FINAL REPORT
Culver City Rainwater Harvesting Program

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January 31, 2012

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Final Report Culver City Rainwater Harvesting Program

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EXECUTIVE SUMMARY

The City of Culver City and the Santa Monica Bay Restoration Commission (SMBRC) developed the Culver City Rainwater Harvesting Program (CCRH Program) as a pilot project completed between October 1, 2010 and September 30, 2011. The CCRH Program was developed to provide Culver City residents and property owners the opportunity to learn about urban water management and participate in best management practices on their properties. In addition, Culver City and the SMBRC implemented this pilot program to evaluate the overall cost and effectiveness of an ongoing rainwater harvesting program. This report is intended to provide the analysis necessary for municipalities and organizations to develop a similar program that is cost effective and successful.

Rainwater harvesting is the process of intercepting rainwater from a roof (or other surface) and utilizing it for beneficial purposes. By implementing rainwater harvesting techniques, residents gain an extra water supply while reducing the pressure on our limited water supplies. The CCRH Program has informed homeowners about the beneficial uses of capturing rainwater and reducing the amount of runoff flowing from their roofs and property into the storm drain system. The CCRH Program included the disconnection of downspouts that discharge to impervious areas and redirection to collect roof runoff into rain barrels and overflow to pervious areas.

The CCRH Program installed 396 rain barrels and redirected overflow runoff to porous areas (gardens and lawns), as well as one rain garden and cistern within the City of Culver City. A rain barrel, cistern and rain garden were installed adjacent to the SMBRC offices on the Loyola Marymount University (LMU) campus to perfect construction and installation methods and allow monitoring of function, durability, water retention and water quality of these systems. In addition, the program provided direct education to residents through public events and home consultations, as well as the distribution of educational and instructional literature.

The 396 rain barrels installed during the CCRH Program will annually capture between 174,240 and 392,040 gallons of water that would otherwise flow into Santa Monica Bay, equivalent to 0.5 to 1.2 acre-feet, of stormwater, and allow between 441,273 and 702,975 gallons to be absorbed by redirecting roof runoff to landscaped areas, equivalent to 1.35 to 2.16 acre-feet. The result is a redirection of 602,825 to 1,094,860 gallons (1.85 to 3.36 acre-feet) of runoff onto properties for reuse or infiltration. An expansion of the program to include all single family residential properties in Culver City would annually capture between 7,168,731 to 16,129,645 (22.0 and 49.5 acre-feet), and infiltrate between 18,149,924 to 28,903,021 gallons (55.7 and 88.7 acre-feet), redirecting 25,318,656 to 45,032,667 gallons (77.7 to 138.2 acre-feet) of runoff from the streets and storm drains.

Along with reducing large volumes of runoff entering storm drains and ultimately our creeks and oceans, implementing a rainwater harvesting program provides significant reductions in

pollutant loads. The estimated annual pollutant reductions from stormwater captured in the 396 rain barrels and/or diverted onto landscaped areas are as follows: copper and lead (3.8 to 6.7 oz.), nitrate as nitrogen (188.6 to 335.58 oz.), phosphorous (94.3 to 167.79 oz.), and E.coli bacteria (220,066 to 391,504 MPN). If the CCRH program was expanded to include all single family residential homes throughout Culver City the estimated pollutant reductions would increase to: copper and lead (155 to 275 oz.), nitrate as nitrogen (7,754 to 13,794 oz.), phosphorous (3877 to 6897 oz.), and E.coli bacteria (9 to 16 million MPN). Projects such as the CCRH program can help cities and municipalities meet current and future water quality requirements.

As part of the CCRH program two rain gardens were constructed; one adjacent to the SMBRC offices on the LMU campus and one at residence in Culver City. A rain garden is a shallow depression created in the landscape where water from rooftops and driveways is directed and allowed to pool. The pooled water is naturally filtered as it is slowly absorbed by the soil and plant roots. The LMU rain garden will capture 1,650 gallons of water per inch of rain and is capable of infiltrating approximately 3,227 gallons within a 24 hour period. The Culver City residential rain garden will capture approximately 576 gallons of water per inch of rainfall off the rooftop and is capable of infiltrating more than 3,500 gallons within a 24 hour period. Grass lawns were replaced with drought tolerant California native plants which will reduce the amount of potable water required for maintenance. The estimated annual potable water saving equates to 50,000 gallons at the LMU rain garden and 63,000 gallons at the Culver City rain garden.

Rain Barrels were given to Culver City residents on a first come first served basis. Residents were required to fill out an online or paper application to ensure they met minimum requirements.The most cost effective outreach method was word-of-mouth communications, which generated approximately 35% of the CCRH Program applications. While media generated the most applications (38%), costs were variable; print advertisements were expensive while televisions and newspaper interviews were free. Word-of-mouth required no direct capital or time resources; it is indirectly stimulated by all other outreach and advertising methods.

The CCRH Program's success depended largely on the dissemination of information to a wide scope of potential participants and a method for these individuals to refer peers. A simple website and print brochures were considered core components to program implementation as they serve as digital and hard copy information portals to the program's purpose and participation specifics. When used in combination, these information methods allow participants to easily access and share information.

1.0 INTRODUCTION

The City of Culver City and the Santa Monica Bay Restoration Commission (SMBRC) developed the Culver City Rainwater Harvesting Program (CCRH Program) as a pilot project completed between October 1, 2010 and September 30, 2011. The CCRH Program was developed to provide Culver City residents and property owners the opportunity to learn about urban water management and participate in best management practices on their properties.

In addition, Culver City and the SMBRC implemented this pilot program to evaluate the overall cost and effectiveness of an ongoing rainwater harvesting program. This report is intended to provide the analysis necessary for municipalities and organizations to develop a similar program that is cost effective and successful.

1.1 About the City of Culver City

Culver City is a Charter City incorporated in 1917. Culver City has a nighttime/resident population of over 40,000 and an even larger daytime population. The City provides a full range of municipal services including transportation services by way of a municipal bus system; public safety; community development; public works; community services, including parks recreation, and senior services; and a sanitation/solid waste collection division.

Culver City is driven to be an environmental steward and dedicated to the protection of its residents and natural areas. The City undertakes efforts to conduct best management throughout the City to preserve the environment and provide opportunities for residents to contribute.

1.2 About the Santa Monica Bay Restoration Commission

The SMBRC is a State agency and a National Estuary Program of the United States Environmental Protection Agency, charged with improving water quality, conserving and rehabilitating natural resources, and protecting the benefits and values of the Santa Monica Bay. The SMBRC builds consensus among diverse stakeholders on environmental issues in the Santa Monica Bay and its watersheds, including water quality, habitat restoration, public access, and environmental justice. The SMBRC raises and expends funds for research, education, planning, cleanup efforts, and other priorities identified in the Bay Restoration Plan.

1.3 Program Overview

Rainwater harvesting is the process of intercepting rainwater from a roof (or other surface) and utilizing it for beneficial purposes. By implementing rainwater harvesting techniques, residents gain an extra water supply while reducing the pressure on our limited water supplies.

Many residential and commercial properties in the City are fitted with downspouts; when it rains, water runs off roofs through these downspouts, and usually onto an impervious surface, such as a sidewalk, driveway or parking lot. Rainwater harvesting helps increase local water resources by promoting groundwater recharge by redirecting the flow of runoff to pervious surfaces where it can percolate into the soil (Figure 1.1).

The CCRH Program has informed homeowners about the beneficial uses of capturing rainwater and reducing the amount of runoff flowing from their roofs and property into the storm drain system. The CCRH Program included the disconnection of downspouts that discharge to impervious areas and redirection to collect roof runoff into rain barrels and overflow to pervious areas.

The CCRH Program installed 396 rain barrels and redirected overflow runoff to porous areas (gardens and lawns), as well as one rain garden and cistern within the City of Culver City. A rain barrel, cistern and rain garden were each installed adjacent to the SMBRC offices on the Loyola Marymount University campus to perfect construction and installation methods and allow monitoring of function, durability, water retention and water quality of these systems. In addition, the CCRH Program provided direct education to residents through public events and home consultations, as well as the distribution of educational and instructional literature.

Figure 1.1 Rainwater harvesting with a rain barrel and overflow to permeable surface.

1.4 Environmental Program Benefits

A rainwater harvesting program provides many benefits to the participants, local and regional community, municipality, water agency, environment, and many others. These benefits include:

- **Protection of Our Bays and Ocean**: Rainwater flowing from a downspout onto sidewalks, driveways, and streets collects a variety of pollutants before reaching a nearby storm drain. By capturing rainwater that falls onto roofs, land owners can reduce the amount of runoff and pollution reaching the Santa Monica Bay, thus aiding in improving the quality of our local water bodies.

- **Reduction of Energy Demands**: The State of California Energy Commission reported that water-related energy consumption in California accounts for nearly 20% of the State's electricity, 30% of its natural gas, and requires about 88 billion gallons of diesel fuel every year. One inch of rain falling on a one thousand foot rooftop produces more than 600 gallons of water. Energy consumption in the State would be greatly reduced if homeowners substituted potable water with captured rainwater.

- **Water Conservation**: California has entered an era of increasing water scarcity, coupled with projections of increased temperatures of up to 10 degrees Fahrenheit by the end of the century. Using rainwater to water plants helps conserve dwindling drinking water supplies.

- **Recharge of Groundwater Supplies**: Approximately 40% of southern California's drinking water comes from groundwater. Harvesting rainwater and allowing it to infiltrate into the ground will help replenish groundwater supplies.

1.5 Program Objectives

The primary objective of a rainwater harvesting program is to educate residents and property owners of the value of our water resources. The development and dissemination of outreach materials are a critical component of this program. Outreach materials are the primary form of education, and reach a much broader audience than the participants in the more involved portion of the program (e.g. workshops, rain barrel retrofits, or converting traditional landscaping to rain gardens) (Figure 1.2). Outreach materials were developed to educate the public about best management practices they can implement on their properties as well as in their community. Every person engaged through the outreach materials has the potential to become a supporter of larger programs to improve water quality and conservation. For example, the implementation of a rainwater harvesting program may help gain support for State propositions or local measures to fund water resource improvement projects.

Figure 1.2 Educational booth at outreach event at Star EcoStation.

Outreach that involves direct engagement with the public (public events, workshops or home consultations) is an opportunity to develop an active public base that will help promote these water resource management programs. The installation of stormwater retrofits at properties throughout the region provides lasting examples of the steps individuals and municipalities can take to improve water resource management. These retrofits continue to engage new stakeholders and spur discussion and support of best management practices long after the installation. This dual approach, outreach and retrofits, can provide a lasting change for public engagement with water management and policy.

2.0 IMPLEMENTATION

The CCRH Program had two major implementation components; outreach and retrofits. Outreach involved both educating the community and the solicitation of volunteers to participate in the retrofit program. Retrofits involved modification of re-purposed food barrels and installation of rain barrels, cisterns and rain gardens. This program was designed to test a variety of options for both outreach and retrofits. The following section describes the steps taken to implement these outreach and retrofit options.

2.1 Outreach

A diversified media and outreach strategy was developed to expose the greatest number of property owners to the CCRH Program. Outreach focused on educating the public, as well as soliciting volunteers to participate in the program through the installation of rain barrels, cisterns or rain gardens on their property. With the increase in current news, social media, and community event outlets accessible to property owners, the CCRH Program employed a variety of methods to reach potential participants. Methods employed included: developing a website and print materials, posting traditional ads in local newspapers, soliciting blog posts and web links, emailing community and environmental groups' members, providing participants with lawn signs, distributing brochures door-to-door to homeowners and check-out stands at local businesses, and directly interacting with potential participants via farmers' markets and other local community events. See Table 3.1 for a complete list. Outreach materials created for print media are available in Appendix B.

Important outreach materials created prior to the installation and outreach portion of the CCRH Program included a basic website and program documents (e.g. brochures, "How-To" Guide, application form, and liability waivers). A basic three page website was developed (www.ballonawatershed.org/CCrainwater.html) to serve as a central location for individuals to access in-depth program information, documents, the online application form, and additional rainwater harvesting resources. The website was a critical component of the outreach program. Nearly all program participants accessed the website for information, program documents or to apply for an installation appointment.

The brochure, "How-To" Guide, application form, and liability waivers were adapted from the City of Los Angeles' Rainwater Harvesting Program (http://larainwaterharvesting.org/). All documents are available in Appendix B and available for use, educational purposes, and as templates for future programs. Brochures were distributed via public events, door-to-door, and posted at community centers and businesses (e.g. nurseries). The "How-To" Guide demonstrates the benefits and practices of different rainwater harvesting techniques, particularly the use of rain barrels and installation of rain gardens (Figure 2.1). The guide provides step-by-step installation and construction instructions for each practice. Development of the CCRH Program documents required substantial up front staff time, yet were reused throughout the course of the program and were instrumental in the dissemination of program information.

Advertisements in local newspapers, partner websites, and Facebook were posted at the beginning and throughout the course of the program. These advertisements both informed the public about the existence of the CCRH Program, and served as a continuing reminder for potential participants requiring additional information. Similar to print media documents, advertisements required an initial time investment, yet proved reusable and effective.

Several community events were attended by CCRH Program staff. Event displays included

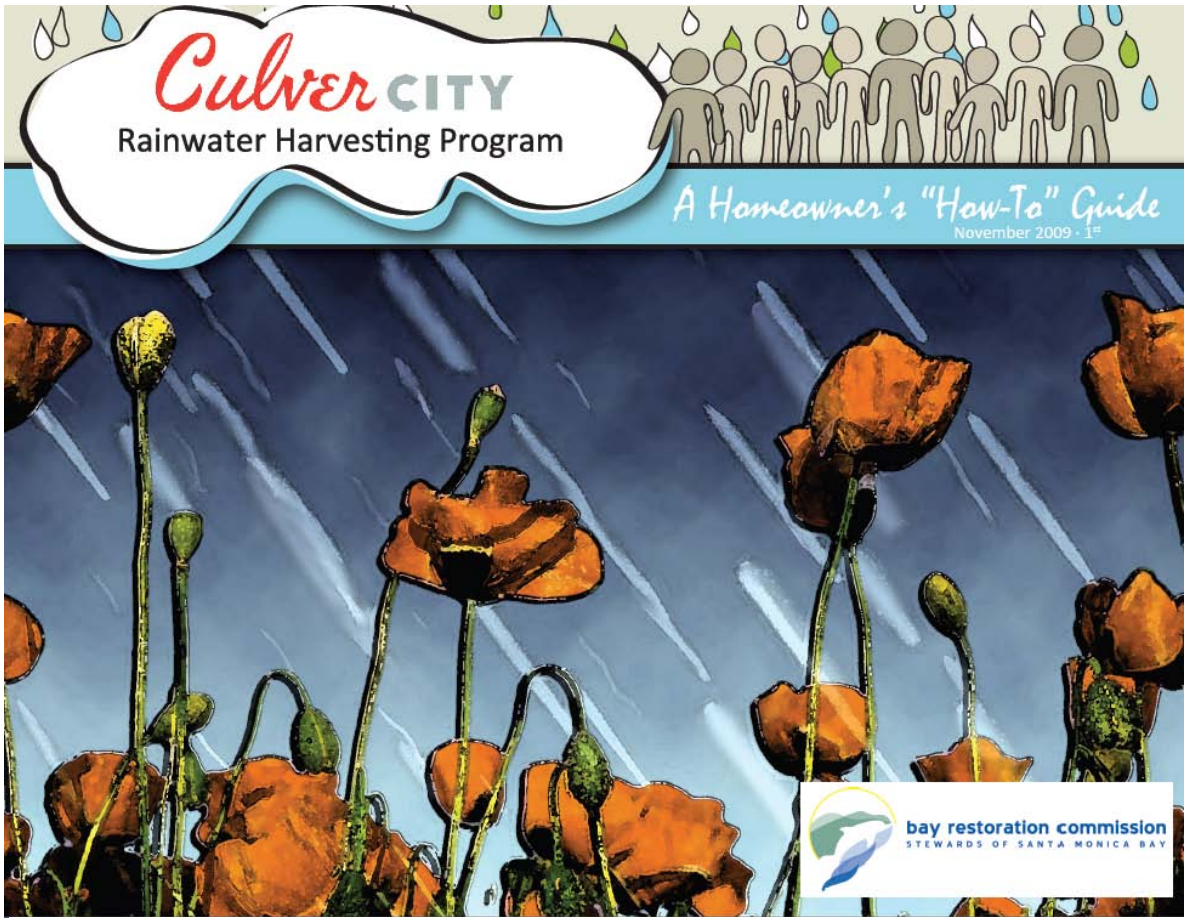

Figure 2.1 Culver City Rainwater Harvesting Program "How-To" Guide.

demonstration rain barrels, CCRH Program documents, paper application forms, organization literature, and additional rainwater harvesting information. Events provided staff an opportunity to educate the public one-on-one about the benefits of the CCRH Program and general rainwater harvesting practices. These events required a sizable time investment, yet provided key opportunities to interact with the public and engage questions and concerns.

Community groups, local environmental non-profits, and environmental bloggers were contacted and encouraged to participate and relay CCRH Program information to their members through list serve emails, blogs, and announcements. This method was effective at reaching a smaller, yet actively involved audience and carried with it the organization's approval.

The combination of these multiple strategies resulted in one of the CCRH Program's most powerful outreach outlets, word-of-mouth communication. Participating community members recruited neighbors and friends directly to join the program. Additionally, the placement of lawn signs (Figure 2.2) in front of homes where rain barrels were installed informed neighbors about the program and how to apply for their own rain barrel.

Figure 2.2 Lawn sign used at participants' homes.

2.2 Application Tracking

Several avenues were made available to enable the registration process and application tracking to be as simple and intuitive as possible for program participants and staff. Most applicants applied by filling out a short, 15 question online application form on the website (http://ballonawatershed.org/CCrainwater/application.html), which automatically populated a Google spreadsheet. Other paper applications mailed to the SMBRC offices or filled out at outreach events were manually entered into the same online form by CCRH Program staff to keep a single, centralized application database. Applicants were emailed with a list of available installation arrival time windows to choose from. One hour arrival windows were scheduled to account for variations in arrival times.

Additionally, qualification requirements were listed on the website homepage which included restriction to residents within Culver City, rain gutters already installed, and an accessible downspout draining to a space measuring 2.5 ft x 2.5 ft or greater to accommodate the average size of each rain barrel. This disclosure resulted in a reduction of ineligible participants.

2.3 Rain Barrels

At the initiation of the CCRH Program, SMBRC assessed potential off-the-shelf (proprietary) and home-made rain barrels, as well as installation methods for each. A selection of proprietary rain barrels that cost less than $150.00 (including shipping) were evaluated. Only one model was assessed when similar styles were available from the same manufacturer.

In addition, SMBRC reviewed potential methods for constructing rain barrels using recycled food barrels (food grade plastic barrels) and easily available materials. Due to high product prices ($75 - $100 per unit) and transportation costs, the purchase of proprietary rain barrels was considered infeasible and cost-prohibitive. Many of the proprietary products were constructed of poor quality plastic fittings that were not durable enough for long-term use of the rain barrel. Ultimately, the purchase of raw materials and in-house construction of each barrel was determined to provide the best value and allowed on-site customization (e.g. location of spigot and overflow). A local wholesaler of food-grade quality high density polyethylene (HDPE) 55-gallon barrels was selected based on barrel quality, available selection, product price and transportation costs. Additional materials were selected to mimic the desirable aspects of other designs with improved materials (e.g. brass spigot instead of plastic). SMBRC continued to perfect the design and materials during the first few months of the program to develop a durable rain barrel at a low cost. Customization allowed site specific modifications, and allowed rain barrels to be connected in series using lengths of standard ¾" garden hose (Figure 2.3). Total modification time to complete a single barrel was approximately 20 minutes.

Figure 2.3 Four rain barrels installed in series at a Culver City residence. Flow direction is from right to left (downhill).

2.4 Rain Barrel Installation

A primary component of the CCRH Program involved on-site rain barrel installation (Figure 2.4). Installations constituted the majority of program resources (e.g. staff time, materials), yet ensured proper usage, location, and the barrel's functionality. Other functional issues were assessed, including properly angled and clear gutters, overflow hose directed to permeable surface, and installation on level surface. Complete 'step-by-step' instructions for installing a rain barrel are outlined in Appendix B.

During all installations, consultations were provided to homeowners including additional rainwater harvesting techniques appropriate for their property. The most common recommendations included: removing unnecessary concrete and asphalt, replacing grass lawns with native, drought tolerant vegetation, and installing permeable rain gardens and cisterns in appropriate locations.

On-site installations required the presence of the property owner to ensure liability forms were signed and provide maintenance instructions. This provided the homeowner an additional opportunity to ask questions regarding the maintenance and use of their rain barrel while ensuring the CCRH Program received the proper legal signatures prior to performing any work on the property.

During installations, additional property data were collected including: roof catchment area, total roof area, total number of downspouts, downspout types, and the location and surface type where overflow water was directed. These data are provided in the Results section of this report.

Figure 2.4 SMBRC staff sealing downspout to ensure proper function of the rainwater harvesting system.

On average, the CCRH Program installed 6-7 rain barrels per day. One hour time arrival windows were given to homeowners to account for additional time required with difficult installations. The average time required for each installation was approximately one hour resulting in a total time investment of two hours for homeowners. Installations performed more rapidly resulted in idle staff waiting for homeowners to arrive at the beginning of their

scheduled time window. It is the recommendation of the CCRH Program to consider a two hour appointment window to account for both simple and more problematic installations.

2.5 Cisterns

Two cisterns were installed as part of the CCRH Program. A 1000-gallon cistern was installed at SMBRC offices on the Loyola Marymount University (LMU) campus to assess the price, durability, customization options, and effectiveness of potential materials. An above-ground, cylindrical, polyethylene water tank design was selected for both cisterns installed as part of this program (Figure 2.5). An above ground cistern reduces costs (subsurface cisterns require extensive excavation), and the tank can be installed for approximately the cost of materials and staff time. A local manufacturer was chosen to allow materials to be picked up rather than incur high delivery costs associated with the bulky tanks.

The cistern required minimal effort to construct a suitable base, which consisted of 8 – 12 in. of ¾ in. drainage gravel. The gravel was packed with a tamper and graded using a carpenter's level attached to a 2x4 equal to the diameter of the tank's base. Additionally, the cistern selected allowed customized inflow with the installation of a bulkhead fitting (Figure 2.5).

All rain flow directional piping (inflow, overflow, and first flush) employed PVC schedule 40 piping. PVC is a low cost, durable industry standard for water conveyance (Figure 2.5). When the cistern fills, the overflow is directed into a native planted rain garden. Due to the build-up of oil, grease, bird dropping, and other harmful particulates, the first ¼ in. of precipitation during a rain event produces the most contaminated runoff. The first flush system is a retention system designed to capture that first ¼ in. of precipitation and reduce the number of contaminants reaching the cistern. After being stored in a retention pipe, the contaminated water is slowly drained onto a permeable area where pollutants may be absorbed by the surrounding soils. The 1000 gallon cistern at LMU receives drainage from an approximately 850 sq. ft. of roof and captures and stores approximately 1.9 in. of precipitation before it completely fills.

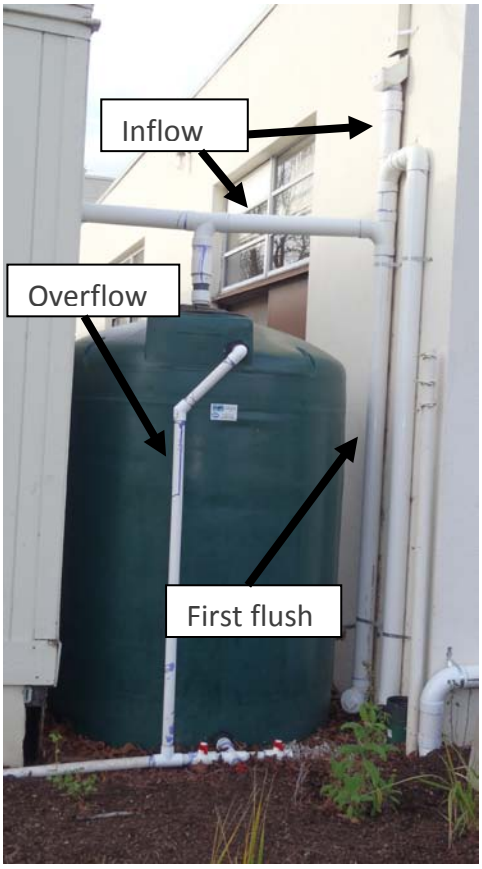

Figure 2.5 1000-gallon cistern adjacent to the SMBRC offices at Loyola Marymount University.

A similar 500-gallon cistern was installed at Star EcoStation in Culver City following the same strategies developed for the installation of the test cistern at LMU. The cistern at Star

EcoStation receives drainage from an approximately 3000 sq. ft. roof and captures and stores approximately 0.28 in. of precipitation before completely filling.

2.6 Rain Gardens

Rain gardens with native vegetation were constructed at both the SMBRC's LMU office and at a residence in Culver City (Figure 2.6). This rainwater harvesting technique reduces polluted runoff entering our bay and recharges groundwater by allowing infiltration of several thousand gallons of rainwater per storm event. Rain gardens are designed to capture and infiltrate stormwater runoff before entering storm drains via a bermed water retention basin (please see Appendix B for detailed description, instructions, and diagrams) (Figure 2.7). The LMU rain garden includes 900 sq. ft. of upland areas and a 200 sq. ft. swale. The LMU rain garden receives rainwater from a 2750 sq. ft. roof area. The rain garden in Culver City totals 1400 sq. ft. of native plantings, including 500 sq. ft. of swale. This rain garden receives rainwater from a 960 sq. ft. roof area. Each garden is designed to infiltrate runoff from a rainfall event equal to or greater than one inch (Figure 2.7).

Figure 2.6 Culver City home before installation of rain garden.

Both gardens were planted with approximately 30 species of native drought tolerant plants (500 individual plants at LMU and 800 plants in Culver City) requiring little to no potable water and minimal maintenance after establishment (Figure 2.8 and 2.9). This equates to an approximate annual savings of 50,000 gallons at the LMU rain garden and 63,000 gallons at the Culver City rain garden of potable water by reducing the high water needs of a grass lawn. The Metropolitan Water District estimates 45 gallons of water per year is required to maintain each square foot of grass lawn in southern California.

The native plants were selected to correspond with specific locations within the rain garden. For example, plants with a high tolerance for inundation [e.g. Mexican rush (*Juncus mexicanus), Common rush (Juncus patens), and Yerba mansa (Anemopsis californica*)] were planted in the lower swale designed to pool water during a rain event (Figure 2.10). Less inundation tolerant plants [e.g. Mugwort (*Artemisia douglasiana),* and Hummingbird sage (*Salvia spathacea*)] were planted on the upper berms and upland areas. Native plants also provide habitat for wildlife, and will attract native birds and butterflies to the rain gardens. A complete list of the native plants installed at LMU and in the Culver City rain gardens can be found in Appendix A.

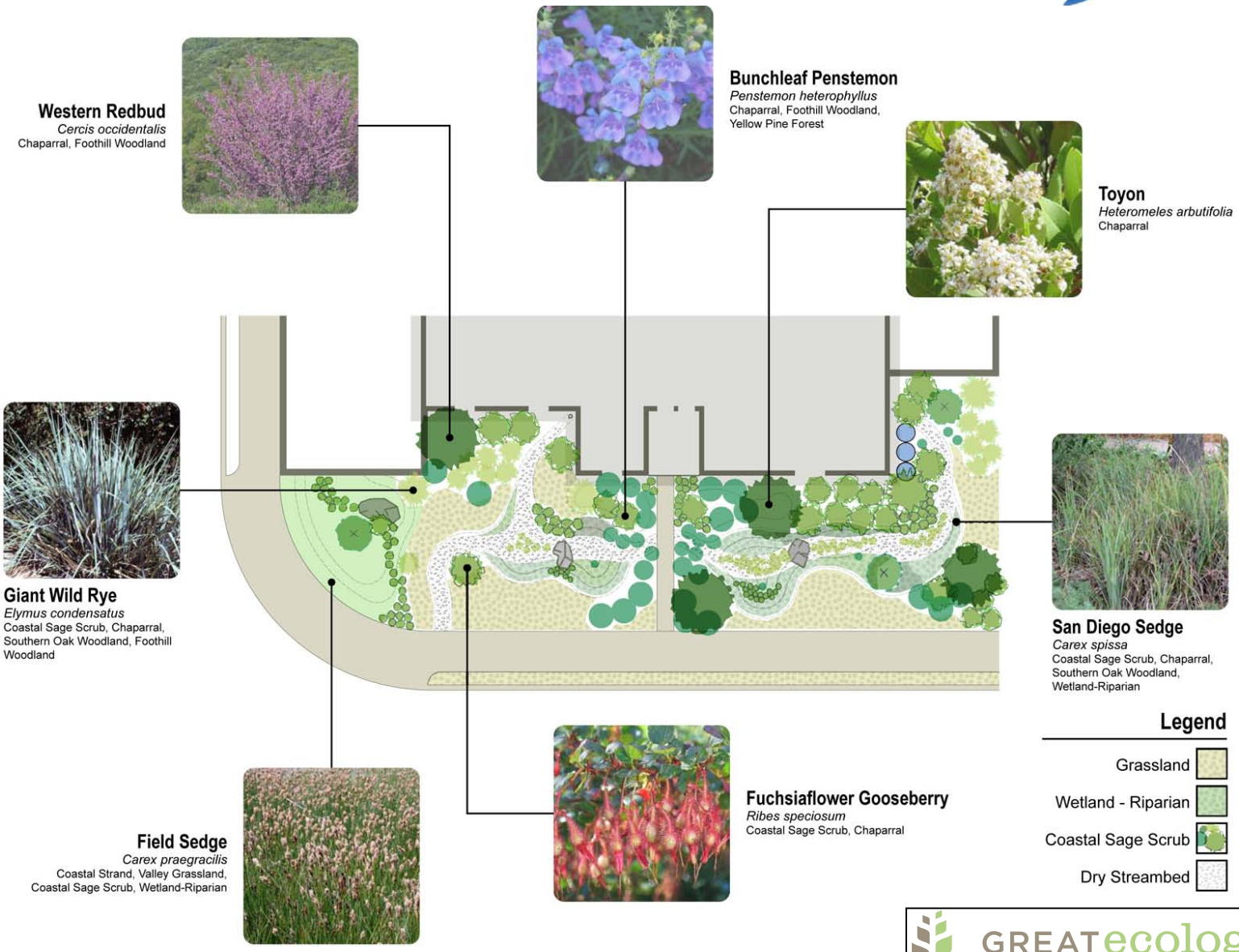

Figure 2.7 Culver City rain garden planting plan.

Figure 2.8 SMBRC staff and volunteers construct the rain garden at a Culver City home.

Figure 2.9 Completed rain garden at Culver City residence.

Figure 2.10 Culver City rain garden artistic rendering of mature landscape.

3.0 RESULTS AND ANALYSIS

396 rain barrels were installed as part of the CCRH Program, as well as two cisterns and two rain gardens. Figure 3.1 displays the locations of all the CCRH Program rain barrel installations within Culver City.

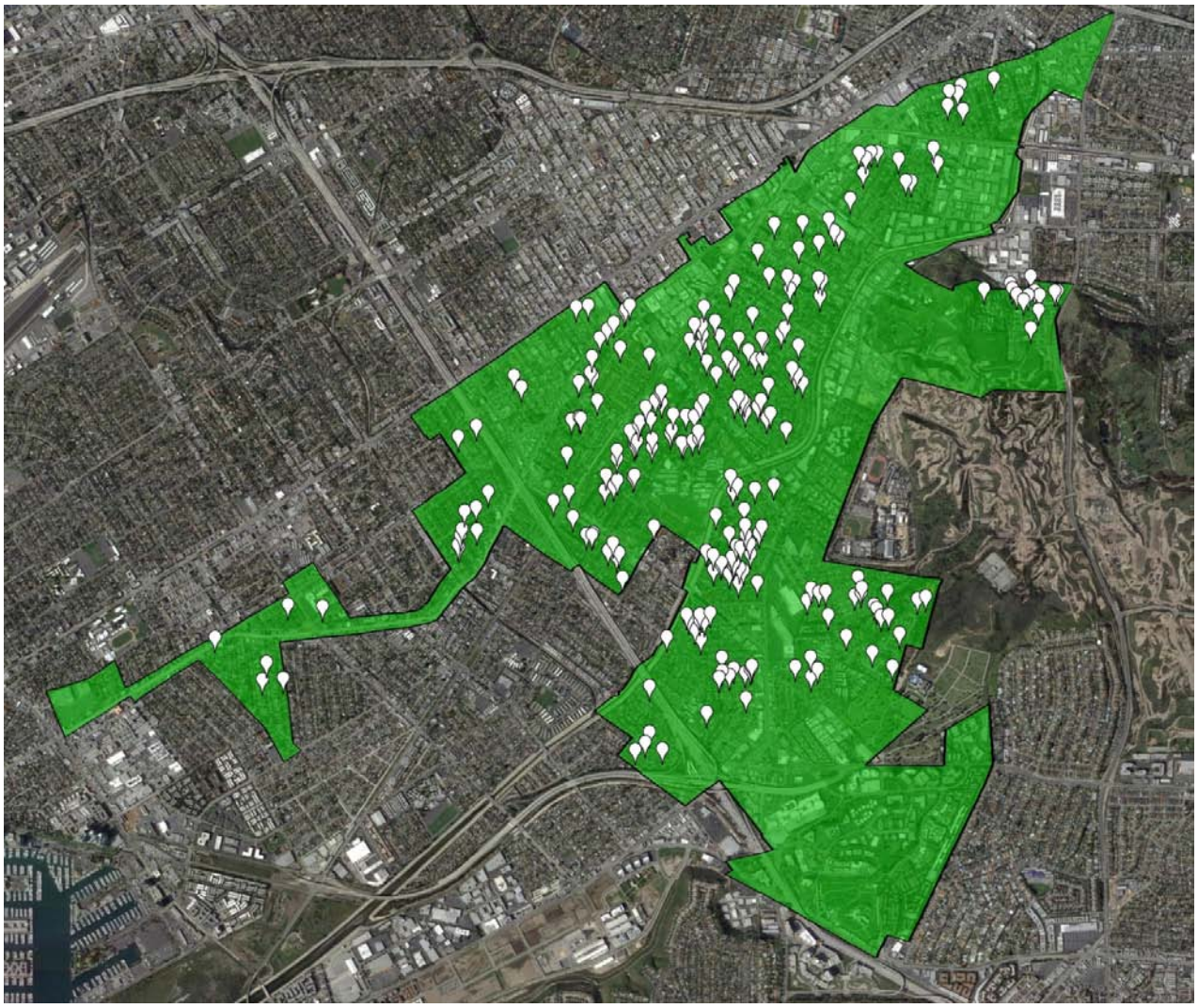

Figure 3.1 Map of Culver City (green area) and the location of rain barrel installations (white markers).

3.1 Outreach Effectiveness

Each of the outreach methods employed in the CCRH Program had various degrees of effectiveness and required an unequal proportion of staff time and capital. The use and effectiveness of each strategy is detailed below and outlined in Table 3.1.

Table 3.1 Summary of outreach method effectiveness, resource use and recommendation.

Outreach Method	Development and Use	Effectiveness	Resources Expended	Recommendation
Website (ballonawatershed.org/ccrainwater.html)	SMBRC developed a website which provided a central information center for SMBRC, Culver City and many others to direct individuals to CCRH Program information.	A key component of the program, most of the program participants used the website at some time.	**Labor** - Low to moderate depending on complexity **Cost -** Low	Necessary. Provides support for all other outreach methods. Can be very simple if budget is limited.
Web Presence	Links to program website from other websites. Use: Started with posting program link on project partner websites, began soliciting blogs and news articles that provided a link to the program website.	A highly effective method, if used to target likely program participants (eg. non-profits and garden clubs).	**Labor -** Low to moderate depending on existing partner networks **Cost -** Free	Very Useful. Highly recommended.
Print Media	SMBRC adapted City of Los Angeles Rainwater Harvesting Program documents, including "How-To" Guide, brochure, application and legal forms. Disseminated at public events, and used in door-to-door brochure distribution.	Vital outreach materials. Informational brochures were used at every event, and were often passed along to neighbors, friends and relatives.	**Labor -** Moderate to high depending on skill level and complexity **Cost -** Moderate	Necessary. Provides support for other outreach methods. Brochure highly recommended.
Local Media Advertisements	Advertised basic program information and contact information. Initial campaign at onset of CCRH Program, continuing sporadically through duration.	Excellent initial publicity, and keeping people informed about continuing program. Limited to readership.	**Labor -** Low to moderate **Cost -** Moderate to high depending on number of published advertisements	Useful for initial publicity and sporadic reminders. Costly if overused.
Blogs/List Serve Emails	Community groups were solicited to relay program information to members. Blogs written by early program participants.	Effective tool for limited audience. Also carries stamp of approval from organization.	**Labor -** Low **Cost -** Free	Useful and effective for limited resources.
Door-to-Door and Community Center	Brochures were left on doorsteps and at	Excellent universal marketing tool.	**Labor -** Low to moderate	Useful, cost-effective

Outreach Method	Development and Use	Effectiveness	Resources Expended	Recommendation
Brochure Distribution	community centers.	Low effort with high yield with properly targeted locations.	depending on efforts **Cost -** Low	advertising strategy when operating on limited budget.
Community Events	Attended by staff for public education on general rainwater harvesting practices, with efforts focused on interfacing with potential Program participants.	Key educational outreach opportunity. Required high effort and time commitment, but excellent for disseminating detailed information.	**Labor -** Moderate to high depending on event **Cost -** Low to high depending on event	Useful to useless depending on type of event and number of potentially eligible participants. Great for education.
Word-of-Mouth	Program participants recruited neighbors and friend within the city to participate.	No additional staff time or resources were needed and was a very effective form of outreach.	**Labor -** None **Cost -** None	Mandatory for success

The development of a website (ballonawatershed.org/ccrainwater.html) was an indispensable tool used throughout the duration of the CCRH Program. The website provided a central location for potential participants to obtain program and contact information, submit applications and access additional rainwater harvesting resources (Figure 3.2). The vast majority of all participants accessed the website during the CCRH Program. The website clearly outlined CCRH Program qualification requirements, including an interactive map outlining the CCRH Program area, which helped reduce the number of ineligible applications. Consequently, staff time required to filter out and correspond with ineligible applicants was decreased. Contact emails were highlighted on the website as the preferred communication medium allowing staff to efficiently utilize limited office time by sending standard group emails, reducing the amount of time spent on phone calls, and written records of correspondences with each program participant.

Additionally, the website provided a platform for the CCRH Program to develop a web presence. Project partners and community groups were solicited to write blogs and include links to aid program advertising. The website created a location for interested parties to obtain detailed information quickly without the need for additional staff time.

The website was used throughout the entirety of the CCRH Program as the main information portal; the moderate time investment was advantageous and well worth the effort. Web hosting costs were nominal (approximately $12 per month). Development of a basic website is highly recommended as a cost-effective expense for a rainwater harvesting program.

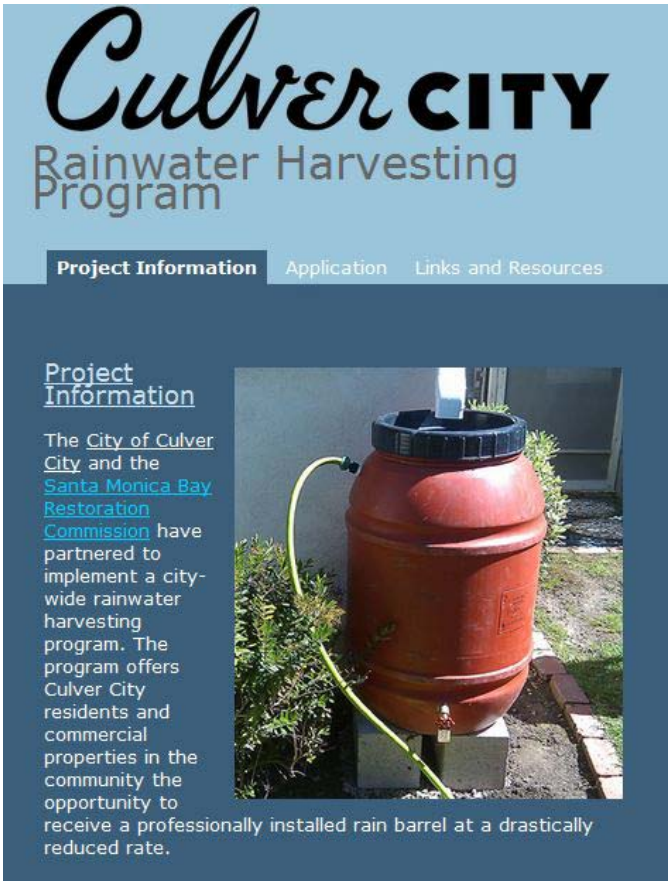

Figure 3.2 Rainwater harvesting website.

The development of print media products was fundamental for program branding and the dissemination of CCRH Program information. Brochure advertisements featuring the website were distributed at every public event and throughout the CCRH Program area. These provided prospective participants with hard copy information about the program they could convey to friends and family and served as reminders to sign up. The "How-To" Guide was a valuable tool to further disseminate information to the public regarding the advantages and methods of various rainwater harvesting techniques. These proved particularly useful at public events and provided ineligible individuals detailed information about how to implement rainwater harvesting practices of their own.

In addition to outreach materials, legal documents protecting all program participants were developed with the aid of legal counsel. Legal forms were designed as a component of the application form, and included the same tone to provide friendly information, while ensuring legal protections. Legal forms are a necessary component of a rainwater harvesting program.

The print media products required considerable time investment of skilled labor, and were a key component of the CCRH Program. There were minimal printing costs associated with each print media product. At minimum, the creation of a visually appealing and informative advertising brochure is recommended and can be easily distributed to a diverse population to convey program information. All print media products are included in Appendix B and are available for editing and reuse with permission from the SMBRC.

The development of print advertisements for use in local print media resulted in varied levels of effectiveness. The first public advertising campaign included publishing ads for several consecutive weeks in the local free newspaper, Culver City News and Culver City Observer (Figure 3.3). The advertisements resulted in the largest application rates for the entire program. However, newspapers are often read and discarded within a few days of printing, which created a rapid response with little to no residual publicity. Additionally, the effectiveness of advertisements was exhausted within a few weeks as there are few new readers each week. This is evident by the decrease of applications when additional ads were published several weeks later (Figure 3.5). Advertisements were published in a few other local news outlets, including other local papers and holiday advertisement packages, but resulted in few responses. The low number of applicants may be the result of improper audience targeting or general low readership.

Figure 3.3 Rainwater harvesting newspaper advertisement.

Advertisements required a relatively low time investment to develop, because many of the graphics and information were modeled after the advertising brochure to maintain a consistent feel with all CCRH Program branding. However, implementation (placement of the advertisements) was very high (approximately $200 per week). Advertising for one or two weeks may be cost effective if placed immediately prior to or at the very beginning of the rainy season. However, continuous advertisements to the general readership may provide program awareness, but will not result in large participation; funding is likely more effective if directed to potential participant groups (e.g. members of environmental non-profits, community improvement organizations, or garden clubs).

Requests to early CCRH Program participants and environmental organizations to write blogs and send emails to members was an effective tool for both local outreach and general networking. The number of applications generated through this method was generally low in comparison to the total applications received, yet this method was very efficient and required minimal staff time and no capital costs. Nonprofit members and blog audiences were small compared to newspaper advertisements but constituted homeowners in the CCRH Program's

target audience. As a result, a high ratio of individuals targeted via this outreach method submitted applications.

Community events attended by staff provided excellent public education opportunities yet resulted in relatively low numbers of applications. A high level of interest was demonstrated by event attendees; however, the majority of individuals resided outside the fairly limited CCRH Program area and were ineligible to participate. However, a program that includes a larger area may not experience these limitations. These events are still considered a success, as general public education was a main program objective.

Attending community events was labor and time intensive and, in some cases, expensive. Events requiring the least amount of resources were farmers' markets. These were only a few hours long and booth space was often provided for free by the City of Culver City. However, other events often required a full day's participation by staff and costs ranging for $100 – $400 to rent booth space. Occasionally, these fees were waived for non-profit participation. The community events were outstanding for public education and outreach and were especially effective for participant sign-ups if attended by a large proportion of eligible homeowners (e.g. Culver City Car Show and Fiesta la Ballona).

The most cost effective outreach method was word-of-mouth communications, which generated approximately 35% of the CCRH Program applications (Figure 3.4). While media generated the most applications (38%), costs were variable; print advertisements were expensive while televisions and newspaper interviews were free. Word-of-mouth required no direct capital or time resources; it is indirectly stimulated by all other outreach and advertising methods. The full advantages of the word-of-mouth phenomenon are only achieved when a large number of program participants and interested parties identify with the benefits of the program, which is ultimately dependent upon the effectiveness of all other outreach methods.

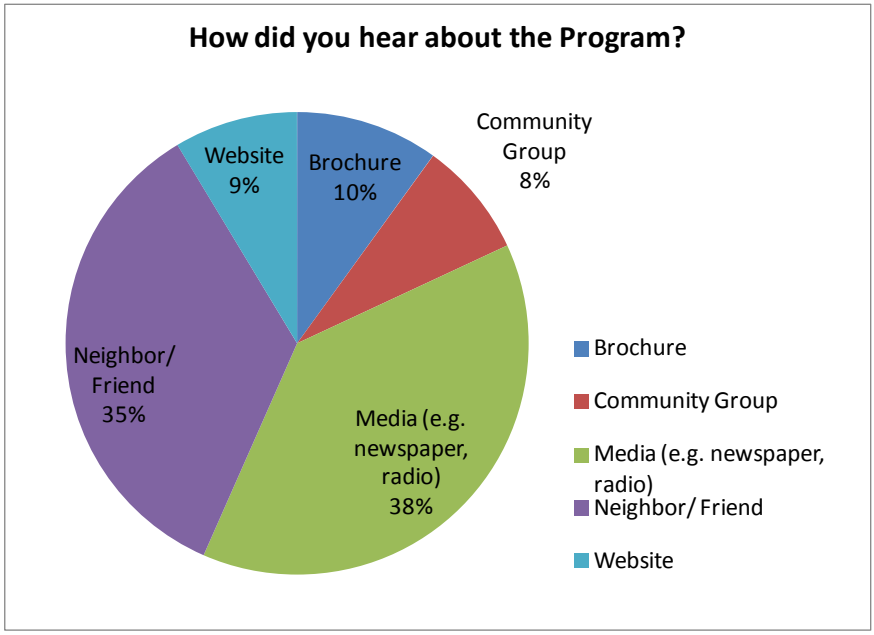

Figure 3.4 CCRH Program outreach response.

Figure 3.5 shows the number of applications per week in response to various advertising and outreach methods employed during those weeks. Advertising and outreach strategies were concentrated at the beginning of the CCRH Program to initiate publicity and towards the end to highlight project milestones (e.g. rain garden installation) and to boost application rates for the final weeks. Spikes in application rates are shown in response to both campaigns. Applications generally decreased over time between those time periods and were driven solely by word-of-mouth communications and delayed responses from earlier outreach and advertising efforts. This demonstrates potential participant loss of interest if continuous efforts are not made to publicize the program. It is recommended to employ high cost advertising methods to create initial publicity and sporadically throughout a program's entirety with less intensive methods utilized in interim periods to maintain local interest.

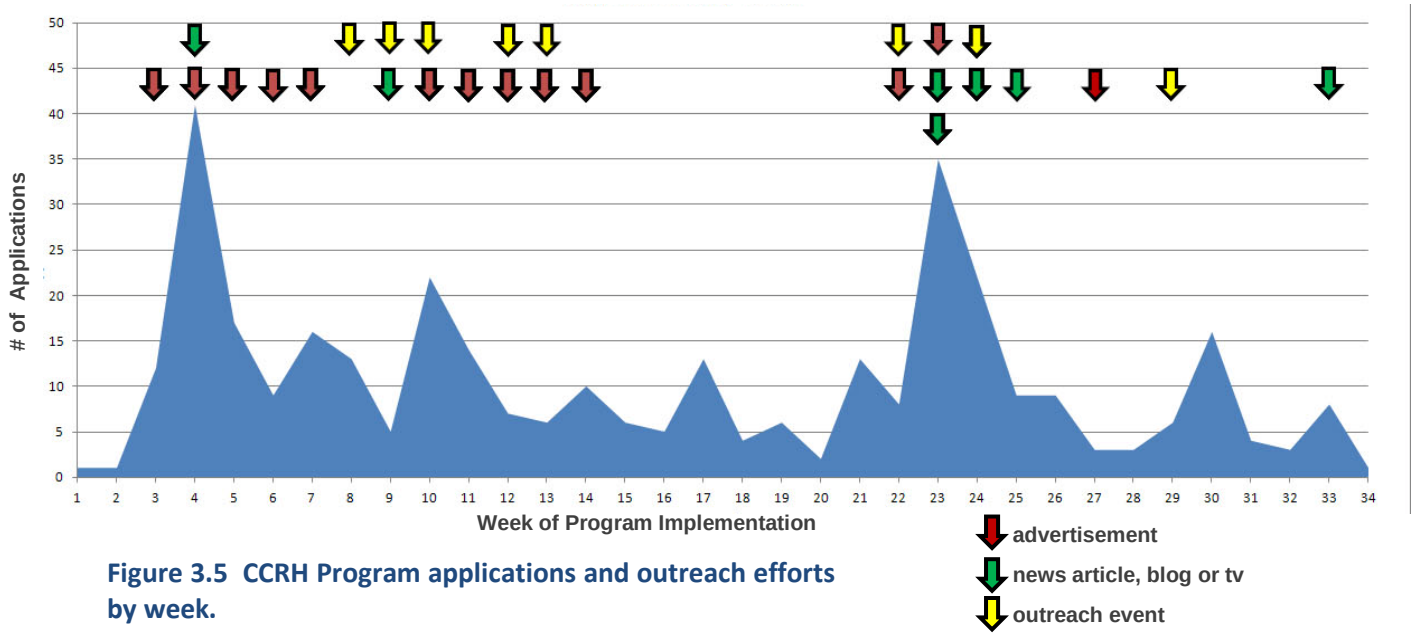

Figure 3.5 CCRH Program applications and outreach efforts by week.

3.2 Stormwater Capture and Infiltration Estimates

The extrapolation of estimated stored and infiltrated stormwater is a useful measure to analyze the direct environmental benefits provided by the installation of rain barrels within Culver City. The rainwater harvesting potential for the 396 rain barrels distributed throughout the CCRH Program reduces the volume and pollutant load of stormwater runoff entering stormdrains. Additionally, stored rainwater used for irrigation lowers the demand for potable water while increasing groundwater reserves through infiltration of rain barrel overflow. The calculations estimating total annual rainwater harvesting potential for the average Culver City downspout are based on the following assumptions:

- The average annual rainfall for Culver City over the last 30 years equals 13.4 in. (U.S. Climate Data)
- The average roof catchment area (per rain barrel) based on site evaluations throughout the program equals 350 sq. ft. (calculated by on-site data collection)

- The stormwater capture capacity for each rain barrel is 55 gallons
- Only 5% of the precipitation falling on the roof catchment will be lost to evaporation and absorption (roof runoff coefficient = 0.95) (Mechell et al 2010)
- Depending on slope, soil type, and vegetation cover, any given yard will infiltrate between 78% and 95 %of the total rain barrel overflow (runoff coefficient = 0.22-0.05) (Brown et al 1996)
- Based on field conditions, approximately 80% of the rain barrel overflow drained onto a permeable surface. The other 20% were in locations surrounded by impervious surfaces where 95% of the overflow will enter stormdrains
- With proper maintenance, and use of stored water, each rain barrel will be filled between 8 and 18 times per season. The 8 refill estimate is an average based on assumed maintenance and use (Chang and Hanna 2010). The 18 refill estimate maximum is based on the local rainfall history of events capable of filling a 55 gallon rain barrel from an average catchment area of 400 sq. ft. (City of Los Angeles 2010)

Total average annual runoff volume directed to each rain barrel was calculated by multiplying the average catchment area by the average annual precipitation in Culver City and converted to gallons per rain barrel by multiplying by a conversion factor of 0.623 (Mechell et al 2010). Five percent of runoff will be lost to evaporation and absorption, reducing the average annual runoff per rain barrel to approximately 2776 gallons (Equation 1). For further comparison the average annual runoff per rain barrel was converted to acre-feet. An acre-foot is a unit of volume equal to the amount of water required to cover a one-acre area to a depth of one foot, or approximately 325,851 gallons (Table 3.2).

Equation 1: Calculates the Average Annual Runoff per downspout on an average Culver City Roof

350	**x**	**13.4**	**x**	**0.623**	**x**	**.05**	**=**	**2776 gallons**
Avg. Catchment Area per downspout (sq. ft.)	**x**	Avg. Annual Precipitation (in.)	**x**	Conversion coefficient	**x**	Loss to evaporation and absorption	**=**	Avg. Annual Runoff per rain Barrel (gal)

With the installation of 396 rain barrels throughout the CCRH Program, a total volume of water that could be captured and/or infiltrated is equal to 1,099,296 gallons or 3.37 acre-feet. If the program was implemented across all 16,278 single family residences in Culver City, 45,187,728 gallons (138.7 acre-feet) of water could be captured and/or infiltrated.

The total volume of water captured by the rain barrels for reuse is dependent upon both the number of rain events and the maintenance or use of stored water between rain events. Two estimates have been used: 8 refills, as an estimated average based on assumed maintenance

and use (Chang and Hanna 2010), and 18 refills as the maximum based on the local rainfall history of events capable of filling a 55 gallon rain barrel with an average drainage size of 400 sq. ft. (City of Los Angeles 2010). Table 3.2 below provides estimates for the number of gallons and acre-feet of water captured annually by a single rain barrel, the entire CCRH Program (396 rain barrels) and all single family residences in Culver City (16,278 rain barrels) for both the average and high rain barrel refill estimates.

Table 3.2 Rain barrel water storage estimates.

Barrels	Refills	Volume (gal)	Volume (acre-ft)
1	8	440	0.001
1	18	990	0.003
396	8	174,240	0.535
396	18	392,040	1.203
16,278	8	7,162,320	21.98
16,278	18	16,115,220	49.46

In addition to capturing rain water, 80% of all the rain barrels installed directed overflow to permeable areas. Using this assumption and the water balance equation below (Equation 2), the rainfall per catchment area should equal: evaporation, plus gallons of water stored in rain barrels, plus rain barrel overflow infiltrated by the landscape, plus any excess water that runs off the landscape into storm drains. Evaporation off rooftops is estimated at 5% (Mechell et al 2010). Storage is reported as a range based on Table 3.2 above and is dependent on the number of times rain barrels are refilled (8 or 18). Excess rainwater unable to be stored constitutes total overflow. Overflow will either be infiltrated into the landscape or escape as runoff into the storm drain system. Dependent on soil type, various runoff coefficients for southern California lawns were derived from Brown et al 1996(table 3.3). A runoff coefficient is the percentage of water which cannot be absorbed by a given landscape and is multiplied by the amount of total overflow from a given rain barrel. Infiltration is then calculated by subtracting the runoff value from total overflow (equation 2).

Equation 2:

Rainfall per catchment = Evaporation/Absorbtion + Storage + Runoff + Infiltration

total overflow

Table 3.3 Runoff coefficients modified from Brown et al 1996.

Surface	High estimate	Low estimate
Lawn, sandy soil, Flat (2% or less slope)	0.1	0.05
Lawn, sandy soil, Average (2% to 7% slope)	0.15	0.1
Lawn, heavy soil, Flat (2% or less slope)	0.17	0.13
Lawn, heavy soil, Average (2% to 7% slope)	0.22	0.18

Based on these assumptions and equations, estimates for the average annual storage, infiltration, and runoff for a single rain barrel, the entire CCRH Program (396 rain barrels), and all single family residences in Culver City (16,278 barrels) are presented in Table 3.4.

Table 3.4 Storage and Infiltration of rain barrels.

Barrels	Rainfall (gal) *Per catchment*	Evap. (gal)	Storage (gal) **8 or 18 refills*	Infiltration (gal) **8 or 18 refills*	Runoff (gal) **8 or 18 refills*
1	2,922	146	440 - 990	1,114 - 1,775	429 - 878
396	1,099,296	57,853	174,240 - 392,040	441,273 - 702,975	169,720 - 347,788
16,278	47,562,200	2,378,110	7,162,320 - 16,115,220	18,138,975 - 28,896,545	6,976,529 - 14,296,185

The CCRH Program will capture between 174,240 and 392,040 gallons, equivalent to 0.5 to 1.2 acre-feet, of stormwater, and infiltrate between 441,273 and 702,975 gallons, equivalent to 1.35 to 2.16 acre-feet. The result is a redirection of 602,825 to 1,094,860 gallons (1.85 to 3.36 acre-feet) of runoff onto properties for reuse or infiltration. An expansion of the program to include all single family residential properties in Culver City would annually capture between 7,168,731 to 16,129,645 (22.0 and 49.5 acre-feet), and infiltrate between 18,149,924 to 28,903,021 gallons (55.7 and 88.7 acre-feet), redirecting a grand total between 25,318,656 to 45,032,667 gallons (77.7 to 138.2 acre-feet) of runoff away from streets and storm drains. The average California household consumes 0.5 to 1.0 acre-ft of water annually (USFS 2011).

3.3 Estimated Pollutant Reductions

Capturing and infiltrating stormwater also reduces the amount of pollutants entering waterways and the ocean. Stormwater captured is equivalent to the amount of rainwater stored by rain barrels and the proportion of the total rain barrel overflow infiltrated by the landscape (Equation 3).

Equation 3:

Stormwater captured = Storage (gal) + Infiltration (gal)

Equation 4 and table 3.5 calculate estimated pollutant reductions achieved through the CCRH Program. Pollutant reductions were calculated by multiplying residential stormwater pollutant load constants found in the National Stormwater Quality Database (Pitt et al, 2004) by the estimated number of gallons captured annually. All pollutant reductions were converted from milligrams per liter to ounces per gallon.

Equation 4:

Pollutant reductions	=	**(Stormwater captured**	x	**3.785)**	x	**(Pollutant load constant**	÷	**1000)**	x	**.1335**
oz/ gal	=	gallons	x	gallons to liters	x	mg/L	÷	convert mg/L to g/L	x	convert g/L to oz/ gal

Table 3.5 Estimated pollutant reductions

	Constant (mg/L)	Estimated Program reductions (oz.)	Estimated reductions for whole city (oz.)
Nitrite + Nitrate	0.6	188.6 - 335.58	7,753.76 - 13,794.18
Oil and Grease	3.9	1,226.1 - 2,181.24	50,399.47 - 89,662.17
Total Phosphorous	0.3	94.3 - 167.79	3,876.88 - 6,897.09
E. Coli	*700	*220,066.5 - 391,504.46	*9,046,058.59 - 16,093,210.39
Arsenic	0.0030	0.9 - 1.68	38.77 - 68.97
Cadmium	0.0005	0.2 - 0.28	6.46 - 11.5
Copper	0.0120	3.8 - 6.71	155.08 - 275.88
Lead	0.0120	3.8 - 6.71	155.08 - 275.88

* = shown in MPN units

Implementing a rain water harvesting program throughout the City of Culver City would dramatically reduce pollutant loading to Ballona Creek. A city-wide rain water harvesting program could be initiated cost effectively and would provide substantial water quality benefits. The pollutant reductions of a city-wide program would assist Culver City in meeting the necessary water quality improvements required by the Ballona Creek watershed metals and bacteria Total Maximum Daily Loads.

3.4 Project Costs

Price per barrel

The final rain barrel design materials were selected to reduce construction time and materials cost, and improve aesthetics and durability. Due to the large quantities of supplies required, online wholesale ordering was cost effective for a majority of items. For example, brass boiler

drains which retail at local hardware stores for approximately $6.50 were found online for almost half the price (Table 3.6). The final design materials, and approximate costs are included in Table 3.6.

Table 3.6 Costs associated with rain barrel construction.

Materials	Cost ($)
55 gallon HDPE barrel	17.00
Nylon vector/debris screen (mesh size < 1.2mm)	0.25 ($20.00 per 80 barrels)
½" or ¾" brass boiler drain	3.35
½" or ¾" locking nut	0.20
¾" overflow PVC nipple	0.20
Hose	1.00 ($10.00 per 10 barrels)
Hose fittings	2.00 (2 @ $1.00 each)
High strength glue (Gorilla Glue^{tm})	0.50 ($20.00 per 40 barrels)
Silicone	0.50 ($20.00 per 20 barrels)
Total Cost per Barrel:	**$25.00**

Rain barrel installations required additional materials. Materials were required to raise and level the barrel, secure the barrel, and modify the outflow of the downspout. Price reductions from online wholesalers were negligible and thus all installation materials mainly purchased from local hardware stores. The additional installation materials and approximate cost are included in Table 3.7.

Table 3.7 Costs associated with rain barrel installations.

Materials	Cost ($)
Two 8" x 8" x 16" cinder blocks	2.00 (2 @ $1.00)
Pea gravel	0.50 ($27.00 per 74 barrels)

Vinyl strap(s)	0.50 ($10.00 per 20 barrels)
Wall anchors and screws	0.50 ($8.00 per 16 barrels)
Downspout elbows	4.00 (2 @ $2.00)
Sheet metal screws	0.20 ($10.00 per 80 barrels)
Total Cost per Barrel:	**$7.20**

Cost Summary

An evaluation of the CCRH Program expenditures reported total costs of $96,307. The vast majority of the costs (66%) involved staff compensation. The CCRH Program also utilized approximately 204 hours of unpaid intern and volunteer assistance for rain barrel and rain garden construction. After deducting supply costs associated with the construction and installation of rain gardens and cisterns ($4,862), the average per unit cost to install each of the 396 rain barrels equaled $231. A breakdown of all costs incurred by the CCRH Program are listed in Table 3.8.

Table 3.8 Total costs incurred by the CCRH Program

Expense	Total costs ($)	% of Total
Advertising	2,688	3
Wholesale Barrels	6,895	6
Rain Garden and Cistern Materials	4,862	5
Personnel	63,207	66
Barrel Modification and Installation Materials	9,270	11
Gas and Travel	1,187	1
Van Rental	8,199	9
Grand Total:	**$96,307**	**100**

US census bureau data from 2005 -2009 project a total of 16,278 residential single family homes in the City of Culver City. Based on a per unit cost of $231 per rain barrel, a program designed to retrofit one downspout at every Culver City home would require a total capital cost of approximately $3,760,218. Water conservation benefits resulting from a Culver City wide program are shown above in Table 3.4.

4.0 CONCLUSION AND RECOMMENDATIONS

The CCRH Program was a very effective public education program. Several hundred homeowners learned about the benefits of rainwater harvesting and many adopted some of these techniques on their property. The CCRH Program staff spoke with over 1000 individuals regarding the benefits of general water conservation at outreach events, installations, and presentations. In addition, the CCRH Program developed a cost-effective structure, which agencies and municipalities may modify to implement their own rainwater harvesting programs. Various outreach strategies were tested to inform future programs of the most effective methods. A cost structure was developed to demonstrate an effective education and rain barrel installation program may be implemented for less than $250 per barrel.

The purchase of wholesale barrels to be modified by staff and/or volunteers is the most effective way to reduce costs. Table 3.4 shows the costs associated with construction of rain barrels is approximately $25, while most proprietary rain barrels cost between $75 and $100 retail, plus shipping fees. Barrel modifications are highly labor intensive, but result in superior product performance and longevity and are strongly recommended.

Culver City and other municipalities should implement a city-wide rainwater harvesting program. At a cost of $3,760,218 Culver City could annually remove between 25,318,656 to 45,032,667 gallons (77.7 to 138.2 acre-feet) of polluted stormwater from reaching Ballona Creek and Santa Monica Bay. A city-wide rainwater harvesting program will drastically reduce local surface water pollution by removing large amounts of **metals**: Copper (155.08 - 275.88 oz.), Lead (155.08 - 275.88 oz.), Arsenic (38.77 - 68.97 oz.) and Cadmium (6.46 - 11.5 oz.); **nutrients**: nitrate as Nitrogen (7,753.76 - 13,794.18 oz.), total Phosphorous (3,876.88 - 6,897.09 oz.); **bacteria**: E. Coli (9,046,058.59 - 16,093,210.39 MPN); and **oil and grease** (50,399.47 - 89,662.17 oz.) as well as other non-listed pollutants. Implementing a city-wide program will greatly assist Culver City in meeting existing and future water quality objectives.

It is also recommended that Culver City and other municipalities create an incentive program for homeowners to replace lawns with rain gardens vegetated planted with southern California native vegetation. Every 1000 sq. ft. of grass lawn removed will result in an annual savings of 45,000 gallons of potable water which would have been used for irrigation. Additionally, rain gardens would allow for significantly more stormwater runoff from roofs and driveways to captured, infiltrated, and naturally cleansed. A 2000 sq. ft. catchment area draining to a 500 sq. ft. rain garden is capable of capturing and treating 3500 gallons of polluted stormwater or the

equivalent of a 3 inch rain event over a 24 hour period. The clean water will also help to recharge depleted groundwater supplies.

The CCRH Program's success depended largely on the dissemination of information to a wide audience of participants and an efficient method for these individuals to refer peers. A simple website and print brochures were considered core components to program implementation. When used in combination, these information methods allow participants to easily access and share information. The program's growth may be restricted or require more expensive methods without these components.

Soliciting bloggers and newspapers to write articles is recommended as a low-cost method to advertise information to large numbers of potential participants. Approaching environmental blogs is a recommended method of conveying program information to individuals who are more inclined to participate in the early stages of a program. News articles are effective at reaching large audiences; however, if articles are distributed to people outside the scope of the program area, staff may spend unnecessary time corresponding with ineligible homeowners. This may be remedied by listing the website and email address as the preferred method of communication, which allows the opportunity to provide qualifications and form responses to ineligible participants.

Lawn signs are relatively inexpensive and recommended as an excellent tool to create word-of-mouth publicity. Aside from the initial expense of purchasing signs, lawns signs provide free, continuous advertising to every neighbor and passerby.

Paid advertisements in local newspapers are recommended for initial publicity, but are expensive and should be utilized sparingly. The number of applications decreased each consecutive week an advertisement ran in the same newspaper presumably because the same readers were viewing the advertisement. It is recommended to advertise in different newspapers, if possible, at the beginning and middle of the program.

Community events provide excellent opportunities to educate the public regarding the general principles of rainwater harvesting techniques. However, depending on the project area and the event's audience, many interested persons may reside outside the project area. Also, community events can be expensive while yielding few eligible applications. It is recommended to attend smaller, more inexpensive community events with localized audiences such as farmers' markets.

A low cost advertising method capable of reaching a broad range of potential participants is simple door-to-door brochure distribution. This is recommended as an effective method to inform individuals who have not been reached by any of the methods listed above. Additionally, this task may be performed by volunteers and interns assisting the program.

4.1 Future Directions

The first year is a critical step for refining and perfecting a long-term rainwater harvesting program. The long-term viability of the program is dependent on both the availability of funding and the interest of the community. The best way to ensure long-term funding for a program is to include partners and reduce costs. When developing a rainwater harvesting program take efforts to include all interested municipal agencies, water districts and NGOs. These groups might include: sanitation districts, stormwater or groundwater management agencies, flood control districts, resource agencies, environmental and or community organizations. Each organization may provide different support for the program, including funding, staffing, management or outreach. By diversifying responsibilities and funding among multiple entities will help ensure the long-term viability of the program.

Various methods may be employed to lower project costs. A program similar to the CCRH Program could include a nominal fee or require participants to pay the full costs of the product and service (with or without a rebate). More expensive components including cisterns and rain gardens could be eliminated or implemented by an agency sponsor. Rain barrels could be distributed to participants through public events, designated pick-up sites, or delivered with instructions for installation.

5.0 REFERENCES

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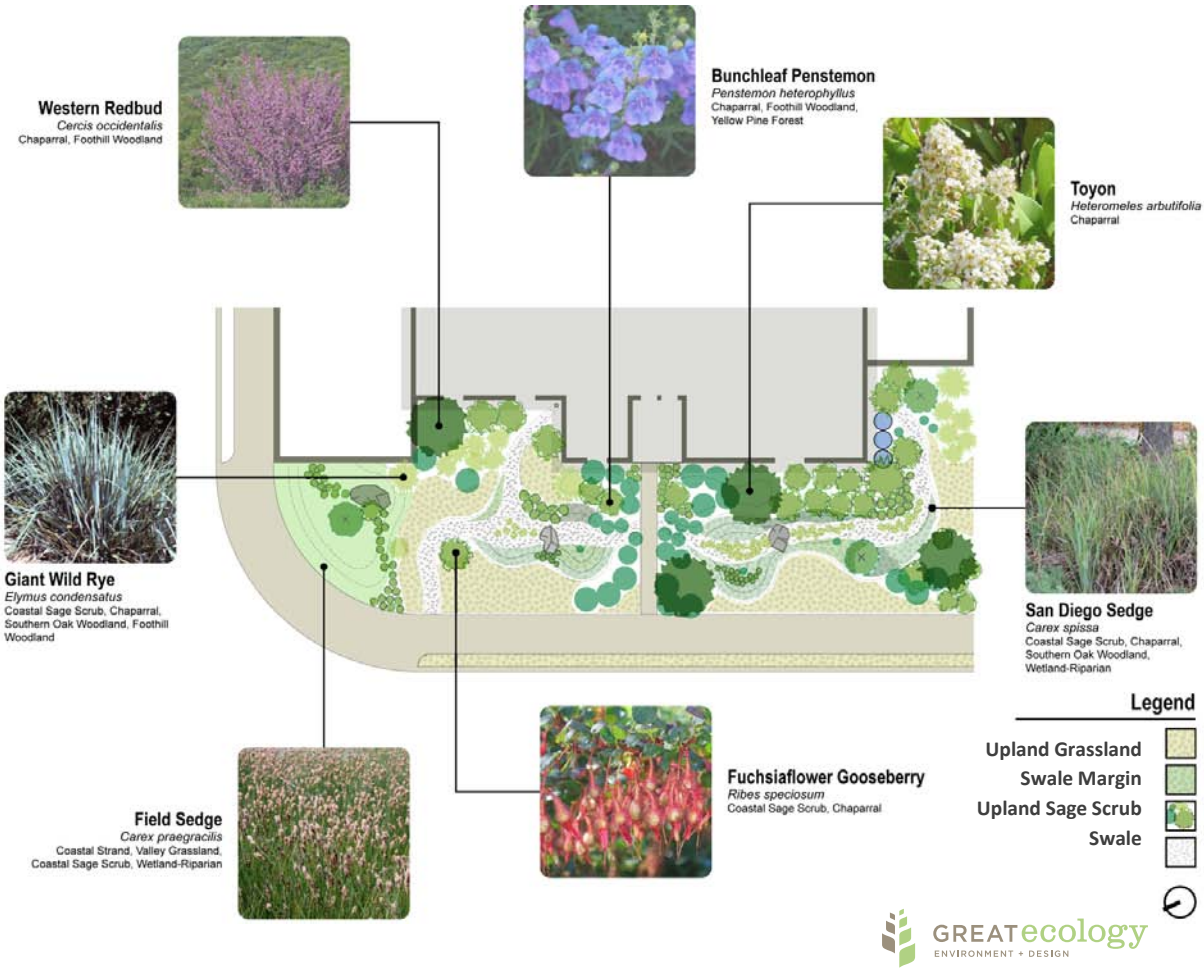
Appendix A - Culver City Rain Garden Plant List

Scientific name	Common name	Size	# Planted	Location in Rain Garden
Achillea millefolium	common yarrow	1g	55	Upland Grassland
Artemisia douglasiana	California mugwort	1g	9	Upland Sage Scrub
Asclepias fascicularis	narrow leaf milkweed	1g	9	Upland Sage Scrub
Carex barbarae	valley sedge	1g	40	Swale margin
Carex praegracilis	field sedge	1g	227	Swale margin
Carex spissa	San Diego sedge	1g	40	Swale margin
Cercis occidentalis	western redbud	15g	2	Upland Sage Scrub
*Cornus sericea** (*C. stolonifera*)	western dogwood	5g	1	Upland Sage Scrub
Eleocharis macrostachya	common spikerush	RP	15	Swale
Encelia californica	California encelia	1g	5	Upland Sage Scrub
Epilobium ciliatum (*E. californicum*)	California fuschia	1g	9	Upland Sage Scrub
Eriogonum parvifolium	coastal buckwheat	1g	3	Upland Sage Scrub
Heteromeles arbutifolia	toyon	1g	2	Upland Sage Scrub
Juncus mexicanus	Mexican rush	1g	35	Swale
Juncus patens	common rush	1g	35	Swale
Juncus textilis	basket rush	1g	7	Swale
Juncus xiphioides	irisleaf rush	1g	25	Swale
*Keckiella cordifolia**	heartleaf keckeilla	1g	2	Upland Sage Scrub
Leymus condensatus	giant wildrye	1g	3	Upland Grassland
Leymus triticoides	creeping wildrye	1g	12	Upland Grassland
Mimulus cardinalis	scarlet monkeyflower	1g	2	Swale margin
Mimulus guttatus	common yellow monkeyflower	1g	1	Swale margin
Muhlenbergia rigens	deergrass	1g	9	Upland Grassland
Nassella cernua	nodding needle grass	1g	70	Upland Grassland
Nassella pulchra	purple needle grass	1g	70	Upland Grassland
Nassella pulchra	purple needle grass	plugs	64	Upland Grassland
Penstemon heterophyllus	foothill penstemon	1g	3	Upland Sage Scrub
Penstemon spectabilis	showy penstemon	1g	3	Upland Sage Scrub
*Rhamnus californica**	California coffeeberry	1g	1	Upland Sage Scrub
Ribes aureum	golden current	1g	2	Upland Sage Scrub
*Ribes speciosum**	fuchsiaflower gooseberry	1g	6	Upland Sage Scrub
*Rosa californica**	California wild rose	1g	6	Upland Sage Scrub

Scientific name	Common name	Size	# Planted	Location in Rain Garden
Salvia mellifera	black sage	1g	3	Upland Sage Scrub
*Salvia spathacea**	hummingbird sage	1g	9	Upland Sage Scrub
Isolepis cernua (*Scirpus cernuus*)	low bulrush	1g	75	Swale
Sisyrinchium bellum	western blue eyed grass	1g	25	Upland Grassland
Symphorcarpos mollis	creeping snowberry	1g	3	Upland Sage Scrub
*Thalictrum fendleri var polycarpum**	Fendler's meadow rue	1g	3	Upland Grassland

*** = tolerates shade or partial shade**



Appendix B - Outreach Materials

Culver CITY
Rainwater Harvesting Program

A Homeowner's "How-To" Guide

November 2009 - 1

bay restoration commission
STEWARDS OF SANTA MONICA BAY

City of Culver City Rainwater Harvesting Program

Table of Contents

Introduction

Background

The City of Culver City Rainwater Harvesting Program is designed to help homeowners learn to capture rainwater for beneficial use, and reduce the amount of rainwater flowing from their roofs into the storm drain system. The Program calls for disconnecting downspouts that discharge to impervious areas and redirecting them to areas where rainwater can percolate into the soil, or collect into rain barrels.

Due to heavy groundwater usage in Southern California, approximately 3.2 million-acre feet of space are available for groundwater recharge. That is equal to 12,000 Rose Bowls filled to the top with water. A recent study described soil conditions in most of the Southern California region as highly permeable, allowing for rapid infiltration into groundwater basins[1]. The rainwater harvesting process described in this "How-To" Guide will help increase local water resources by promoting groundwater recharge.

What is Rainwater Harvesting?

Many residential and commercial properties in the City of Culver City are fitted with downspouts. When it rains, water runs off roofs, through these downspouts and usually onto an impervious surface such as a sidewalk, driveway or parking lot.

Rainwater harvesting is the process of intercepting rainwater from a roof (or other surface) and putting it to beneficial use. By implementing the harvesting techniques in this guide, homeowners gain an extra water supply while simultaneously reducing the pressure on our limited water supplies.

Who Should Use this Manual?

This guidance manual will help homeowners implement the first steps of harvesting rainwater. It contains "How-to" information for the homeowner interested in disconnecting downspouts to capture and use rainwater. By following the step-by-step instructions homeowners can: (1) disconnect existing downspouts; (2) extend downspouts to areas that can infiltrate rainwater; (3) install a rain barrel; and (4) construct a rain garden or other infiltration mechanism. Homeowners looking to implement additional rainwater harvesting methods, or seeking supplemantal "How-to" or troubleshooting information should refer to Additional Resources provided in this guide. The program website (**CCrainwater.ballonawatershed.org**) will be updated with useful information as well.

[1] Natural Resource Defense Council Technical Report. A Clear Blue Future: How Greening California Cities Can Address Water Resources and Climate Challenges in the 21st Century. August 2009.

Why Harvest Rainwater?

To Protect Our Bays and Ocean

When rainwater flows from a downspout onto our sidewalks, driveways and streets, it collects a variety of pollutants. By capturing rainwater that falls on roofs, landowners help reduce the amount of runoff ultimately reaching the Santa Monica Bay, and thus aid in improving the quality of our local surface waters.

To Reduce Energy Demands

The State of California Energy Commission reported that water-related energy consumption in California accounts for nearly 20% of the State's electricity, 30% of its natural gas, and requires about 88 billion gallons of diesel fuel every year [2]. One inch of rain falling on 1,000 square feet of rooftop produces more than 600 gallons of water. If homeowners replaced this amount of potable water with captured rain water, energy consumption in the State should be reduced.

To Practice Water Conservation

California has entered an era of increasing water scarcity, coupled with projections of increased temperatures up to 10 degrees Fahrenheit by the end of this century.[2]

Using rainwater to water plants helps conserve dwindling drinking water supplies.

To Recharge Groundwater Supplies

Approximately 40% of Southern California's drinking water comes from groundwater. Harvesting rainwater and allowing it to infiltrate into the ground replenishes our groundwater supplies.

Overview of Rainwater Harvesting

Redirection Options

The City suggests redirecting stormwater runoff from downspouts to either a rain barrel or an on-site pervious area such as a flower bed or rain garden as "first-steps" in the rainwater harvesting process. There are many more features that can be implemented on a residential property to capture and utilize rainwater. Please refer to the Sections: Other Rainwater Harvesting Options and Additional Resources for more rainwater harvesting ideas.

What is a Rain Barrel?

Rain barrels store rainwater from roofs for reuse in landscape irrigation. Rain barrels are containers typically made of a heavy duty plastic and can range in size from the standard 55 gallons to more than 80 gallons. Eco-friendly rain barrels assembled from recycled food barrels or manufactured from recycled plastics are available to consumers.

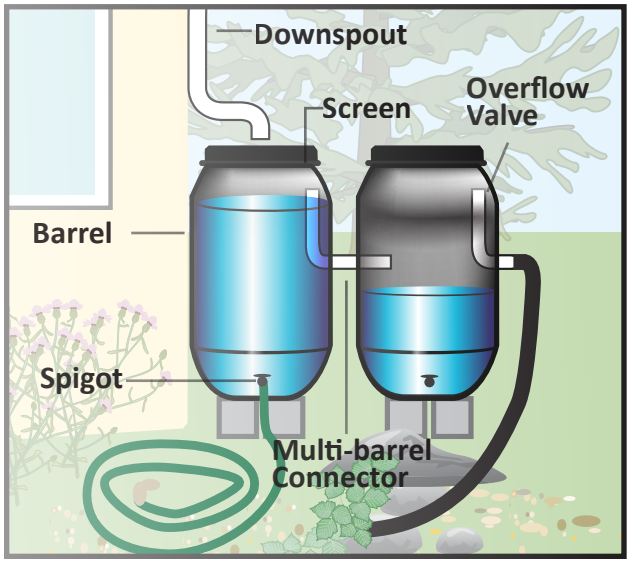
[2] The State of California Energy Commission. California's Water-Energy Relationship Final Staff Report. November 2005. (http://www.energy.ca.gov/2005publications/CEC-700-2005-011/CEC-700-2005-011-SF.PDF)

Key components of a rain barrel include the following:

- A screen to keep debris and mosquitoes out
- A spigot
- An overflow
- A connector for linking multiple rain barrels (if desired).

Rain barrels are typically placed below downspouts and must meet the following requirements:

- Rain barrels should not allow UV light penetration in order to prevent algae growth;
- Rain barrels must be covered and any openings must be screened to prevent mosquito breeding; and
- Rain barrels must be accessible for periodic cleaning.



A typical rain barrel set up

Information on where to purchase a rain barrel and rain barrel pricing can be found on the City's website at:
CCrainwater.ballonawatershed.org

What is a Rain Garden?

Homeowners can maximize both environmental and economic benefits by installing a rain garden in place of a grassy or impervious area. A rain garden is a shallow depression that captures rainwater and allows it to soak into the ground. Plants help to filter harmful pollutants in the the rainwater as it moves through the soil layer. A rain garden is most often planted with native species creating a natural ecosystem on properties where birds, butterflies, and beneficial insects thrive. Rain gardens also capture sediments carried by rainwater, preventing them from clogging the stormdrains.

A swale directs water from the downspout to the rain garden. Many swales use rocks that create a dry creek bed look.

How to Harvest Rainwater on Your Own

Assess Your Site

Preparing a site sketch will help to determine downspouts to disconnect. Begin by drawing an outline of the home from a bird's eye view. Walk the perimeter and mark the location of all downspouts on your sketch. Note which downspouts are connected to rain gutters; these downspouts are candidates for disconnection. Draw in roof lines, and estimate the square footage of the roof area (**Figure 1**).

Redirection Criteria Checklist and Safety Considerations

It is suggested that the following list of conditions are met in order to safely redirect a downspout from a roof to a pervious area without damaging building foundations, or flooding a basement or neighboring properties.

As a guideline, direct downspouts:

- To gently sloped areas (preferably 10% slopes or less – See How to measure a slope);
- To areas sloping away from buildings;
- To rain gardens (See How to Build a Rain Garden);
- Never above septic tanks;
- Never to areas that experience ponding;
- Never to fill areas.

As a guideline, locate downspouts:

- At least 3 feet away from public sidewalks;
- At least 5 feet away from property lines;
- At least 5 feet away from house foundations and crawl spaces, assuring at least a 2% slope away from the home;
- At least 6 feet away from basement walls.

How to measure a slope:

Tie a level string to two stakes pounded into the ground. Make certain that the string attached to the uphill stake is at ground level. Measure the distance between the stakes. This is considered the width. Measure the distance from the string on the downhill stake to the ground. This is the height. Make certain that the height and width are the same units. Divide the height by the width to get the slope. Multiply this by 100 to obtain the percent slope. (**Figure 2**)

Example of Slope Calculation:

Height = 6 inches = 0.5 feet

Width = 10 feet

0.5 feet ÷10 feet= 0.05

0.05 ×100 = **5% Slope**

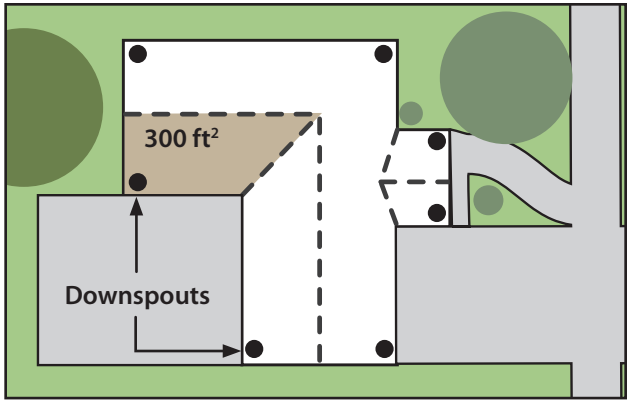


Figure 1: Example sketch of site

Example of Roof Area Calculation:

L^r = 25 ft L^t = 10 ft

W_r, W_t = 10 ft

Roof Area = (Lr x Wr) + 1/2(Lt x Wt) =
250 (square feet) + 50 (square feet) =
300 (square feet)

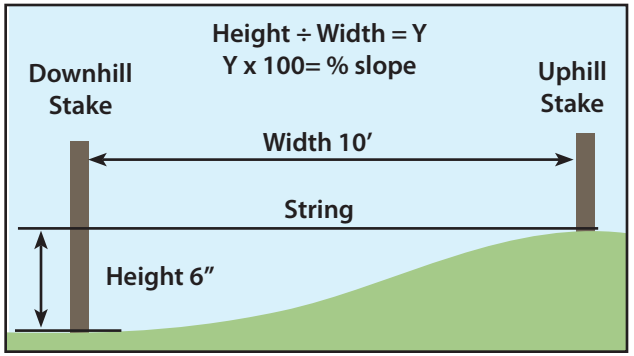


Figure 2: How to measure a slope

How to Redirect a Downspout to a Pervious Area

Before you Begin

Prepare all of the tools and materials that you need. It is best to use durable, gutter-grade materials, such as ABS Schedule 40 plastic options. Other materials such as corrugated black plastic, PVC pipe, or dryer hose can be used but tend to be less durable. Consult a home and garden specialist when purchasing materials for further assistance. See the list below and Figure 3 for tools and materials you will need. Be sure to wear safety glasses.

Tools:

- Hacksaw
- Tin snips
- Drill
- Needle-nose pliers or crimpers
- Tape measure
- Screwdriver or nut driver
- Safety glasses

Materials:

- Downspout extension
- Sheet metal screws
- Elbow
- Bracket
- Splash guard

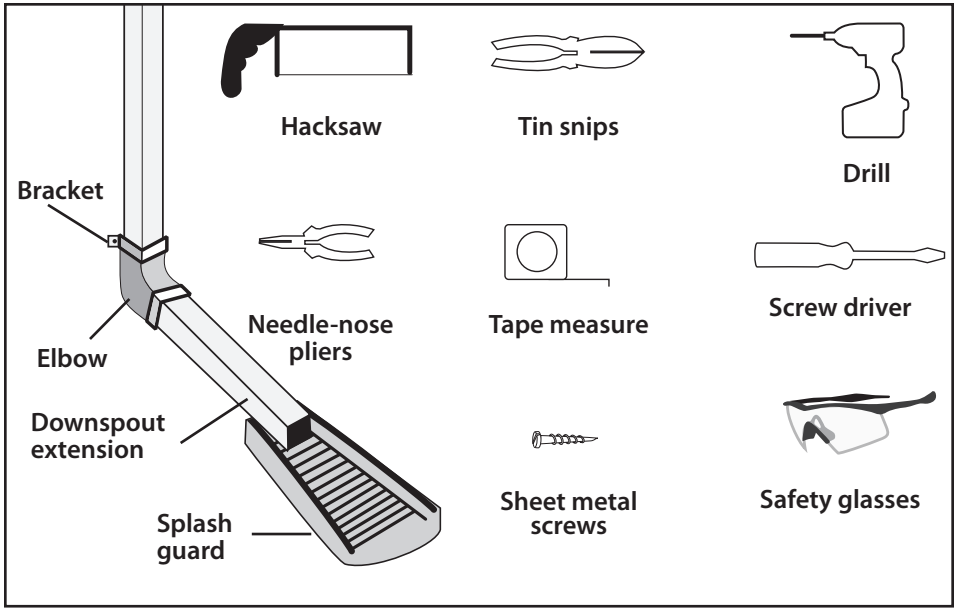


Figure 3: Materials and tools for redirecting the downspout

Select downspouts to disconnect that are connected to a rain gutter **(Figure 4)**. Some homes in the City of Culver City are not fitted with rain gutters. If a home does not have rain gutters along the perimeter of the roof, homeowners might consider installing them. This guidance manual does not provide information on how to install rain gutters because these tasks involve roof seals and require professional expertise.

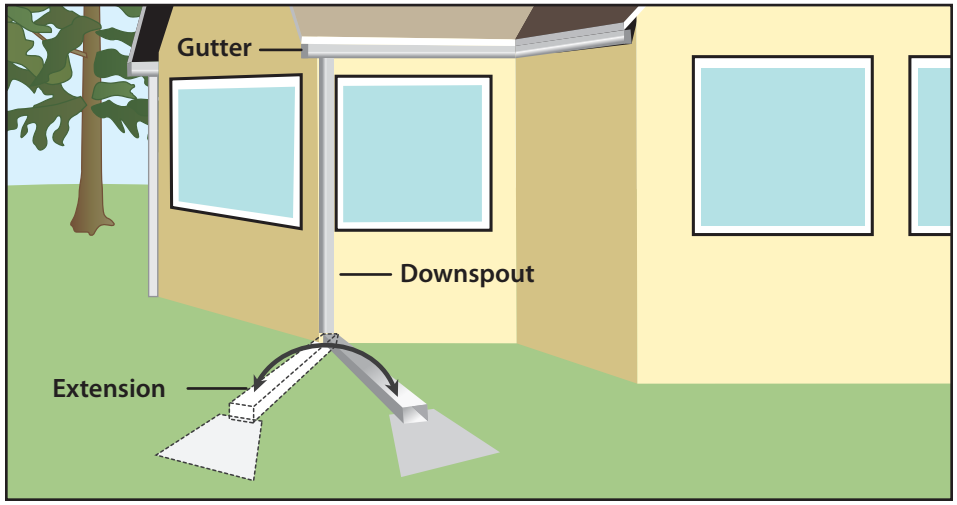
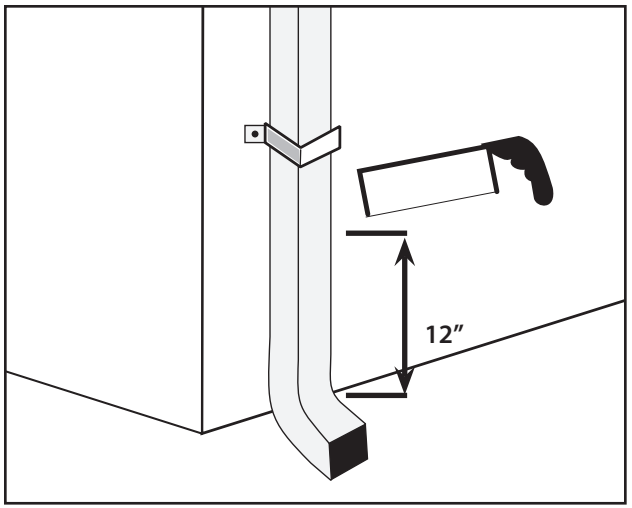
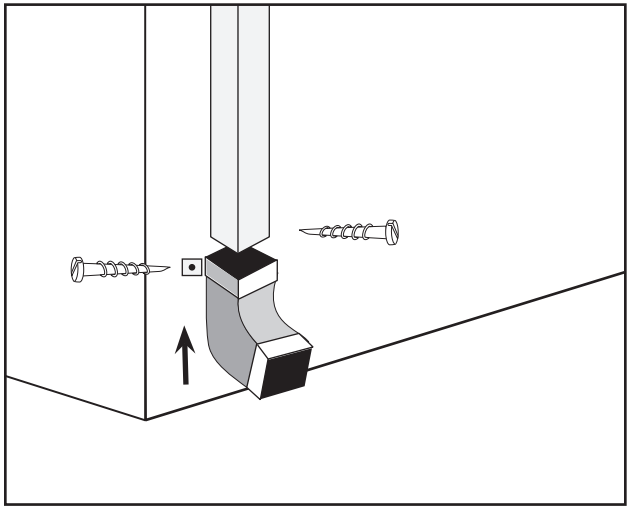


Figure 4: Rain gutter and downspout



Steps 1-2



Step 3

Redirection Procedure

Redirecting a downspout to a pervious area is a simple procedure.

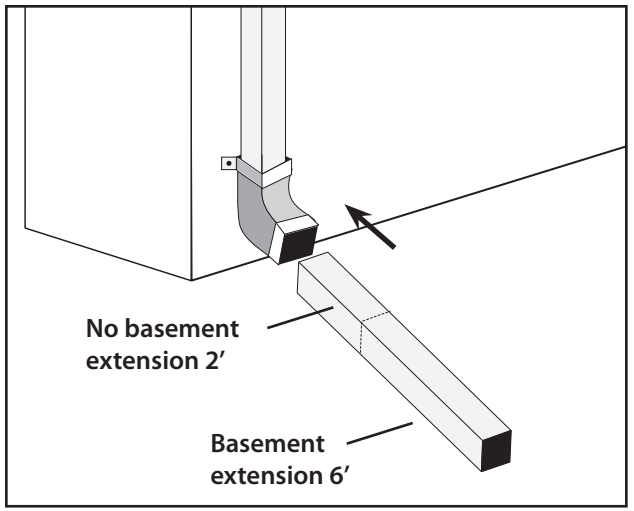
Step 1: Mark approximately 12 inches from the ground to the downspout. This height should work for up to a 6 foot extension. Cut the downspout higher for longer extensions.

Step 2: Using a hacksaw, cut the downspout at the mark. Remove the cut piece. You may need tin snips to smooth the material.

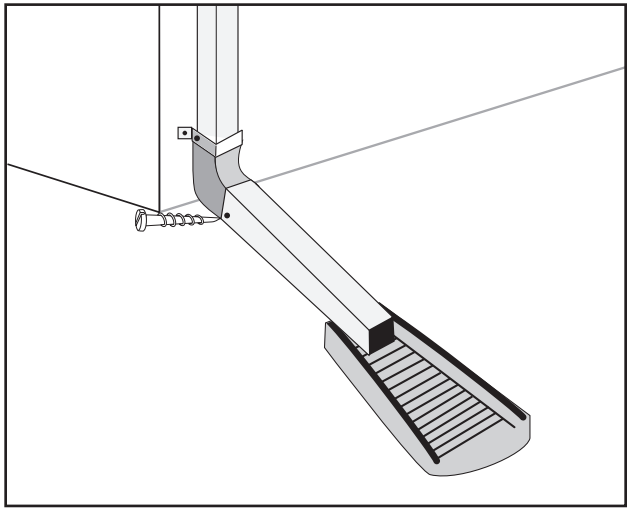
Step 3: Attach the elbow over downspout. If the elbow does not fit over the downspout, use crimpers or needle-nose pliers to crimp the ends of the cut downspout and slide it inside the elbow. Attach the elbow to the downspout with screws; it might help to pre-drill holes. For additional stability, consider securing the elbow to the building with a bracket.

Step 4: Measure and cut the downspout extension to the desired length. Attach the extension to the elbow by slipping the extension over the end of the elbow.

Step 5: Use screws to attach the extension to the elbow; it might help to pre-drill holes. For additional stability consider resting the extension on a support like a cinder block. To prevent erosion, place a splash guard at the end of the downspout or direct the extension to a swale.



Step 4



Step 5

How to Redirect a Downspout to a Rain Barrel

Before you Begin

Make a list of the tools and materials needed. The installation of a rain barrel requires materials for the downspout disconnection, and materials to build a platform that the barrel can sit on, such as wood or cinder blocks. Homeowners may also need an additional strap to secure the barrel. Be sure to wear safety glasses.

Tools:

- Hacksaw
- Tin snips
- Drill
- Needle-nose pliers or crimpers
- Tape measure
- Screwdriver or nut driver
- Level
- Safety glasses

Materials:

- Downspout extension
- Sheet metal screws
- Elbow
- Bracket
- Splash guard
- Wood/cinder blocks
- Securing strap

You can transfer water from the rain barrel to a garden by filling a watering can, connecting a garden hose, or installing a manual drip irrigation system. Water pressure at the rain barrel spigot will depend on the level of the water in the rain barrel. The higher the water level, the greater the amount of pressure. You can also improve flow through a hose attached at the rain barrel spigot by elevating the barrel.

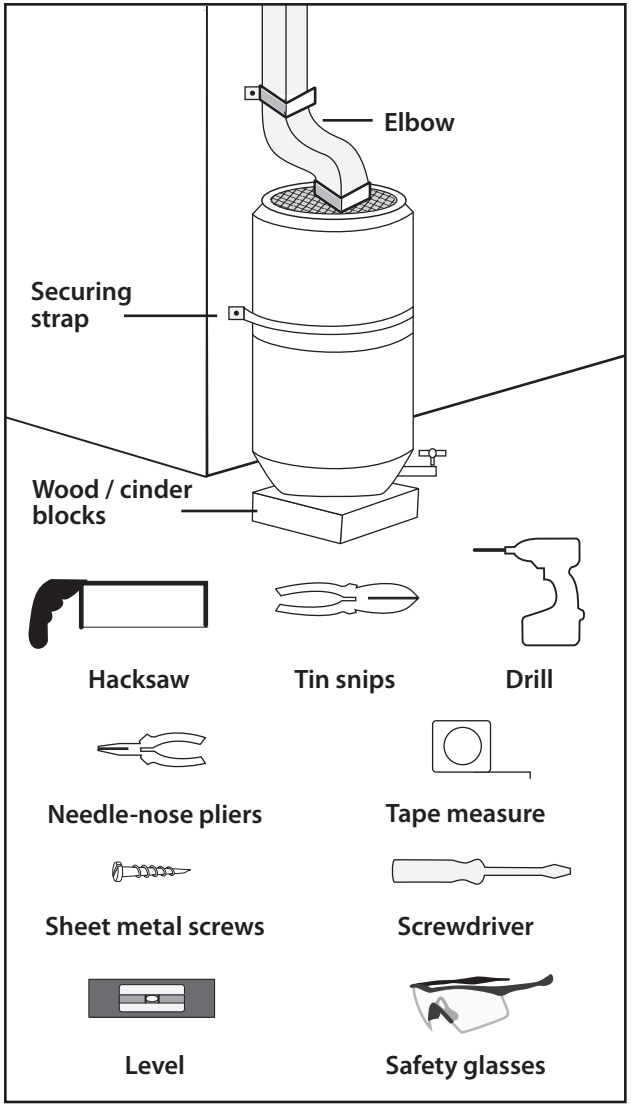


Figure 5: Materials and tools needed for installing a rain barrel

Redirection Procedure

Redirecting a downspout to a rain barrel is a relatively simple procedure.

Step 1: Decide where to locate a rain barrel. The best place is either directly under or a few feet from the disconnected downspout. By attaching a hose to the spigot, a homeowner can transport water from the barrel to another area of the yard.

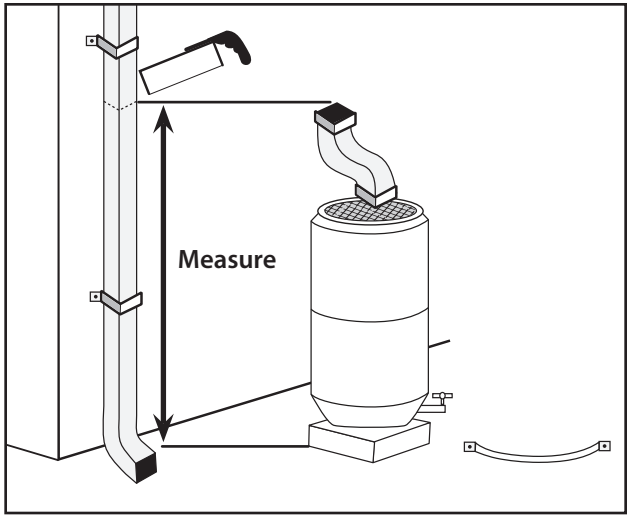
Step 2: Estimate how high the barrel will rest under the downspout. Be sure to include the height of the cinder blocks or platform for the barrel. Mark where the downspout will be cut. Make sure to make your cut just high enough above the rain barrel to accommodate attaching an elbow.

Step 3: Cut the downspout with a hacksaw so that the elbow will be inserted just above the rain barrel inlet. You may need tin snips to smooth the material.

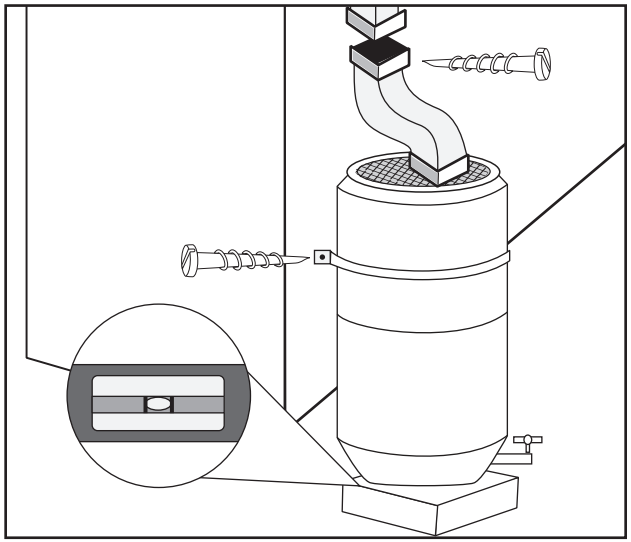
Step 4: Assemble the rain barrel platform. Make sure it is level.

Step 5: Attach the elbow over the downspout with a screw. Secure the downspout to the house with the bracket.

Step 6: Place the barrel beneath the elbow, making certain that the barrel overflow valve is positioned in an appropriate location and away from the home. Secure the barrel to the house with a strap.



Steps 1-3



Steps 4-6

How to Build a Rain Garden

Before you Begin

Design and build a rain garden before disconnecting a downspout. Helpful video instructions for installing a rain garden are available by Metro Blooms at www.metroblooms.org. The construction of a rain garden will potentially result in the redistribution of soil on a property. As a consequence, underground utilities are a concern. Before digging, call 1-800-227-2600 to acquire the location of potential underground utilities. If a project does require the redistribution of soil it may be possible to contour the dirt into berms or terraces designed to slow the flow of water. Additionally, the formation of shallow depressions on the upflow side of the berms may trap water altogether allowing the opportunity for it to infiltrate into the soil. Constructing a rain garden may be an issue if you live on a designated landslide or hillside area. Visit the Navigate LA website for a hillside area map or the Zone Information and Map Access System (Z1 MAS) websites for area maps. Permits are not required for typical residential landscaping projects. If you plan on making major landscaping modifications such as moving more than 50 cubic yards of soil or altering 1 acre or more, contact the Culver City Building and Safety Department at (310) 253-5780 for further assistance.

Assess Potential Rain Garden Sites

Locate rain gardens where they can intercept and collect roof runoff. Potential rain garden sites are down slope of a downspout, or adjacent to an impervious surface. The following factors must be considered when siting a rain garden:

- Build a rain garden in a relatively flat area.
- Build a rain garden in a naturally low lying area with good drainage.
- Remove grass or paved surfaces to create space for a rain garden.
- Do not site rain gardens underneath the canopy of existing trees.
- Do not site rain gardens above septic systems.
- Do not site a rain garden where potential overflow will run onto neighboring properties.

As a guideline, site the edge of a rain garden:

- At least 3 feet away from public sidewalks;
- At least 5 feet away from property lines;
- At least 5 feet away from house foundations, assuring at least a 2% slope away from the home.

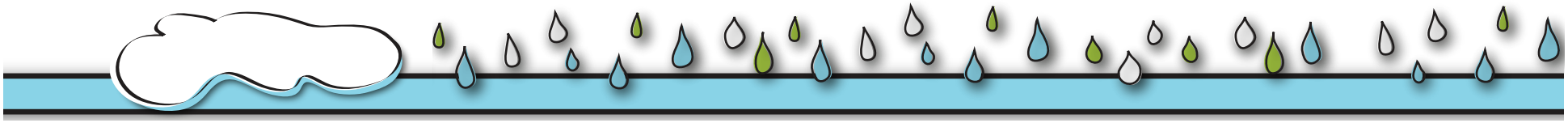
Design

Size your garden: It is easy to size a rain garden to capture a common 3/4" storm event. There are three key elements which are discussed in depth on the next page:

A rain garden in bloom

1. Perform a simple soils infiltration test to calculate the drainage rate of the potential rain garden site.
2. Calculate the rainfall that will run off the portion of the roof that will be directed to the rain garden.
3. Use the example calculations to estimate the size of your rain garden.

The rain garden sizing methodology is helpful for maximizing the volume of runoff captured from a typical storm event. However, rain gardens smaller than the calculated size, or with slow infiltration, can also make a difference.



Remember, you should always incorporate an overflow in your rain garden such that any excess water, from larger storm events, will flow into another infiltration area, or to the storm drain system and away from the home's foundation or neighboring property.

Perform a Soils Infiltration Test

The following is a list of tools and materials you will need to conduct a soils test:

- Measuring tape
- Garden spade
- Empty gallon container
- A watch

Step 1: Dig a square hole two feet deep and one foot wide in the deepest section of the potential rain garden. This size works best for the equation provided in this "How-To" Guide.

Step 2: Fill the hole with water and let it drain completely. Fill the hole again with 5 gallons of water and monitor how fast the water drains. Record how many hours it takes to drain the hole. **[T = ____ (hours)]**

Step 3: Consider digging more holes in the potential rain garden site to determine if drainage is uniform. If drainage is too slow to measure, improve the drainage by tilling in a mixture of two-thirds sandy loam topsoil and one-third compost to a depth of 18 inches.

Calculate Runoff and Rain Garden Size

Step 4: Estimate the total roof area (RA) that will drain to your potential rain garden. Note that rooftop runoff from multiple downspouts can be used to support one rain garden. **[R_A = ___ (square feet)]**

Step 5: Multiply the roof area by a factor of 0.65 to determine the volume of rooftop runoff that will flow to your rain garden. **[V = R_A x 0.65 = ___ (gallons)]**

Step 6: Plug the numbers into the equation below to determine the required size of the rain garden. If the calculated rain garden size is too big for the property, improve drainage by the tilling method and recalculate the rain garden size. Smaller gardens can be installed with an overflow. **[(hours) x (gallons) x 0.008 = _____ square footage area of rain garden]**

Example:

Optimal Area of Rain Garden:
T x V x 0.008 = 26 (square feet)

Where,
T = 10 (hours)
R_A = 500 (square feet)
V = R_A x 0.65 = 325 (gallons)

Direct water flow

A splash guard, followed by a grassed channel or swale, directs water from the end of a downspout extension to the rain garden site (Page 3). Make sure that the swale is lined with an impermeable material, such as a geotextile, if it located in the vicinity of buildings. To prevent erosion and create a dry creek bed look, add different sized river rocks to the swale. When the rain garden is filled with water and begins to overflow, direct excess water flows away from buildings and neighboring properties.

Choose your plants

There are a variety of plants that can be used in a rain garden. Diversity in plant selection will add an aesthetic quality to your garden. Consider native and drought tolerant species that adjust well to seasonal rainfall patterns, and require minimal supplemental irrigation. If a rain barrel is installed, the captured water can be used for watering plants.

There are several resources available for the selection of rain garden plants native to Southern California. Native plant nursery professionals or garden clubs can provide assistance. The Rancho Santa Ana Botanic Gardens provides native plant palette lists and offers native plant gardening workshops. Please visit their website at **www.rsabg.org** . Other groups include the Water Conservation Garden at Cuyamaca College, the California Native Plant Society, The

Garden Spot (bewaterwise), the Surfrider Foundation Ocean Friendly Gardens, and the Green Garden Group (G3). See the Additional Resources section for more information.

Avoid using invasive plant species in your rain garden. Lists of invasive species can be found at the California Invasive Plant Council, Southern California region website: **www.cal-ipc.org** . Some trees are protected by the City and require a special permit for removal. These include: all native Oak species, Black Walnut, California Bay, and California Sycamore. Contact the Culver City Department of Public Works , at (310) 253-5600 for more information.

Plants for Southern California

A few of the many plants available to you are described below. Photography is courtesy of Michael Charters at **www.calflora.net**

Bush Anemone

California Buckwheat

Bush Anemone – Shrub. Likes full sun and well drained soil. Does best with minimum care. Produces white flowers with yellow center in the spring. Attracts butterflies and birds.

California Buckwheat – Groundcover. Likes sun to partial sun and dry to semi-dry soils. Hardy and shrubby with tiny pink and white flowers. Attracts butterflies, bees and birds.

California Lilac "Concha" - Shrub. Fragrant with bright blue flowers. Likes semi-dry soil, grows to be 6-8' tall. Attracts hummingbirds.

California Poppy – Annual Wildflower. Likes full sun and dry to semi-dry soils. Thrives everywhere with brilliant orange flowers. Attracts butterflies and birds.

California Poppy

Deer Grass

Rose Sage

Woolly Blue Curls

Deer Grass – Grass. Likes full sun and dry to semi-dry soil. Mixes well with wildflowers. Source of nesting materials for birds.

Coyote Bush – Shrub. Likes full sun and dry soils. Hardy and fast growing. Attracts birds and butterflies.

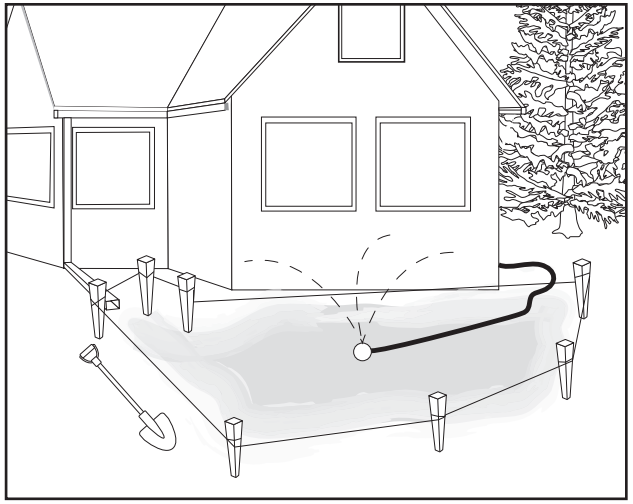
Elegant Clarkia – Wildflower. Likes sun and dry to semi-dry soils. Easy to grow and long-lasting showy flowers in pink, red or purple. Attracts hummingbirds and butterflies.

Purple Needle Grass – Grass. Likes sun to partial sun and semi-dry soils. Hardy and showy with purple seed heads. Attracts songbirds.

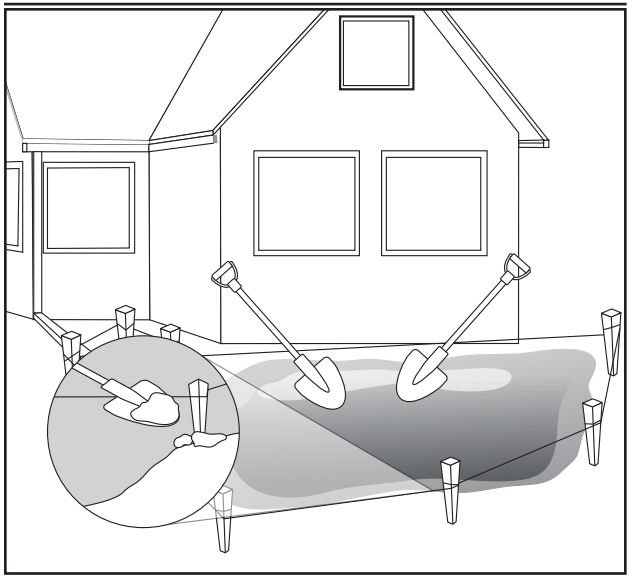
Rose Sage –Shrub. Likes sun to partial sun and dry soil. Compact and scented with rose and blue colored flowers. Attracts hummingbirds, songbirds, butterflies, bees and lizards.

White Sage – Shrub. Likes sun to partial sun and dry soils. Flower stalks are long and arching with white flowers. Attracts butterflies, bees, birds, lizards and nectar-loving insects.

Woolly Blue Curls – Shrub. Likes sun to partial sun and dry soils. Native to Santa Monica Mountains and requires no water in the summer. Blue and pink woolly flowers bloom in the spring and fall. Attracts hummingbirds and butterflies.



Steps 1-2



Step 3

Build a Garden

Use the following steps as a guide for building a rain garden:

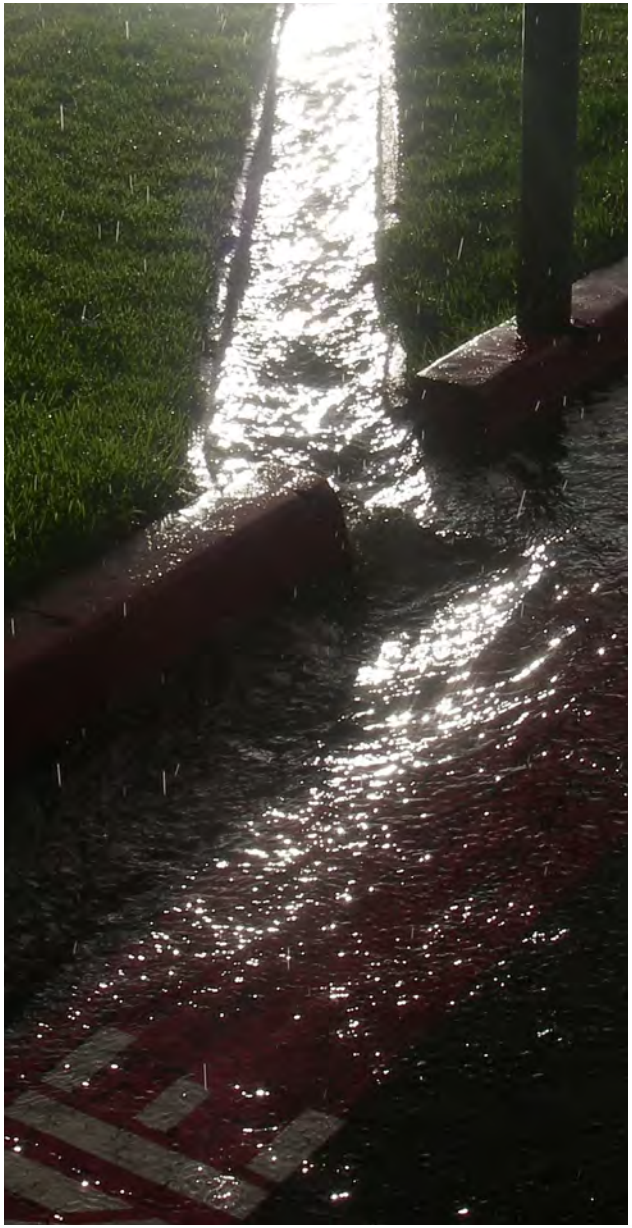
Step 1: Outline the rain garden area with string and stakes.

Step 2: If the soil is too hard to dig, moisten it with a garden hose. Allow the water to seep in overnight. Dig up existing grass and plants. Set aside any native plants that can be used in the garden.

Step 3: Dig the rain garden 18 inches deep. Frame the rain garden with the sides sloped to about 20%. To minimize the risk of erosion, consider lining the side slopes with stones or plant vegetation. If the rain garden is on a slight slope, add a berm on the downhill slope to hold in rainwater.

Step 4: Plant the rain garden. Use a variety of species. After planting, add compost to provide nutrients to the plants. Compost or soil amendments can be purchased at most garden supply stores. The City of Los Angeles offers free compost at the Griffith Park Composting Facility. Call (323) 913-4166 for further information.

Step 4



Other Rainwater Harvesting Options

In addition to rain barrels and rain gardens, additional rainwater harvesting features can be installed at a residential property. Visit local demonstration gardens, take a workshop, and review references provided in the Additional Resources section of this "How-To" Guide to gather ideas. Consider consulting a contractor or a landscape designer to address site specific needs. Some noteworthy rainwater harvesting applications include installation of dry wells (also known as French drains) or infiltration basins, and replacing paved surfaces with permeable paving.

A dry well is a trench or basin completely filled with coarse media, such as angular gravel, to create a porous layer for infiltrating runoff. Dry wells are suitable for foot-traffic, and are typically placed between a driveway or patio and a vegetated area, where runoff from the paved surfaces is used to soak deep into the roots of adjacent plants. Dry wells are not suitable for areas that would generate sediment or silt-laden runoff.

A rain garden is a type of infiltration basin. There are several additional infiltration basin designs that can accommodate existing contours and vegetation on your property. For instance depressions extending beyond the canopy of a tree can be created to catch and infiltrate runoff. Terraced infiltration basins can be formed on sloped properties.

Impervious walkways and driveways can be removed and replaced with permeable paving such as "pavers". Pavers are brick-like materials that are manufactured in a variety of shapes. Pavers fit together like tiles and are set with small gaps between them creating grooves for water to infiltrate the soil below. Other materials such as broken pieces of recycled concrete can also be used. Paved walkways can also be removed and replaced with gravel or mulch.

Regardless which option you choose, the primary goal of any rainwater harvesting strategy is to redirect water into the ground or a holding tank before it reaches the storm drains. Imagine a property as a "mini-watershed", the principal objective is to completely eliminate runoff from leaving the property boundaries. These strategies and ideas will assist in recharging the groundwater in a drought ridden state and filtering harmful pollutants from the waterways.

Rainwater Harvesting System Maintenance

Perform the following activities to maintain your rainwater harvesting system:

Rain Gutters

- Clean gutters at least twice a year, and more often if you have overhanging trees.
- Make sure gutters are pitched to direct water to downspouts.
- Repair leaks and holes.
- Look for low spots or sagging areas along the gutter line, and repair with spikes or place new hangers as needed.

Downspouts

- Check and clear elbows or bends in downspouts to prevent clogging.
- Repair any leaks and holes.
- Each elbow or section of the downspout should funnel into the one below it. All parts should be securely fastened together with sheet metal screws.

Rain Barrels

- Make sure all parts are securely fastened together and the rain barrel is securely fastened to the building.
- Clean out the rain barrel and check for leaks at least once a year.
- Check and clear downspout elbows, rain barrel screening, and overflow to prevent clogging.
- Repair any leaks and holes.
- Make sure the rain barrel remains securely screened to prevent mosquito entry.
- Inspect overflow area to make sure that water will continue to drain away from structures and does not flow onto pavement, sidewalks or neighboring properties.

Rain Gardens (or other landscaping)

- Irrigate deeply once a week during dry months to encourage root growth and keep plants strong, especially while plants are getting established.
- Maintain the garden regularly.
- Inspect your garden after a heavy rain. Remove sediment and debris, watch for erosion, and replace plants as needed.
- If a plant isn't surviving in one area, try moving it to another.

Where Can I Get More Information?

Help can be acquired from several sources. Start with the City of Culver City Rainwater Harvesting Program. Explore other resources including local organizations that provide help and information about rain gardens and the use of native plants.

The City of Culver City

The City of Culver City Rainwater Harvesting Pilot Program
CCrainwater.ballonawatershed.org

rainwater@santamonicabay.org

Culver City Department of Public Works, Environmental Programs
http://www.culvercity.org/Government/PublicWorks/Environmental-Programs.aspx

Additional Resources

California Invasive Plant Council
http://www.cal-ipc.org/

Native Plant Nurseries and Local Botanic Gardens
http://lasmmcnps.org/nativenurseries.html

Green Garden Group (G3)
http://www.greengardensgroup.com/

Metro Blooms (Rain garden installation video and information)
http://metroblooms.org/index.php

The Surfrider Foundation Ocean Friendly Gardens
http://www.surfrider.org/ofg.asp

TreePeople
http://www.treepeople.org/

Glossary of Terms

Berm – A mound of earth used to retain water, such as along the down-slope side of a rain garden

Downspout – Pipe that directs stormwater runoff from the roof of a house to the ground.

Impervious – Not allowing water to penetrate. Examples of impervious surfaces include paved driveways, walkways, or roofs.

Pervious – Allowing water to penetrate. Examples of pervious surfaces include flower beds and rain gardens.

Rain Garden -A planted depression that allows rainwater runoff from impervious urban areas like roofs, driveways, walkways and compacted lawn areas to be absorbed into the earth.

Rain gutter – Captures and redirects stormwater runoff from the roof to a downspout. (Figure 3)

Runoff – Water that does not soak into the ground and flows over impervious areas or areas already saturated with water. In the City of Culver City runoff from storm events flows into the ocean without being treated.

Swale – A shallow ditch, usually lined with river cobble or vegetation to prevent erosion, which conveys runoff to a certain location, such as a

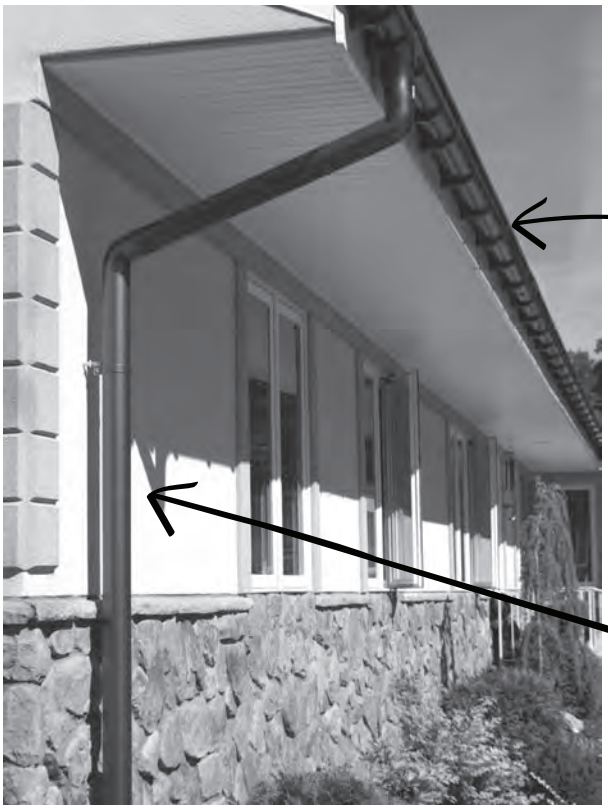
Culver CITY
Rainwater Harvesting Program

As a covered entity under Title II of the Americans with Disabilities Act, the City of Culver City does not discriminate on the basis of disability and upon request, will provide reasonable accommodation to ensure equal access to its programs, services and activities.

Culver City Rainwater Harvesting Program

Step 1 of 3

APPLICATION FORM



Please complete the following form to the best of your ability. It may help to take a walk around your property before completing the application. Your privacy is important to us. For that reason, we will use the information we have gathered in this form strictly for the purposes of the Rainwater Harvesting program.

1.

• Name:..... • Date: .....

• Street Address:.....

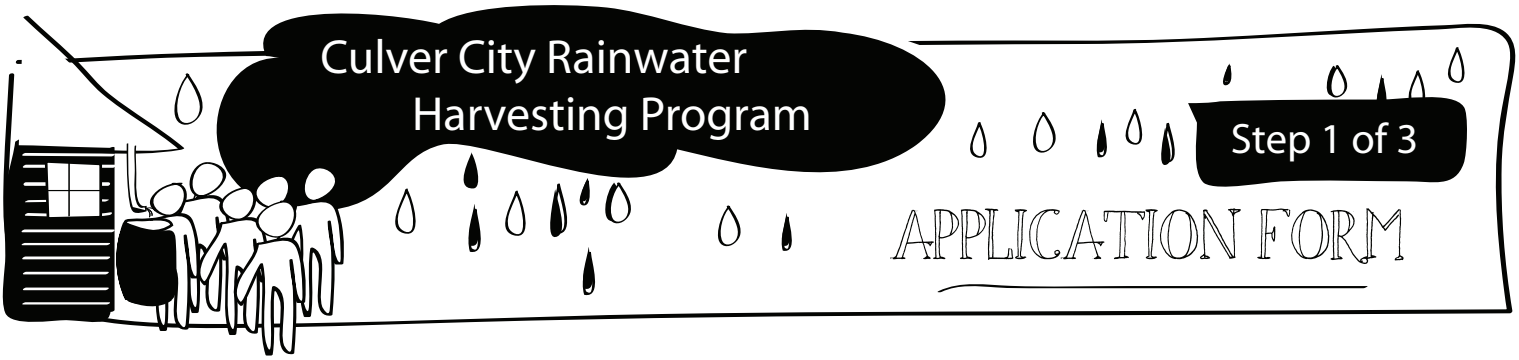
• City/Neighborhood.....• Zip Code:.....

• Phone #:..... • email:.....

Completed forms should be emailed (scanned) or mailed to: SMBRC Attn: Ivan Medel
1 LMU Dr., North Hall, MS: 8160 Los Angeles, CA 90045
phone: Heather (424) 645 - 7017 or Ivan (310) 961 - 4606
email: rainwater@santamonicabay.org

CCrainwater.ballonawatershed.org

Program funded by the Santa Monica Bay Restoration Commission



2. Is your property a business or a residence?
Business ☐ Residence ☐

3. Do you own or rent your property? (If you're renting, your property owner must sign section 3.)
Own ☐ Rent ☐ Don't Know ☐

4. Does your property have rain gutters along the roof's edge? (You must have rain gutters to participate in this program.)
Yes ☐ No ☐ Don't Know ☐

5. Do you know where on the property you would like your rain barrel installed?
Yes ☐ No ☐
If yes, what type of surface would your barrel be placed on?
Dirt ☐ Pavement ☐ Other.....

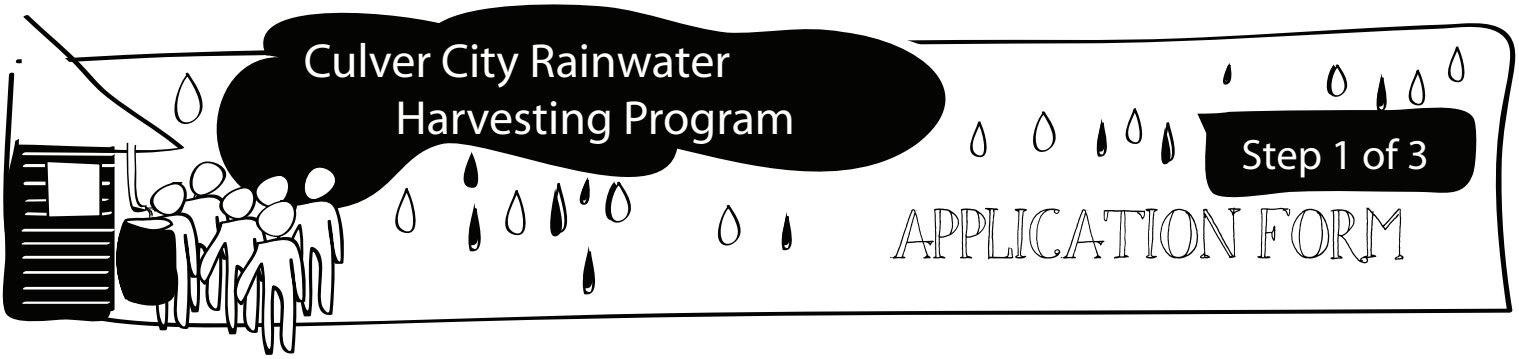
6. What size are you downspouts?
2" x 2" ☐ 2" x 3" ☐ 3" x 4" ☐ Don't Know ☐ Other.....

7. How many downspouts are there in the front of the property?
0 1 2 3 4 5 6 7 8 9+ Don't Know ☐

8. How many of these downspouts in the front of your property drain to a paved area such as a driveway or sidewalk?
0 1 2 3 4 5 6 7 8 9+ Don't Know ☐

9. How many downspouts are there in the back of your property?
0 1 2 3 4 5 6 7 8 9+ Don't Know ☐

10. How many of these downspouts in the back of your property drain to a paved area such as a driveway or sidewalk?
0 1 2 3 4 5 6 7 8 9+ Don't Know ☐



11. Do any areas of the property have plastic lining to prevent weeds from growing in flower beds or gardens?

Yes ☐ No ☐ Don't Know ☐

If yes, where?

.....

12. Are there any septic tanks on your property?

Yes ☐ No ☐ Don't Know ☐

If yes, where?

.....

13. Are there any other features about your property you would like to tell us about?

.....

The following questions are included to help us in reaching future participants for the rainwater harvesting program. Your input is much appreciated.

14. How did you hear about the program (check all that apply)?

☐ Neighbor/Friend (name): .....

☐ Community Group (name): .....

☐ Media (e.g. newspaper, radio) (outlet): .....

☐ Website URL (address): .....

☐ Brochure (from): .....

15. Do you have any friends or neighbors that you recommend us contacting to join the program?

Yes ☐ No ☐ Don't Know ☐

If yes, name and contact information:

.....

You have now completed step 1 of 3 of the Culver City Rainwater Harvesting Program forms.
Be sure to submit this Application with the Maintenance Commitment (step 2) and the Liability Waiver (step 3).

Completed forms should be emailed (scanned) or mailed to: SMBRC Attn: Ivan Medel
1 LMU Dr., North Hall, MS: 8160 Los Angeles, CA 90045
phone: Heather (424) 645 - 7017 or Ivan (310) 961 - 4606
email: rainwater@santamonicabay.org

CCrainwater.ballonawatershed.org

Program funded by the Santa Monica Bay Restoration Commission

• Name: ..... • Phone Number:.....

Regular inspection and maintenance of the downspout disconnection system, including disconnections to on-site pervious areas and rain barrels, is vital to the long-term viability of the system. It is the responsibility of the property owner to maintain the downspout disconnection system in accordance with the minimum requirements provided below for a period of at least three years.

Maintenance Activities For On-Site Pervious Areas	Suggested Frequency
• Leaf screens, gutters, and downspouts should be inspected and cleaned to prevent clogging. • Determine if splash guard has been inadvertently moved to an ineffective location. • On-site impervious areas should be checked to ensure that they are free of trash, debris, and sediment. • On-site impervious areas should be reviewed for signs of channelized flow and compaction.	After Large Storm Events.
• Make certain that the downspout straps are secured to the walls and the elbow connections fit tightly.	Annually
Maintenance Activities for Rain Barrels	**Suggested Frequency**
• Leaf screens, gutters, and downspouts should be inspected and cleaned to prevent clogging. • Inspect rain barrel overflow device for obstructions or debris that would prevent proper drainage when storage capacity is reached. • Dewater rain barrel between rain events so that the required storage volume is available. • Inspect for presence of mosquitoes.	After Large Storm Events.

Completed forms should be emailed (scanned) or mailed to: SMBRC Attn: Ivan Medel
1 LMU Dr., North Hall, MS: 8160 Los Angeles, CA 90045
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• Rain barrel should be disconnected, drained, and cleaned at the start of the rainy season. • The rain barrel should be inspected for structural stability twice each year, preferably before and after the rainy season. • Check the rain barrel to ensure it has not shifted or moved off it's surface. • Check the bricks and ground to make sure the barrel sits on a flat and LEVEL surface. • Make sure the brick stand is secure, level and properly aligned to hold a full barrel of water. • DRAIN THE WATER before making any adjustments. If a strap is in place, tug on the strap to make sure it's tight and secure.	Annually

I have read the Maintenance Commitment and do understand that I should maintain my property in accordance with the minimum requirements. By my signature I pledge to maintain my property as stated above for at least three years.

....

Property Owner Signature Date

.....

Type or Print Property Owner Name

.....

Property Owner Address

You have now completed step 2 of 3 of the Culver City Rainwater Harvesting Program forms.

Be sure to submit this Maintenance Commitment with the Program Application (step 1) and the Liability Waiver (step 3).

Completed forms should be emailed (scanned) or mailed to: SMBRC Attn: Ivan Medel
1 LMU Dr., North Hall, MS: 8160 Los Angeles, CA 90045
phone: Heather (424) 645 - 7017 or Ivan (310) 961 - 4606
email: rainwater@santamonicabay.org

CCrainwater.ballonawatershed.org

Program funded by the Santa Monica Bay Restoration Commission

• Name: ..... • Phone Number:.....

Many residential and commercial properties in the City of Culver City are fitted with downspouts. When it rains, water runs off roofs, through the downspouts, usually onto an impervious surface, such as a sidewalk, driveway or parking lot. Before reaching the storm drain, rain water can carry with it a variety of pollutants including trash, pet waste, oil and grease or other chemicals. This "toxic soup" of rainwater and pollution flows directly to the storm drain system and eventually empties into either the Santa Monica or San Pedro Bays.

The City of Culver City Rain Water Harvesting Pilot Program is designed to help landowners reduce the amount of rain water flowing from their roofs into the storm drain system and reaching the ocean. The Program provides for the disconnecting of downspouts from impervious surfaces, so that rain water can be redirected to areas where it will be soaked into the ground. Plants and soils can then work to filter out pollutants.

The City of Culver City will perform low-cost services ("Installation Services") in order to provide a modification to one downspout to distribute water onto a permeable surface.

In order to provide these services, we will need to enter into an agreement that will permit the City and its agents to enter your property and perform the work. To receive the Installation Services, including your downspout replacement and rain barrel, please review and sign this agreement ("Agreement").

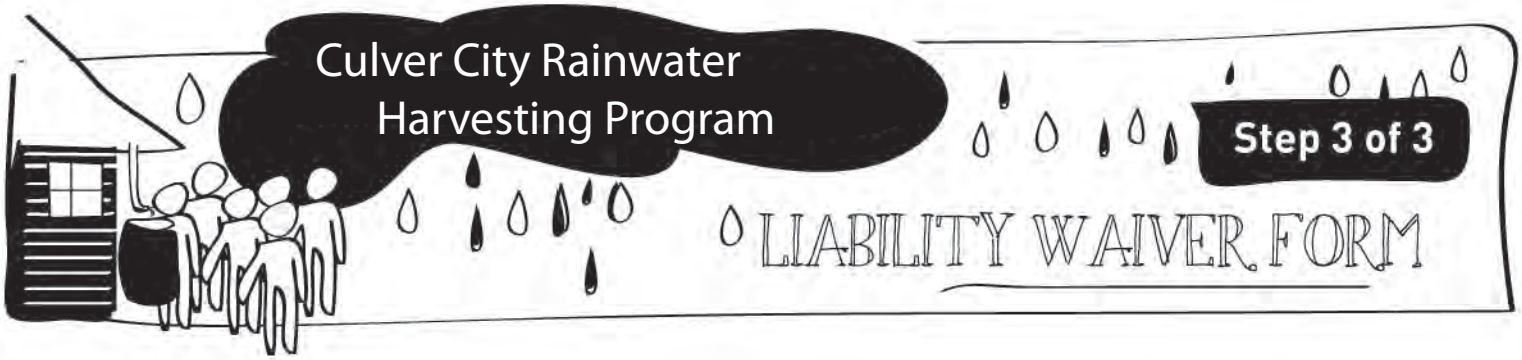
1. The undersigned is the owner, ("Owner") of the property described below (the "Property").

2. By signing this Agreement, Owner hereby grants access to the Property (solely for the pupose of performing Installation Services) to the City of Culver City and their representatives, agents, subcontractors and consultants, including the Santa Monica Bay Restoration Commission (collectively, the "City").

3. Prior to commencement of the Installation Services, the City and Owner will agree upon the Installation Services to be performed, and the reasonable expectation of time it will take to perform the Installation Services. These agreed upon services will be set forth in an installation Services, substantially as set forth in the attached "Maintenance Commitment"

4. Once a downspout is disconnected, a downspout replacement is installed and the Installation Services are completed, I understand and agree that it will be my responsibility to ensure that the downspout replacement and its associated attachments are not removed and properly maintained and operated, and that the City will assume no responsibility for maintenance.

5. In consideration for the Installation Services, Owner, on behalf of Owner and Owner's heirs, sucessor and assigns, hereby agrees to release, indemnify and hold harmless and forever discharge City from and against any and all litigation, demands, liabilities, claims and expenses of any kind or nature (including, without limitation, attorney's fees and court



costs)asserted against or incurred by the City in connection with any alleged damage to property or injury to person (including death) arising from or in connection with the Installation Services or the operation and/or maintenance of the downspout and rain barrel; provided, however, that this indemnity, hold harmless and release clause shall not include injuries caused solely by the gross negligence or reckless misconduct of the City.

6. Wherever possible, each provision of this Agreement shall be interpreted in such a manner as to be valid under applicable law, but, if any provision of this Agreement shall be invalid or prohibited there under, such provision shall be ineffective to the extent of such prohibition without invalidating the remainder of such provision or the remaining provisions of this Agreement.

7. Owner further agrees, promises, and covenant not to sue, assert, or otherwise maintain any claim against the City for any injury, death, illness or disease, or damage to Owner or to the Property, arising from or in connection with Owner's participation in the Installation Services.

• Date: ..... •Homeowner Signature: .....

• Printed Name:.....

• Telephone: ..... • Address: .....

• City: ..... • State: ..... • Zip: .....

You have now completed step 3 of 3 of the Culver City Rainwater Harvesting program forms.
Be sure to submit this Liability Waiver with the Application (step 1) and Maintenance Commitment (step 2).

Completed forms should be emailed (scanned) or mailed to: SMBRC Attn: Ivan Medel
1 LMU Dr., North Hall, MS: 8160 Los Angeles, CA 90045
phone: Heather (424) 645 - 7017 or Ivan (310) 961 - 4606
email: rainwater@santamonicabay.org

CCrainwater.ballonawatershed.org

Program funded by the Santa Monica Bay Restoration Commission

WHAT'S THE RAINWATER HARVESTING PROGRAM?

The City of Culver City is offering its residents and commercial properties in your community low cost materials and installation of a rainwater capture system. Rainwater capture systems will include the installation of a rain barrel on your property.

WHY SHOULD I SIGN-UP?

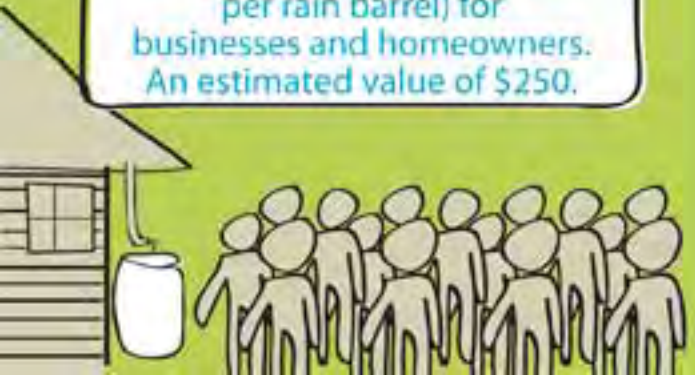
Save money
on your water expenses

Conserve water
by capturing and reusing rainwater on your property

Protect our environment
by reducing runoff and thereby improving the quality of our rivers and ocean for future generations.

Join your neighbors
in doing the right thing by joining the movement in your community to preserve and protect

Low cost program (suggested donation of $40 per rain barrel) for businesses and homeowners. An estimated value of $250.



SIGN UP FOR THE

Culver CITY
Rainwater Harvesting Program

online
CCrainwater.ballonawatershed.org
by calling
(310) 961 - 4606 or
(424) 645 - 7017
or emailing
rainwater@santamonicabay.org

Culver CITY GOING GREEN

Santa Monica Bay Restoration Commission

One Call to City Hall: (310) 253 - 6000

Culver CITY
Rainwater Harvesting Program

SIGN UP FOR THIS PROGRAM!

HOW DO I KNOW IF I'M ELIGIBLE?

This pilot program is for residents and businesses within the Culver City communities .

SIGN-UP AS EASY AS 1,2,3!

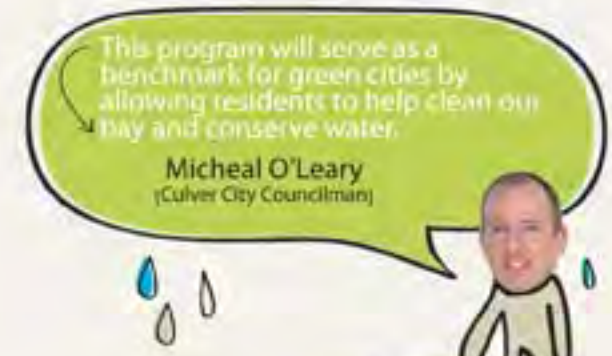
1. Fill out the Application Form online*, or call (310) 961 - 4606 or (424) 645 - 7017.

2. Mail or email the Maintenance Commitment and Liability Waiver forms to:
   SMBRC
   Attn: Ivan Medel
   1 LMU Dr., North Hall, M5: 8160
   Los Angeles, CA 90045
   rainwater@santamonicabay.org

3. All approved property owners will receive a call from the SMBRC to set-up a date and time for the installation (homeowner need NOT be present during installation).

*Application packets can be found online at www.CCrainwater.ballonawatershed.org

WHAT FOLKS ARE SAYING



THIS HOME PROUDLY HARVESTS RAINWATER.

Conserve water. Protect our rivers and ocean.

www.CCRainwater.BallonaWatershed.org

Culver CITY
GOING GREEN

Funding provided by:
bay restoration commission
STEWARDS OF SANTA MONICA BAY

Funding provided by:
bay restoration commission

Culver CITY
Rainwater Harvesting Program

Online: CCrainwater.ballonawatershed.org
Email: rainwater@santamonicabay.org
Phone: (310) 961-4606 or (424) 645-7017

Culver CITY
Rainwater Harvesting Program

THIS HOME PROUDLY HARVESTS RAINWATER.

Conserve water. Protect our rivers and ocean.

www.CCRainwater.BallonaWatershed.org

Culver CITY
GOING GREEN

Please use water for irrigation only. Do not drink.