CITY OF HAWTHORNE OCEAN FRIENDLY GARDEN DEMONSTRATION PROJECT

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INTRODUCTION

A comprehensive approach to reducing landscape water use was implemented in the Demonstration Garden in the City of Hawthorne. By creating healthy soil, grading to capture and retain rainwater, using California native and climate-appropriate plants, and implementing sustainable maintenance practices, the garden was designed to mimic the natural processes of a mini-watershed. The soil is now able to soak up and retain rainwater, reducing the need for supplemental irrigation and eliminating urban runoff. Habitat and food for wildlife was introduced, and maintenance costs were minimized by reducing green waste and eliminating the need for chemical fertilizers, herbicides, and pesticides. The installation was supplemented by two classes offered free to the public: a three hour introduction to California Friendly Landscaping principles, and a half day hands-on workshop in which participants used their newly-acquired knowledge to plant California natives and install drip irrigation. California native plantings were selected for their long-lasting and colorful blooms to introduce the public to the beauty and diversity of California's indigenous flora, which has, until recently, been under-represented in garden centers and under-utilized in residential and commercial landscapes.

KEYWORDS

urban runoff, Ocean Friendly Gardens, California Friendly Landscape Training, California native plants, retention basin, rainwater capture, watershed, first flush, soil biology, plant factor, evapotranspiration, drip irrigation, organic maintenance, hands-on workshop.

URBAN RUNOFF

The largest source of water pollution in urban areas cannot be traced to a single cause: it's the accumulated runoff that carries pollutants from millions of residential and commercial landscapes, streets, parking lots and roof tops into storm drains, rivers, and the ocean. Fertilizers, pesticides, oil, trash, and brake dust from cars are easily picked up by the power of water.

Runoff from urban landscapes affects the quality of our oceans and the quality of our lives. Following are the common pollutants and their effects:

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Synthetic fertilizers increase nutrients which lead to algal blooms and red tides. This results in lowered dissolved oxygen levels, smothering and killing marine life.

Pesticides, herbicides and fungicides poison wildlife, humans, and soil biology.

Automobile engine oil, exhaust and brake pad dust, as well as contaminants from utility plants are toxic to marine life.

Bacteria from manure fertilizers and pet waste sicken marine life. Additionally, since they also pose a threat to human health, they can lead to beach closures.

Fine Soil Sediment can be laced with cancer-linked heavy metals, such as lead and mercury, which accumulate in fish consumed by humans. Too much sediment can also smother coral.

All these pollutants contribute to ocean acidification, the ongoing decrease in the ocean's pH caused by the uptake of atmospheric carbon dioxide. Increased ocean acidification can depress the metabolic rates and immune systems of some marine animals and cause coral bleaching. It also interferes with calcification, the process by which shellfish form and maintain their protective shells and plates, thereby threatening their survival. Ocean acidification has the potential to threaten food chains associated with the oceans (Surfrider Foundation, 2014).

Urban runoff increases the ocean's turbidity, the degree to which water loses its transparency due to the presence of suspended particulates. As these suspended particles absorb heat from the sun, turbid waters become warmer. This reduces the concentration of oxygen in the water, since oxygen dissolves better in cold water than in warm. Suspended particles also scatter the light. This decreases the photosynthetic activity of plants and algae, which lowers the oxygen concentration even more. As a consequence of the particles settling to the bottom, shallow lakes fill in faster, fish eggs and insect larvae are suffocated, and gill structures get clogged or damaged. Furthermore, some organisms simply can't survive in warmer water (Lenntech, 2014).

The first one-inch of rain after a dry spell is called the "first flush" and contains most of the pollutants. Traditionally, municipal building codes have required rainwater to be directed away from residential and commercial properties to prevent flooding of the sites (Figure 1).

FIGURE 1: A typical residential landscape contains many impermeable surfaces that contribute to urban runoff.

However, this can overwhelm those flood control systems in which the storm drains and sewer infrastructures are combined, thereby causing raw sewage to be released into waterways. Such traditional policies have ignored rainwater as a free source of irrigation for the landscape.

While runoff is greatest during and after storms, dry periods contribute to the problem too. Known as "dry-weather runoff," it's caused by such activities as overwatering landscapes, improperly installed and/or maintained spray irrigation systems overshooting the landscape, hosing down hardscape surfaces, washing cars, and draining swimming pools and hot tubs.

OCEAN FRIENDLY GARDENS CRITERIA

In response to the increasing number of beach closures due to urban runoff issues, the Surfrider Foundation established its Ocean Friendly Gardens (OFG) Program in 2009 to both raise awareness and to provide an inexpensive and easily implemented plan for reducing urban runoff generated from home and business properties. The principles of Conservation, Permeability, and Retention (CPR) were developed as a guide to assist home and business owners in redesigning their landscapes (Figure 2):

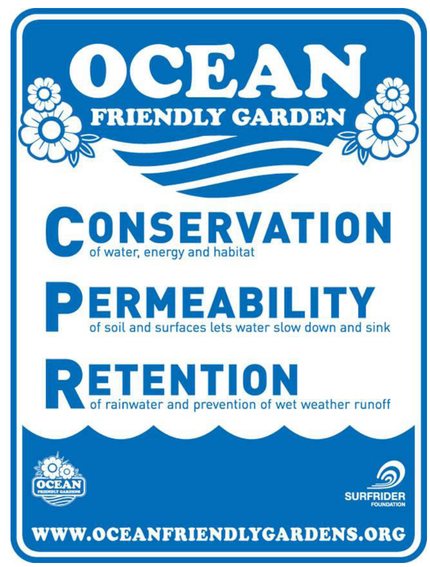


FIGURE 2. The Ocean Friendly Garden yard sign displays the principles of CPR: Conservation, Permeability and Retention.

Conservation: Conserving the use of water and reducing or eliminating fertilizers and pesticides are key components of an OFG. Using less irrigation creates a drier landscape and allows it to hold more water. Applying fewer, if any, fertilizers and pesticides, and/or using non-toxic alternatives, improves the condition of the water that does run off. Restricting grass to active play areas, utilizing a diverse range of plants, and selecting plants that are adapted to the climate are all conservation-oriented design practices.

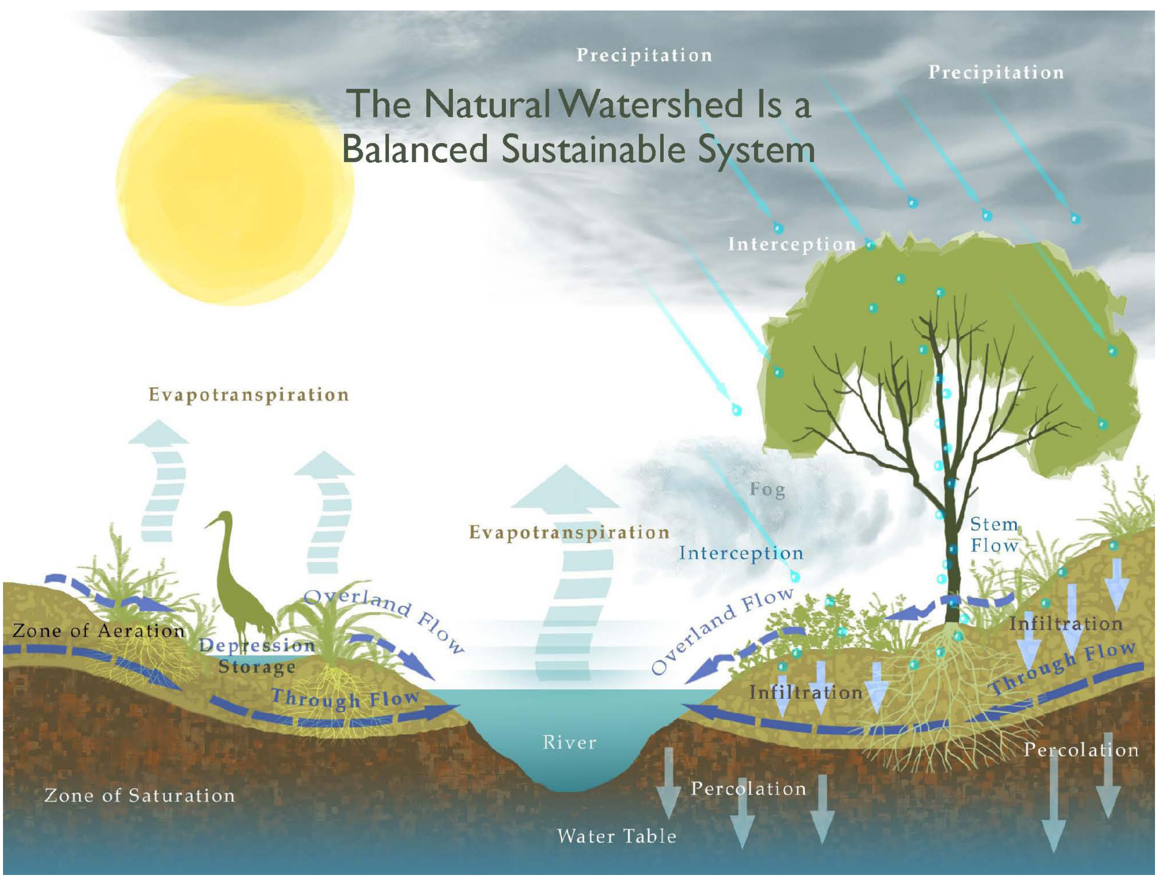
Permeability: A landscape's ability to slow and hold water is related to its permeability. Any increase in the amount of permeable surfaces – however small – will appreciably reduce the amount of runoff. Permeability is increased by substituting hardscape materials, such as concrete with sand-set brick, stone, or non-stabilized decomposed granite. Creating an irregular ground surface will also improve permeability by putting obstacles in the water's path.

Retention: For either infiltration or immediate use, retention involves strategies that help landscapes collect water. Bio-retention basins and infiltration trenches are commonly constructed devices for rainwater collection and eventual infiltration. A rooftop rainwater collection system designed to capture and store water is another example.

The Surfrider Foundation engaged G3 Green Gardens Group (G3) in 2010 to develop a specific set of standards that apply the principles of CPR for use by the general public (Appendix A). The result was a guide for retrofitting existing landscapes or building new landscapes to qualify as OFGs. Rather than focusing only on reducing runoff and improving water quality, the OFG standards address the interrelationship between soil, plants, rainwater retention, irrigation, and maintenance. The aim is to treat every landscape as a "mini-watershed" (Figure 3).

By designing landscapes to mimic the natural hydrologic cycle, significant environmental problems that face urban centers can be mitigated: runoff pollution, poor water and air quality, ground water depletion, green waste, loss of wildlife habitat, increased temperatures due to lack of tree cover and predominance of paved surfaces, and lessened absorption of atmospheric carbon back into the soil.

FIGURE 3. An Ocean Friendly Garden is designed to mimic the natural functions of a mini-watershed.



THE SOIL'S ESSENTIAL ROLE

The Western United States is an arid region that has become drier due to persistent drought conditions. But the drought is just a symptom of something much more insidious, namely desertification – creating a man-made desert out of a historically dry area (USGS, 2014).

Reviving soil health is the first step in reversing the process of desertification. Traditional turf-centric landscapes and their maintenance practices continue to degrade the health of the soil through the use of toxic chemicals, removal of organic material, overwatering, and erosion of topsoil from both runoff and the use of leaf blowers. All of these result in the soil becoming compacted and unable to absorb water and oxygen.

Changing both the design and maintenance practices as prescribed in the OFG standards can transform compacted soil from a sterile "brick" to a living "sponge," soaking up and storing both rain and supplemental irrigation water, and, most importantly, re-establishing the essential soil microbe populations that support plant health without the need for chemical fertilizers.

IMPLEMENTATION

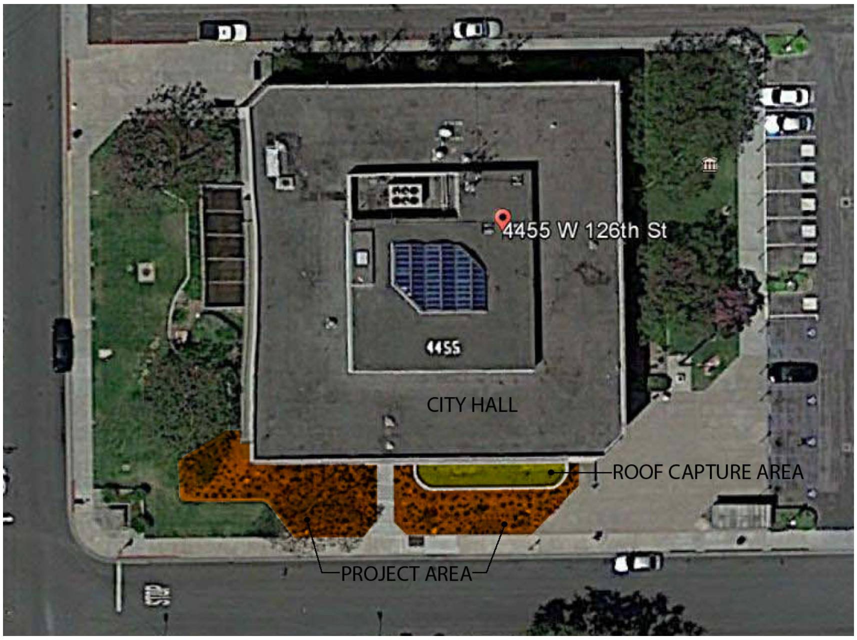
In 2009, the West Basin Municipal Water District (West Basin), a public agency that provides potable and recycled water to cities and companies in a 185 square mile area of southwest Los Angeles County, contracted with G3 and the Surfrider Foundation to design and oversee the construction of a series of sixteen OFG Demonstration Gardens in communities served by West Basin. The demonstration projects have been funded by various sources, including grants stemming from California's Proposition 50 that was passed by public vote in 2002.

West Basin asked cities within its service area to submit potential sites to build gardens that would show the general public how applying OFG principles could reduce their outdoor water usage, build healthier soil and reduce urban runoff. In addition, the gardens would be partially built through a hands-on workshop to both train professionals and educate property owners. The City of Hawthorne, California, submitted a proposal and was accepted. Hawthorne covers six square miles adjacent to the I-405 and I-105 freeway intersection in southwest Los Angeles County, a few miles east of the Los Angeles International Airport. The city of 86,000 people enjoys a mild, coastal-influenced Mediterranean, or Dry-Summer Subtropical, climate with a preponderance of sunny days and only thirty-five days with measurable precipitation annually.

Although thirty-five rain days may sound like a lot, the Los Angeles region averages merely fifteen inches of precipitation annually, which mainly occurs during the winter and spring (November through April) with generally light rain showers, although sometimes as heavy rainfall and thunderstorms. In the last three years, however, annual precipitation has been only six to eight inches per year, less than half the historical average as the drought enters its fourth year.

The Hawthorne City Hall, located at 4455 West 126th Street near the intersections of Hawthorne and El Segundo Boulevards, was selected as an OFG Demonstration site for its accessibility to the public and high visibility as a civic facility. West Basin and G3 selected a 2,282 square feet area on the south side of the building fronting West 126th Street to construct the demonstration garden (Figure 4). A 561 square foot portion of the roof drains into the project site which would allow for the capture and infiltration of 348 gallons of rainwater in a one inch rain event (561 square feet * .62 conversion factor = 348 gallons).

FIGURE 4. An aerial view of Hawthorne City Hall, showing the project area in orange and roof rain capture area in yellow.



ESTIMATED TOTAL WATER USE OF PRE-EXISTING LANDSCAPE

The existing non-native landscaping consisted primarily of medium-water use trees and shrubs (Figure 5) as classified in the manual of Water Use Classification of Landscape Species (WUCOLS) (Costello, L., & Jones, K.). These included Jacaranda mimosifolia (Jacaranda), Betula pendula (European White Birch), Hedera helix (English Ivy), Agapanthus africanus (Lily of the Nile), Hemerocallis hybrids (Daylily), Pittosporum tobira variegata (Variegated Mock Orange). Existing irrigation consisted of overhead spray heads operated by a centralized irrigation controller.

FIGURE 5. The "before" landscaping at Hawthorne City Hall had non-native, medium-water use plants and no means to capture and retain rain water.

An estimate of the total annual water use of the existing landscaping was calculated using the following assumptions:

Annual Evapotranspiration Rate (ETo), the amount of water per year required to maintain healthy cool season turf grass for the subject area is 46.6 inches per year, as published by the California Irrigation Management Information System (CIMIS)

Medium-Water Use Plant Factor (PF) of 50% per WUCOLS

Irrigation Efficiency (IE) Factor of 50% for overhead spray irrigation

Estimated Total Water Use (ETWU) = Landscape Area * ETo * PF / IE

ETWU for the existing landscaping in the project area was **106,341** gallons per year (2,282 square feet * 46.6 inches per year ETo * 0.50 PF / 0.50 IE)

DESIGN CONSIDERATIONS FOR REDUCING WATER USE

A significant reduction in supplemental water use required for the OFG Demonstration project was attained by incorporating the following into the design:

Capture and Retain Rainwater as a resource to reduce the amount of supplemental irrigation required. Estimated annual rainfall for an average year of 15 inches would yield a total of 5,403 gallons (15 inches per year * 581 square feet of roof area * .62 conversion factor).

Reduce the Overall Plant Water Usage Factor by using low and very low-water use plants in all areas with the exception of the infiltration basins. The basins, damper by nature, would include plants adapted to seasonal wet and dry conditions such as Carex praegracilis (Field Sedge), and become a separate hydrozone for irrigation purposes. The low and very low-water use hydrozone would be 1,994 square feet, or 87% of the total area, and the medium-water use hydrozone would be 288 square feet, or 13% of the project area.

Convert to Drip Irrigation which increases the irrigation efficiency from 50% for overhead spray irrigation to 90% for drip irrigation.

To estimate the total annual water use for the demonstration garden, the following assumptions were used:

Annual Evapotranspiration Rate (ETo) for the subject area is 46.6 inches per year per CIMIS

Medium-Water Use Plant Factor (PF) of 50% for Hydrozone 1 consisting of 288 square feet

Low-Water Use Plant Factor (PF) of 20% for Hydrozone 2 consisting of 1,994 square feet

Irrigation Efficiency (IE) Factor of 90% for drip irrigation

Rainwater Capture (RWC) of 5,403 gallons per year

Estimated Total Water Use (ETWU) = [ETo* (PF *Hydrozone 1 Area + PF *Hydrozone 2 Area) / IE] - RWC

ETWU for the proposed demonstration project is 22,702 gallons per year [46.6 inches per year ETo * (0.50 PF * 288 square feet + 0.20 PF * 1,994 square feet) / 0.90 IE] – 5,403 RWC

The estimated total annual water savings would be **83,639** gallons after converting the existing landscape to OFG standards.

DESIGN PROCESS

The City of Hawthorne City Engineer and Public Works Department preferred that the demonstration garden be experienced by the public only from the sidewalk frontage and the existing walkway bisecting the site, due to loitering concerns. Therefore, the project site would not contain any new pathways or seating areas. All existing vegetation would be removed except for the mature Jacaranda mimosifolia (Jacaranda) with its twenty-eight foot diameter canopy.

The project area was broken into two phases: a 1,912 square foot portion to be funded and constructed by West Basin, and a 370 square foot portion to be the site of a free hands-on workshop led by a G3 Instructor in which local homeowners would be invited to participate in planting and laying drip irrigation. A preliminary conceptual plan was prepared (Figure 6), which included four alternative locations, labeled A1 through A4, for constructing infiltration

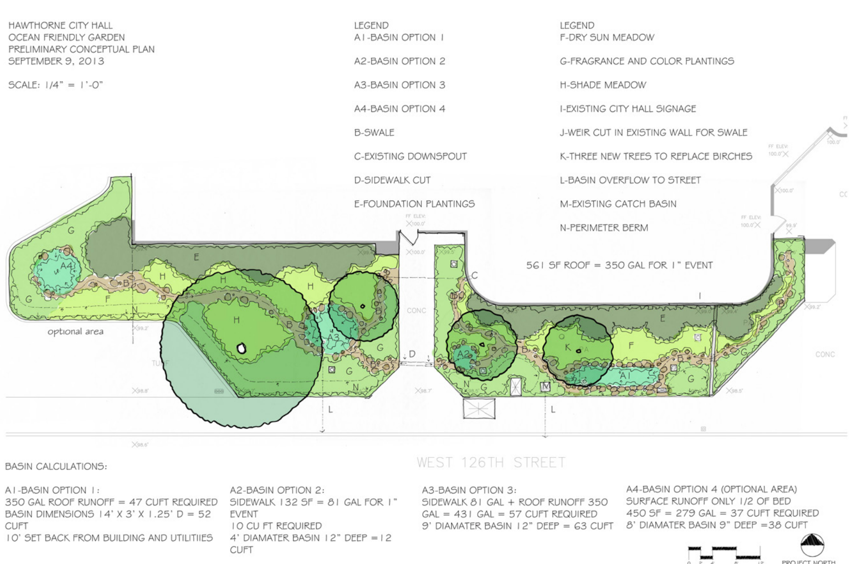


FIGURE 6. The preliminary conceptual plan included the locations and calculations used to design four potential in filtration basins.

basins to capture and retain rainwater from the roof, as well as surface runoff from the existing concrete pathway. To avoid causing soil settlement which could disturb foundations, infiltration basins had to be located a minimum of ten feet away from the building and utility vaults, and situated to avoid shallow underground utility lines running through the site. Storage capacity needed to accommodate the estimated 350 gallons of runoff from the roof, plus an additional estimated eighty-one gallons of surface runoff from the walkway to be captured by a new trench drain.

The four basin locations were evaluated and a final conceptual plan (Figure 7) developed as follows:

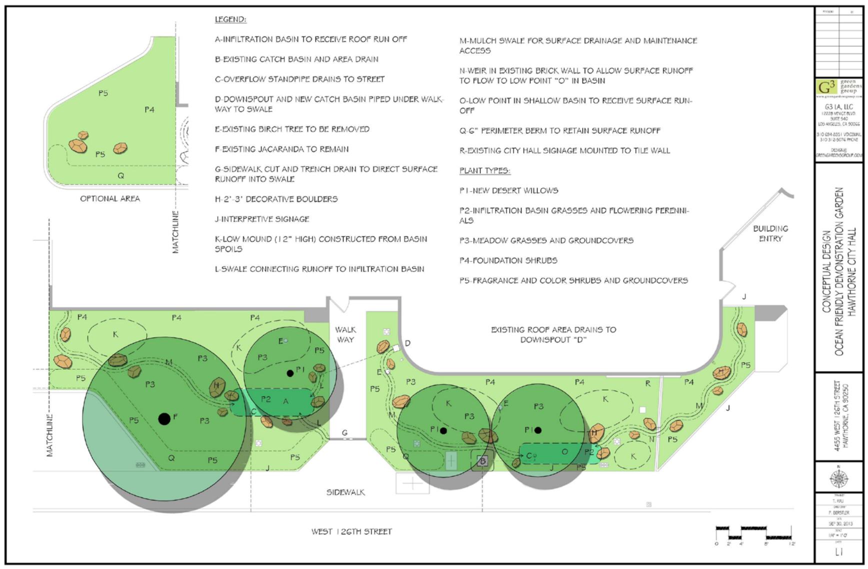


FIGURE 7. The final conceptual plan shows the three infiltration basins selected and the proposed swales, plant types, and hardscape elements.

Basin A1 was too constrained by the ten foot building setback and the sidewalk, as well as the presence of underground utility lines, to accommodate the fifty-seven cubic feet of volume required to retain the one inch "first flush" of rain, calculated as follows: (350 gallons from roof + 81 gallons from pathway) / 7.48 cubic feet per gallon. In the final design, Basin A1 was retained, but only as a shallow depression to collect surface runoff from within the planting areas. Also, Basin A1 serves as an example of rainwater capture grading, given that it is most visible from the entrance of City Hall.

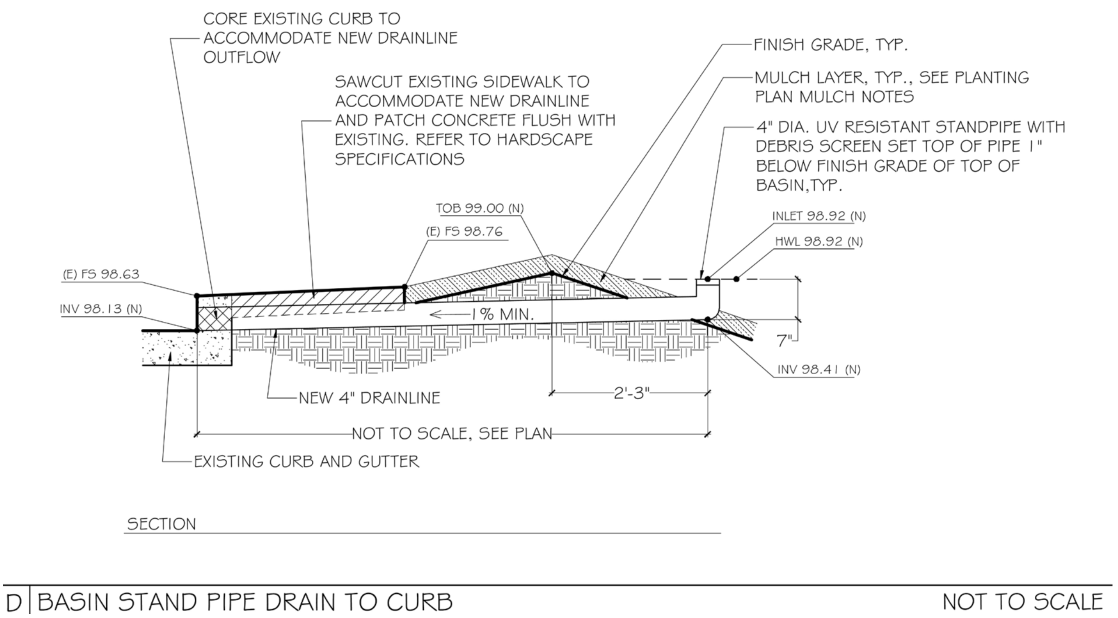
Basin A2 was eliminated and combined with Basin A1 to collect surface runoff.

Basin A3 was selected as the best option for capturing and retaining the roof and sidewalk runoff: it had ample clearance from the building and was not too close to underground utilities. For an average basin depth of twelve inches, the total area of Basin A3 would need to be at least fifty-seven square feet (Volume / Depth = Area); a nine foot diameter basin averaging twelve inches deep would provide sufficient storage and fit within the spatial limitations.

Basin A4, located in the hands-on workshop area, was included for purposes of collecting additional surface runoff.

Shallow swales, measuring eighteen inches wide by three inches deep, were incorporated into the planting areas to direct surface runoff to each of the basins. Both Basins A1 and A3 were designed to include a four inch diameter overflow outlet to the street in the event that capacity was exceeded during a heavy rain event (Figure 8).

FIGURE 8. An overflow pipe drains excess water in the event that rainfall exceeds the one inch "first flush" used to design the basins.



Soil removed from the basins and swales was used to create mounds and berms. The mounds, located in the planting areas for visual interest, are up to twelve inches in height, while the berms are up to six inches high and abut the sidewalk along the southern edge of the project area. The berm placement prevents runoff from spilling onto the sidewalk and finding its way into the storm drain. No excavated soils were removed from the site.

BIOLOGICAL SOIL TEST

A manual soil texture test, commonly known as the "ribbon method," revealed that the soil texture was sandy loam. The soil was, however, compacted and required amending, both in order to improve drainage and to resuscitate the soil biology. Resuscitation is essential for supporting California native plants which do not need, and will not tolerate, chemical fertilizers.

A biological soils test was performed by Earth Fortification Supplies Company (Earthfort), which provided the basis for an analysis and recommendations prepared by Compost Teana's Organic Landscapes (Appendix B). In healthy soil, the following organisms need to be present: bacteria, fungi, protozoa, and nematodes. Bacterially dominant soils can support only the lowest plants in the succession order such as grasses; woody plants, shrubs and trees require the presence of the higher orders of fungi, protozoa, and nematodes to thrive (Lowenfels & Lewis, 2010).

The test results of the soil indicated that the bacterial population was overrepresented, while fungi, protozoa and nematodes were significantly underrepresented. In addition, of the organisms present, few were awake and metabolizing. Such soil conditions are common in traditional landscapes that have been overwatered, have consisted mostly of turf, and have been maintained with applications of chemical fertilizers, herbicides and pesticides. These practices result in soil unable to support healthy growth of shrubs and perennials, and with below average water holding capacity.

The following recommendations, as prescribed by Compost Teana's Organic Landscapes, were incorporated into the plans and specifications:

> **Amend the Soil** with two inches of biologically active, fungal-dominant compost and two inches of fresh worm castings across the site, worked into the soil to a depth of eight to twelve inches.
>
> **Apply Biologically Active Aerated Compost Tea (ACT)**, containing fish hydrolysate and humic acids, on a quarterly basis for the year after planting to assist in developing the soil biota.
>
> **Inoculate Mycorrhizal Spores** when installing the plant material. Mycorrhizal fungi extend the reach of roots for most plants (except grasses). These beneficial and symbiotic fungi break down organic matter, unlock and absorb essential nutrients, and deliver them to the plant's roots. Mycorrhizal fungi are present in natural undisturbed soil. However, they are easily destroyed by tilling, chemical fungicides and compaction (Lowenfels & Lewis, 2010).
>
> **Mulch** with three to four inches of non-aromatic wood chips to protect the soil from erosion and encourage fungal growth and diversity. Aromatic woods such as pine, cedar, redwood, and eucalyptus contain oils that inhibit fungal growth.

PLANT SELECTION

Creating an inviting and enjoyable experience for visitors was a primary design objective for the demonstration garden. A variety of California native plants and cultivars was developed to showcase their unique appearance and to create a sense of place. The following characteristics were considered in developing the plant palette: evergreen, low-water use, long-lasting and colorful bloom period, fragrant, and attractive to pollinators.

In Southern California, many commonly used landscape plants provide little, if any, food or habitat for wildlife. The existing landscaping in the project area consisted primarily of non-native ivy that offered no food or habitat; such conditions are typical of the urban "food desert" in which local and migrating pollinators are forced to survive. Many species of native wildlife depend on native plants for their food sources; therefore, replacing exotic plants with native ones improves the health of urban ecosystems.

Until recent years, California's beautiful and diverse flora was seldom used in public and commercial projects due to a lack of familiarity by the landscape industry and limited plant offerings by wholesale nurseries. Major home improvement stores and garden centers have also been slow to offer California native plants; it is still a commonly-held belief by the public that natives are an either/or proposition: either composed mostly of cacti or tending toward a weedy and dead look for most of the year. This is not the case.

By investing in demonstration gardens, innovative agencies such as West Basin can shape public perception regarding the aesthetics and benefits of using California native plants and inspire homeowners to plant natives in their own gardens. Furthermore, expectations of prolonged drought conditions have boosted efforts by the native plant horticultural community to promote California natives as a viable and desirable alternative to the ubiquitous exotic plant species. Wholesale nurseries have responded to the demand by stocking greater quantities and a wider selection of native plants.

Criteria for developing the plant list for the garden (Figure 9) were as follows:

FIGURE 9. The plant list was developed to meet specific design criteria, such as water needs, size, appearance, and growth rate.

PLANT LEGEND

SYM.	QTY.	SIZE	BOTANICAL NAME / COMMON NAME	BLOOM	PLANT FACTOR	SIZE H X W	SHT & DET#
			Trees				
T1	3	15 gal.	Chilopsis linearis 'Lois Adams' / Lois Adams Desert Willow	P, Su	L	20' x 15'	L-9 -- 'R'
			Shrubs				
1	3	1 gal	Abutilon palmeri / Indian Mallow	Y, Wi-Fa	L	48" x 48"	L-9 -- 'S'
2	9	4"pot	Achillea millefolium `Paprika` / Red Yarrow	R, Sp-Su	L	36" x 24"	"
3	14	4"pot	Achillea x `Moonshine` / Moonshine Yarrow	Y, Sp-Su	L	36" x 24"	"
4	2	5 gal	Arctostaphylos edmundsii `Greensphere` / Greensphere Manzanita	W, Wi-Sp	L	48" x 48"	"
5	8	1 gal	Berberis aquifolium repens / Creeping Barberry	Y, Sp	L	30" x 48"	"
6	5	1 gal	Berberis aquifolium var aquifolium / Common Barberry	Y, Sp	L	72" x 72"	"
7	40	4"pot	Bouteloua gracilis `Blonde Ambition` / Blue Grama	V,Y, Su-Fa	L	24" x 24"	"
8	23	4"pot	Carex praegracilis / Slender Sedge	Su	M	12" x 24"	"
9	4	1 gal	Ceanothus maritimus / Maritime Ceanothus	B, Wi-Sp	L	12" x 48"	"
10	3	5 gal	Ceanothus thyrsiflorus `Skylark` / Skylark Ceanothus	B, Sp	L	48" x 60"	"
11	5	1 gal	Epilobium californicum "Everette's Choice" / California Fuschia	R, Su-Fa	VL	24" x 48"	"
12	12	1 gal	Eriogonum crocatum / Saffron Buckwheat	Y, Sp-Su	VL	12" x 36"	"
13	18	1 gal	Eriogonum parvifolium / Cliff Buckwheat	P, Su	VL	24" x 24"	"
14	18	4"pot	Eschscholzia califomia / California Poppy	O, Sp-Su	L	24" x 12"	"
15	11	4"pot	Festuca californica / California Fescue	Sp	M	24" x 24"	"
16	13	1 gal	Galvezia speciosa 'Firecracker' / Island Snap Dragon	R, Sp-Su	VL	30" x 36"	"
17	18	1 gal	Heuchera x `Wendy` / Coral Bells	Pi, Sp-Su	M	24" x 24"	"
18	10	1 gal	Iris douglasiana / Douglas Iris	Pu, Sp	M	24" x 24"	"
19	5	1 gal	Lessingia filaginifolia 'Silver Carpet' / Silver Carpet Aster	V/P, Su-Fa	L	6" x 36"	"
20	8	1 gal	Rhamnus californica 'Little Sur' / Little Sur Coffeeberry	W, Sp	VL	36" x 36"	"
21	3	5 gal	Ribes malvaceum 'Dancing Tassels' / Dancing Tassels Currant	P, Wi	VL	72" x 60"	"
22	4	1 gal	Ribes viburnifolium / Catalina Perfume	R, Sr	L	24" x 72"	"
23	2	1 gal	Salvia clevelandii `Allen Chickering` / Cleveland Sage	L, Sp-Su	L	48" x 48"	"
24	30	4"pot	Sisyrinchium bellum / Blue Eyed Grass	B, Sp-Su	L	12" x 12"	"
25	6	1 gal	Sphaeralcea ambigua 'Louis Hamilton'/ Apricot Mallow	Pi, Wi-Su	L	36" x 36"	"
26	19	1 gal	Verbena lilacina `De la Mina` / Lilac Verbena	Pu, Sp	L	36" x 36"	"

Limit the Height of shrubs and ground covers to four feet or less to maintain a clear line of sight throughout the garden. Excepted were the three trees, Chilopsis linearis (Desert Willow), which will reach fifteen feet high at maturity, because they have an open habit and are deciduous.

In the Basins, Use Plants Adapted to Temporary Submergence during rain events such as Carex Praegracilis (Field Sedge), Sisyrinchium bellum (Blue Eyed Grass), and Iris douglasiana (Douglas Iris).

Emphasize Fast-Growing and Long-Flowering Evergreens to grab the attention of passers-by and to present an attractive public image for the City of Hawthorne (Figure 10). Such plants included Salvia clevelandii 'Allen Chickering' (Cleveland Sage), Eschscholzia californica (California Poppy), Verbena lilacina 'De La Mina' (Lilac Verbena), Achillea 'Moonshine' (Golden Yarrow), Abutilon palmeri (Indian Mallow), Galvezia speciosa 'Firecracker' (Island Snap Dragon), and Sphaeralcea ambigua (Apricot

FIGURE 10. Colorful and long-lasting blooms of California native plants grab the attention of passers-by.

Mallow). Yellow blooming Abutilon and Achillea and orange blooming Sphaeralcea and Eschscholzia were selected to complement the blue tile walls of City Hall (Figure 11).

FIGURE 11. Yellow and orange flowers complement the blue tile wall of City Hall.

Provide Pollinator Food and Habitat for local wildlife such as birds, bees and butterflies. In addition to the showy and long-flowering shrubs above, nectar sources important to Southern California pollinators included Eriogonum crocatum (Saffron Buckwheat), Eriogonum parvifolium (Cliff Buckwheat), Epilobium californicum 'Everette's Choice' (California Fuschia), and Chilopsis linearis (Desert Willow).

Plant Grasses in the Swales to diminish the flow of surface runoff, thereby preventing erosion and promoting infiltration. Bouteloua gracilis 'Blonde Ambition' (Blonde Ambition Grama Grass) was used in the full sun areas, and Festuca idahoensis 'Siskiyou Blue' (Siskiyou Blue Fescue) in partial shade areas.

Minimize Care and Maintenance by selecting plants that would require only seasonal deadheading and an occasional light pruning to shape growth.

The window for planting California native plants is from late October to early May. Many species go dormant during the hot and dry summer months; during such time they require less (if any) supplemental water. If overwatered they become susceptible to root rot and may die. When scheduling construction of the demonstration garden, West Basin took this into consideration and so the garden was installed by March of 2014.

HARDSCAPE DESIGN

Boulders ranging from twelve to thirty-six inches in diameter were placed in and around both the infiltration basins and the swales to enhance their visibility and to dissuade people from walking through the garden. A six foot long trench drain was installed in the existing walkway to capture and direct surface runoff into the garden (Figure 12).

FIGURE 12. A trench drain was installed in the concrete walkway to direct surface runoff into the garden.

IRRIGATION DESIGN

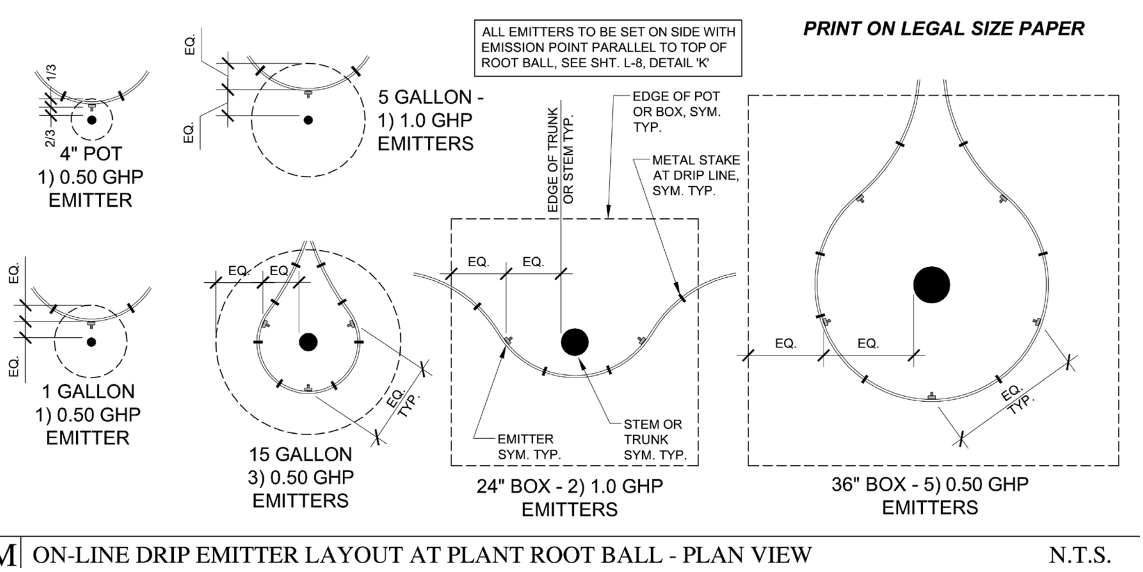
The existing irrigation was a conventional overhead spray system, in which typically half the water emitted by the spray heads is lost to evaporation and misting. Heads located adjacent to sidewalks spray water onto the paving, and broken or improperly adjusted heads send runoff into storm drains, carrying pollutants with it. This also occurs even when the equipment is functioning correctly – when it's windy during run cycles, for instance. A centralized irrigation controller operated all of the remote control valves on the City Hall landscaping.

Existing spray heads were removed and the laterals capped to accommodate the new more efficient drip irrigation system. Two new low-flow, remote control irrigation valve assemblies with pressure regulators and filters were tied into the irrigation main line for the two new hydrozones: one valve for the medium-water use basin plants, and one valve for the balance of low-water use trees and shrubs.

A water flow meter was installed at the point of connection to measure actual water use which, ten months after installation, totaled 30,000 gallons. On an annualized basis, actual water use in the first year would be about 36,000 gallons, exceeding the estimated total water use of 22,700 gallons. However, the difference can be attributed to more frequent watering during the first season for plant establishment, and rainfall of less than half of a normal season. Watering during the second season will be reduced as the plants become more established. California natives typically require three seasons to become fully established, at which time they will reach their full drought-tolerance potential.

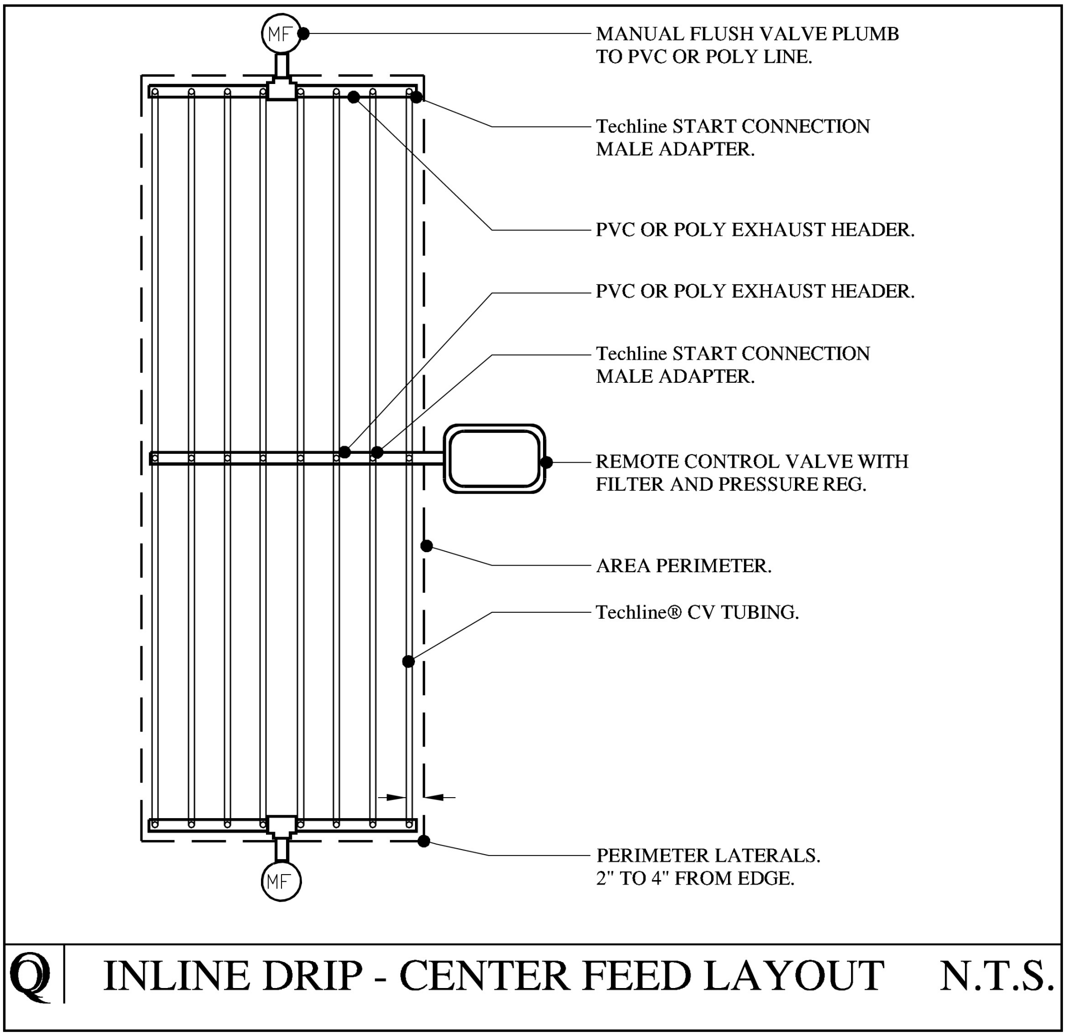
Two types of drip emitters were specified: on-line emitters, which can be manually inserted into blank ½" polyethylene tubing at any desired spacing, and in-line emitters, which are regularly spaced and built-in to the ½" tubing. In the low-water use shrub hydrozone, blank drip lines were laid on the surface of the soil and snaked around the plants. On-line drip emitters were inserted in quantities and locations at the plant root balls as shown in the emitter layout detail (Figure 13). Four inch and one gallon plants each received one ½-gallon per hour emitter placed halfway between the plant stem and the edge of the root ball; five

FIGURE 13. The locations, quantities and type of on-line drip emitters were detailed by size of plant.



gallon and larger shrubs received one or more one-gallon per hour emitters. In the medium-water-use basin hydrozone, plants were laid out on a twenty-four inch grid and in-line tubing used with 0.40 gallon per hour emitters spaced twelve inches apart (Figure 14).

FIGURE 14. In-line drip tubing was laid out in a grid for regularly spaced plants.



Each of the two irrigation systems had a "tattle tale." Because drip irrigation emitters are mostly hidden from view under the plants, it is not easy to tell when they are activated and watering. The tattle tale assembly consists of a twelve inch pop-up sprinkler with the nozzle replaced by a white cap; thus, no water is released, but the pop up provides a visual indication that the remote control valve is open and the tubing is under pressure. To allow periodic flushing of the drip tubing, manual flush valve assemblies were installed at the end of each run of tubing and placed in six inch round valve boxes for accessibility by maintenance workers.

After installation, the drip tubing was covered with three to four inches of mulch. An area of six inches around each plant crown was left clear to prevent crown rot, and to expose the drip emitters for periodic inspections to make sure they are not clogged and are functioning properly.

PROJECT BUDGET

Given that the project would be constructed from public funds, labor rates were budgeted using prevailing wages: $71.00 per hour for the owner/operator and journeyman, and $27.52 for laborers. Below is a summary of the construction budget:

Item	Budget	Square Foot Cost (1,912 sf)
Site Security	$594	$0.31
Soil Preparation and Amendment	520	0.27
Grading for Rainwater Capture	3,498	1.83
Hardscape Modifications and Repairs	1,931	1.01
Catch Basin, Trench Drain and Standpipes	4,219	2.20
Installing Boulders	2,277	1.19
Irrigation Installation and Flow Meter	6,220	3.25
Plants, Compost and Mulch Installation	8,348	4.37
Maintenance and Warranty Period	1,445	0.76
Total	$29,052	$15.19

Excluded were the costs to remove and dispose of the existing vegetation, the irrigation controller and the backflow preventer, all of which were provided by the City of Hawthorne.

CONSTRUCTION

Construction commenced in the beginning of February 2014 and was completed in approximately four weeks. Representatives from West Basin, the City of Hawthorne, G3, and the Surfrider Foundation conducted weekly job meetings with Stout Design Build, the landscape contractor. Due to the presence of shallow underground utility lines, grading for rainwater capture was done by hand. To prevent mishaps, Dig Alert, a free service that marks the location of underground utility lines, was contacted prior to construction. As each stage of construction was completed, the work was inspected and approved by members of the project team. The final walkthrough and punch list inspection was conducted in the first week of March 2014.

PUBLIC EDUCATION AND HANDS-ON WORKSHOP

As a part of its community education and outreach program, West Basin arranged two free classes for home and business owners in conjunction with the completion of the demonstration garden. First, a California Friendly Landscape Training (CFLT) class was held at the Hawthorne City Hall. Forty-four people attended the three hour CFLT class which was funded by The Metropolitan Water District (MWD) of Southern California and taught by G3. CFLT seminars are held in a classroom setting and introduce homeowners to the basic concepts of watershed-wise landscaping and the benefits of converting their turf-centric landscape to California Friendly Landscaping. California Friendly Landscaping principals are an adaptation of the Surfrider Foundation's OFG criteria tailored to factors specific to California, such as its weather patterns, reliance on imported water, and recurring drought conditions.

Second, a hands-on workshop (HOW) was conducted in the 370 square foot optional portion of the demonstration garden. Workshop participants included customers of West Basin, crew leaders and maintenance personnel from the City of Hawthorne Parks Maintenance Division, and a few dozen young men and women from the Los Angeles Conservation Corps (LACC). The LACC is a private non-profit youth development organization which provides job training, work experience and educational opportunities by performing community and environmental services such as planting trees, restoring watersheds, and constructing parks. The landscape contractor also attended and provided assistance with the installation.

Prior to the HOW, the City of Hawthorne Parks Maintenance Division had prepared the site for planting by removing the existing vegetation, grading, amending the soil, and capping off the existing spray irrigation heads. Additionally, the City of Hawthorne purchased the plants and the irrigation materials to be installed in the workshop. The three hour HOW focused on how to plant California natives and install drip irrigation. Before any plants were installed, the HOW participants were given the following instructions for successful planting:

Dig a Planting Hole twice the width of the container, but no deeper than the container. If the hole is too deep, replace some soil and tamp it down firmly to give the plant a solid base.

Fill the Hole Twice with Water, allowing it to drain completely each time. Since this will be time consuming unless the soil is sandy and not compacted, dig more holes and begin filling them with water while the first ones drain.

Submerge the Root ball in ACT while the plant is still in the container. Keep the plant submerged until the air bubbles stop. Soluble humate or fish hydrolysate may be substituted for ACT.

Dust the Root ball with Mycorrhizae Inoculant, using a shaker as per the manufacturer's directions. Note that inoculant should not be used on grasses, given their requirements for bacteria-dominant, versus fungal-dominant, soil.

Place the Plant in the Hole, making sure the crown of the plant is ½ to one inch above the surrounding soil. This allows the plant to settle without the crown becoming buried.

Fill the Hole with Water Again with the plant in place, allowing the water to drain completely.

Tamp the Soil Down gently with your feet.

Do Not Create a Bowl around the plant. Not only is this unnecessary, a bowl may create a moat that could drown the plant.

Water the Soil around the Plant deeply one more time.

Keep the Plants Hydrated for a few weeks while they establish, checking that the soil remains moist but not saturated by using a moisture meter or your finger.

After the plants were installed, the landscape contractor hooked up ½” drip tubing to the new drip irrigation hydrozones and demonstrated how to snake the line around the plants and install staples to hold the tubing in place. Next, HOW participants were shown how to punch the drip line and install drip emitters at the proper location at the root ball. Participants then were given the chance to perform the tasks themselves.

After the CFLT class and HOW were held, West Basin dedicated the garden and installed interpretative signage at the entrance to City Hall (Figure 15).

FIGURE 15. Interpretive signage at the entrance of Hawthorne City Hall informs visitors about Ocean Friendly Gardens.

MAINTENANCE WORKSHOP

A month after the garden was completed, a maintenance training workshop was held for crew leaders and maintenance personnel of the Parks Maintenance Division. Maintenance specifications (Appendix C) were prepared and distributed, along with a copy of the book *Care and Maintenance of Southern California Native Plant Gardens* (O’Brien, Landis & Mackey).

Procedures for maintaining an organic native plant garden differ from conventional landscape practices in several fundamental ways, as summarized below:

Allow Organic Matter to Accumulate and Decompose on the surface of the soil. Leaf litter should not be raked up or blown away, as it contributes organic matter to the mulch layer that is feeding the soil biology.

No Weekly Pruning is necessary and can harm native plants, many of which require little or no pruning. Any selective pruning should only be done to the extent and at the times indicated in the *Care and Maintenance of Southern California Native Plant Gardens*. Plants should never be clipped into balls or boxes, or trimmed into hedges. Cuttings from any pruning should be cut into small pieces and added to the mulch layer to decompose, a method known as “chop and drop,” which minimizes green waste and replenishes mulch.

Monitor the Appearance of Weeds and remove them before they seed or colonize. Broad-leaved weeds are pulled by hand and then "chopped and dropped" as described above to allow the minerals in the weeds to feed the soil. Grassy weeds, on the other hand, are hand-pulled and removed to avoid spreading seeds or stolons. Herbicides, toxic to soil biology, are prohibited, as is the use of mechanical equipment such as "weed whackers."

Quarterly Applications of ACT are applied to replenish and build up the living soil biology necessary to promote healthy plants. California native plants do not tolerate concentrated applications of the nitrogen, phosphorus and potassium found in chemical fertilizers. In addition, fertilizers, fungicides and herbicides are toxic to soil biology.

Monitor and Adjust Irrigation Run Times based upon soil moisture and weather patterns. During the normally rainy season of November through April, some additional irrigation may be needed if it is unusually dry and/or unseasonably warm, as has been the case during recent years. Although it may sound counterintuitive to supplement during this period, keep in mind that many California native plants are deep-rooted and adapted to dry summer conditions. If they receive sufficient moisture during the rainy season, they will require little water during the summer months.

Maintain the Drip Irrigation System in good condition. This includes making sure there are no clogged or damaged emitters, opening the manual flush valves to flush the drip tubing, and cleaning the remote control valve filter assembly and y-strainer on a regular basis.

CONCLUSION

As the garden enters its second growing season, the months of November and December 2014 brought 4.72 inches of much needed rain, replenishing soil moisture and promoting plant growth. Rainfall predictions are uncertain, but if the high pressure weather pattern that has persisted over the region returns, higher temperatures and drier conditions will likely prevail. After reaching their maximum drought-tolerance potential in three seasons, many California native plants will be able to survive without supplemental irrigation provided they receive winter rains. Therefore, supplemental irrigation will be necessary during the garden's second season in 2015. In the meantime, the demonstration garden will attract visitors and – hopefully – inspire them to replace their turf-centric and high-water use landscapes with Ocean – and California – Friendly Gardens.

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Ocean Friendly Gardens™ Yard Sign Criteria

An Ocean Friendly Garden (OFG) is a garden that applies CPR - Conservation, Permeability, and Retention© - to revive the health of our watersheds and oceans

An OFG Sign will be awarded to any garden that achieves the following criteria:

CONSERVATION

Turf Areas

☐ Climate-appropriate turf grass is limited to 20% of total square footage of the landscaped area.

- ☐ Turf grass is limited to only those areas where it serves a specific purpose (documented play area).
- ☐ Turf grass is maintained organically without synthetic fertilizers and never over-watered.
- ☐ Turf grass is kept away from the perimeter of the garden, where irrigation overspray is hard to control.

☐ Cool season turf grass is not in front yard gardens in areas receiving less than an average 44 inches of annual rainfall.

☐ Warm season turf grass, if present, is not over-seeded with cool season grass during winter months.

Irrigation

☐ No automatic irrigation is utilized OR:

☐ Irrigation system is in good repair (no breaks or leaks) with no visible signs from stains on nearby hard surfaces or erosion on vegetated surfaces from repeated overspray or runoff. (See maintenance details below)

☐ No spray irrigation of any kind is installed in areas less than 10 feet wide OR a total surface area of less than 100 square feet.

☐ Drip irrigation is ½ inch diameter tubing or larger -- utilizing either line source ("in-line") OR point source emitters ("on line").

- ☐ No 1/4" diameter irrigation tubing is present, except where needed for irrigating containers and raised beds. (See maintenance details below)

☐ Hoses have shut-off attachments.

☐ A weather-based irrigation controller (WBIC) or "smart" irrigation controller is installed OR

☐ Absent a WBIC, the irrigation controller has a rain shut-off installed.

Mulch

☐ A minimum of 2 inches to 4 inches of natural woodchip mulch is present in all planted and open areas.

☐ 50% or more of the woodchip mulch must be smaller than 1 inch in length or diameter.

☐ Small open mulch-free areas are permitted if they are designated for native bee or insect habitat.

Plants

☐ Plants are grouped according to plant community or hydrozones including:

- ☐ Similar sunlight exposure, water requirements, root depth, soil type, hardiness and temperature adaptation, and/or size at maturity.

☐ New gardens are planted with sufficient space between plants to accommodate mature growth without over-crowding, and to minimize pruning at maturity.

☐ Plants requiring regular shearing are not permitted, unless they are edible or produce edible fruit.

☐ Plant material is 80% climate-appropriate unless it is edible or produces edible fruit. (Climate-appropriate plant material is defined as plant material with a Species Factor or Crop Co-efficient of 50% or less or is described by reliable local references as a "medium" water-using plant in the particular climate. In California, use www.water.ca.gov/wateruseefficiency/docs/ for Species Factors.)

☐ Local native plant material is utilized for at least 10% of the visible garden area, whether or not the other plant material is edible or produces edible fruit.

☐ No invasive species are present. Invasive species are defined as those listed on the local Invasive Plant Council website as invasive or on the "watch list". (General information at: http://plants.usda.gov/java/noxiousDriver, and in California http://www.cal-ipc.org.)

Water Features

☐ Water features may improve the habitat of the garden and are allowed within these guidelines:

- ☐ Water is recycled by the water feature.
- ☐ Open water features are covered at least 50% by vegetation,
- ☐ All water features are maintained without chemicals or additives that are toxic to fish.
- ☐ Overflow from the water feature drains into a vegetated area.

☐ Swimming pools and chemically treated water bodies are drained to sewer systems.

☐ Swimming pools must be covered to minimize evaporation when not in use.

PERMEABILITY

Healthy Living Soil

☐ Soil health is maintained organically without chemical additives.

☐ Soil health is maintained by the addition of compost, compost tea, and worm castings.

☐ Soil is not visible beneath a mulch layer, EXCEPT

- ☐ Areas 4 inches-12 inches around the crown of woody plants should remain un-mulched, and
- ☐ Areas 12 inches to 60 inches around the trunks of trees should remain un-mulched.
- ☐ These un-mulched areas should be minimized, but depends on the size of tree/plant crown.

Permeable Hardscape

☐ Walkways and patios are made permeable with

- ☐ Plants, mulch or decomposed granite in gaps between pavers or other hard surfaces; OR
- ☐ Materials that permit water to "flow-through," e.g., permeable concrete or asphalt.

☐ Impermeable surfaces or minimally permeable surfaces, such as permeable pavers or decomposed granite, are graded to direct excess surface flow of water into adjacent vegetated areas.

☐ Existing impermeable surfaces such as driveways or large patio areas have been altered to direct surface flow of water into adjacent vegetated areas or retention/detention devices.

RETENTION

Downspout Re-direct

☐ If gutters are installed, all visible downspouts are directed away from impermeable surfaces into vegetated areas, mulched areas or retention/detention devices.

- ☐ Rain chains and other devices to slow the fall of water are recommended as a replacement for downspouts.

☐ If gutters are not installed, surfaces beneath the roof eaves are EITHER

☐ Vegetated with hearty plants that can withstand the beating; OR

☐ Covered with mulch, gravel or other sturdy and permeable materials, AND

☐ Hardscape surfaces beneath roof eaves are altered to create areas of permeability and direct surface flow of rainwater into vegetated or mulched areas or retention/detention devices.

☐ Drains carrying roof runoff or surface drain runoff from back yards or areas not visible to the street are EITHER:

☐ Directed into rainbarrels or cisterns at the downspouts to slow and reduce the flow of water into the drainage system, OR

☐ Disconnected from their overflow to street and re-directed into a vegetated or mulched area.

Sponge Gardens

☐ The visible garden area has been designed to capture as much of the rainfall from rooftops and other impermeable surfaces as possible.

☐ The flat areas on the property have been replaced with high and low contoured areas ("graded retention areas") to prevent rainfall from "sheeting" across the garden and off the property - helping to retain the first 1" of rainwater after a dry spell: AND/OR

☐ A dry creek bed or vegetated swale ("bioswale") captures the majority of the surface flow of downspout water and water from adjacent hard surfaces, creating sufficient area to slow, spread and sink it.

☐ Dry creek beds or vegetated swales are designed to hold at least 1" of rain from roof and adjacent hard surfaces, AND

☐ Rainfall in excess of 1" or the water-holding capacity of the garden, whichever is greater, is safely directed off-site after having been run through vegetated areas, including bioswales and creek beds, to remove pollutants and retain sediment.

☐ At least one tree or very large shrub has been planted at its proper distance from hard surfaces and buildings to help naturally store water for the entire garden.

Retention Devices

☐ Rainbarrels or above-ground cisterns are visible and are

☐ Installed properly in accordance with any prevailing local building standards or codes,

☐ Secured for safety purposes, and

☐ Overflow into vegetated or mulched areas, AND/OR

☐ Below surface retention areas and devices such as dry wells or cisterns are utilized to do the same.

Maintenance Details

1. Valve assemblies installed properly & in permeable areas (preferably surrounded by mulch or gravel).
2. Irrigation shut-off valves are easily identified.
3. Separate irrigation valves are utilized for each hydrozone (see "hydrozone" description in 4a below).
4. Back-flow prevention and pressure regulation is visible in or at the valve assembly.

Irrigation Details

1. Spray irrigation is matched precipitation, "multi-stream, multi-trajectory."
2. Spray irrigation requires anti-drain check valves to prevent low head drainage.
3. Spray irrigation heads of any kind are installed at least 24 inches from hard surfaces and buildings.

earthfort

Biological Analysis
Soil

Report prepared for:

Compost Teana`s Organic Lan
Sherilyn Powell-Wolff - SFA 20
3784 Redwood Ave
Los Angeles, CA 90066 USA
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sheri@compostteana.com

Report Sent: 7/12/2013
Sample#: 01-116746 | Submission:01-023184
Unique ID: Hawthorne CH
Plant: shrubs
Invoice Number: 0
Sample Received: 6/28/2013

For interpretation of this report please contact:
Earthfort Labs
info@earthfort.com
(541) 257-2612

Consulting fees may apply

Organism Biomass Data		Dry Weight	Active Bacteria (µg/g)	Total Bacteria (µg/g)	Active Fungi (µg/g)	Total Fungi (µg/g)	Hyphal Diameter (µm)
Results		**0.910**	39.0	475	28.7	463	2.9
Comments		Above Range	In range	In range	Below range	Below range	
Expected Range	Low	0.45	30	300	90	900	
	High	0.85	60	600	180	1800	

		Protozoa (Numbers/g)			Total	Mycorrhizal Colonization (%)	
		Flagellates	Amoebae	Ciliates	Nematodes #/g	ENDO	ECTO
Results		**3048**	30479	468	**1.54**	Not Ordered	Not Ordered
Comments		Low	Good	High	Low		
Expected Range	Low	10000	10000	0	10	40%	40%
	High	100000	100000	200	20	80%	80%

Organism Biomass Ratios		Total Fungi to Tot.Bacteria	Active to Total Fungi	Active to Total Bacteria	Active Fungi to Act.Bacteria	Nitrogen Cycling Potential (lbs/ac)
Results		**0.98**	**0.06**	**0.08**	**0.73**	100-150
Comments		Low	Low	Low	Low	
Expected Range	Low	3	0.1	0.1	3	
	High	5	0.2	0.2	5	

Nematode detail (# per gram or # per mL)
Classified by type and identified to genus.
(If section is blank, no nematodes identified.)

Bacterial Feeders	0.64		
Achromadora			0.04
Diploscapter			0.13
Eucephalobus			0.04
Geomonhystera			0.04
Plectus			0.13
Prodesmodora			0.04
Rhabditidae			0.21
Fungal Feeders	0.04		
Tylencholaimus			0.04
Fungal/Root Feeders	0.26		
Aphelenchus			0.04
Ditylenchus		Stem & Bulb nematode	0.17
Filenchus			0.04
Predatory	0.04		
Mylonchulus			0.04
Root Feeders	0.56		
Diphtherophora			0.13
Hoplolaimus		Lance nematode	0.04
Paratylenchus		Pin nematode	0.34
Pratylenchus		Lesion nematode	0.04

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Dry Weight:	Add organic matter to build soil structure, increase water holding capacity.
Active Bacteria:	Bacterial activity within normal levels.
Total Bacteria:	Good bacterial biomass.
Active Fungi:	Fungal activity low, foods may be required.
Total Fungi:	Low fungal biomass, foods and biology may be required.
Hyphal Diameter:	Good balance of fungi.
Protozoa:	Lacking species diversity.
Total Nematodes:	Low numbers, good diversity, but root feeders present.
Mycorrhizal Col.:	
TF/TB:	Lacking adequate fungi for best growth and health of shrubs
AF/TF:	Low fungal activity, foods may be required.
AB/TB:	Low bacterial activity relative to total biomass
AF/AB:	Balanced fungal and bacterial biomass, but becoming more bacterial.

Interpretation Comments:

Fairly good fungal diversity, hyphal diameter: 1.5 to 5.0 um. Actinobacteria Biomass = 6.30 ug/g

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01-116746: Page 2 of 2

7/16/12 2:00 PM

Analysis by Sheri Powell-Wolff/Compost Teana's Organic Landscapes

Hawthorne City Hall - Biology Test Explanation

General: This is a bacterial dominant soil which shows indications of compaction. There's plenty of bacteria present, but a relatively small population is awake and metabolizing. There is not enough fungi present to support healthy growth of shrubs and perennials. Of the fungi present, there is a good balance of beneficial species present. The protozoa are balanced and nutrient cycling is excellent. However, there are indications of anaerobic conditions in the sample, which may indicate compaction or overwatering. The nematode population and diversity are extremely low. There are several root-feeders and "switchers" present in this sample.

Dry Weight: This test result is high. This indicates that there is not enough organic matter present and that the water holding capacity of the soil is below average. An inoculation of organic matter in the form of biologically active compost can help to reverse this. This will aid in drought tolerance and will create a habitat in which the beneficial microorganisms can thrive.

Bacteria: This soil has a good number of bacteria present (total) but a relatively small amount of it is awake and metabolizing (active). As the very bottom of the food web, there is a crucial need to maintain the bacterial numbers, which serve as a food source for the higher order biota. Bacteria also sequester heavy metals and help to lessen their impact on plant growth. In addition, bacteria secrete a slime material, which gives structure to soil.

Fungi: There is not enough fungal biomass present (total) in this soil, and of that which is there, almost none of it is awake & metabolizing (active). Fungal foods should be added to stimulate the fungi present and an inoculation of high-fungal compost added to increase the biomass and diversity. The fungal diversity is good, with hyphal diameters as large as 5um. This indicates that a fair number of the fungal species present are of the beneficial varieties. The increased active fungal population is crucial for disease suppression and general hardiness for most types of plants.

Protozoa: The flagellate and amoebae populations are critically out of balance. In a healthy soil, the populations of these 2 protozoa should be roughly equal. This imbalance is often a symptom of a systemic imbalance in the foodweb allowing one species to out compete the others. Protozoa exist where there is food, so this condition may self-

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correct as their food source, the active bacteria population, is increased and the diversity of species present is bolstered. These organisms are the main nitrogen cyclers in the soil. The protozoa produce the nutrients and micro-nutrients which plants need and they secrete them in a form the plant can use. In this sample, nitrogen cycling is too low to support healthy growth of shrubs and perennials. In addition, there is a high ciliate count, which can indicate anaerobic conditions, such as compaction or over-watering.

Nematodes: Nematode population, and diversity, is quite low. In a healthy food web, there should be a minimum of 10 nematodes in a gram of soil. In this sample there were fewer than 2 individuals per gram. Ideally, at least 7 of each of the beneficial types (fungal-feeders, bacterial-feeders, predatory) should be present. In this sample, there are 7 bacterial-feeders, 1 fungal feeders and 1 predatory species present. Also, there are 4 root feeding species present and 3 fungal/root feeders ("switchers"). The switchers will feed on fungus, but when there isn't enough present to sustain them, they will turn to root feeding. This is another good reason to maintain the fungal content of the soil. Predatory nematodes prey upon other species of nematodes are needed to keep the root-feeding population in check. An inoculation of predatory nematodes should be considered.

ActinoBacteria: This number is fine. High numbers (>10 um/g) can retard fungal growth and can be an indicator of anaerobic conditions.

Mycorrhizal Colonization: This test was not ordered

Recommendations:

1. Amend soil with 2″ of biologically-active, fungal-dominant compost, and 2″ of fresh worm castings, site-wide to a depth of 8-12″
2. Apply biologically active compost tea, containing fish hydrolysate and humic acids, quarterly for the first year after planting to assist in biota growth and diversity
3. Inoculate with mycorrhizal spores when installing plant material
4. Mulch with 3-4″ of non-aromatic wood chips to protect the soil and encourage fungal growth & diversity
5. Consider inoculation of beneficial nematodes prior to installation

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Hawthorne City Hall OFG Maintenance Memo 4/14/14

Prune only in keeping with the following guide: ***Care and Maintenance of Southern California Native Plant Gardens by Rancho Santa Ana Botanic Garden***, June 2006.

Review :

Location of water flow meter
Location of valves
Location of cleanouts on each irrigation line
Location of tattle-tale assemblies on each irrigation line
Location and running of the timer
Location of the downspout catch basin
Locations of the basin overflow drains
Location of the trench drain

3 Month Establishment Period Tasks (Additional to Weekly Tasks):

1) Run through the irrigation system weekly and observe each plant. Make sure that each valve is operational and that there are no clogged or damaged emitters. Open cleanouts on each irrigation line and flush the system.
2) Remove suckers from the base of tree trunks.

Weekly Tasks:

1) Trash removal.
2) Graffiti removal.
3) Maintain mulch over all irrigation tubing so no tubing is visible to public. This is critical! Mulch must be maintained CONSTANTLY. Bring a container of mulch each week if necessary.
4) During rainy season November – April make sure that there is no standing water in the basins (greater than 72 hours.) If there is standing water, use a soil probe or small auger to make holes in the bottom of the basin. If problem persists, auger 2" – 3" holes in bottom of basins, fill with worm castings and replenish mulch. The drainage problem should be solved by the improved soil profile from adding the worm castings. If the problem is still unresolved, apply

compost tea on a monthly basis until a soil probe is easily inserted into the soil to the depth of the original compaction.

5) Note any plant material that is not appearing healthy and use soil moisture probe (or even finger) to determine if the rootball is wet or dry. Check the emitter closest to the rootball and adjust or clean it accordingly.
6) Assess plant health by looking for: yellowed or wilting leaves, dried or dead foliage, burned leaves, pests, or fungus. Remove diseased leaves and dispose of in trashcan, not green waste container. For white fly or aphids, spray leaves off with hose to remove bugs and place 1″ – 2″ of worm castings around base of plant, leaving 1″ – 2″ free around the stem of the plant. In general, always determine if a beneficial insect or worm castings can be introduced to control outbreaks (i.e. leaf miners, white fly).
7) Check that timer is running and the date/time is correct. If it is not, adjust accordingly.
8) DO NOT BLOW! Sweep any mulch that has been swept out of the planter areas. This is likely to be a difficult task to keep on top of, but approximate replacement to the beds is all that is required.
9) Note appearance of weeds. If weeds are broad-leaf, then remove immediately by cutting at the base and/or pulling (if small enough). Broadleaf weeds, once cut/removed, may be cut up into small pieces, dropped on the garden, and covered with mulch. This is called "chop and drop," and allows the minerals from the weeds to feed the soil.
    a. If weeds are grassy-looking, approx. 2″+ high, bright or deep green, then carefully pull by removing mulch from around the base of the plant and gently removing it from the soil and the site. Be careful to remove the small "nut" at the roots as well as the grassy top part. The grassy weeds are not to be dropped in the garden! Note that this grassy-looking weed is prevalent throughout the garden, and in some places the emphasis may not be on removing it, but on keeping it sheared so it does not go to seed. During winter months, it is critical to continue removing it as much as possible, and as quickly as possible after it becomes 2″ high.
10) No weekly pruning.

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Monthly Tasks:

1) During rainy season: November – April, be sure to adjust irrigation system to provide **additional winter irrigation if it is an unusually dry year.** This additional irrigation is a proxy for the rainfall the garden would be receiving during a normal rainy season. Sufficient water (even from irrigation) during the winter months will reduce the plant's need for water during the summer, typically dry months.
2) Remove suckers from the base of tree trunks.

Quarterly Tasks:

1) Run through the irrigation system to make sure that each valve is operational and that there are no clogged or damaged emitters.
2) Open manual flush valves in boxes for each irrigation line and flush the system.
3) Apply compost tea/worm castings at the base of plants that appear weak or struggling. Water into the soil completely before covering with 2″ – 4″ of mulch, kept 3″ – 4″ away from the stems of woody plants.

Semi-annual Tasks:

1) Maintain 2″ – 4″ of fresh tree trimming mulch on the garden at all times. After the first six months, during which weekly application of mulch may be needed, Semi-annual refreshment should be sufficient.
2) Check filters at irrigation valves, clean or replace as needed.
3) Lightly prune for aesthetics and form. Consider Habitat Impact – will food or shelter for habitat be impacted? If so make adjustments to the garden when the plant is pruned. The Handbook provides pruning information for the various plants. DO NOT "BOX" OR "BALL" the plants. Many of the plants require little or any pruning.
4) Keep training shrubs/groundcover from growing into the walkways and paths, but do not become aggressive in keeping a clear pathway edge.

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Annual Tasks:

1) Note groundcover growing through larger shrubs and remove as needed.
2) Plants may grow down and cover the edges of the pathway up to 4" on either side. Do not hedge groundcovers!
3) Pruning should be selective and done only in accordance with the reference book indicated at the top of the memo. DO NOT "BOX" OR "BALL" any of the plants. Many of the plants require little if any pruning.
    a. After the Chilopsis linearis are done flowering the seed heads can be removed to prevent reseeding and for a neater appearance.
    b. Cut back ornamental grasses to 12-18 inches when new spring growth appears.
    c. Cut Salvias back 2/3 after flowering.
    d. Deadhead Achillea and Verbena.
    e. Keep spent Eriogonum blooms on plants as long as possible for food and teaching opportunity.
    f. When pruning groundcover and plants at base of raised area, feather edges for a natural appearance, not a straight, hedged appearance.
4) Make sure tree stakes and rubber ties are in working order and are still required by the tree. If the stakes are rotting, or tree is wind bent, replace, repair, or tighten the stakes and ties as required to keep the tree trunks straight, but flexible.
5) Make note of amount of water used by the garden (read the meter).
6) Clean out any accumulated debris in the downspout catch basin and trench drain. Inspect intakes at overflow standpipes for blockage.

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