Ground Water Augmentation Model Demonstration Report

A component of the Water Augmentation Study

Los Angeles & San Gabriel Rivers Watershed Council

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Executive Summary

As Southern California faces a future of critically reduced water imports, methods to utilize local supplies are increasingly important. Nearly 60% of the water supply to the Los Angeles region is imported from distant watersheds yet a large percentage of the local precipitation is underutilized. Much of our local rainfall is routed across impermeable urban surfaces, where it picks up pollution before being discharged into the ocean. The Watershed Council and its partners began the Water Augmentation Study in 2000 to find answers to many questions regarding the use of storm water to recharge groundwater including "is supplementing local groundwater supplies with local-scale storm water recharge activities feasible" and also "how much and where can storm water provide additional groundwater recharge?" The Ground Water Augmentation Model seeks to answer the latter.

The Ground Water Augmentation Model (GWAM) estimates the amount of deep percolation (groundwater recharge) and storm water runoff generated within the urbanized portion of the Greater Los Angeles Region and within the Los Angeles and San Gabriel Rivers watershed (Figure 1). GWAM does not make predictions of how much water eventually contributes to recharge. However, the model's deep percolation estimates give an estimate of the maximum amount of recharge that might occur in areas where confining layers in the aquifer do not prevent the downward migration of water and where migrating water is not lost to intersecting streams. Using runoff-diversion-to-infiltration scenarios, the model shows the potential increase in groundwater recharge given changes to the urban landscape. The model can be used to evaluate multi-benefit approaches to solving the supply and runoff problem by predicting the results of methods to capture storm water via low impact design or other best management practices (BMPs).

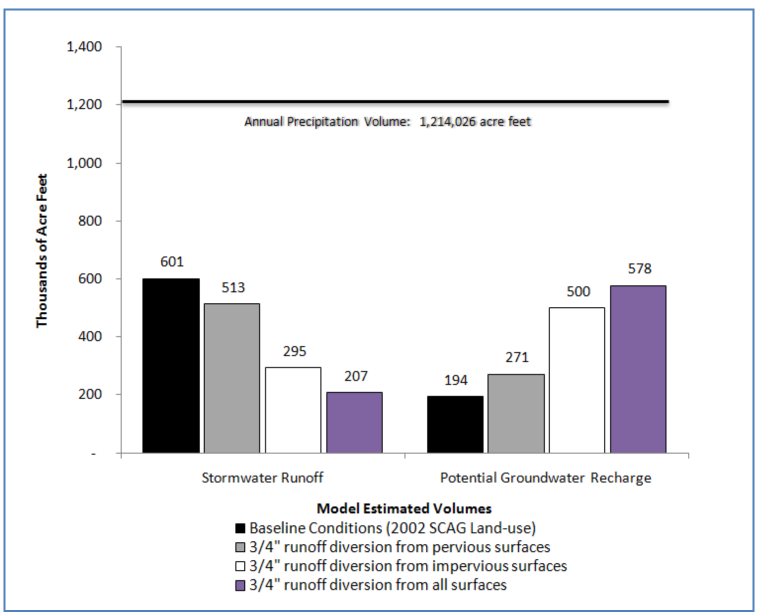

Figure 1 - GWAM Estimated Water Potentially Available for Recharge

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Within an average year under baseline conditions, GWAM estimates that 16% of precipitation percolates past the root zone as deep percolation (~194,000 acre/feet) in the modeled area of Greater Los Angeles, while 48% of precipitation becomes runoff which flows into our existing storm systems, rivers, and ocean (~600,000 acre/feet). The region's existing Standard Urban Stormwater Management Plan (SUSMP) policy (LA County DPW, 2002) requires capturing and infiltrating or treating and releasing the first 3/4" of rainfall in every storm event. This policy is currently only applied to specific new developments. GWAM calculations indicate that if the policy required infiltration of the first ¾" of storms on every parcel within the modeled area, regardless of its land-use/land-cover status (all land-use types), there would be a potential increase of groundwater recharge representing 47% of precipitation (~578,000 acre/feet/year), and stormwater runoff volume would potentially decrease to only 17% of precipitation (~206,000 acre/feet/year). This represents 384,000 acre/feet/year of additional groundwater recharge, a volume sufficient for the annual needs of three-quarters of a million (768,000) typical Southern California families (MWD, 2010).

As a planning tool GWAM provides an understanding of baseline conditions for the fate of precipitation within a study area, and the potential gains from changing runoff to deep percolation through stormwater diversion techniques. The model is able to apply various BMP implementation scenarios to land-use types, watersheds, or groundwater basins. This allows evaluations to determine which areas or land-uses have better potential for recharge efforts and where the best locations are for particular storm water BMPs. The deep percolation estimates predicted by GWAM could then be applied within existing detailed groundwater models to predict how much water would eventually contribute to recharge.

Model Overview

GWAM was developed by the U.S. Department of Interior, Bureau of Reclamation and the Los Angeles & San Gabriel Rivers Watershed Council for use in the Los Angeles Basin Water Augmentation Study. The model provides an estimate of the amount of infiltration, runoff and deep percolation (groundwater recharge) under current conditions and the potential for greater groundwater recharge if various capture strategies are implemented (Bureau of Reclamation, 2007).

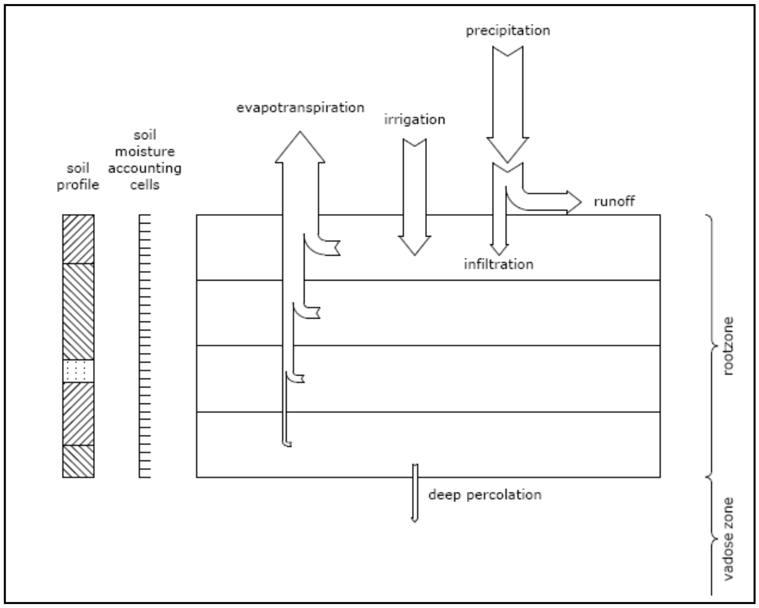

Figure 2 - GWAM process

The model is GIS-based and works in concert with Microsoft Access. The GWAM performs a daily accounting of soil moisture using soil properties, land cover, slope, and daily precipitation as inputs to predict the fate of precipitation: conversion to runoff, evapotranspiration, or infiltration through the root zone as deep percolation to groundwater (Figure 2, Soil Moisture Accounting in GWAM) (Bureau of Reclamation, 2007).

Purpose of the Model

As Southern California faces critically reduced water supplies, methods to increase local supplies are increasingly important. Nearly 60% of the water supply to the Los Angeles region is imported from distant watersheds yet a large percentage of the local precipitation is underutilized. Much of the local rainfall is routed across impermeable urban surfaces, where it picks up pollution, into a robust storm drain system before being discharged into the ocean. A multi-benefit approach to solving these two problems involves a change in practice and infrastructure design.

To provide a scientific analysis to justify these changes, the Watershed Council and its partners began the Water Augmentation Study in 2000. The GWAM is a component of that study. It estimates baseline runoff-recharge conditions for the region, as well as showing the potential benefit of making changes to how urban runoff is handled by the infrastructure.

Areal Extent of the Model

The GWAM is programmed with coverage of the urbanized area of the Los Angeles Basin, the San Fernando Valley, and the San Gabriel Valley. The model has been programmed with certain study areas, including watersheds (Table 1 & Figure 3), subwatersheds (Table 1 & Figure 4), and groundwater basins (Table 2 and Figure 5).

Watershed	Subwatershed	Area (acres)
Los Angeles River		410,286
	Rio Hondo	75,279
	Arroyo Seco	17,469
	Compton Creek	26,911
	Tunjunga Wash	58,249
	Sun Valley	3,057
San Gabriel River		264,462
	Upper San Gabriel River	8,554
	Walnut Creek	50,906
	San Jose Creek	54,493
	Coyote Creek	89.765
Ballona Creek		70,122
Dominguez Channel		74,157

Table 1 - Watersheds & Subwatersheds in GWAM

Portions of the Los Angeles River Watershed and San Gabriel River Watershed are not included in the modeled area because they are outside the urbanized extent. Multiple factors led to the decision to omit some of the upper watershed, primary among them is the fact that most runoff from these areas is actively managed as an infiltration resource. Additionally, the amount of infiltration capacity is limited by the geologic structure of these upper watershed areas.

Additionally, portions of the modeled area are not included within the designated groundwater basins. These areas are considered non-water-bearing. However, when the entire model area is processed, the soil moisture of these areas is calculated.

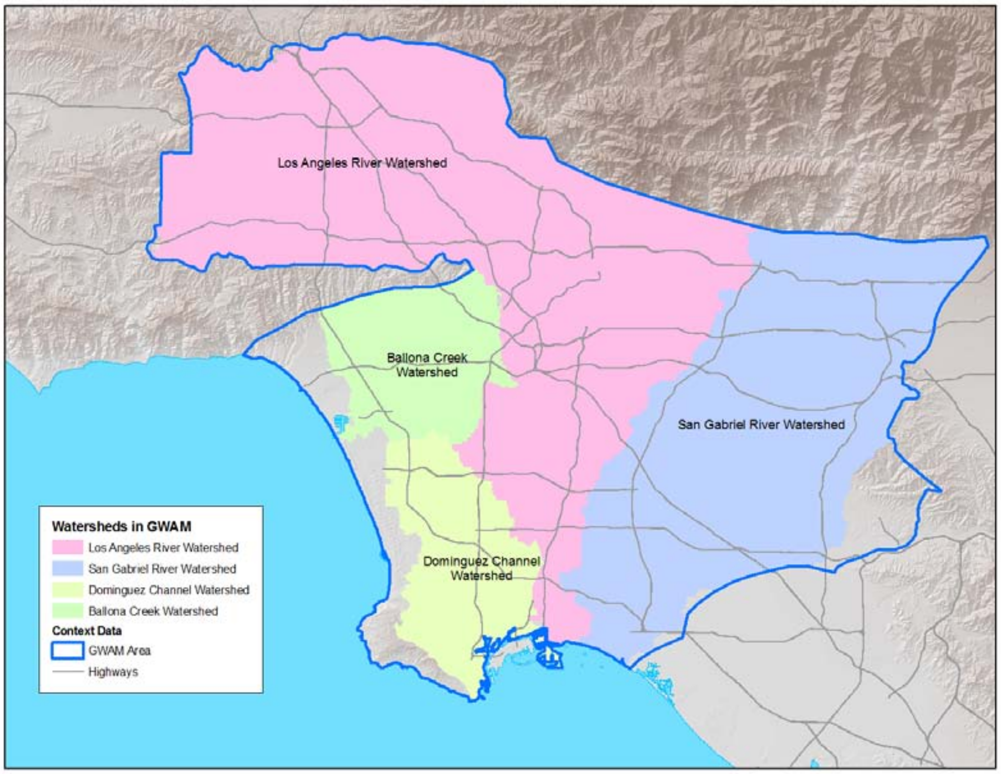

Figure 3 - Watersheds in GWAM

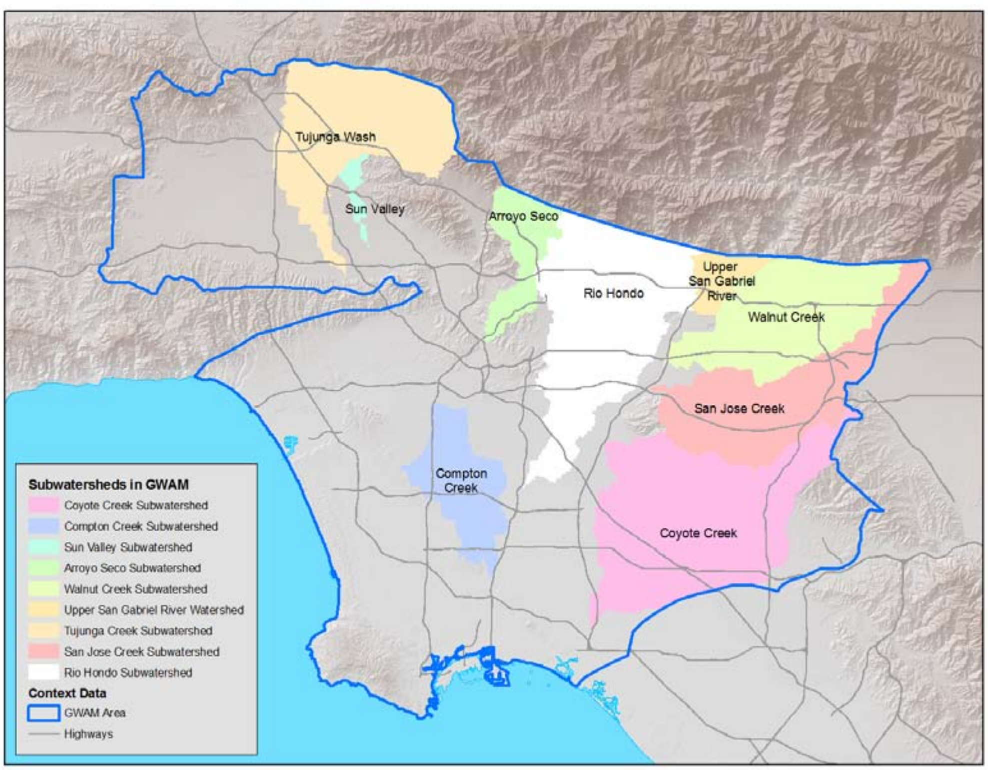

Figure 4 - Subwatersheds in GWAM

Groundwater Basin	SubBasin	Area (km²)
Los Angeles County Coastal		1266.81 (sum)
	Hollywood	40.74
	Santa Monica	130.12
	West Coast	369.43
	Central	726.52
Orange County Coastal		259.69
San Fernando Valley		858.92
San Gabriel Valley		583.02 (sum)
	Raymond Basin	105.97
	East Basin	477.05
Upper Santa Ana River		0.98 (sum)
	Chino Basin	0.98

Table 2 - Groundwater Basins in GWAM

The watersheds and subwatersheds can be modeled individually. Along with the recognized groundwater basins (Figure 5, Groundwater Basins in GWAM), several specific sub-areas are also available for modeling including the Los Angeles Forebay, the Montebello Forebay, Whittier Area, and the Central Basin Pressure Area.

Study areas are not limited to the pre-programmed areas described above. A GIS user can generate a coverage of any area within the model's geographic extent for processing. Particular soil types and land-use classes can be modeled in isolation, allowing a particular study area to be assessed for the optimal combination of diversion strategies.

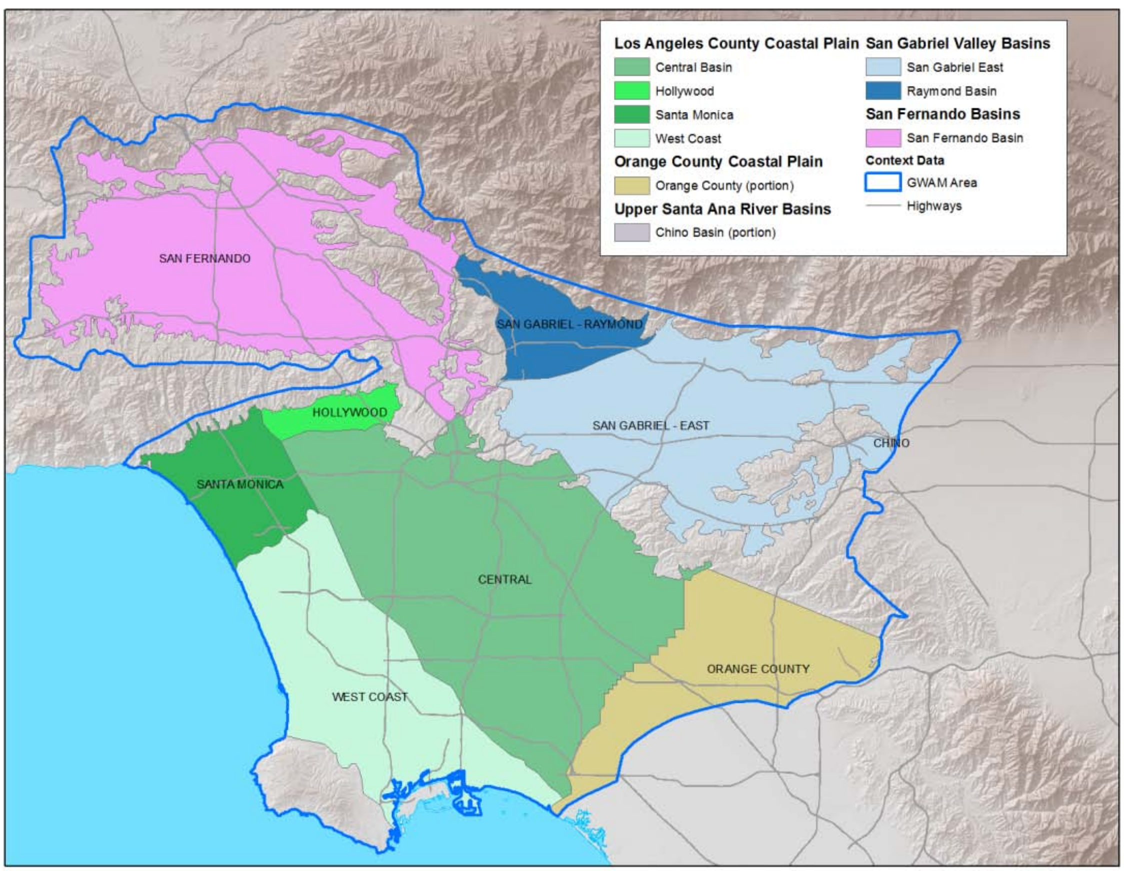

Figure 5- Groundwater Basins in GWAM

Model Parameters

Two mass balance principles are integral to the estimates made by this model. These principals are described in a simplified manner in this document. The GWAM Users Manual contains more rigorous descriptions of the equations used in the model, and is available for download at the Watershed Council website (www.lasgrwc.org). The first principle depicts the amount of infiltration generated when it rains and is described with this generalized equation:

$$Infiltration = Precipitation - Bare\ Surface\ \&\ Canopy\ Evaporation - Runoff$$

Where:

Infiltration	Is the volume of water (acre feet) entering into the root zone.
Precipitation	Is hourly precipitation data from a fifty year record, in inches.
Bare Surface & Canopy evaporation	Is the volume of water intercepted and/or evaporated before it can become runoff or infiltration
Runoff	Is runoff predicted by the model using the SCS curve number procedure.

The second principle is for deep percolation which is described by the following generalized equation:

$$Deep\ Percolation\ = Previous\ Soil\ Moisture + Infiltration + Irrigation - Evapotranspiration$$

Where:

Deep Percolation	Is the volume of water predicted to infiltrate past the root zone and into the vadose zone
Previous Soil Moisture	Is the soil moisture from each previous daily time step in the model
Infiltration	Is as described above
Irrigation	Is applied water to fulfill deficits in soil moisture
Evapotranspiration	Is calculated within the model from California Irrigation Management System data, and processed using accepted methods.

The dynamics of runoff and infiltration in the model can be altered with user-selected diversions of runoff to infiltration. This allows the model to consider efforts to diminish runoff volume by retaining water as a potential recharge source. The diversions are set prior to the model run as a fraction of runoff (a percentage) or an absolute amount of runoff (a depth of water).

If no diversion is set, the model factors the saturated hydrologic conductivity of the soils as a limiting factor on infiltration. In impervious diversion scenarios, the diverted volume is routed past the root zone directly to the vadose zone, and therefore the soil's capacity is not a factor. In pervious diversions, saturated hydrologic conductivity can be activated as a limiting factor, or left disabled to imply that the unnamed BMP is capable of surface storage capacity allowing as much time as is needed to completely drain the diverted volume into the root zone.

One of the most important data layers in the model is land-use. The Southern California Association of Governments (SCAG), which serves as the Metropolitan Planning Organization for six southern California counties, produces spatial land-use data on a 5- and/or 10-year cycle. These data are digitized from aerial imagery and field checked. Land-use types considered "critical" have a resolution of 1 acre, while non-critical land-uses are at a 2.5 acre resolution. Critical land-uses are municipal land, including schools, public safety facilities, parks, government buildings, among others. Non-critical land uses make up the remainder (SCAG, 2008).

Land-use in this model is combined with a Los Angeles County Department of Public Works runoff coefficient dataset that was generated to match the SCAG land-use categories. Land-use, when attributed with irrigation and vegetation characteristics, allows calculations of root zone uptake, evapotranspiration, and bare-surface evaporation.

Modeling Output

This report depicts the output from modeled base-line and diversion scenarios for each of the watersheds and subwatersheds, groundwater basins and sub-basins coded into the model. The base-line data uses the existing conditions of land use, as represented by the SCAG 2002 land-use dataset (SCAG, 2002) to determine the amount of precipitation that would contribute to deep percolation. In addition, the data output evaluates scenarios to determine the potential increase of deep percolation to groundwater resulting from infiltration projects. The raw data output can be found on the last few pages of this report.

The SCAG land-use data is classified hierarchically using a modified Anderson Land-Use Classification System (Anderson, et. al. 1976). This classification system has been used within the model to allow certain land-use classes to be modeled separately. Therefore, certain study areas can be modeled with different types of land-use isolated, for instance Commercial, or Multi-Family residential. This allows the model to reveal optimal land-uses to focus stormwater retention and infiltration efforts.

The model suggests under existing conditions that the modeled area produces approximately 194,000 acre/feet (AF) of deep percolation in an average year (Table 3). The Los Angeles River Watershed contributes 102,777 AFY from 410,279 acres (.25 acre/feet per acre) while the San Gabriel River Watershed contributes 55,152 AFY from 264,457 acres (.21 acre/feet per acre). In both watersheds, 48% of precipitation becomes runoff, with 166,026 AFY generated in the San Gabriel River Watershed, and 286,565 AFY generated in the Los Angeles River Watershed. These values, especially on the Los Angeles watershed, agree closely to estimates produced in other studies and resources in the region (Dallman and Piechota, 1999).

In addition to the existing conditions, each of the watersheds and basins were modeled to simulate capturing up to ¾ inch of runoff from all precipitation events and diverting it to infiltration. Impervious surface diversions contribute directly to the vadose zone (so, diverted volume equals the increase to deep percolation). Pervious surface diversions transit the root zone (so have plant-uptake and ET loss), and were constrained to the saturated hydraulic conductivity of the underlying soils.

These model runs illustrate the potential increase in deep percolation with the addition of infiltration projects designed to capture storms of ¾ inch or less. How much of this water would eventually be counted as recharge would have to be determined using an existing detailed groundwater model, as not all water that is predicted as deep percolation would result in rechargedue to the presence of confining layers in some areas of the basin, and some interception by intersecting streams in the area.

Findings

The baseline results for the various study areas within the model are displayed in the tables at the end of this report. Shown are the estimates of current deep percolation, or groundwater recharge, based on the input data described above. The size of each study area, and precipitation estimates are the two most obvious forces driving the results.

A series of calculations were performed on the model results to produce statistics about the various modeled areas. The best statistical result for comparing one modeled area to another is acre-feet of recharge per acre of study area. This statistic results in an area-independent height of water column of recharge. Also calculated are the percentage of rainfall becoming runoff, the percentage of rainfall becoming infiltration, and the percentage of infiltration plus irrigation becoming deep percolation. In each case these calculations allow comparisons to be drawn between areas.

In the entire modeled area, under baseline conditions, the model calculates 1,214,026 AF of precipitation and 193,827 AF of deep percolation, meaning ~16% of precipitation is predicted to percolate past the root zone and become aquifer recharge (the true fate of infiltration depends on aquifer and stream conditions, and is not modeled by GWAM).

Using diversion from only pervious surfaces, the model predicts that deep percolation would increase to 271,474 AF (~22% of precipitation). Diverting from only impervious surfaces increases deep percolation to 499,891 AF (~41% of precipitation). In a scenario where all surfaces receive a ¾ inch diversion, deep percolation increases to 577,538 AF (~49% of precipitation). This additional potential recharge represents 77% of the Greater Los Angeles County Integrated Regional Water Management Plan goal for 2025 which calls for an additional 750,000 AF of locally-sourced water (2006, IRWMP Leadership Committee, 2-17). This increase to recharge represents 384,000 AFY of additional deep percolation, a volume sufficient for the annual needs of three-quarters of a million (768,000) typical Southern California families (MWD, 2010).

When considering watersheds and subwatersheds within the model area, a pattern is clear that the subwatersheds located near or originating in the foothills infiltrate a larger volume of water per area, and convert a greater percentage of precipitation to deep percolation. Arroyo Seco subwatershed has the highest score in both categories, followed by Walnut Creek subwatershed and the Rio Hondo Watershed. When considering ground water basins it is not surprising that the

Raymond Basin, which is overlain primarily by the Arroyo Seco watershed, has the highest acre/feet per acre of deep percolation.

In both the basins and watersheds, the modeled results are best correlated to the land-use characteristics of the study area. The more heavily developed sections of the model area show the lesser infiltration and percolation values in baseline conditions.

The diversion scenarios reflect areas of greater potential increases over baseline conditions, and are more difficult to spatially categorize than the patterns of baseline conditions. The three groundwater basins that reflect the greatest increase during diversion scenarios are the Los Angeles Forebay, the Hollywood Basin, and the West Basin. Further quantification is in order, but the hypothesis for this pattern suggests a greater level of impervious surface cover overlying these basins, as well as the existence of better soil conditions for infiltration.

Sun Valley, Ballona Creek, and Dominguez Channel watersheds all suggest large increases in deep percolation under impervious surface diversion conditions. All three of these watersheds are dominated by land-uses with high runoff coefficients. This implies that most of the storms of ¾ inch or less are primarily converted to runoff in baseline, and under diversion conditions would be infiltrated.

In terms of relative volume increase per acre, the largest projected increase over existing condition would occur in the Raymond Basin. The GWAM projected an increase from 0.3 to 1.3 acre-feet per acre within Raymond Basin. Due to the relatively small size of the Basin, however, the total volume of increase to deep percolation would only be 21,872 acre-feet per year (Figure 8, GWAM Basin Results). In contrast, the Central Basin would increase from 0.16 to 0.62 acre-feet per acre, but factoring in the size of this basin, the largest within the WAS area, the annual increased volume of deep percolation would be around 81,200 acre-feet. Based on their location and total amount of impervious surface, and regardless of their size, the Rio Hondo, Coyote Creek, Ballona Creek and Dominguez Channel watersheds would potentially each yield between 30,000 and 35,000 additional acre-feet to the groundwater aquifers if all parcels diverted the ¾ inch storm (Figure 9, GWAM Watershed Results). The greatest potential for total volume of stormwater infiltrated by capturing a ¾ inch storm would be on portions of the Los Angeles Coastal Plain due to the large surface area, extent of impervious cover, and the quality and condition of the underlying soils and aquifer.

The San Fernando Basin is second largest groundwater basin in the model. At 169,000 acres, it deep percolates only 45,500 AFY in existing conditions. With a diversion of ¾" of runoff from both pervious and impervious land-uses the deep percolation would increase to nearly 123,000 AFY, or a 170% increase. In baseline conditions the San Fernando Basin receives 0.26 acre feet per acre of potential recharge, and in the diversion scenario this number increases to 0.72. For another project, a scenario calling for a 100% diversion from high-density residential land was performed in the San Fernando Basin. That land-use accounts for 42% of the area of the Basin, and in this diversion scenario 0.93 acre feet per acre of potential deep percolation was generated, or an increase of 66,700 AFY.

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Further Efforts

The two most useful functions for this model are providing an understanding of baseline conditions (as shown herein) and determining optimization within a study area. By viewing the baseline data compared to the diversion examples a sense can be gained for where diversions will create the largest decrease in runoff and the largest increase in deep percolation.

The model can be used to explore the optimal diversion technology for a given area. Through a series of model runs, the best combination of diversion type and diversion amount can be discovered for a particular study area. These results would potentially provide a useful tool for planners or developers interested in exploring the opportunities for groundwater recharge in an area under their responsibility.

GWAM can also output spatial data, providing results that align with the input polygons, which would allow greater spatial analyses to account for other data of interest. For example, an area considering diversion strategies may also be seeking stream-daylighting opportunities, and a spatial analysis of these two goals could provide an important piece of the decision matrix. Spatial data output is limited to small model areas. To provide spatial data for the entire modeled area will likely require hundreds of model runs. More study is needed to understand the edge effects of breaking the entire model area into smaller pieces for the model run, and then reassembling the results into a larger area output.

The output from GWAM is an estimate of potential recharge only. As a planning tool GWAM provides direction, but must be supported with a rigorous groundwater model to quantify the amount of deep percolation and potential extraction that would be expected given the estimates GWAM provides.

Limitations

The GWAM is a planning tool and has limitations. The general findings of the model are sound; however, as in all models, the exactness of the numerical output can mask some of the uncertainties in the model input assumptions. For example, the precipitation values are modeled using Thiessen polygons[1] generated from weather station locations. Because of this purely geometric approach, the precipitation values may not account for all the topographic or spatial variation of precipitation across the study area.

The GWAM does not perform channel routing and cannot make an assessment of infiltration from streams. Runoff from one polygon is not calculated as run-on in the next down-shed polygon, which could lead to underestimations of infiltration in some areas. However, considering that BMPs would be implemented on specific land parcels for the purpose of increasing infiltration from those parcels then it is likely that GWAM is predicting conservative infiltration values for consideration in planning studies.

[1] *Polygons whose boundaries define the area that is closest to each point relative to all other points in a set.*

While this model provides estimates of the baseline conditions, the strength and value of the model lies in its ability to depict the relationships between different set parameters to allow for evaluation of policy decisions and scenarios in comparison to one another.

Conclusion

This report provides an understanding of the baseline conditions and potential increase of deep percolation from infiltration projects within the modeled portions of Greater Los Angeles. The Ground Water Augmentation Model is capable of producing general knowledge about baseline runoff, infiltration, evapotranspiration and deep percolation conditions. Through user-selected scenarios, various diversion efforts can be modeled to observe the relational change they would create. The numerical output of the model is based on best available data to provide a context for determining the relative potential change created by a runoff diversion. This model provides valuable information for evaluating policies and actions that can be taken within Southern California to divert storm water-runoff and the potential increase in local supplies of groundwater.

References:

Bureau of Reclamation, 2007. Los Angeles Basin Ground Water Augmentation Model: User's Manual and Technical Documentation, Version 4.1.40. Denver, CO: Bureau of Reclamation, Technical Services Center, Water Resources Division

Dallman, Suzanne, 2008. GIS Modeling for Stormwater and Groundwater Management. Proceedings, AWRA 2008 Spring Specialty Conference, San Mateo, CA

IRWMP Leadership Committee, 2006, The Greater Los Angeles County Integrated Regional Water Management Plan

Los Angeles County Department of Public Works, 2002, Development Planning for Storm Water Management: A manual for the Standard Urban Storm Water Mitigation Plan (SUSMP). < http://dpw.lacounty.gov/wmd/npdes/SUSMP_MANUAL.pdf>

Southern California Association of Governments "SCAG Home" <http://www.scag.ca.gov/> (viewed 19 June 2008)

Groundwater Basins

	Acres	Precip Inches	Precip AF	Canopy Bare Surface Evaporation AF	Runoff AF	Runoff Diversion Impervious AF	Runoff Diversion Pervious AF	Combined Runoff Diversion AF	Infiltration AF	Irrigation AF	ET AF	Change in Soil Moisture AF	Deep Percolation AF	Area of total	Deep Perc (AF) /Acre	Infil / Precip	Deep/ precip	Deep/ Infil	Deep Increase	Deep Perc Increase
Entire Model Area	886,278	16.44	1,214,026	196,558	601,454	-	-		416,014	691,013	1,135,720	(222,521)	193,827	100%	0.219	34.27%	15.97%	46.59%		
3/4 inch diversion pervious limited to K_{sat}	886,278	16.44	1,214,026	196,558	512,821	-	88,567		504,647	687,142	1,135,720	(215,405)	271,474		0.306	41.57%	22.36%	53.79%	77,647	40.06%
3/4 inch diversion impervious	886,278	16.44	1,214,026	196,558	295,390	306,064	-		416,014	691,013	1,135,720	(222,521)	499,891		0.564	34.27%	41.18%	120.16%	306,064	157.91%
3/4 inch diversion impervious and pervious	886,278	16.44	1,214,026	196,558	206,823	306,064	88,567	394,631	504,647	687,142	1,135,720	(215,405)	577,538		0.652	41.57%	47.57%	114.44%	383,711	197.97%
Montebello Forebay	25,737	13.84	29,673	5,449	16,808	-	-		7,416	20,278	25,320	(1,832)	4,206	2.90%	0.163	24.99%	14.18%	56.72%		
3/4 inch diversion pervious limited to K_{sat}	25,737	13.84	29,673	5,449	15,627	-	1,181		8,597	20,210	25,320	(1,774)	5,261		0.204	28.97%	17.73%	61.20%	1,055	25.07%
3/4 inch diversion impervious	25,737	13.84	29,673	5,449	6,188	10,620	-		7,416	20,278	25,320	(1,832)	14,827		0.576	24.99%	49.97%	199.93%	10,620	252.48%
3/4 inch diversion impervious and pervious	25,737	13.84	29,673	5,449	5,006	10,620	1,181	11,802	8,597	20,210	25,320	(1,774)	15,881		0.617	28.97%	53.52%	184.74%	11,675	277.55%
Los Angeles Forebay	15,646	14.74	19,213	3,698	11,608	-	-		3,907	10,189	13,475	(1,505)	2,125	1.77%	0.136	20.33%	11.06%	54.40%		
3/4 inch diversion pervious limited to K_{sat}	15,646	14.74	19,213	3,698	11,045	-	563		4,470	10,163	13,475	(1,475)	2,633		0.168	23.26%	13.70%	58.91%	508	23.90%
3/4 inch diversion impervious	15,646	14.74	19,213	3,698	4,255	7,353	-		3,907	10,189	13,475	(1,505)	9,478		0.606	20.33%	49.33%	242.63%	7,353	346.01%
3/4 inch diversion impervious and pervious	15,646	14.74	19,213	3,698	3,692	7,353	563	7,916	4,470	10,163	13,475	(1,475)	9,986		0.638	23.26%	51.98%	223.41%	7,861	369.92%
Whittier Area	17,660	14.51	21,348	3,674	10,122	-	-		7,552	17,040	24,912	(3,351)	3,031	1.99%	0.172	35.38%	14.20%	40.14%		
3/4 inch diversion pervious limited to K_{sat}	17,660	14.51	21,348	3,674	7,818	-	2,304		9,856	16,790	24,912	(3,162)	4,897		0.277	46.17%	22.94%	49.68%	1,866	61.55%
3/4 inch diversion impervious	17,660	14.51	21,348	3,674	5,388	4,734	-		7,552	17,040	24,912	(3,351)	7,765		0.440	35.38%	36.37%	102.83%	4,734	156.17%
3/4 inch diversion impervious and pervious	17,660	14.51	21,348	3,674	3,084	4,734	2,304	7,038	9,856	16,790	24,912	(3,162)	9,631		0.545	46.17%	45.11%	97.71%	6,600	217.73%
Central Pressure Area	102,212	13.40	114,144	23,526	60,157	-	-		30,461	101,283	120,676	(6,844)	17,912	11.53%	0.175	26.69%	15.69%	58.80%		
3/4 inch diversion pervious limited to K_{sat}	102,212	13.40	114,144	23,526	56,487	-	3,661		34,131	101,011	120,676	(6,693)	21,159		0.207	29.90%	18.54%	61.99%	3,247	18.13%
3/4 inch diversion impervious	102,212	13.40	114,144	23,526	21,482	38,675	-		30,461	101,283	120,676	(6,844)	56,587		0.554	26.69%	49.57%	185.77%	38,675	215.91%
3/4 inch diversion impervious and pervious	102,212	13.40	114,144	23,526	17,821	38,675	3,661	42,336	34,131	101,011	120,676	(6,693)	59,834		0.585	29.90%	52.42%	175.31%	41,922	234.04%
Central Basin	179,524	14.16	211,850	40,623	119,317	-	-		51,910	158,981	192,739	(11,404)	29,556	20.26%	0.165	24.50%	13.95%	56.94%		
3/4 inch diversion pervious limited to K_{sat}	179,524	14.16	211,850	40,623	111,012	-	8,295		60,214	158,323	192,739	(11,119)	36,918		0.206	28.42%	17.43%	61.31%	7,361	24.91%
3/4 inch diversion impervious	179,524	14.16	211,850	40,623	45,477	73,840	-		51,910	158,981	192,739	(11,404)	103,397		0.576	24.50%	48.81%	199.19%	73,840	249.83%
3/4 inch diversion impervious and pervious	179,524	14.16	211,850	40,623	37,182	73,840	8,295	82,135	60,214	158,323	192,739	(11,119)	110,758		0.617	28.42%	52.28%	183.94%	81,202	274.74%

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	Acres	Precip Inches	Precip AF	Canopy Bare Surface Evaporation AF	Runoff AF	Runoff Diversion Impervious AF	Runoff Diversion Pervious AF	Combined Runoff Diversion AF	Infiltration AF	Irrigation AF	ET AF	Change in Soil Moisture AF	Deep Percolation AF	Area of total	Deep Perc (AF) /Acre	Infil / Precip	Deep/ precip	Deep/ Infil	Deep Increase	Deep Perc Increase
Groundwater Basins																				
Chino Basin	241	16.54	333	52	178	-	-		102	258	303	(10)	68	0.03%	0.281	30.73%	20.36%	66.25%		
3/4 inch diversion pervious limited to K_{sat}	241	16.54	333	52	166	-	12		114	258	303	(10)	79		0.329	34.32%	23.87%	69.56%	12	17.23%
3/4 inch diversion impervious	241	16.54	333	52	70	108	-		102	258	303	(10)	175		0.727	30.73%	52.71%	171.50%	108	158.86%
3/4 inch diversion impervious and pervious	241	16.54	333	52	58	108	12	120	114	258	303	(10)	187		0.775	34.32%	56.22%	163.82%	119	176.09%
Hollywood Basin	10,066	17.06	14,310	2,077	9,336	-	-		2,897	6,614	8,058	(168)	1,622	1.14%	0.161	20.24%	11.33%	55.97%		
3/4 inch diversion pervious limited to K_{sat}	10,066	17.06	14,310	2,077	8,558	-	778		3,674	6,557	8,058	(161)	2,335		0.232	25.68%	16.32%	63.55%	714	44.02%
3/4 inch diversion impervious	10,066	17.06	14,310	2,077	4,287	5,049	-		2,897	6,614	8,058	(168)	6,670		0.663	20.24%	46.61%	230.24%	5,049	311.35%
3/4 inch diversion impervious and pervious	10,066	17.06	14,310	2,077	3,509	5,049	778	5,827	3,674	6,557	8,058	(161)	7,384		0.734	25.68%	51.60%	200.95%	5,762	355.36%
Orange County area	64,168	14.42	77,095	13,385	41,238	-	-		22,472	51,564	70,304	(7,532)	11,264	7.24%	0.176	29.15%	14.61%	50.12%		
3/4 inch diversion pervious limited to K_{sat}	64,168	14.42	77,095	13,385	36,971	-	4,266		26,740	51,265	70,304	(7,303)	15,003		0.234	34.68%	19.46%	56.11%	3,739	33.20%
3/4 inch diversion impervious	64,168	14.42	77,095	13,385	17,378	23,861	-		22,472	51,564	70,304	(7,532)	35,124		0.547	29.15%	45.56%	156.30%	23,861	211.84%
3/4 inch diversion impervious and pervious	64,168	14.42	77,095	13,385	13,111	23,861	4,266	28,127	26,740	51,265	70,304	(7,303)	38,863		0.606	34.68%	50.41%	145.34%	27,600	245.03%
San Fernando Basin	169,521	17.95	253,550	37,312	125,241	-	-		90,997	145,197	237,449	(46,781)	45,525	19.13%	0.269	35.89%	17.96%	50.03%		
3/4 inch diversion pervious limited to K_{sat}	169,521	17.95	253,550	37,312	106,862	-	18,370		109,375	144,612	237,449	(45,601)	62,139		0.367	43.14%	24.51%	56.81%	16,614	36.49%
3/4 inch diversion impervious	169,521	17.95	253,550	37,312	64,431	60,810	-		90,997	145,197	237,449	(46,781)	106,336		0.627	35.89%	41.94%	116.86%	60,810	133.57%
3/4 inch diversion impervious and pervious	169,521	17.95	253,550	37,312	46,061	60,810	18,370	79,180	109,375	144,612	237,449	(45,601)	122,949		0.725	43.14%	48.49%	112.41%	77,424	170.07%
East San Gabriel Basin	133,140	17.31	187,225	29,647	95,852	-	-		61,726	119,494	171,436	(23,426)	33,209	15.02%	0.249	32.97%	17.74%	53.80%		
3/4 inch diversion pervious limited to K_{sat}	133,140	17.31	192,077	30,410	87,205	-	11,887		74,463	120,915	174,015	(23,032)	44,395		0.333	38.77%	23.11%	59.62%	11,185	33.68%
3/4 inch diversion impervious	133,140	17.31	192,077	30,410	45,206	53,897	-		62,564	121,394	174,015	(23,703)	87,543		0.658	32.57%	45.58%	139.93%	54,333	163.61%
3/4 inch diversion impervious and pervious	133,140	17.31	192,077	30,410	30,068	53,897	11,887	65,784	74,463	120,915	174,015	(23,032)	98,728		0.742	38.77%	51.40%	132.59%	65,519	197.29%
Raymond Basin	26,186	19.73	43,052	6,549	21,239	-	-		15,264	30,869	39,635	(3,031)	9,528	2.95%	0.364	35.45%	22.13%	62.42%		
3/4 inch diversion pervious limited to K_{sat}	26,186	19.73	43,052	6,549	18,361	-	2,875		18,142	30,766	39,635	(2,972)	12,245		0.468	42.14%	28.44%	67.50%	2,717	28.51%
3/4 inch diversion impervious	26,186	19.73	43,052	6,549	10,981	10,258	-		15,264	30,869	39,635	(3,031)	19,786		0.756	35.45%	45.96%	129.63%	10,258	107.66%
3/4 inch diversion impervious and pervious	26,186	19.73	43,052	6,549	1,313	17,048	-	17,048	15,264	30,869	39,635	(3,031)	34,118		1.303	35.45%	79.25%	223.52%	21,872	178.62%

Groundwater Basins

	Acres	Precip Inches	Precip AF	Canopy Bare Surface Evaporation AF	Runoff AF	Runoff Diversion Impervious AF	Runoff Diversion Pervious AF	Combined Runoff Diversion AF	Infiltration AF	Irrigation AF	ET AF	Change in Soil Moisture AF	Deep Percolation AF	Area of total	Deep Perc (AF) /Acre	Infil / Precip	Deep/ precip	Deep/ Infil	Deep Increase	Deep Perc Increase
Santa Monica Basin	32,153	17.84	47,787	7,126	28,248	-	-		12,413	26,950	35,881	(2,880)	6,362	3.63%	0.198	25.98%	13.31%	51.25%		
3/4 inch diversion pervious limited to K_{sat}	32,153	17.84	47,787	7,126	24,778	-	3,459		15,883	26,728	35,881	(2,747)	9,477		0.295	33.24%	19.83%	59.67%	3,115	48.96%
3/4 inch diversion impervious	32,153	17.84	47,787	7,126	14,710	13,538	-		12,413	26,950	35,881	(2,880)	19,900		0.619	25.98%	41.64%	160.32%	13,538	212.79%
3/4 inch diversion impervious and pervious	32,153	17.84	47,787	7,126	11,251	13,538	3,459	16,998	15,883	26,728	35,881	(2,747)	23,015		0.716	33.24%	48.16%	144.90%	16,653	261.75%
West Basin	91,286	13.83	105,240	19,357	60,903	-	-		24,980	63,130	83,432	(9,454)	14,132	10.30%	0.155	23.74%	13.43%	56.57%		
3/4 inch diversion pervious limited to K_{sat}	91,286	13.83	105,240	19,357	57,308	-	3,584		28,575	62,849	83,432	(9,218)	17,210		0.189	27.15%	16.35%	60.23%	3,078	21.78%
3/4 inch diversion impervious	91,286	13.83	105,240	19,357	23,499	37,404	-		24,980	63,130	83,432	(9,454)	51,536		0.565	23.74%	48.97%	206.31%	37,404	264.68%
3/4 inch diversion impervious and pervious	91,286	13.83	105,240	19,357	19,915	37,404	3,584	40,988	28,575	62,849	83,432	(9,218)	54,614		0.598	27.15%	51.89%	191.12%	40,482	286.45%

San Gabriel River Watershed

	Acres	Precip Inches	Precip AF	Canopy Bare Surface Evaporation AF	Runoff AF	Runoff Diversion Impervious AF	Runoff Diversion Pervious AF	Total Runoff Diversion AF	Infiltration AF	Irrigation AF	ET AF	Change in Soil Moisture AF	Deep Percolation AF	Area of total	Deep Perc (AF) /Acre	Infil / Precip	Deep / precip	Deep / Infil	Deep Increase	Deep Perc Increase
Entire Watershed Baseline:	264,457	15.63	344,415	58,603	166,026	-	-		119,787	216,244	342,276	(61,397)	55,152	100.00 %	0.209	34.78%	16.01%	46.04%		
3/4 inch diversion pervious limited to K_{sat}	264,457	15.63	344,415	58,603	141,796	-	24,221		144,016	215,109	342,276	(59,203)	76,052		0.288	41.81%	22.08%	63.49%	20,900	37.90%
3/4 inch diversion impervious	264,457	15.63	344,415	58,603	76,956	89,070	-		119,787	216,244	342,276	(61,397)	144,222		0.545	34.78%	41.87%	120.40%	89,070	161.50%
3/4 inch diversion impervious and pervious	264,457	15.63	344,415	58,603	52,735	89,070	24,221	113,291	119,787	216,244	342,276	(61,397)	165,122		0.624	34.78%	47.94%	137.85%	109,970	144.60%
Coyote Creek Subwatershed Baseline	89,764	14.42	107,870	19,203	53,954	-	-		34,713	74,547	108,539	(15,056)	15,777	33.94%	0.176	32.18%	14.63%	45.45%		
3/4 inch diversion pervious limited to K_{sat}	89,764	14.42	107,870	19,203	46,413	-	7,538		42,254	73,995	108,539	(14,354)	22,063		0.246	39.17%	20.45%	63.56%	6,286	39.84%
3/4 inch diversion impervious	89,764	14.42	107,870	19,203	24,370	29,584	-		34,713	74,547	108,539	(15,056)	45,361		0.505	32.18%	42.05%	130.67%	29,584	187.51%
3/4 inch diversion impervious and pervious	89,764	14.42	107,870	19,203	16,832	29,584	7,538	37,121	34,713	74,547	108,539	(15,056)	51,647		0.575	32.18%	47.88%	148.78%	29,584	134.09%
Walnut Creek Subwatershed Baseline	50,905	18.81	79,776	12,314	35,775	-	-		31,688	43,518	76,751	(16,771)	15,226	19.25%	0.299	39.72%	19.09%	48.05%		
3/4 inch diversion pervious limited to K_{sat}	50,905	18.81	79,776	12,314	29,463	-	6,309		37,999	43,377	76,751	(16,304)	20,929		0.411	47.63%	26.24%	66.05%	5,703	37.46%
3/4 inch diversion impervious	50,905	18.81	79,776	12,314	18,569	17,206	-		31,688	43,518	76,751	(16,771)	32,432		0.637	39.72%	40.65%	102.35%	17,206	113.00%
3/4 inch diversion impervious and pervious	50,905	18.81	79,776	12,314	12,260	17,206	6,309	23,515	31,688	43,518	76,751	(16,771)	38,135		0.749	39.72%	47.80%	120.35%	22,909	150.46%

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San Gabriel River Watershed

	Acres	Precip Inches	Precip AF	Canopy Bare Surface Evaporation AF	Runoff AF	Runoff Diversion Impervious AF	Runoff Diversion Pervious AF	Total Runoff Diversion AF	Infiltration AF	Irrigation AF	ET AF	Change in Soil Moisture AF	Deep Percolation AF	Area of total	Deep Perc (AF) /Acre	Infil / Precip	Deep / precip	Deep / Infil	Deep Increase	Deep Perc Increase
Upper San Gabriel River	8,553	20.48	14,598	2,253	5,884	-	-		6,460	2,505	12,337	(5,582)	2,210	3.23%	0.258	44.25%	15.14%	34.21%		
3/4 inch diversion pervious limited to K_{sat}	8,553	20.48	14,598	2,253	4,549	-	1,335		7,796	2,496	12,337	(5,448)	3,403		0.398	53.40%	23.31%	52.68%	1,193	53.97%
3/4 inch diversion impervious	8,553	20.48	14,598	2,253	3,510	2,374	-		6,460	2,505	12,337	(5,582)	4,585		0.536	44.25%	31.41%	70.97%	2,375	107.44%
3/4 inch diversion impervious and pervious	8,553	20.48	14,598	2,253	2,175	2,374	1,335	3,710	6,460	2,505	12,337	(5,582)	5,777		0.022	1.88%	1.68%	4.82%	3,567	161.41%
San Jose Subwatershed Baseline	51,492	16.43	70,480	11,111	33,995	-	-		25,375	37,946	69,855	(16,651)	10,116	19.47%	0.196	36.00%	14.35%	39.87%		
3/4 inch diversion pervious limited to K_{sat}	51,492	16.43	70,480	11,111	27,518	-	6,473		31,851	37,610	69,855	(15,959)	15,566		0.302	45.19%	22.09%	61.34%	5,449	53.87%
3/4 inch diversion impervious	51,492	16.43	70,480	11,111	17,398	16,597	-		25,375	37,946	69,855	(16,651)	26,713		0.519	36.00%	37.90%	105.28%	16,597	164.06%
3/4 inch diversion impervious and pervious	51,492	16.43	70,480	11,111	10,925	16,597	6,473	23,070	25,375	37,946	69,855	(16,651)	32,163		0.122	7.37%	9.34%	26.85%	22,046	217.93%

Los Angeles River Watershed

	Acres	Precip Inches	Precip AF	Canopy Bare Surface Evaporation AF	Runoff AF	Runoff Diversion Impervious AF	Runoff Diversion Pervious AF	Total Runoff Diversion AF	Infiltration AF	Irrigation AF	ET AF	Change in Soil Moisture AF	Deep Percolation AF	Area of total	Deep Perc (AF) / Acre	Infil / Precip	Deep / precip	Deep / Infil	Deep Increase	Deep Perc Increase
Entire Watershed Baseline:	410,279	17.51	598,565	92,542	286,565	-	-		219,458	319,695	563,371	(126,995)	102,777	100.00%	0.251	36.66%	17.17%	46.83%		
3/4 inch diversion pervious limited to K_{sat}	410,279	17.51	598,565	92,542	240,189	-	46,346		265,834	318,204	563,371	(123,593)	144,260		0.352	44.41%	24.10%	54.27%	41,482	40.36%
3/4 inch diversion impervious	410,279	17.51	598,565	92,542	148,311	138,254	-		219,458	319,695	563,371	(126,995)	241,031		0.587	36.66%	40.27%	109.83%	138,254	134.52%
3/4 inch diversion impervious and pervious	410,279	17.51	598,565	92,542	101,965	138,254	46,346	184,600	219,458	319,695	563,371	(126,995)	282,514		0.689	36.66%	47.20%	128.73%	179,737	174.88%
Arroyo Seco Baseline	17,468	19.44	28,294	4,234	12,996	-	-		11,064	17,930	28,512	(5,150)	5,631	4.26%	0.322	39.10%	19.90%	50.90%		
3/4 inch diversion pervious limited to K_{sat}	17,468	19.44	28,294	4,234	10,191	-	2,801		13,868	17,795	28,512	(4,978)	8,129		0.465	49.02%	28.73%	58.61%	2,498	44.35%
3/4 inch diversion impervious	17,468	19.44	28,294	4,234	7,782	5,214	-		11,064	17,930	28,512	(5,150)	10,845		0.621	39.10%	38.33%	98.03%	5,214	92.59%
3/4 inch diversion impervious and pervious	17,468	19.44	28,294	4,234	4,980	5,214	2,801	8,015	11,064	17,930	28,512	(5,150)	13,343		0.764	39.10%	47.16%	120.60%	7,712	136.95%
Rio Hondo Baseline	75,277	17.44	109,436	17,583	54,250	-	-		37,603	69,438	99,132	(13,359)	21,268	18.35%	0.283	34.36%	19.43%	56.56%		
3/4 inch diversion pervious limited to K_{sat}	75,277	17.44	109,436	17,583	47,750	-	6,492		44,103	69,204	99,132	(13,118)	27,293		0.363	40.30%	24.94%	61.89%	6,025	28.33%
3/4 inch diversion impervious	75,277	17.44	109,436	17,583	25,021	29,229	-		37,603	69,438	99,132	(13,359)	50,497		0.671	34.36%	46.14%	134.29%	29,229	137.43%
3/4 inch diversion impervious and pervious	75,277	17.44	109,436	17,583	18,529	29,229	6,492	35,721	37,603	69,438	99,132	(13,359)	56,522		0.751	34.36%	51.65%	150.31%	35,254	165.76%

Los Angeles River Watershed

	Acres	Precip Inches	Precip AF	Canopy Bare Surface Evaporation AF	Runoff AF	Runoff Diversion Impervious AF	Runoff Diversion Pervious AF	Total Runoff Diversion AF	Infiltration AF	Irrigation AF	ET AF	Change in Soil Moisture AF	Deep Percolation AF	Area of total	Deep Perc (AF) / Acre	Infil / Precip	Deep / precip	Deep / Infil	Deep Increase	Deep Perc Increase
Tujunga Baseline	58,248	17.71	85,985	12,825	31,085	-	-		42,075	30,170	93,102	(36,689)	15,833	14.20%	0.272	48.93%	18.41%	37.63%		
3/4 inch diversion pervious limited to K_{sat}	58,248	17.71	85,985	12,825	23,381	-	7,702		49,779	30,112	93,102	(35,815)	22,604		0.388	57.89%	26.29%	45.41%	6,771	42.76%
3/4 inch diversion impervious	58,248	17.71	85,985	12,825	18,155	12,930	-		42,075	30,170	93,102	(36,689)	28,763		0.494	48.93%	33.45%	68.36%	12,930	81.67%
3/4 inch diversion impervious and pervious	58,248	17.71	85,985	12,825	10,452	12,930	7,702	20,632	42,075	30,170	93,102	(36,689)	35,534		0.610	48.93%	41.33%	84.45%	19,701	124.43%
Sun Valley Subwatershed Baseline	3,057	16.39	4,176	665	2,265	-	-		1,247	1,886	3,359	(845)	618	0.75%	0.202	29.85%	14.81%	49.61%		
3/4 inch diversion pervious limited to K_{sat}	3,057	16.39	4,176	665	2,054	-	211		1,458	1,883	3,359	(829)	810		0.265	34.90%	19.40%	55.59%	192	31.03%
3/4 inch diversion impervious	3,057	16.39	4,176	665	989	1,277	-		1,247	1,886	3,359	(845)	1,895		0.620	29.85%	45.37%	152.01%	1,277	206.39%
3/4 inch diversion impervious and pervious	3,057	16.39	4,176	665	778	1,277	211	1,488	1,247	1,886	3,359	(845)	2,087		0.683	29.85%	49.97%	167.40%	1,468	237.42%
Compton Creek Subwatershed Baseline	26,911	13.61	30,521	6,285	16,415	-	-		7,822	25,269	30,180	(1,639)	4,548	6.56%	0.169	25.63%	14.90%	58.15%		
3/4 inch diversion pervious limited to K_{sat}	26,911	13.61	30,521	6,285	15,598	-	814		8,638	25,213	30,180	(1,606)	5,277		0.196	28.30%	17.29%	61.09%	729	16.02%
3/4 inch diversion impervious	26,911	13.61	30,521	6,285	5,747	10,668	-		7,822	25,269	30,180	(1,639)	15,216		0.565	25.63%	49.85%	194.54%	10,668	234.54%
3/4 inch diversion impervious and pervious	26,911	13.61	30,521	6,285	4,933	10,668	814	11,482	7,822	25,269	30,180	(1,639)	15,945		0.592	25.63%	52.24%	203.86%	11,396	250.56%
Sepulveda Basin subwatershed Baseline	92,560	19.37	149,426	20,698	69,893	-	-		58,836	78,680	144,158	(33,363)	26,720	22.56%	0.289	39.37%	17.88%	45.41%		
3/4 inch diversion pervious limited to K_{sat}	92,560	19.37	149,426	20,698	54,715	-	15,166		74,013	78,121	144,158	(32,468)	40,443		0.437	49.53%	27.07%	54.64%	13,724	51.36%
3/4 inch diversion impervious	92,560	19.37	149,426	20,698	41,818	28,075	-		58,836	78,680	144,158	(33,363)	54,795		0.592	39.37%	36.67%	93.13%	28,075	105.07%
3/4 inch diversion on both impervious & pervious	92,560	19.37	149,426	20,698	26,652	28,075	15,166	43,241	58,836	78,680	144,158	(33,363)	68,518		0.740	39.37%	45.85%	116.46%	41,799	156.43%

all numbers are water year averages calculated or from 50yr data | negative numbers in parentheses

Other Watersheds

	Acres	Precip Inches	Precip AF	Canopy Bare Surface Evaporation AF	Runoff AF	Runoff Diversion Impervious AF	Runoff Diversion Pervious AF	Total Runoff Diversion AF	Infiltration AF	Irrigation AF	ET AF	Change in Soil Moisture AF	Deep Percolation AF	Area of total	Deep Perc (AF) /Acre	Infil / Precip	Deep / precip	Deep / Infil	Deep Increase	Deep Perc Increase
Ballona Creek Watershed	70,121	17.06	99,713	15,831	58,850	-	-		25,032	58,306	76,679	(6,140)	12,800	100.00%	0.183	25.10%	12.84%	51.13%		
3/4 inch diversion pervious limited to K_{sat}	70,121	17.06	99,713	15,831	52,069	-	6,765		31,813	57,810	76,679	(5,834)	18,778		0.268	31.90%	18.83%	59.03%	5,978	46.70%
3/4 inch diversion impervious	70,121	17.06	99,713	15,831	28,900	29,950	-		25,032	58,306	76,679	(6,140)	42,750		0.610	25.10%	42.87%	170.78%	29,950	233.98%
3/4 inch diversion on both impervious & pervious	70,121	17.06	99,713	15,831	22,134	29,950	6,765	36,715	25,032	58,306	76,679	(6,140)	48,728		0.695	25.10%	48.87%	194.66%	35,928	280.68%
Dominguez Channel	74,156	13.19	81,533	16,231	46,642	-	-		18,660	56,329	74,904	(9,497)	9,581	100.00%	0.129	22.89%	11.75%	51.35%		
3/4 inch diversion pervious limited to K_{sat}	74,156	13.19	81,533	16,231	42,901	-	3,732		22,400	55,909	74,904	(9,177)	12,583		0.170	27.47%	15.43%	56.17%	3,001	31.32%
3/4 inch diversion impervious	74,156	13.19	81,533	16,231	18,311	28,331	-		18,660	56,329	74,904	(9,497)	37,912		0.511	22.89%	46.50%	203.18%	28,331	295.69%
3/4 inch diversion on both impervious & pervious	74,156	13.19	81,533	16,231	14,579	28,331	3,732	32,063	18,660	56,329	74,904	(9,497)	40,914		0.552	22.89%	50.18%	219.26%	31,332	327.02%

all numbers are water year averages calculated or from 50yr data | negative numbers in parentheses

THE LOS ANGELES & SAN GABRIEL RIVERS WATERSHED COUNCIL
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