatter rooftops. A large sheet of asphalt is simply glued down with tar or plastic. Asphalt roofs can either have a granular surface or a smooth surface. Although granular surfaces are slightly less efficient in catching rain water because it is easily trapped in the pieces of ground glass, it is preferred over smoother roofs. Granular roofs wear slowly, resist cutting and keep UV rays from degrading it. Typically, a few years after the granular roof is installed, it is painted with aluminum to lock in grains that may have fallen loose (see picture on right[15]).

Cedar shake or wooden roofs are installed in a vertically overlapping fashion. Wood is the least efficient in catching rain water because it is porous. However, once the wood is saturated, it will no longer absorb water (see picture on left[16]).

Seasonal Maintenance

To ensure your health and safety the Water Resources Group recommends the following seasonal maintenance schedule for keeping your rainwater free of contaminants.

Spring

- Close spigot
- Re-direct roof water from the drain pipe back into tank storage system by replacing the in-line plunger or changing the position of the valve
- Clean any winter debris from gutters, leader inlets and roof
- Repair any leaks in barrel or tanks
- Inspect and clean barrel tops
- Fill system with a few inches of water to check hose connections for leaks
- Inspect rope/cable retainers to assure that barrels are secure
- Be sure that your tank is labeled with a “do not drink the water” sign in all appropriate languages
- To help ensure that children do not drink the water remove the valve from spigot and store with tools

Summer

- Keep the roof, gutters and leader inlets clear of debris, check monthly

- Inspect vents at top of each barrel to insure that they are clean and intact
- Visit your system during a heavy rain or shortly after to check for leaks and overflow problems.
- Any water from the overflow system should drain within 24 hours of a rainfall; if puddles form, you should move the outflow pipe to a more porous site or consider installing a small rain garden
- Inspect pipes and connectors regularly for any damage or disrepair
- Check man-way hatch on top of your tank to make sure it is securely closed

Fall

- Remove plunger from the PVC joint to redirect water into the drain pipe to the sewer
- **Empty water from the entire system- roof washer and tank**
- Open main valve of storage tank and rain barrels
- Open valve on roof washer. Valves should remain open all winter to keep water from freezing in system
- Disconnect leader from system and re-route water as necessary for particular system
- Cover any openings in leaders

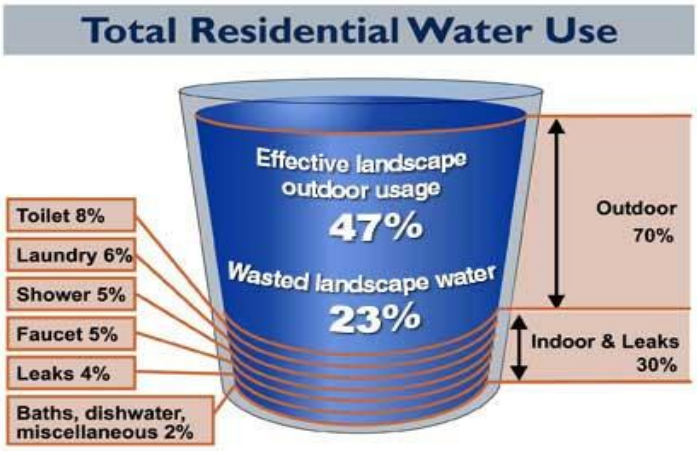
Living with the RWH System

Now that you have built your rain water harvesting system, you have helped to conserve one of the Earth's most valuable resources. A rain barrel is not something you build and walk away from. It is important to make sure there are no leaks in your barrel and to drain the first flush after every storm.

Remember to drain your roof washer and tank during the winter and to take out your wintering tee! Freezing water will BREAK the system. The cracks seen in the two pictures below are from left over water freezing and expanding.

If properly built and maintained, your rain water harvesting system will last many years. Even the smallest tanks will save thousands of gallons of water.

It is essential to learn how to manage your water usage. Seventy percent of residential water use goes to outdoor activities. One third of that water is wasted (see diagram on right[17]). Using pumps or sprinklers to water plants are one of the most inefficient ways to irrigate. Plants only need to be watered at the roots. Sprinklers relentlessly waste water by randomly shooting out water to tree branches or leaves. Drip irrigation systems with outlets placed strategically next to plant roots are the most efficient ways to irrigate.



Existing RWH Systems

Organic Gardening Magazine has been sponsoring construction of rain water harvesting systems in community gardens since 2007. Their Waterworks Project funded 30 systems in the past 2 years. Looking at existing rain water harvesting systems and talking to community gardeners may assist you in building your own. Locations in the USA and Canada include:

Alemany Farm - San Francisco, CA
Ashview Community Garden - Atlanta, GA
Aspen Farms - Philadelphia, PA
Boyd Street Urban Farm - Portland, ME
Bradner Gardens Park – Seattle, WA
Brentwood Community Garden - Portland, OR
Children Garden - Camden, NJ
City Seeds Urban Farm - St. Louis, MO
Dias y Flores – New York, NY
The Farm Garden at the Early Childhood Education Center - Columbus, OH
Fremont Community Garden - Sacramento, CA
The Garden of Dreams - New York, NY
Global Gardens - Tulsa, OK
Gloryland Community Garden, Detroit, MI
Growing Green Youth Garden, Buffalo, NY
Guadalupe Montessori School, Silver City, NM
Hope Community Garden - Toronto, ON Canada
Marigold Meadows - Phoenix, AZ
Master Peace Youth and Community Garden - Riverdale, MD
Our Saviour Community Garden - Dallas, TX
The 1100 Block Bergen Street Garden - Brooklyn, NY
Urban Ministry Center - Charlotte, NC
Wasatch Community Gardens - Salt Lake City, UT
Woodlawn Garden - Portland, OR
Xochiquetzal Peace Garden - Chicago, IL

For more information on these gardens, visit their website at:
http://www.organicgardening.com/feature/0,7518,s1-2-10-1531-1-1X2X3-4,00.html

This guide can be found on GrowNYC's website at:
http://www.GrowNYC.org/openspace/rainwater

10 Ways to Conserve Water

1. Turn off the faucet when brushing your teeth, washing your face and shaving.

2. Fix any leaky sinks, toilets or showerheads.

3. Wash only full loads- for clothing and dishes.

4. Do not run water to thaw meats.

5. Water plants at the roots.

6. Take showers instead of baths.

7. Replace showerheads and sink aerators with low flow ones.

8. Use a pitcher to store cold water in the refrigerator instead of running the tap every time.

9. Water plants during early mornings and late afternoons to reduce evaporation.

10. Do not flush the toilet unnecessarily. Dispose of bugs, cigarette butts and tissues another way. [18] [19] [20]

The Water Resources Group (WRG), a coalition of NYC greening & community garden groups is dedicated to the preservation of NYC water resources through gardening, ecological design and education programs. WRG is installing rainwater harvesting systems in gardens across NYC to conserve water and prevent pollution. For more information on how you can help conserve water in New York City, visit the Water Resources Group website at www.waterresourcesgroup.org.

If you have any questions regarding the construction of your rain water harvesting system e-mail Lenny Librizzi, Assistant Director of Open Space Greening at GrowNYC at llibrizzi@GrowNYC.org.

Endnotes

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This manual was put together by Julia Leung, Lenny Librizzi, Assistant Director of Open Space Greening at GrowNYC and Lars Chellberg.

After reading this manual, please fill out this feedback form and mail it to:

GrowNYC
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New York, NY 10007

On a scale of 1 – 10, 10 being the most agreeable, 1 being the least, assess the following statements:

This manual is easy to understand.
1 2 3 4 5 6 7 8 9 10

This manual contains clear instructions.
1 2 3 4 5 6 7 8 9 10

This manual helped you make your rain water harvesting system.
1 2 3 4 5 6 7 8 9 10

You understand how a rain water harvesting system works.
1 2 3 4 5 6 7 8 9 10

You are no longer interested in rain water harvesting.
1 2 3 4 5 6 7 8 9 10

You would recommend this manual to your friends.
1 2 3 4 5 6 7 8 9 10

You know the importance of water conservation.
1 2 3 4 5 6 7 8 9 10

What are the strong points of this manual?

What are the weak points of this manual?

APPENDIX
eight

PROJECT AREA
CSO MAP

Courtesy of: NYC OpenData, State of New Jersey, Esri, HERE, DeLorme, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA

APPENDIX nine

PROJECT AREA ZONING & LAND USE MAP

Green Buffer Project: Land Use Map

Primary Land Use

- One & Two Family Residence
- Multi-Family Residence (Walkup)
- Multi-Family Residence (Elevator)
- Mixed Residential & Commercial
- Commercial Use
- Industrial / Manufacturing
- Transportation / Utility
- Public Facilities and Institutions
- Open Space & Recreation
- Parking
- Vacant Land

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