Supporting Document No. 14
Item No. 6
November 10, 2010

DRAFT MEMORANDUM

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STETSON ENGINEERS INC.

TO:	Jeremy Jungreis	DATE:	October 1, 2010
FROM:	Stetson Engineers	JOB NO:	2197-5000-5001AC
RE:	Comments on Tentative Order R9-2010-0016		

RWQCB Order R9-2010-0016 (Order) does not specifically address the quantities of water that may be lost from baseflows due to the impact of implementing on-site retention and infiltration of rainfall. However, by specifying the 85th percentile, 24-hour rainfall event as the standard for on-site retention (p. 33), the Order assures that significant amounts of rainfall may be captured. The impact to baseflows will depend on how widely LID retrofits are implemented, and on the size of the projects' drainage areas. The example below illustrates how streamflow may be affected in the Murrieta Creek sub-watershed of the Santa Margarita River watershed.

At the Wildomar rainfall station, located in Riverside County near the western boundary of the Murrieta Creek sub-watershed, the 85^{th} percentile, 24-hour rainfall amount is about 0.8 inch. This station averages rainfall of about 14.0 inches per year. Two recent water years (WY) were reviewed in order to roughly estimate the amount of rainfall that would be captured by on-site LID detention designed for the 85^{th} percentile rainfall. At the Wildomar station, WY 2003 was an above-average year, with 18.3 inches of rain. WY 2006 was a below-average year, with 7.4 inches of rain. In WY 2003 and 2006, the total measured streamflow at the Murrieta Creek streamflow gaging station (USGS 11043000, Murrieta Creek at Temecula) was 14,831 acre-feet and 5,523 acre-feet, respectively.

The impact to streamflow from the Order will depend upon the total drainage area of existing development that is retrofitted with on-site LID stormwater capture. The total area and types of developments are not known, but an example is provided here to illustrate potential impacts to streamflow in the Murrieta Creek drainage.

The net loss of streamflow due to LID retrofit projects depends on the proportion of rainfall that is lost on-site to groundwater infiltration and evapotranspiration compared to how much rainfall became surface water runoff to streams. This percentage, known as the runoff coefficient, depends on the soil type, land cover, slope, and antecedent conditions of a particular site. Each area that undergoes a LID retrofit will have a runoff coefficient associated with it that is determined by its site-specific conditions. The impact associated with retrofitting a 1,000-acre commercial area in the Murrieta Creek sub-watershed with LID is discussed as an example. Rainfall amounts from WY 2003 are used in this example.

A typical estimate of the runoff coefficient[1] for a commercial site is 0.5, meaning 50% of rainfall will infiltrate or evaporate, and 50% will run off as surface water (Caltrans, 2008). Prior to LID retrofit, the quantity of surface water runoff from this area in WY 2003 was 760 acre-feet (50% of the 18.3 inches, applied to 1,000 acres). With LID in place, the first 0.8 inches of rainfall from each event is assumed to be captured and infiltrated on-site. The remainder of the rainfall is assumed to infiltrate and run off following the same runoff coefficient of 0.5. In WY 2003, about 6.5 inches of rainfall would be captured and infiltrated by LID measures; of the remaining 11.8 inches of rainfall, 5.9 would also infiltrate, and 5.9 inches would become surface runoff. This equates to an annual surface water runoff volume of 490 acre-feet. The result of LID is a 270 acre-feet net reduction in surface water runoff downstream of the LID site. For comparison, this amount equates to 2% of the flow at the Murrieta Creek gage for WY2003. The rainfall, infiltration, and runoff volumes are given in Table 1. Figure 1 also shows the infiltration and runoff depths before and after implementation of LID measures.

If the same assumptions are applied to the 1,000-acre commercial area using WY 2006 rainfall, 5.8 inches of the total 7.4 inches of rainfall would be captured by LID measures. However, in this case, the runoff coefficient is assumed to be 0.25, in order to account for the dry conditions. Dry antecedent conditions mean a higher percentage of rainfall would infiltrate. The pre-LID runoff quantity is 155 acre-feet, while the post-LID runoff quantity is 33 AF, resulting in a net reduction of 120 acre-feet of surface water flows immediately downstream of the site. Compared to the total flow at the Murrieta stream gage, the additional water infiltrated on-site amounts to 2% of the total flow at the gage for WY 2006. The rainfall, infiltration, and runoff volumes are given in Table 1. Figure 2 also shows the infiltration and runoff depths

[1] The runoff coefficient is a simplified concept intended to be used with the rational method, generally used to calculate single-event storm runoff. The coefficient is used here in lieu of a more sophisticated daily model, which would account for antecedent moisture conditions. However, for this general, order-of-magnitude-level analysis, the runoff coefficient provides a simple estimate of annual runoff volumes.

before and after implementation of LID measures. The net reduction in surface water flows could be higher if larger areas of existing development are retrofitted with LID or if the sites have higher runoff coefficients.

The policy of promoting on-site infiltration in the upper Santa Margarita River watershed will reduce surface water flows to Camp Pendleton. In the 1950s and 1960s, groundwater pumping in the upper Santa Margarita basin led to a disconnection between the upper basin and the lower basin (the limit between the two is the Temecula Gorge). This is demonstrated by Figure 3, which shows the decline in baseflows in the River at the Gorge. Because of this disconnection, increasing infiltration in the upper groundwater basin will increase groundwater storage in the upper basin, but none of this water will be conveyed to the lower watershed. Instead, additional water infiltrated on-site by the proposed Order will be retained for use by groundwater pumpers upstream of Camp Pendleton. The Base's ability to exercise its water right to use water from the Santa Margarita River will likely be impacted from diminished surface water flows resulting from the proposed Order.

Reference

California Department of Transportation (Caltrans) Highway Design Manual. 2008. Chapter 810 Hydrology. Updated July 1, 2008. Sacramento, CA.

TABLE 1. SUMMARY OF INFILTRATION AND RUNOFF FOR 1,000-ACRE COMMERCIAL AREA, BEFORE AND AFTER IMPLEMENTATION OF LID

[1]	[2]	[3]	[4]		[5]	[6]	[7]		[8]
Water Year	Total Rainfall at Wildomar	Runoff Coef-ficient	Pre-LID Runoff		Rainfall Depth Captured by LID	Additional Infil-tration	Post-LID Runoff		Net Change in Surface Runoff
			Depth	Volume			Depth	Volume	
	(inches)	(--)	(in)	(AF)	(in)	(in)	(in)	(AF)	(AF)
2003	18.3	0.50	9.1	760	6.5	5.9	5.9	490	-270
2006	7.4	0.25 [a]	3.7	155	5.8	1.2	0.4	35	-120

Column Descriptions:

[1] Water year: October 1 through September 30, 2010

[2] From daily data obtained from the Riverside County Flood Control and Water Conservation District; average annual amount is 14.0 inches.

[3] Estimated proportion of rainfall that becomes surface runoff; Range of values from Caltrans (2008) is 0.50 to 0.70 for a "neighborhood business district"; 0.50 was used for normal to wet hydrology but was reduced as described in note "a" for dry conditions.

[4] Total runoff from developed site, prior to LID retrofit, equal to the runoff coefficient in [3] multiplied by [2]; converted to a volume by multiplying by (1 ft/12 in) and multiplying by the area of the site, 1,000 acres.

[5] Rainfall depth captured by LID measures, assuming design volume equal to the 85th percentile, 24-hour rainfall, which is 0.8 inches for Wildomar. Capture rainfall was determined by examining the daily rainfall record for the water year and assuming the first 0.8 inches of each event is captured on-site. Converted from depth to volume by multiplying by (1 ft/12 in) and multiplying by the area of the site, 1,000 acres.

[6] Quantity of rainfall, after LID capture, which is infiltrated: ([2] – [5])* [3]

[7] Surface water runoff from the developed side, with LID implementation, equal to [2] – [5] – [6]. Converted from depth to volume by multiplying by (1 ft/12 in) and multiplying by the area of the site, 1,000 acres.

[8] Net change in surface runoff volume from the site: [4] – [7]

Note:

a. For WY 2006, the textbook value of 0.50 for a commercial site was reduced to 0.25 to account for antecedent conditions during the below-normal rainfall conditions of that water year. The rational method runoff coefficient does not account for antecedent soil conditions.

FIGURE 1. INFILTRATION AND RUNOFF DEPTHS FOR 1,000-ACRE LIGHT COMMERCIAL AREA FOR WY 2003

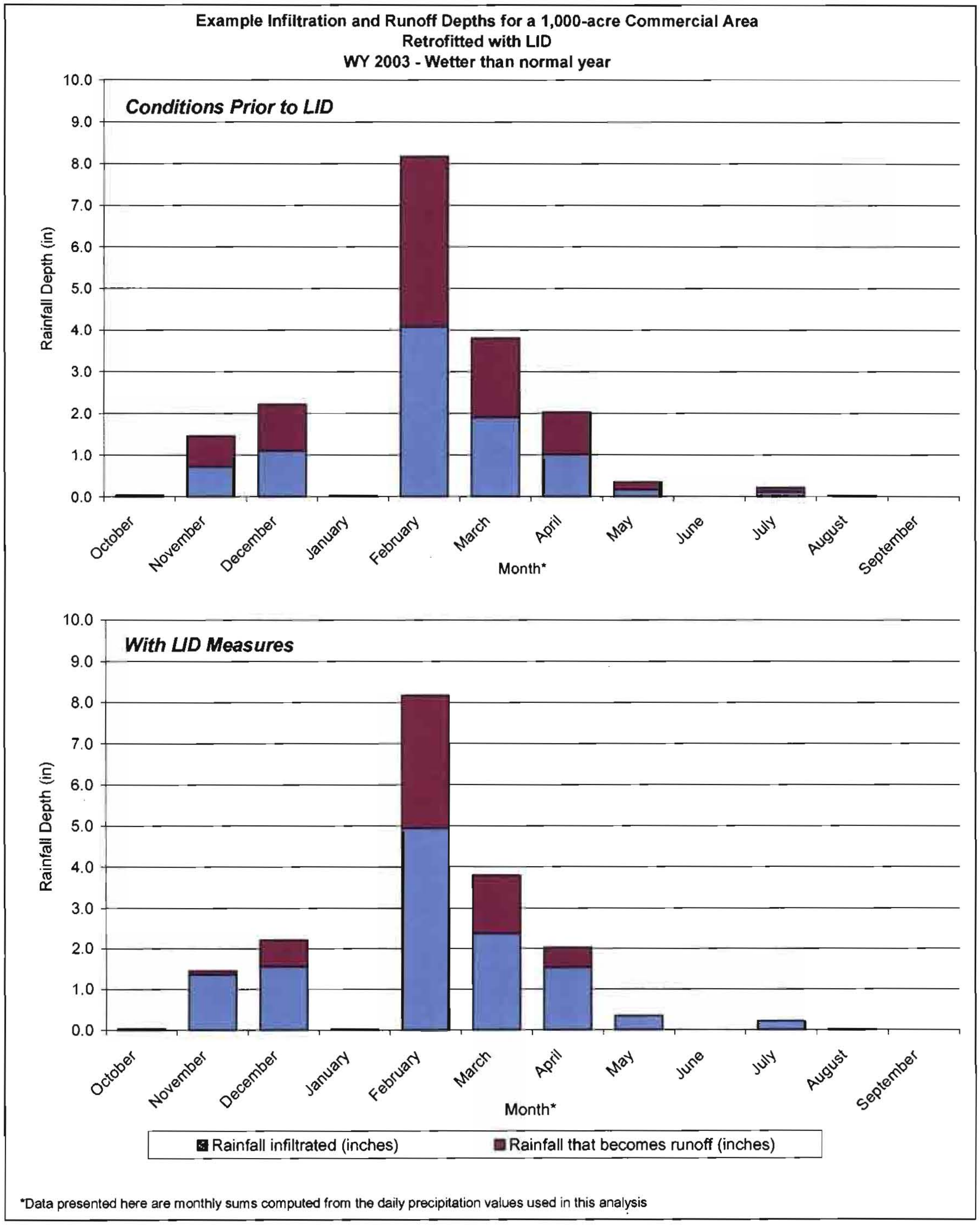


FIGURE 2. INFILTRATION AND RUNOFF DEPTHS FOR 1,000-ACRE COMMERCIAL AREA FOR WY 2006

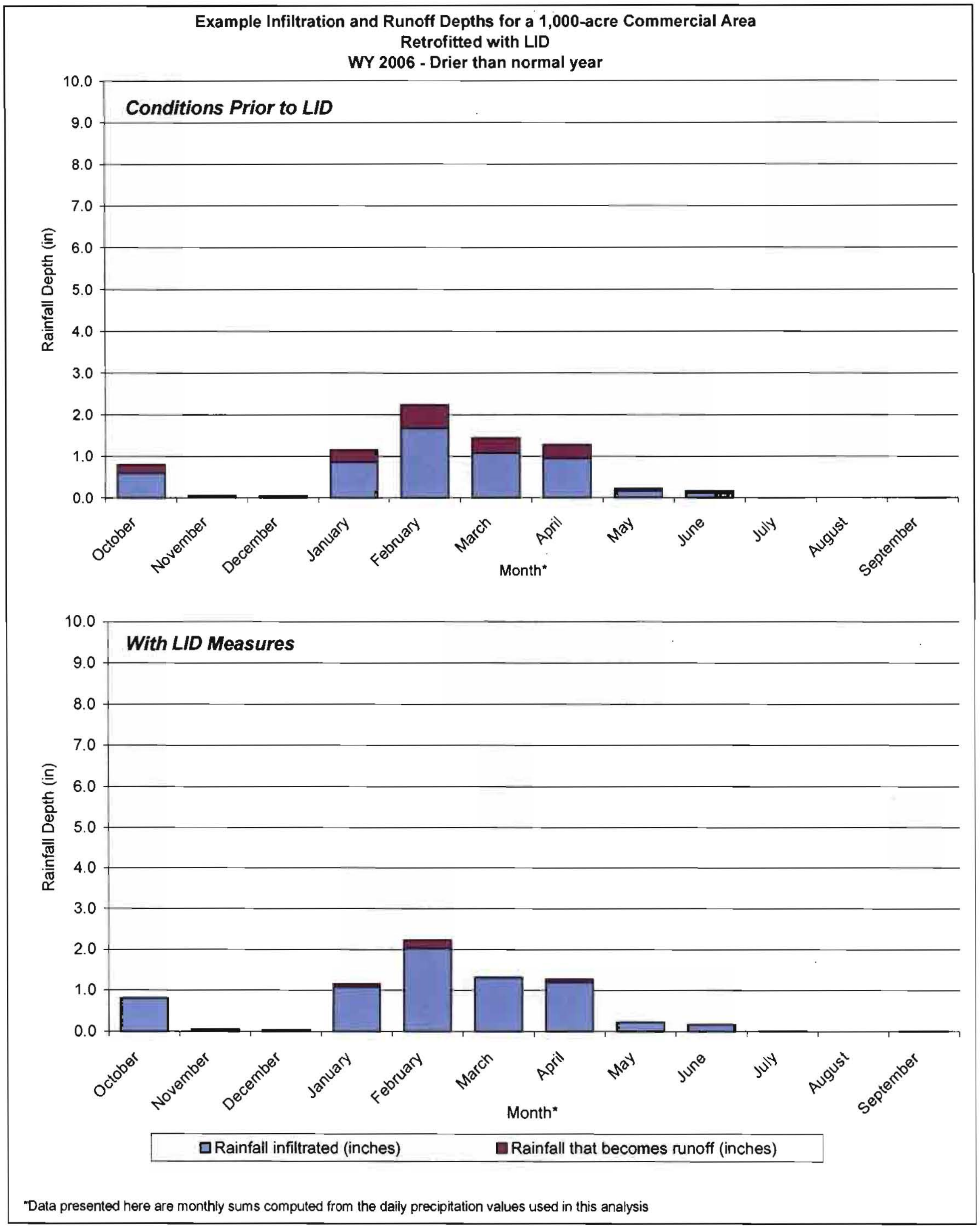
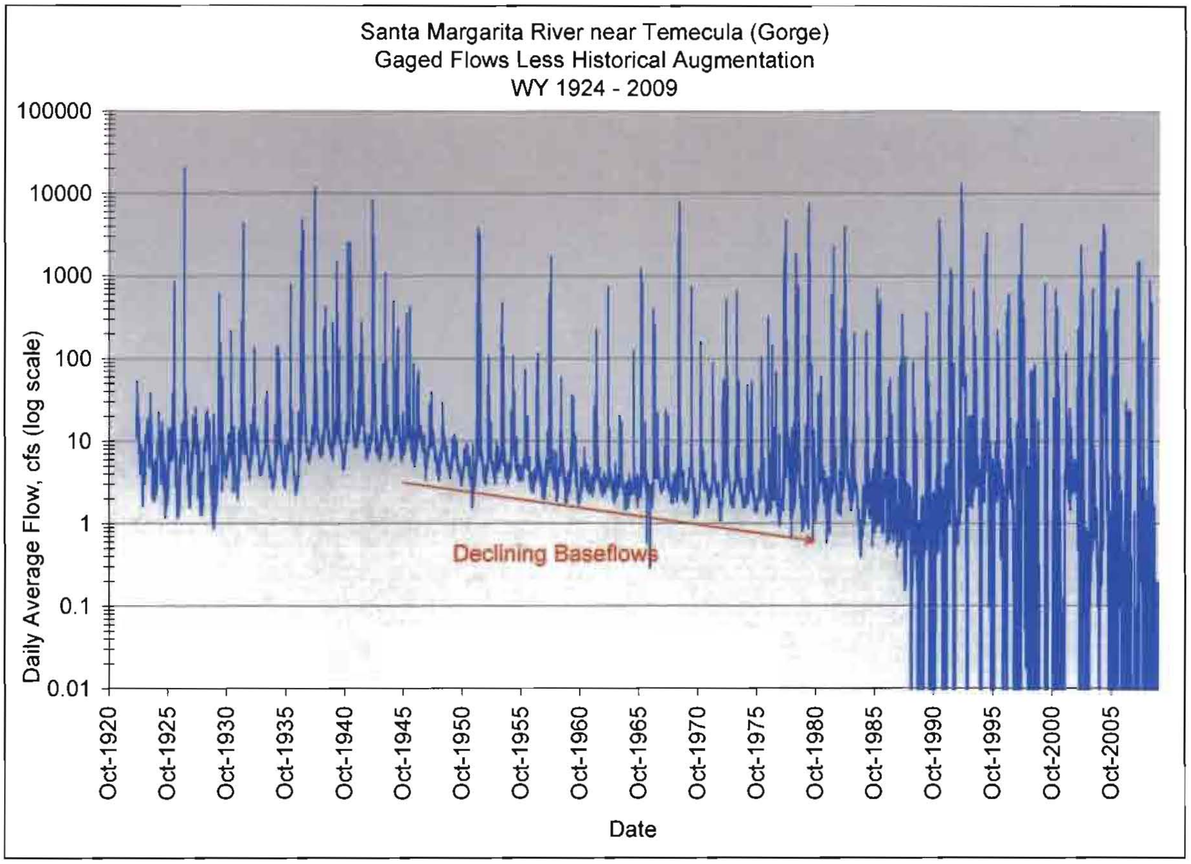


FIGURE 3. NON-AUGMENTED FLOW AT THE SANTA MARGARITA RIVER GORGE



ALTERNATIVES BELOW ARE BASED ON THE LANGUAGE IN THE TENTATIVE ORDER

Preferred Language

(c) LID BMPs sizing criteria:

(i) LID BMPs must be sized and designed to ensure onsite retention without runoff, of the volume of runoff produced from a 24-hour 85th percentile storm event[1] ("design capture volume");

(ii) If onsite infiltration LID BMPs are technically infeasible per section F.1.d.(7)(b), other LID BMPs may treat any volume that is not retained onsite provided that the other LID BMPs are sized to hold the design storm volume that is not infiltrated. The LID BMPs must be designed for an appropriate surface loading rate to prevent erosion, scour and channeling within the BMP.

Alternate Language #1

From section F.1.d.

(d) LID BMPs sizing criteria:

(i) LID BMPs must be sized and designed to ensure onsite retention without runoff, of the volume of runoff produced from a 24-hour 85th percentile storm event[2] ("design capture volume") that is in excess of the runoff from the pre-development site;

(ii) If onsite ~~infiltration~~ retention LID BMPs are technically infeasible per section F.1.d.(7)(b), other LID BMPs may treat any volume that is not retained onsite. Due to the flow through design of non-retention LID BMPs, the total volume of the BMP, including pore spaces and pre-filter detention volume, must be sized to hold at least 0.75 times the portion of the design capture volume that is not retained onsite by LID retention BMPs. ~~provided that the other LID BMPs are sized to hold the design storm volume that is not infiltrated~~. The LID BMPs must be designed for an appropriate surface loading rate to prevent erosion, scour and channeling within the BMP.

Alternate Language #2

From section F.1.d.

(c) LID BMPs sizing criteria:

(i) LID BMPs must be sized and designed to ensure onsite retention without runoff, of the volume of runoff produced from a 24-hour 85th percentile storm event[3] ("design capture volume");

(ii) If onsite ~~infiltration~~ retention LID BMPs are technically infeasible per section F.1.d.(7)(b), other LID BMPs may treat any volume that is not retained onsite. Due to the flow through design of non-retention LID BMPs, the total volume of the BMP, including pore spaces and pre-filter detention volume, must be sized to hold at least 0.75 times the portion of the design capture volume that is not retained onsite by LID retention BMPs. ~~provided that the other LID BMPs are sized to hold the design storm volume that is not infiltrated~~. The LID BMPs must be designed for an appropriate surface loading rate to prevent erosion, scour and channeling within the BMP.

With concurrent changes to section F.1.d.(7)

(b) For each Priority Development Project participating, the Copermittee must find that it is technically infeasible to implement LID BMPs that comply with the requirements of Section F.1.(d)(4). The Copermittee(s) must develop criteria to determine the technical feasibility of implementing LID BMPs . Each Priority Development Project participating must demonstrate that LID BMPs were implemented as much as feasible given the site's unique conditions. Technical infeasibility may result from conditions including, but not limited to:

(i) Locations that cannot meet the infiltration and groundwater protection requirements in section F.1.c.(6) for large, centralized infiltration BMPs. Where infiltration is technically infeasible, the project must still examine the feasibility of other onsite LID BMPs;
(ii) Insufficient demand for storm water reuse;
(iii) Sites where full retention of the design capture volume would reduce runoff from the site below the pre-development conditions, or would otherwise conflict with hydromodification requirements, must still examine the feasibility of retaining that portion of the design capture volume that is in excess of the runoff from the pre-development site.
(iv) Smart growth and infill or redevelopment locations where the density and/or nature of the project would create significant difficulty for compliance with the LID BMP requirements; and
(v) Other site, geologic, soil, or implementation constraints identified in the Copermittees updated SSMP document.

Alternate Language #3

From section F.1.d.

(c) LID BMPs sizing criteria:

(i) LID BMPs must be sized and designed to ensure onsite retention without runoff, of the volume of runoff produced from a 24-hour 85th percentile storm event[4] ("design capture volume");

(ii) If onsite infiltration LID BMPs are technically infeasible per section F.1.d.(7)(b), other LID BMPs may treat any volume that is not retained onsite. Due to the flow through design of non-retention LID BMPs, the total volume of the BMP, including pore spaces and pre-filter detention volume, must be sized to hold at least 0.75 times the portion of the design capture volume that is not retained onsite by LID retention BMPs. ~~provided that the other LID BMPs are sized to hold the design storm volume that is not infiltrated~~. The LID BMPs must be designed for an appropriate surface loading rate to prevent erosion, scour and channeling within the BMP.

~~(iii)~~

(iii) The sizing criteria identified in section F.1.d.(4)(c)(i) above shall remain in effect until the completion of the special study identified in Attachment E, on the *Effects of LID retention of Downstream Hydrology.* At that time the following LID sizing criteria shall become effective unless the study has determined that the following criteria would be detrimental to downstream beneficial uses:

[a] LID BMPs must be sized and designed to ensure onsite retention without runoff, of the volume of runoff produced from a 24-hour 85th percentile storm event.

With concurrent addition to Attachment E, Section II.E. (in place of one of the other special studies)

Effects of LID Retention of Downstream Hydrology:

The Copermittees must conduct a study to assess if there will be any downstream hydrologic effects resulting from the full retention of the 24-hour 85th percentile storm runoff, that may negatively affect beneficial uses. The analysis should assess the potential effects on both habitat and municipal uses, and must be complete by XXXX. The Copermittees must implement the special study unless otherwise authorized in writing by the San Diego Water Board.

COOPERATIVE WATER RESOURCE MANAGEMENT AGREEMENT

between

CAMP PENDLETON

and

RANCHO CALIFORNIA WATER DISTRICT

March, 2002

COOPERATIVE WATER RESOURCE
MANAGEMENT AGREEMENT

1. Purpose. This Cooperative Water Resources Management Agreement ("Agreement") is between the United States, on behalf of Camp Pendleton (sometimes "Camp Pendleton"), and the Rancho California Water District, ("District"), and is effective upon approval of the Court. Certain terms used in this Agreement are defined in Exhibit "A" hereto, including a map of the Santa Margarita River watershed. At the present time, two Judgments affect the rights of the parties with respect to water supplies from the Santa Margarita River watershed. The first is a Stipulated Judgment in the case of Rancho Santa Margarita v. Vail, San Diego Superior Court Action No. 42850 ("1940 Judgment"). The second is the Judgment in the case of United States v. Fallbrook Public Utility District, Civ. No. 1247, S.D. Cal. ("Fallbrook Case"). However, these Judgments do not fully meet the needs of the parties for effective water management under present conditions. The meanings of certain provisions of the 1940 Judgment are also in dispute. The parties, therefore, propose to manage these water resources in a practical way that will meet their needs, consistent with the essential rights and obligations of the two Judgments, while avoiding potential conflicts over disputed provisions.

2. Term. Unless sooner terminated because of an uncured default as set forth in Section 15 below, this Agreement shall remain in effect for a minimum of 10 years

from its effective date, and until either party exercises its right to terminate as set forth in Section 16 below.

3. Incorporation in Fallbrook Case and Continuing Jurisdiction. The Agreement will be submitted to the Court for approval and incorporated by stipulation into the Fallbrook Case, pursuant to the Court's continuing jurisdiction therein, and will be administered by the Watermaster appointed by the Federal District Court, Southern District of California, by order dated March 13, 1989, or subsequent order. The Court shall retain continuing jurisdiction to make such further orders as may be necessary to interpret or enforce this Agreement, provided that the Court shall not have the power to modify the terms of this Agreement or the 1940 Judgment. If either party believes there is a substantial change of circumstances, the parties shall attempt to reach agreement as may be appropriate in light of the changed circumstances, or shall engage in mediation if agreement is not reached.

4. 1940 Judgment. The United States is the successor in interest to the plaintiff Rancho Santa Margarita in the 1940 Judgment. The Rancho California Water District is a successor in interest to the defendants in the 1940 Judgment, and has certain rights and obligations under a 1978 Agreement between KACOR Realty and Rancho California Water District relative to Vail Lake. Both parties have certain rights and entitlements under the 1940 Judgment and are obligated to comply therewith. Without waiving their rights and entitlements under the 1940 Judgment, the parties

intend to forbear enforcing them for so long as this Agreement is in effect and being complied with. The parties realize that certain provisions of this Agreement differ from the 1940 Judgment. For example, the measurement of the flows required to be maintained under this Agreement will be accomplished at USGS Gage ID No. 11044000 on the Santa Margarita River near Temecula ("the Gorge"), and those guaranteed flows to Camp Pendleton are in terms of usable flows, including habitat maintenance flows, instead of total flows. Without waiving any of their rights and entitlements under the 1940 Judgment, the parties agree that, to the extent provisions of this Agreement are inconsistent with the 1940 Judgment, the provisions of this Agreement shall control for so long as this Agreement is in effect and being complied with. The parties agree further that, so long as this Agreement is in effect and is being complied with, neither party will undertake any proceeding with respect to the 1940 Judgment against the other, either judicially or administratively. Should either party fail to comply with this Agreement, or should it expire or be terminated, the parties preserve their respective rights to enforce the 1940 Judgment against each other, as each interprets it, and the provisions of this Agreement shall not be used to supply meaning to the 1940 Judgment.

5. Guaranteed Flows at the Gorge.

(a) The parties have developed a Groundwater Model, which indicates that the simulated total natural streamflow at the Gorge over the period 1935-1998 would have averaged 30.35 cfs, without diversions or pumping. For the purpose of establishing flow requirements, the daily natural streamflow at the Gorge was simulated using the Hydrologic Simulation Program Fortran (HSPF) model developed by Camp Pendleton and reviewed by both parties. Both models are more fully described in Exhibit "B" hereto. Flows at the Gorge, as set forth in the table on page 5, are based on two-thirds of the median natural flow during very wet, above normal, below normal, and critically dry conditions. Daily flow values for very wet and critically dry conditions are based on the daily median flows for the periods 1937 to 1946 and 1957 to 1966, respectively. Above normal flows are based on the mean of the median of very wet flows and the median of all flows for the period 1931-1996. Similarly, below normal flows are based on the mean of the median of critically dry flows and the median of all flows for the period 1931-1996. This methodology eliminates the large storm flows from the calculation of required flows for Camp Pendleton (two-thirds of natural flow), and results in average annual flows ranging from 3.6 cfs to 15.6 cfs, with a median flow of 8.8 cfs for the period 1931-1996. The results of the modeling efforts and the above calculations are shown on the following table:

	Critically Dry Flow	Below Normal Flow	Above Normal Flow	Very Wet Flow
Month	cfs	cfs	cfs	cfs
Jan - April	4.5	8.0	17.8	24.1
May	3.8	5.7	11.7	15.7
June	3.3	4.9	9.4	12.2
July	3.0	4.3	7.8	9.7
August	3.0	4.4	7.6	9.2
September	3.0	4.1	7.4	9.4
October	3.0	3.9	7.7	10.1
November	3.0	4.5	8.8	11.5
December	3.3	5.3	10.4	13.5

The hydrologic conditions described in the table above are derived from a hydrologic index combining the October through April natural streamflow at the Murrieta Creek gage, and the October through April natural streamflow at Vail Lake. Natural flow at Murrieta Creek is calculated using the rainfall/run-off relationship between rainfall at Wildomar and the HSPF natural flow at Murrieta Creek. Natural flow at Vail Lake is calculated using the run-off correlation between Aguanga streamflow and inflow to Vail Lake during the period water years 1958 to 1996.

On May 1st of each year the October through April rainfall at Wildomar is used to estimate natural flow at Murrieta, and the October through April measured streamflow at Aguanga is used to estimate natural flow at Vail Lake. A simple computer spreadsheet, maintained and operated by the Technical Advisory Committee ("TAC"), adjusts for antecedent conditions and calculates the hydrologic index based on these input parameters. The computer spreadsheet is more fully described in Exhibit "C" hereto. Once the hydrologic condition is determined, the above table is then used to prescribe the flows at the Gorge.

Recognizing the seasonal variations in such flows that naturally occur under different hydrologic conditions, it is agreed that the District hereby guarantees winter and monthly minimum average flows at the Gorge as hereinafter provided. Full implementation of such guarantee requires the construction of certain facilities, which the District agrees to construct as expeditiously as possible. Any make-up obligations in excess of 3.0 cfs shall commence upon completion of such facilities, but in no event later than June 1, 2002, unless precluded by law.

(b) The winter period includes the months of January through April. For the winter period, minimum daily flow requirements are: 11.5 cfs for very wet and above normal conditions; 8.0 cfs for below normal conditions; and 4.5 cfs for critically dry conditions. Notwithstanding the foregoing, in the first winter period following the effective date of this Agreement, the minimum daily flow requirement is 11.5 cfs, calculated on a 10 day running average. The District shall provide whatever make-up water is needed to meet this requirement. On May 1st immediately following the first winter period, and on each May 1st thereafter, the hydrologic condition for the immediately preceding October-April period shall be determined. Such condition, and the daily flow requirements set forth in this Section 5(b), shall be used to determine the actual flow requirement for the prior winter period, and whether this requirement was exceeded. In providing minimum daily flows of 11.5 cfs during the first winter period, if the District has provided make-up water in excess of its actual requirement, the District shall be entitled to a credit for such excess. The quantity of the excess flow shall be converted to a cfs equivalent, and applied during the following winter periods to reduce the 11.5 cfs requirement. In all years following the first winter period, the same procedure shall be followed, provided that the minimum daily flow requirement for each winter period shall be 11.5 cfs, less any credit unused in a previous year, and less any credit established by the May 1st accounting of the prior year.

(c) The non-winter period includes the remaining months of May through December. Minimum daily flow requirements, calculated on a 10 day running average, for the non-winter months are provided by the above table, based upon the particular hydrologic condition established on May 1st for the prior October-April period; provided that the 10 day average shall begin on the 11th day of each month. The District shall provide whatever make-up water is required to meet these monthly requirements.

(d) Notwithstanding any provision to the contrary, the District shall not be required to provide more than the equivalent of 11.5 cfs make-up water for any month.

(e) When the District is required under this Section to provide make-up water in any calendar year in excess of 4000 acre feet, measured at the Gorge, it shall be entitled to a credit for the excess, taking into account transmission losses, to be applied during the following two winter periods. Any deliveries pursuant to Section 17 are outside of, and in addition to, this subsection. The United States shall have the option of eliminating the District's credit in this subsection by the United States, or its designee, paying the District a cash amount equal to The Metropolitan Water District of Southern California's then current price for untreated water.

(f) Notwithstanding any provision to the contrary, the District guarantees that flows, based upon a 10 day running average, shall at no time be less than 3.0 cfs, and this obligation is independent of the construction of any facilities.

(g) Camp Pendleton, with the cooperation of the District, shall institute a monitoring program to assess the impacts of the parties' operations under this Agreement on the water supply, water quality and riparian habitat within Camp Pendleton. If adverse impacts are observed or if notice of such impacts is provided to Camp Pendleton by the Environmental Protection Agency, Fish and Wildlife Service, or other monitoring agencies, the District will cooperate with Camp Pendleton to assess operations under this Agreement to determine whether and what changes may be needed to remedy such impacts. The District agrees to participate in good faith in appropriate watershed protection or watershed planning activities aimed at preserving water quality, enhancing watershed recharge, and encouraging watershed conservation within the Santa Margarita River watershed.

6. Makeup Water. Compliance with the requirements of Section 5 shall be based upon actual flow measurements as recorded by the USGS gage at the Gorge. Any losses of makeup water incurred between the point of discharge by the District and the Gorge shall be borne by the District, and shall not diminish the United States' entitlement, as measured at the Gorge. Makeup water which the District may be required to release at the Gorge in order to comply with the requirements of Section 5 may be supplied at its option from: (1) its wells upstream of the Gorge; (2) flows from its Live Stream Discharge Project subject to the provisions of the NPDES Permit and Section 9 below; (3) deliveries from its domestic water system; (4) deliveries of imported water from The Metropolitan Water District of Southern California; (5) or Vail Reservoir. With the consent of Camp Pendleton, the District may substitute treated water by exchange or direct delivery to Camp Pendleton for flow at the Gorge. Makeup water that the District releases to the stream shall meet all requirements of the California Water Quality Control Board, San Diego Region, and shall not cause a violation of any rule, regulation, standard or objective established by federal, state, or

local enforcement agencies, including but not limited to the federal and state Safe Drinking Water Acts.

7. Safe Yield Operation.

(a) The District agrees to manage its pumping of the "natural supply of groundwater" in the area upstream of the Gorge on a "safe yield" basis. The term "natural supply of groundwater" as it is used herein includes all return flows that recharge the groundwater supply, including return flows from imported and reclaimed water. "Safe yield" recognizes that groundwater levels will fluctuate during hydrologic cycles, and that amounts of pumping may also vary from year to year, but that the District's pumping over time will not cause damage to the aquifers. The District's demands in excess of safe yield will be met from imported or reclaimed water supplies.

(b) In addition to its pumping of the natural supply, the District shall be entitled to pump such amounts of direct import water recharge and direct reclaimed water recharge as may have been percolated and stored underground by way of the VDC operations or other direct recharge facilities.

(c) So long as the quantity of groundwater extracted by the District, including makeup and emergency water provided hereunder, does not exceed safe yield as set forth above, and subject to Section 19 of this Agreement, there are no restrictions on the number of wells which the District may operate, where they may be located, the aquifers from which they may draw water, or the amounts of groundwater which may be pumped from each well.

(d) The District, with the cooperation of Camp Pendleton, shall install and maintain a multi-level monitoring network to obtain additional data which, when reviewed with the data from the surface monitoring system, may be used to assess safe-yield operations. The District, in consultation with Camp Pendleton, shall update the Groundwater Model from time to time but in no event less frequently than every five years. The Groundwater Model will be updated with current data and such other improvements as may be appropriate, and shall be utilized to monitor conditions, and to indicate whether adjustments to the District's pumping are required to operate within the safe yield of the basin.

8. Vail Dam and Reservoir.

(a) The District holds Permit 7032 from the State Water Resources Control Board for the construction and operation of Vail Dam and Reservoir. The Reservoir will be operated in accordance with such permit, as amended by the District's current application on file with the Board. The District's operations of the Reservoir are also constrained by its agreement with KACOR Realty, Inc., dated April 28, 1978, with respect to recreation levels in the Reservoir. The United States is not a party to this KACOR agreement and disputes the applicability of the Vail Lake recreational pool limit to the United States. The District agrees, in accord with the Mahlon Vail letter dated October 6, 1947, that its yield from the Reservoir and all losses including net evaporation are chargeable against its one-third share under the 1940 Judgment. Moreover, the District agrees that the pumping of water that has been released from the Reservoir and has percolated underground downstream shall be a part of, and not an addition to, the natural supply and safe yield of the basin.

(b) The United States on behalf of Camp Pendleton only will withdraw without prejudice the protest filed with the State Water Resources Control Board to the District's Permit 7032 change petition, provided that if this Agreement should be terminated, the United States shall have the right to reinstitute its protest, and any Permit amendments shall be conditioned upon such right. The United States will also seek dismissal of the case entitled United States of America v. Rancho California Water District, Riverside County Superior Court, Case No. EO 14837, Court of Appeal, Fourth Judicial District, Case No. 229096, each side to bear its own costs and attorneys fees. Except as allowed under Permit 7032, or any license confirming such rights, the District agrees that it will not seek rights from the State Water Resources Control Board, or otherwise, to store natural surface water flows of the Santa Margarita River or its tributaries.

(c) On December 2, 1999 Vail Lake USA, LLC, as a claimed successor to KACOR Realty, Inc. under the April 28, 1978 Agreement with the District, gave notice to the District alleging that the District had failed to perform its obligations under the Agreement; that Vail Lake USA, LLC was exercising its claimed right of reversion; and that it intended to retake possession of Vail Dam and Reservoir, among other properties. The District disputes this claim, and believes that it is without merit. However, the District's rights and obligations under this Agreement stem in part from the acquisition of Vail Dam and Reservoir pursuant to the April 28, 1978 Agreement, and should Vail Lake USA, LLC be successful in its claim, it may be necessary to modify this Agreement section accordingly. The District agrees to oppose, and the United States shall take such action as it deems appropriate, any effort by Vail Lake USA, LLC, or its successor, through amendment of Permit 7032 or otherwise, to export any waters subject to such permit for use outside of the Santa Margarita River watershed, or otherwise to interfere with the historic use of such stored waters.

9. Live Stream Discharge Project. Subject to the provisions of the Four Party Agreement, or any amendments thereto, flows discharged to the stream by the District from its Santa Rosa Water Reclamation Facility pursuant to and in compliance with Order No. 96-54, NPDES Permit No. CA0108821, or any amendments thereto or extension thereof, shall be considered part of the flows at the Gorge to which the United States is entitled, and may be used to provide any makeup water required to meet such entitlements.

10. Monitoring. In addition to the monitoring programs required under Section 5(g) hereunder, the Watermaster appointed in the Fallbrook Case shall measure

and monitor both water flows and water quality at the Gorge, and shall incorporate into his reports the results of all monitoring programs provided for in this Agreement.

11. Use of Flows. The flows at the Gorge guaranteed herein, and any make up obligation by the District, shall be subject to the reasonable and beneficial use requirements of federal and California law. It is expressly recognized that the minimum flows set forth in Section 5 may be used to meet the ecological habitat maintenance requirements for the riparian corridor below the Gorge, and that such use constitutes a reasonable and beneficial use.

12. Upstream Pumping by Others. To the extent that it is legally capable, the District shall be responsible for controlling, if necessary, any pumping or diversions by non-federal entities within its boundaries. Except for any actions undertaken by any Indian tribe, band or community or any federal agency, and further excepting any actions affecting federal lands or the trust resources of any Indian tribe, band or community located within the Santa Margarita River watershed, the parties agree to act jointly, by judicial means or otherwise, to prevent any pumping or diversion upstream of the Gorge by others located outside of the boundaries of the District from adversely affecting flows at the Gorge. In any event, none of the pumping upstream of the Gorge shall affect the District's obligations set forth in Sections 5 and 6.

13. Annual Report. By March 31 of each year, the Watermaster shall prepare an annual report for filing in the Fallbrook case on the performance of this Agreement

during the prior water year. He shall consult with the TAC on the contents of such report.

14. Technical Advisory Committee. The TAC, which shall continue to include the Watermaster, will serve as a forum for discussion and cooperation between the parties as to the performance of this Agreement. The TAC will conduct the reviews described in Sections 5 and 7, and may also, with the approval of the parties, undertake such studies as may be useful in implementing the Agreement. Such studies may include, but are not limited to, updating and reviewing the performance of the Groundwater Model and the HSPF Model; evaluating safe yield; calculating transmission losses; groundwater conditions and any changes in groundwater storage; comparing actual data with the assumptions used in negotiating this Agreement; identifying any substantially changed hydrologic conditions within the watershed; and determining losses of any groundwater stored for the account of Camp Pendleton.

15. Default. Should either party fail to perform any portion of this Agreement, or otherwise breach any of its respective obligations under this Agreement, and upon notice of such breach or failure to perform, the party which is alleged to be in default shall cure its default within thirty days of receipt of notice, or within a reasonable time in the event more time is required. In the event of a dispute over the default, either party may apply to the Federal Court in the Fallbrook case, under its continuing jurisdiction, to obtain appropriate judicial relief. During the pendency of the court

proceedings, the party alleged to be in default shall continue to cure the default, unless otherwise directed by the court. If the alleged default has been totally or partially cured, but an actual default is not finally established by the court, the curing party shall be entitled to appropriate relief to compensate it for the expense of its total or partial cure. If the default is not cured or excused by the court, the other party shall be entitled to terminate the Agreement without further notice, notwithstanding any provision in Section 16. Once terminated, the covenant to forbear from enforcing rights under the 1940 Judgment as set forth in Section 4 above will no longer apply and either party may then undertake judicial or administrative proceedings with respect to the 1940 Judgment.

16. Termination. In addition to the right to terminate upon an uncured default as set forth in the preceding Section, either party shall have the right to terminate this Agreement with or without cause upon two years written notice; provided, however, that in no event shall the right to terminate under this Section be exercised prior to ten years after the effective date of this Agreement, including the two years notice. Once terminated, the covenant to forbear from enforcing rights under the 1940 Judgment as set forth in Section 4 above will no longer apply, and either party may then undertake judicial or administrative proceedings with respect to the 1940 Judgment.

17. Emergency Supplies. In the event that the Commanding General of Camp Pendleton declares a water supply emergency based upon a drought affecting the water

supply to Camp Pendleton and its riparian habitat corridor, or upon mobilization demands requiring additional potable water supplies for Camp Pendleton, and upon agreement of the parties or approval of the Court, the District will: (1) work with Camp Pendleton to acquire untreated water from the San Diego Aqueduct of The Metropolitan Water District of Southern California, and discharging such water into the Santa Margarita River or its tributaries; (2) deliver water in the amount of any groundwater held by Camp Pendleton in the basin upstream of the Gorge into the Santa Margarita River at the Gorge; or (3) assist in supplying treated water directly or by exchange to Camp Pendleton. Camp Pendleton may acquire rights to such groundwater above the Gorge by foregoing its right to makeup water from the District; or to the extent that the District's actual flow maintenance requirements are less than the flows in the table in Section 5; provided: (1) that Camp Pendleton's rights to such groundwater in storage shall not exceed 5000 acre-feet at any one time; and provided further: (2) that the District's obligation to deliver stored groundwater shall not exceed 2200 acre-feet per year over any required makeup obligation which the District may have, and in no event at a rate in excess of 11.5 cfs. Any such groundwater held in the basin for the account of Camp Pendleton shall be subject to a proportionate share of losses. All governmental approvals required to discharge either Metropolitan Water District water or stored groundwater into the river, pursuant to this Section, shall be the responsibility of Camp Pendleton.

18. Use of River Channel. With respect to the flow requirements under Section 5 and the emergency surplus delivered to the Gorge under Section 17, it is the Parties' express intent that the natural channel of the Santa Margarita River serve as a conduit for delivery of those flows to Camp Pendleton.

19. Federal and Indian Water Rights. This Agreement is entered into by the United States solely on behalf of Camp Pendleton and not on behalf of any other federal agency or in any other capacity, including, but not limited to, its capacity as trustee for any Indian tribe, band or community. Nothing in this Agreement may affect the water quality, water rights or the water rights claims of any Indian tribe, band or community or federal agency located within the Santa Margarita River watershed, or of the United States acting on their behalf.

20. Representations and Warranties. The parties to this Agreement represent and warrant as follows:

(a) The parties affirm that the representatives executing the Agreement are empowered to do so and thereby bind the respective parties, and that there is no other condition to be satisfied or approval to be secured from any governmental or quasi-governmental agency or body in order to execute this Agreement;

(b) Each party affirms its present competence to enter into the settlement provided for in this Agreement, with respect to the advisability of executing this Agreement, and with respect to its meaning;

(c) Each party affirms that, as of the effective date of this Agreement, each has not previously assigned or transferred in any manner, or purported to have assigned or transferred in any manner, any of the claims set forth in this Agreement;

(d) No party is relying upon any statement, representation or promise of any other party or any officer, director, agent, partner, employee, consultant, representative or attorney of or for any other party in executing this Agreement or in making the settlement provided for, except as expressly stated in this Agreement and admissible to interpret the Agreement.

21. Successors-in-Interest and Assigns. Subject to any restriction on transferability contained in this Agreement, this Agreement shall be binding upon and shall inure to the benefit of the successors-in-interest and assigns of each party to this Agreement. Nothing in this Section shall create any rights enforceable by any person not a party to this Agreement, except for the rights of the successors-in-interest and assigns of each party to this Agreement, unless such rights are expressly granted in this Agreement to other specifically identified persons.

22. Integration. This Agreement is an integrated agreement and constitutes the entire Agreement between the parties and supersedes all prior and contemporaneous oral and written agreements and discussions.

23. Modification in Writing. This Agreement may be modified only by a writing executed by the parties to this Agreement against whom enforcement of such modification is sought.

24. Drafting Ambiguities. Each party to this Agreement and its counsel have reviewed and revised this Agreement. The rule of construction that any ambiguities are to be resolved against the drafting party shall not be employed in the interpretation of this Agreement or of any amendments or exhibits to this Agreement.

25. Partial Invalidity. Each provision of this Agreement shall be valid and enforceable to the fullest extent permitted by law. If any provision of this Agreement or the application of such provision to any person or circumstance shall, to any extent, be invalid or unenforceable, the remainder of this Agreement or the application of such provision to persons or circumstances other than those as to which it is held invalid or unenforceable, shall not be affected by such invalidity or unenforceability, unless such provision or such application of such provision is essential to this Agreement.

26. Waiver. Any waiver of a default under this Agreement must be in writing and shall not be a waiver of any other default concerning the same or any other provision of this Agreement. No delay or omission in he exercise of any right or remedy shall impair such right or remedy or be construed as a waiver. A consent to or approval of any act shall not be deemed to waive or render unnecessary consent to or approval of any other or subsequent act.

27. Further Assurances. Each party to this Agreement shall execute all instruments and documents and take all actions as may be reasonably required to effectuate this Agreement.

28. Time of Essence. Time and strict punctual performance are of the essence with respect to each provision of this Agreement.

29. Headings. The headings of the Sections of this Agreement have been included only for convenience, and shall not be deemed in any manner to modify or limit any of the provisions of this Agreement, or be used in any manner in the interpretation of this Agreement.

30. Effectiveness. This Agreement shall become effective when it has been executed by all of the parties, and approved by the Court as provided in Section 3.

31. Anti-Deficiency Act. The parties to this Agreement recognize and acknowledge that any payment obligations of the United States on behalf of Camp Pendleton in satisfaction of this Agreement can only be paid from appropriated funds legally available for such purpose. Nothing in this agreement shall be interpreted as a commitment or requirement that the United States obligate funds or pay costs in contravention of Anti-Deficiency Act, 31 USC §§ 1301, 1341, or any other applicable provision of law.

32. Notice. All notices or other communications required or permitted to be given to a party to this Agreement shall be in writing and shall be personally delivered,

sent by registered or certified mail, postage pre-paid, return receipt requested, or sent by an overnight express courier service that provides written confirmation of delivery to such party at the following respective addresses:

UNITED STATES:	Assistant Attorney General United States Department of Justice Environmental and Natural Resources Division Washington, DC
WITH A COPY TO:	Director, Office of Water Resources Box 555013, MCB Camp Pendleton, CA 92055-5013
DISTRICT:	General Manager Rancho California Water District P.O. Box 9017 Temecula, CA 92589-90017
WITH A COPY TO:	General Counsel Rancho California Water District P.O. Box 9017 Temecula, CA 92589-9017

UNITED STATES OF AMERICA

Date: ________________ By: ________________________________

Andrew F. Walch, Senior Counsel
United States Department of Justice
Environment and Natural
Resources Division
General Litigation Section
999 18th Street, Suite 945
Denver, CO 80202

Date: ________________ By: ________________________________

____

____

United States Marine Corps
Camp Pendleton, California

RANCHO CALIFORNIA WATER DISTRICT

Date: ________________

By:______________________________
President

ATTEST:

____
Secretary

APPROVED AS TO FORM

BEST BEST & KRIEGER LLP

____
Arthur L. Littleworth

____
C. Michael Cowett

EXHIBIT A

EXHIBIT A

DEFINITIONS AND MAP

EXHIBIT A

DEFINITIONS

Basin
The groundwater basin consists of the Temecula, Pauba, and Younger Alluvial aquifers. The younger alluvial aquifer is located along the river bottoms and is generally considered the most permeable. The Pauba and Temecula aquifers underlie the Younger Alluvium and are generally less permeable.

Direct Recharge Facilities
Direct recharge facilities presently include the Valle De Caballos located in the upper part of the Pauba Valley. Natural run-off from Temecula Creek is released from Vail Lake and imported waters are diverted to the VDC to recharge the aquifers used for groundwater production from the groundwater system.

Gorge
The Gorge is located at the head of the Santa Margarita River at the confluence of Murrieta and Temecula Creeks. The USGS presently operates streamflow gage 11044000 at the Gorge with a period of record beginning in 1923.

Groundwater Model
The groundwater model simulates surface and groundwater movement in the Younger Alluvium, Pauba, and Temecula aquifers. The groundwater model uses the USGS's finite difference code MODFLOW and consists of 102 rows, 127 columns, and three layers. The transient calibration period extends from 1935 to 1999 using quarterly stress periods. The groundwater model was developed from 1995 to 1999 by the District with continuous involvement by all members of the TAC.

Groundwater Supply
Groundwater supply includes the natural supply and that portion of imported water, reclaimed water, and other waters that directly or indirectly recharge the three aquifers.

Groundwater System
The Groundwater system is described by the groundwater model and consists of all aquifers located above the Gorge. Furthermore, recharge from direct precipitation, recharge from surface water, discharge to surface water, subsurface recharge, and movement of water between aquifers also pertain to the groundwater system.

HSPF Surface Water Model	The Hydrologic Simulation Program Fortran (HSPF) surface water model was developed to simulate natural flow at the Gorge. The model was calibrated using the period water year 1931 through 1936 as natural flow conditions in the upper basin. The model was developed in 1999 by Camp Pendleton and reviewed by the TAC.
Imported Water	Water the source of which is outside the Santa Margarita River watershed.
Natural Supply	The natural supply of water in the upper basin is defined by the amount of water that is recharged to the groundwater system from direct precipitation, surface flow, releases from Vail Lake, subsurface inflow, and return flow from imported or reclaimed water.
TAC	The Technical Advisory Committee (TAC) consists of representatives from the Rancho California Water District, Camp Pendleton, the United States Geological Survey, and the Watermaster.
VDC	The Valle De Caballos (VDC) is a direct recharge facility located in the upper portion of Pauba Valley. Both natural run-off and imported water are applied at these facilities in order to recharge the groundwater system.
Year	Unless otherwise indicated, year refers to the water year running from October 1st through September 30th of the following year.

SANTA MARGARITA RIVER WATERSHED

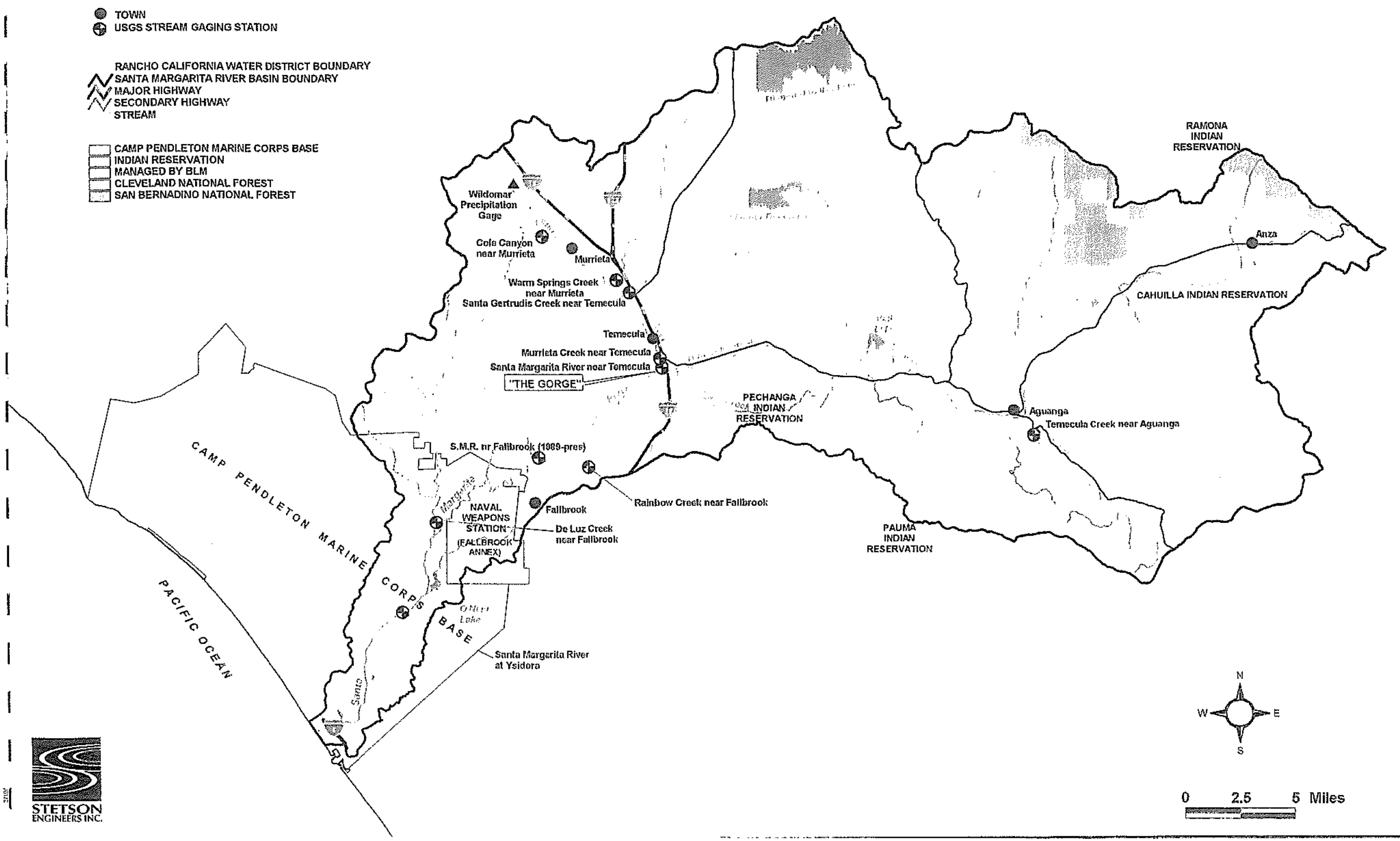


EXHIBIT B

EXHIBIT B

DESCRIPTION OF THE GROUNDWATER MODEL AND HSPF SURFACE WATER MODEL, AND APPLICATION TO FLOW REQUIREMENTS

DESCRIPTION OF THE GROUNDWATER MODEL AND HSPF SURFACE WATER MODEL, AND APPLICATION TO FLOW REQUIREMENTS

The purpose of this Exhibit is to memorialize and explain the method used to develop the flows guaranteed in the Agreement. To the extent there may be any inconsistencies, the language of the Agreement, and not this Exhibit, establishes the District's flow guarantees.

MODFLOW GROUNDWATER MODEL

The RCWD/CAMP PENDLETON surface and groundwater model (Groundwater Model) was developed to investigate the effects of groundwater pumping on streamflow within the Murrieta-Temecula area of Riverside County in southern California. The Groundwater Model was developed by GEOSCIENCE Support Services, Inc. (GEOSCIENCE) in cooperation with the United States Geologic Survey (USGS). Rancho California Water District (RCWD), the United States Marine Corps - Camp Pendleton Base (Camp Pendleton), Stetson Engineers, Inc. (Stetson), and the Santa Margarita River Watershed Watermaster (SMR Watermaster).

The Groundwater Model was developed for streams and the unconsolidated and poorly consolidated sediments of the Murrieta-Temecula Basin. The Groundwater Model consists of three distinct model layers: Layer 1 - Younger Alluvium; Layer 2 - Pauba Formation; and Layer 3 - Temecula Arkose. The streams crossing the model area in the aquifers (i.e., Younger Alluvium, Pauba Formation and Temecula Arkose) can be both influent (losing water to the aquifer) and effluent (gaining water from the aquifer). The streamflow inflow components are the surface runoff generated from rain events and water gained from aquifers. The streamflow outflow components are leakage into the aquifers and flow out of the model area through the Gorge. The primary sources of recharge to the aquifers include subsurface recharge, underflow recharge, areal recharge, artificial recharge, return flow and streamflow leakage. The primary discharge terms are groundwater pumping, evapotranspiration, underflow discharge and leakage out of the aquifer.

MODFLOW was the computer code used in the Murrieta-Temecula Basin model. MODFLOW is a block-centered, three-dimensional, finite-difference groundwater flow model developed by the USGS (McDonald and Harbaugh, 1988) for the purpose of modeling groundwater flow model to account for the interaction between surface streams and groundwater.

The model covers approximately 288 square miles with a three layer variable-grid network consisting of 102 nodes in the north-to-south direction (i-direction), 127 nodes in the west-to-east direction (j-direction), for a total of 38,862 nodes. Most nodes represent an area 600 ft (north-south) by 600 ft (east-west). Nodes near the edges of the model are of variable size, ranging up to 5,000 ft on a side.

The period selected for the model calibration was 1935 to 1994. This period covers various wet and dry hydrologic cycles, and pre-development and development conditions. A quarterly stress period was used for model calibration. After the model was calibrated, a verification run (Run 89) was simulated by adding the period 1995-1998 to the final model calibration run (Run 88B).

Model simulation (Run 93) of the condition of actual precipitation without any pumping or any effect of Vail Dam was conducted to calculate the natural streamflow at the Gorge. This was done using the same model input data from Model Run 89 (final calibration and verification) except for the Streamflow-Routing Package and Well Package. Quarterly flux for Vail Releases and Vail Spill of the Streamflow Routing Package was based on the net Vail Dam inflow. The net Vail Dam inflow calculation involve estimating the calculated Vail inflow by balancing the Vail Dam releases, Vail Dam spill, evaporation, precipitation and change in storage on a monthly basis. The net Vail Dam inflow then can be calculated by subtracting the evapotranspiration of the phreatophytes under no Vail Dam conditions, from the calculated Vail Dam inflow. The well package was recompiled to include only subsurface recharge, underflow recharge, and underflow discharge. RCWD pumping, private pumping, artificial recharge, and return flow were excluded. The results of this model run are presented in the report Surface and Groundwater Model of the Murrieta-Temecula Basin, California (GEOSCIENCE, 2000).

HSPF SURFACE WATER MODEL

Monthly base flows at the Gorge are defined by hydrologic conditions based on rainfall at the Wildomar precipitation station and streamflow at the Aguanga streamflow gage (see Exhibit C). The current hydrologic condition and the monthly base flows are used in Section 5 of the Agreement to provide a basis for supplementing streamflow at the Gorge to meet the flow guarantees of the Agreement.

Natural streamflow at the Gorge was simulated using daily precipitation input values to the HSPF model. The calibration period chosen was from October 1930 to September 1936 and the transient period extended from 1936 to 1996. HSPF is able to account for antecedent conditions in the watershed using daily rainfall data from the Wildomar rain gage. Figure B-1 shows a comparison of simulated versus actual streamflow during the calibration period. Frequency distribution tables and plots were constructed to show the distribution of daily natural flow on a monthly basis. The results of this analysis is presented in Technical Memorandum 3.0 (Stetson Engineers, March 1, 2000)

Comparison of HSPF and RCWD/Camp Pendleton Groundwater Models

The Environmental Protection Agency's Hydrologic Simulation Program Fortran (HSPF) was used to simulate daily streamflow based on daily precipitation data from the Wildomar station. The correlation between rainfall and runoff provides the ability to determine the conditions of the basin based on daily rainfall data. The RCWD/Camp Pendleton Groundwater Model simulates streamflow at the Gorge based on quarterly values of tributary inflow, subsurface inflow, aerial recharge and other recharge mechanisms.

Table B-1

Comparison of HSPF and Groundwater Model Natural Flow Quarterly Streamflow Values at the Gorge (1935 to 1996)

Quarterly Period	Median HSPF (cfs)	Median G-W Model (cfs)	Difference (%)
October – December	8.8	10.0	14
January – March	19.0	17.1	-10
April – June	11.7	10.1	-13
July – September	7.9	7.7	-2
Annual Mean	11.8	11.2	-5

Comparison of quarterly values of both the HSPF and Groundwater Model indicates a high degree of correlation. Statistically, the annual mean of quarterly median streamflow of both the HSPF and Groundwater Models is 11.82 cfs and 11.24 cfs, respectively. Quarterly medians are also similar between the two models, differing by no more than 1.9 cfs (10%) during the winter quarter (Table B-1). The natural flow analysis presented in this exhibit is based on the HSPF model since it compares well with the Groundwater Model, is based on daily precipitation, and can be calculated on either a daily, monthly, or annual basis.

Natural Flow of the Santa Margarita River Near Temecula

The frequency distribution table and graphs allow the hydrologist to estimate the statistical occurrence and probabilities of specific flows. This method is extremely useful in southern California streams with flows that vary order of magnitudes during any given year. The 50% probability on the frequency distribution graph represents the median daily flow for the stream system. In general, flows calculated based on means will be greater than flows based on the median. For example, the mean daily natural flow during the month of October is calculated to be 10.6 cfs, while the median flow is simulated to be only 7.9. During high flow months such as February, mean daily natural flow is estimated to be 211 cfs, while median daily flow during the same month is 17.4 cfs. Frequency distribution allows hydrologists to estimate the variability and distribution of flows based on seasonal and hydrological changes.

Streamflow values during dry, normal, and wet hydrologic conditions may be estimated using the variability of the historical natural flow during dry, normal, and wet hydrologic conditions. In order to estimate median flows during dry and wet cycles, two separate period of records were chosen to represent these different hydrologic conditions. Water years 1957 to 1966 were selected to represent dry natural flow conditions, while water years 1937 to 1946 were chosen to represent a wet hydrologic cycle. In order to estimate median flows during these periods, frequency distribution analysis and plots were developed for each cycle.

The mean median annual natural flow during dry hydrologic conditions is 5.3 cfs, less than half of the annual natural flow for the entire period of record of 12.0 cfs. The mean median annual natural flow during wet hydrologic conditions is 23.4 cfs, almost twice the annual natural flow. The median daily flow during the wet period ranged from 13.8 cfs in August to 49.4 cfs in March.

Determining Flow Requirements at the Gorge

Flow requirements at the Gorge are based on two-thirds the median natural flow during wet, normal, and dry conditions. Flow requirements for critically dry and very wet conditions are based on the 50% median flows for the period 1957 to 1966 and 1937 to 1946, respectively. Above normal flows are based on the mean of the 50% median wet flows and the 50% median all years. Similarly, below normal flows are based on the mean of the 50% median dry flows and the 50% median all years. Table B-2 shows the results of this determination and is the basis for the flow guarantees established in Section 5 of the Agreement.

TABLE B-2

DAILY FLOWS AT THE GORGE BASED ON TWO-THIRDS OF THE MEDIAN NATURAL FLOW AS DETERMINED BY THE HSPF MODEL

MONTH	CRITICALLY DRY FLOW (CFS)	BELOW NORMAL FLOW (CFS)	ABOVE NORMAL FLOW (CFS)	VERY WET FLOW (CFS)
October	3.0	3.9	7.7	10.1
November	3.0	4.5	8.8	11.5
December	3.3	5.3	10.4	13.5
January	3.3	6.9	13.6	16.8
February	4.6	8.1	17.5	23.4
March	4.9	8.7	22.7	32.9
April	5.0	8.2	17.2	23.1
May	3.8	5.7	11.7	15.7
June	3.3	4.9	9.4	12.2
July	3.0	4.3	7.8	9.7
August	3.0	4.4	7.6	9.2
September	3.0	4.1	7.4	9.4
Total	3.6	5.8	11.8	15.6

Note: Flow is based on 2/3 natural flow or 3 cfs, whichever is greater.

DETERMINATION OF HYDROLOGIC CONDITIONS

The methodology used to estimate the required monthly base flows at the Gorge is based on flows occurring during different hydrologic conditions. The median flow during the wet hydrologic cycle defines the break between above normal and very wet conditions when compared to the entire period of record. Similarly, the median flow during the dry hydrologic cycle defines the break between critically dry and below normal conditions. In order to determine the frequency at which these different hydrologic cycles occur, the median from the dry and wet cycles are compared to the monthly flow values for the entire period of record. Table B-3 below shows the results for each month when the dry and wet cycle median natural flow is plotted on the entire period of record for each month. For example, the December median dry cycle (WY 1957-1966) natural flow value of 4.9 cfs was plotted on the frequency distribution graph for the entire period of record (WY 1931-1996). The result indicated that the 4.9 cfs flow would be met or exceeded 87.4% of the time (Table B-3). The table shows the variation between the months for both dry and wet cycles. In order to remain consistent while determining different hydrologic cycles, the median values for the twelve months were used.

TABLE B-3

WET AND DRY TIME EXCEEDANCE VALUES FOR EACH MONTH USING THE ENTIRE PERIOD OF RECORD

MONTH	DRY FLOW (%)	WET FLOW (%)
October	84.5	22.1
November	84.7	22.8
December	87.4	24.2
January	90.1	28.1
February	87.1	26.8
March	86.9	26.5
April	83.3	24.6
May	84.7	25.1
June	85.0	21.4
July	83.8	24.2
August	82.7	27.8
September	80.4	19.8
Median	84.7	24.4

Exhibit C describes the development of a hydrologic index for the Santa Margarita River Basin which is based on the median values of the monthly wet and dry time exceedance. The hydrologic break between extremely dry and below normal occurs at the 84.7% exceedance value while the break between above normal and very wet hydrologic conditions occurs at 24.4%. The hydrologic break between above normal and below normal occurs at the 50% exceedance interval.

Simulated versus Historical Streamflow at the Gorge (WY 1931-1936)

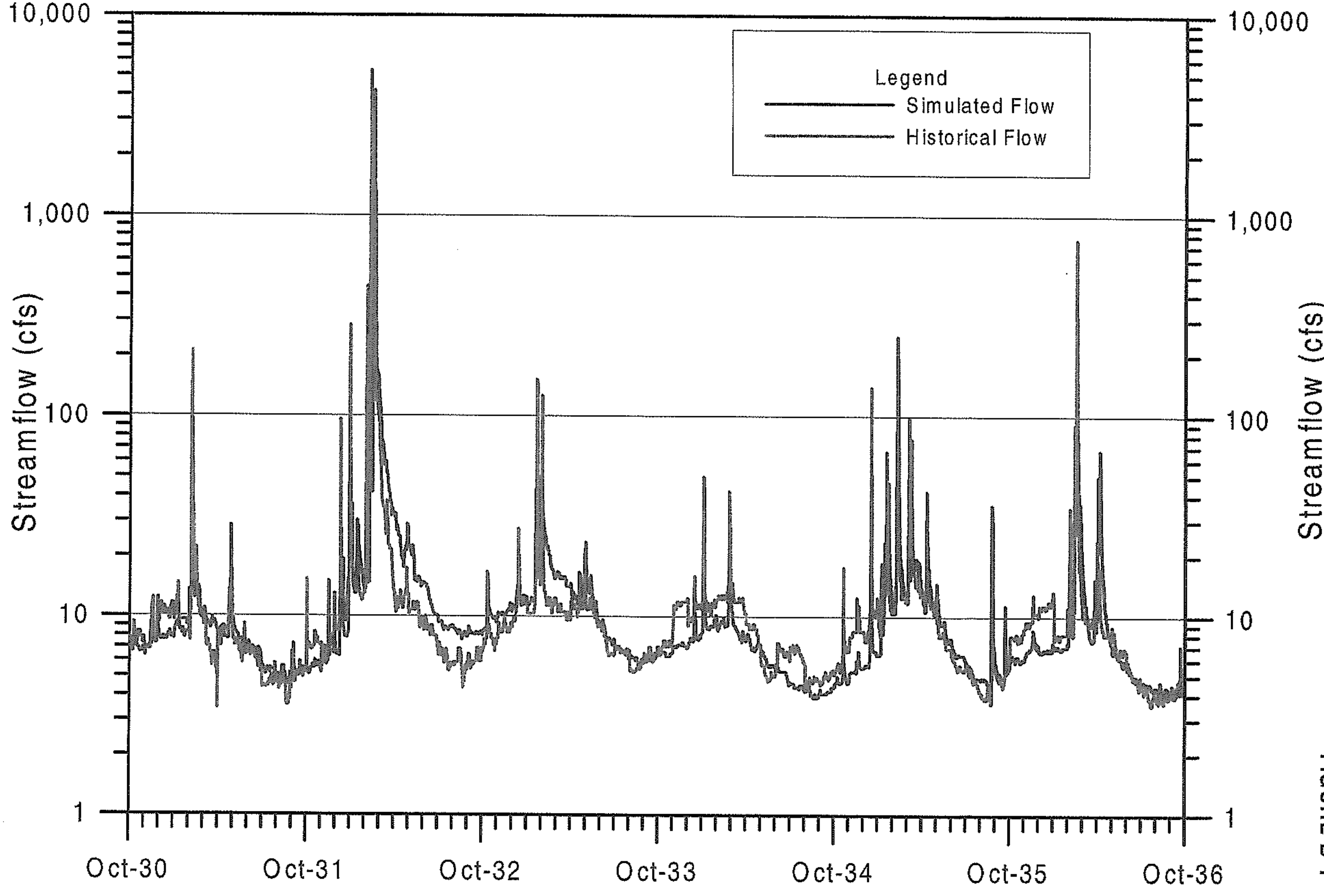


FIGURE B-1

Frequency Distribution of Natural Flow at the Gorge During The Month of October (WY 1931-1996)

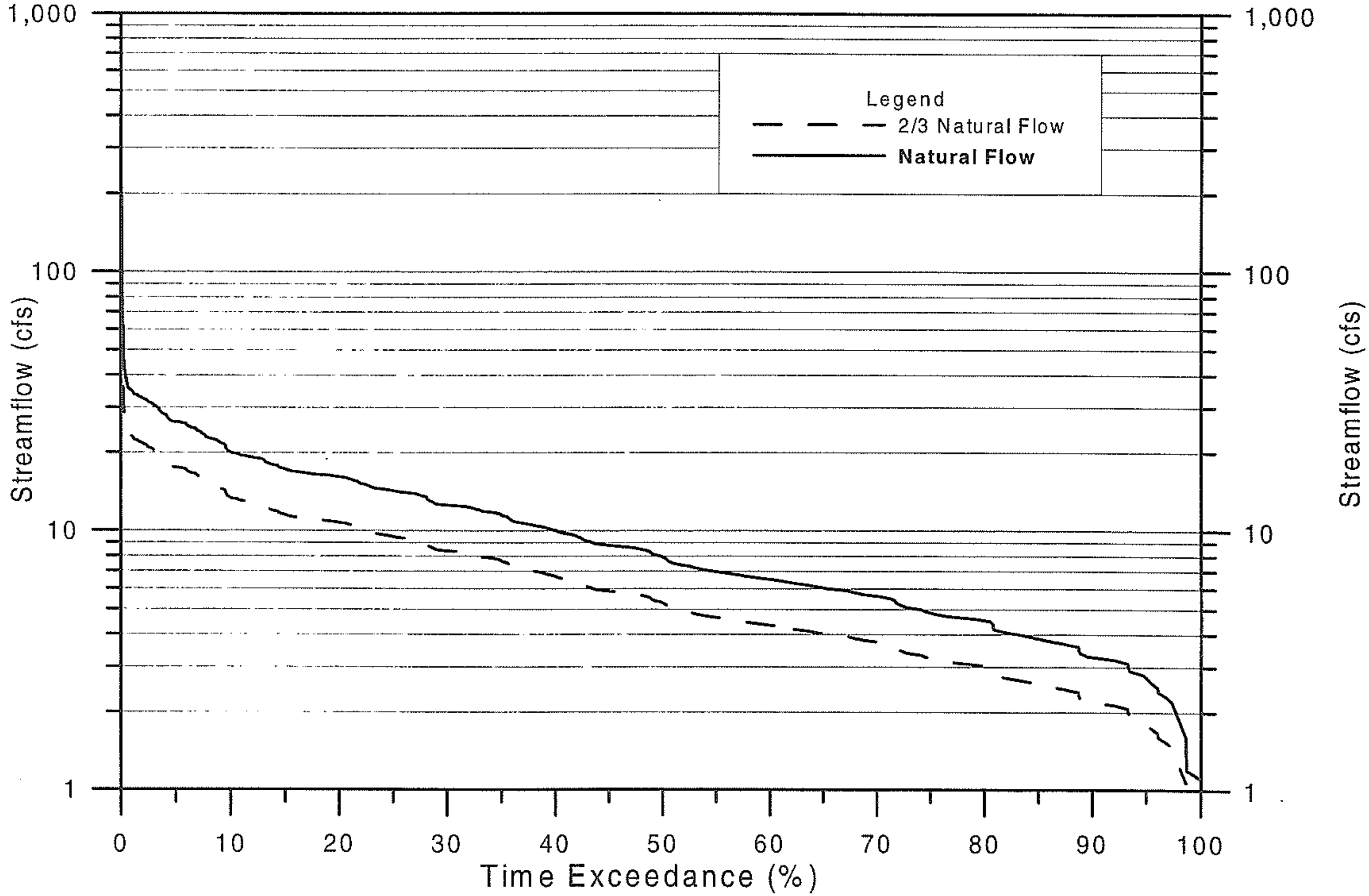


FIGURE B-2

EXHIBIT C

EXHIBIT C

DETERMINATION OF HYDROLOGIC CONDITIONS IN THE SANTA MARGARITA RIVER BASIN

EXHIBIT C

DETERMINATION OF HYDROLOGIC CONDITIONS IN THE SANTA MARGARITA RIVER BASIN

The purpose of this Exhibit is to memorialize and explain the method used to develop the flows guaranteed in the Agreement. To the extent there may be any inconsistencies, the language of the Agreement, and not this Exhibit, establishes the District's flow guarantees.

This Exhibit describes the streamflow and precipitation data available in the upper basin and the hydrologic index used to describe the hydrologic condition of the Santa Margarita River Basin above the Gorge. The hydrologic index is calculated using the historical precipitation record at the Wildomar precipitation gage, streamflow at the Aguanga streamflow gage, and calculated natural streamflow at the Gorge and Murrieta gages. The methodology accounts for antecedent conditions that existed prior to the year being determined, allowing for a previous wet year or dry year to influence the current year's hydrologic condition. The methodology provides a means to determine the flow requirements at the Gorge for twelve months, in conjunction with other provisions of the Agreement.

Based on the October through April's natural streamflow totals at Murrieta and Vail Lake, the May through December monthly streamflow requirement at the Gorge is categorized as either Critically Dry, Below Normal, Above Normal, or Very Wet hydrologic conditions. The January through April streamflow requirement is predetermined to be 11.5 cubic feet per second (cfs), calculated from the average of January through April's median natural flow requirement at the Gorge. The median natural flow requirement is two-thirds the simulated natural flow at the Gorge based on the period of record 1931 through 1996.

ESTABLISHMENT OF A HYDROLOGIC INDEX

The hydrologic index combines October through April natural streamflow at Murrieta, natural streamflow at Vail Lake, and natural streamflow from Pauba and Wolf Valleys. Natural flow at Murrieta is calculated using the rainfall/run-off relationship between rainfall at Wildomar and the HSPF natural flow at Murrieta, developed in Technical Memorandum 1.0 (January 20, 2000). Natural flow at Vail Lake is calculated using the run-off correlation between Aguanga streamflow and Inflow to Vail Lake during the period water years 1958 to 1996, also developed in Technical Memorandum 1.0 (January 20, 2000). The natural flow contribution from Pauba and Wolf Valleys is calculated to be 50% of the natural run-off into Vail Lake.

Natural streamflow at Murrieta is calculated by the rainfall/runoff relationship developed between monthly rainfall at Wildomar and monthly natural streamflow determined from the HSPF model. Equation 1 provides the polynomial equation that describes this relationship, where X is the monthly rainfall in inches and Y is the monthly natural streamflow at Murrieta in cubic feet per second (cfs):

$$Y = 9.068 - 34.798 * X + 11.339 * X^2. \qquad (X \geq 2.79) \qquad (1)$$
$$Y = 0 \qquad (X < 2.79)$$

Runoff at Vail Lake is calculated by the runoff/runoff relationship developed between runoff at Aguanga and inflow to Vail Lake. Equation 2 provides the linear equation that describes this relationship, where X is October through April natural streamflow at Aguanga (Acre-Feet) and Y is October through April natural streamflow at Vail Lake (Acre-Feet):

$$Y = 1.380 * X \quad \text{(Acre-Feet).} \qquad (2)$$

Contribution from the Pauba and Wolf valleys was estimated to be 50% of the natural inflow to Vail Lake. Run-off relationships between Aguanga, Murrieta, Pechanga Creek, and the Gorge, as well as sensitivity analysis during development of the Hydrologic Index, were used to determine the proportion of contribution from these two valleys..

Figure C-1 provides the frequency distribution curves of the combined total October through April natural streamflow at Murrieta, natural streamflow at Vail Lake, and natural streamflow contribution from Pauba and Wolf Valleys. The frequency distribution curve was divided into four parts established by the 24^{th}, 50^{th}, and 85^{th} percentile breaks (Exhibit B and Technical Memorandum 3.0, February 25, 2000). Using these breakpoints, the division between Critically Dry, Below Normal, Above Normal, and Very Wet hydrologic conditions was established. The corresponding breaks between hydrologic conditions are 3,230 acre-feet, 14,510 acre-feet, and 47,810 acre-feet, respectively. Review of 66 years of historical data indicates that ten years would have been classified as Critically Dry, 23 years as Below Normal, 17 years as Above Normal, and 16 years as Very Wet.

The hydrologic index was compared to actual water years for the 66 year period from 1931 to 1996. Of the 66 years that were compared, the hydrologic index mismatched nineteen years; overestimating nine years while underestimating the hydrologic conditions during the other ten years (Table C-1, Attached). The antecedent conditions prior to the Below Normal and Above Normal "misses" were reviewed in order to correct errors. If the hydrologic condition was determined to be Below Normal and the prior year was determined to be Above Normal or Very Wet, 2,200 AF was added to the hydrologic condition. Similarly, if the hydrologic condition was determined to be Above Normal and the previous year was classified as Critically Dry, 10,000 AF was subtracted from the hydrologic condition. These adjustment values were developed from an iterative process of refining the Hydrologic Index by minimizing the number of mismatches. The algorithm used to adjust for antecedent conditions prior to Above Normal and Below Normal years was applied to all values in column (7). Hydrologic conditions that were incorrectly classified as Very Wet or Critically dry were not adjusted.

The results of adjusting for antecedent conditions during Above Normal and Below Normal years decreases the number of misses to thirteen. Of these thirteen years, seven years are overestimated while six years are underestimated. Closer inspection of the data shows that the hydrologic index tends to overestimate hydrologic conditions during the first half of the data set and underestimate hydrologic conditions during the later half of the record. For example, five of the seven years that are overestimated occur when calculated inflow to Vail Lake or streamflow at Butterfield Canyon were used to estimate natural flow at Vail Lake. The data set used in the regression analysis used to convert streamflow at Aguanga to natural flow at Vail Lake began in 1958.

IMPLEMENTATION OF THE HYDROLOGIC INDEX

The hydrologic index used to estimate the required streamflow at the gorge is based on natural streamflow at Murrieta and Vail Lake. On May 1st of each year the rainfall at Wildomar is used to estimate natural flow at Murrieta and the streamflow at Aguanga is used to estimate natural flow at Vail Lake. A simple spreadsheet, that would adjust for antecedent conditions, may be used to calculate the hydrologic index based on these input parameters. Once the hydrologic condition is determined, the table in Section 5 of the Agreement is used to determine the required flows at the Gorge.

Figure C-2 provides a schematic diagram of the steps to be followed to determine the hydrologic condition that would prescribe the current year's summer time flows and the following year's winter flow requirement. The following outline provides the steps necessary to implement the Agreement. **[Both Figure C-2 and the following outline do not address credits for groundwater banking to Camp Pendleton]**

First Year of Agreement:

- F-1. Provide 11.5 cfs at the Gorge from January 1 to April 30
- F-2. Determine Hydrologic Condition on May 1
  - a. Convert monthly precipitation at Wildomar to monthly natural flow at Murrieta using equation (1) above.
  - b. Sum October through April natural flow at Murrieta.
  - c. Sum October through April streamflow at Aguanga.
  - d. Convert streamflow at Aguanga to natural flow at Vail lake using equation (2) above.
  - e. Add 50% of Natural Flow at Vail Lake for Pauba and Wolf Valleys' contribution.
  - f. Add (b) + (d) + (e) and calculate hydrologic condition Using Figure C-1.

g. Correct for antecedent condition:
   i. If hydrologic condition is classified as Above Normal and previous year was Critically Dry, subtract 10,000 from (f).
   ii. If hydrologic condition is classified as Below Normal and previous year was Above Normal or Very Wet, add 2,200 to (f).

h. Redetermine Hydrologic Condition Using corrected value and Figure C-1.

F-3. Determine Flow Requirements

a. Based on the Hydrologic Condition determined in F-2(h), specify May through December required flows at the Gorge using the table in Section 5 of the Agreement.
b. If Hydrologic Condition is "Below Normal" or "Critically Dry", determine the District's Carry-Over Credit to be applied the during the following winter.
c. If Hydrologic Condition is "Above Normal" or "Very Wet", no Carry-Over Credit is to be applied during the following winter.

Subsequent Years of the Agreement:

S-1. Provide 11.5 cfs less Carry-Over Credit, if available, from January 1 to April 30

S-2. Determine Hydrologic Condition on May 1

a. Follow F-2(a) through (h).

S-3. Determine Flow Requirements

a. Based on the Hydrologic Condition determined in S-2(a), specify May through December required flows at the Gorge using the table in Section 5 of the Agreement.
b. If Hydrologic Condition is "Below Normal" or "Critically Dry", determine the District's Carry-Over Credit to be applied during the following winter. Add to existing Carry-Over Credit that has not been applied.
c. If Hydrologic Condition is "Above Normal" or "Very Wet", apply any unused Carry-Over Credit to the following Winter.

In order to illustrate the procedure for determining and meeting flow requirements at the Gorge, actual rainfall and streamflow data from 1992 and 1993 were chosen. The example below would represent the implementation of the hydrologic determination and flow requirements during the first and second years of the Agreement. Although not shown below, if the Agreement were in place in 1991, the Carry-Over Credit to 1992 would have been 227 AF, reducing the winter flow requirement from 11.5 cfs to 10.5 cfs.

F-1. Provide 11.5 cfs at the Gorge from January 1, 1992 to April 30, 1992

F-2. Determine Hydrologic Condition on May 1

- a. October 1991 through April 1992 rainfall at Wildomar:
  - 10/91 precip = 0.18 inches ≡ 0 AF streamflow
  - 11/91 precip = 0.04 inches ≡ 0 AF streamflow
  - 12/91 precip = 1.79 inches ≡ 0 AF streamflow
  - 01/92 precip = 2.71 inches ≡ 0 AF streamflow
  - 02/92 precip = 7.06 inches ≡ 20,204 AF streamflow
  - 03/92 precip = 4.34 inches ≡ 4,404 AF streamflow
  - 04/92 precip = 0.26 inches ≡ 0 AF streamflow
- b. October 1991 through April 1992 natural streamflow at Murrieta = 24,608 AF.
- c. October 1991 through April 1992 streamflow at Aguanga = 2,886 AF.
- d. Natural flow at Vail Lake = 3,982 AF.
- e. Add an additional 1,991 AF for contribution from Pauba and Wolf Valleys.
- f. Hydrologic Condition is "Above Normal" based on 30,580 AF of Natural Flow (Figure C-1) at approximately 30% Exceedance.
- g. Previous year classified as "Very Wet" so,
  - i. No correction necessary
- h. Hydrologic Condition remains "Above Normal".

F-3. Determine Flow Requirements

- a. Non-Winter Flow Requirements:
  - May = 11.5 cfs
  - June = 9.4 cfs
  - July = 7.8 cfs
  - August = 7.6 cfs
  - September = 7.4 cfs
  - October = 7.7 cfs
  - November = 8.8 cfs
  - December = 10.4 cfs
- b./c. 0 AF Carry-Over Credit since Hydrologic Condition was "Above Normal".

S-1. Provide 11.5 cfs - 0 Carry-Over Credit from January 1, 1993 to April 30, 1993.

S-2. Determine Hydrologic Condition on May 1

a. October 1992 through April 1993 rainfall at Wildomar:
10/92 precip = 0.66 inches ≡ 0 AF streamflow
11/92 precip = 0.00 inches ≡ 0 AF streamflow
12/92 precip = 4.46 inches ≡ 4,884 AF streamflow
01/93 precip = 15.39 inches ≡ 132,767 AF streamflow
02/93 precip = 9.41 inches ≡ 42,161 AF streamflow
03/93 precip = 1.20 inches ≡ 0 AF streamflow
04/93 precip = 0.00 inches ≡ 0 AF streamflow

b. October 1992 through April 1993 natural streamflow at Murrieta = 179,812 AF.

c. October 1992 through April 1993 streamflow at Aguanga = 37,668 AF.

d. Natural flow at Vail Lake = 51,968 AF.

e. Add an additional 25,984 AF for contribution from Pauba and Wolf Valleys.

f. Hydrologic Condition is "Very Wet" based on 257,764 AF of Natural Flow (Figure C-1) at approximately 1% Exceedance.

g. Previous year classified as "Above Normal" and existing year classified as "Very Wet", so,
   i. No correction necessary

h. Hydrologic Condition remains "Very Wet".

S-3. Determine Flow Requirements

a. Non-Winter Flow Requirements:
May = 11.5 cfs
June = 11.5 cfs
July = 9.7 cfs
August = 9.2 cfs
September = 9.4 cfs
October = 10.1 cfs
November = 11.5 cfs
December = 11.5 cfs.

b./c. 0 AF Carry-Over Credit since Hydrologic Condition was "Very Wet".

As mentioned above, if the Agreement had been in place in 1991 there would have been 227 AF of Carry-Over Credit from 1991 to 1992, reducing the flow requirement at the Gorge from 11.5 to 10.5. Since 1992 was an "Above Normal" year, only 161 AF of the 227 AF would have been applied as credit, leaving 66 AF to be applied in 1993. The 66 AF applied to 1993 would reduce the winter time flow requirement 0.3 cfs from 11.5 cfs to 11.2 cfs. **[The credit to Camp Pendleton for foregoing higher minimum flows during "Above Normal" and "Very Wet" years is not addressed in this example.]**

Figure C-1

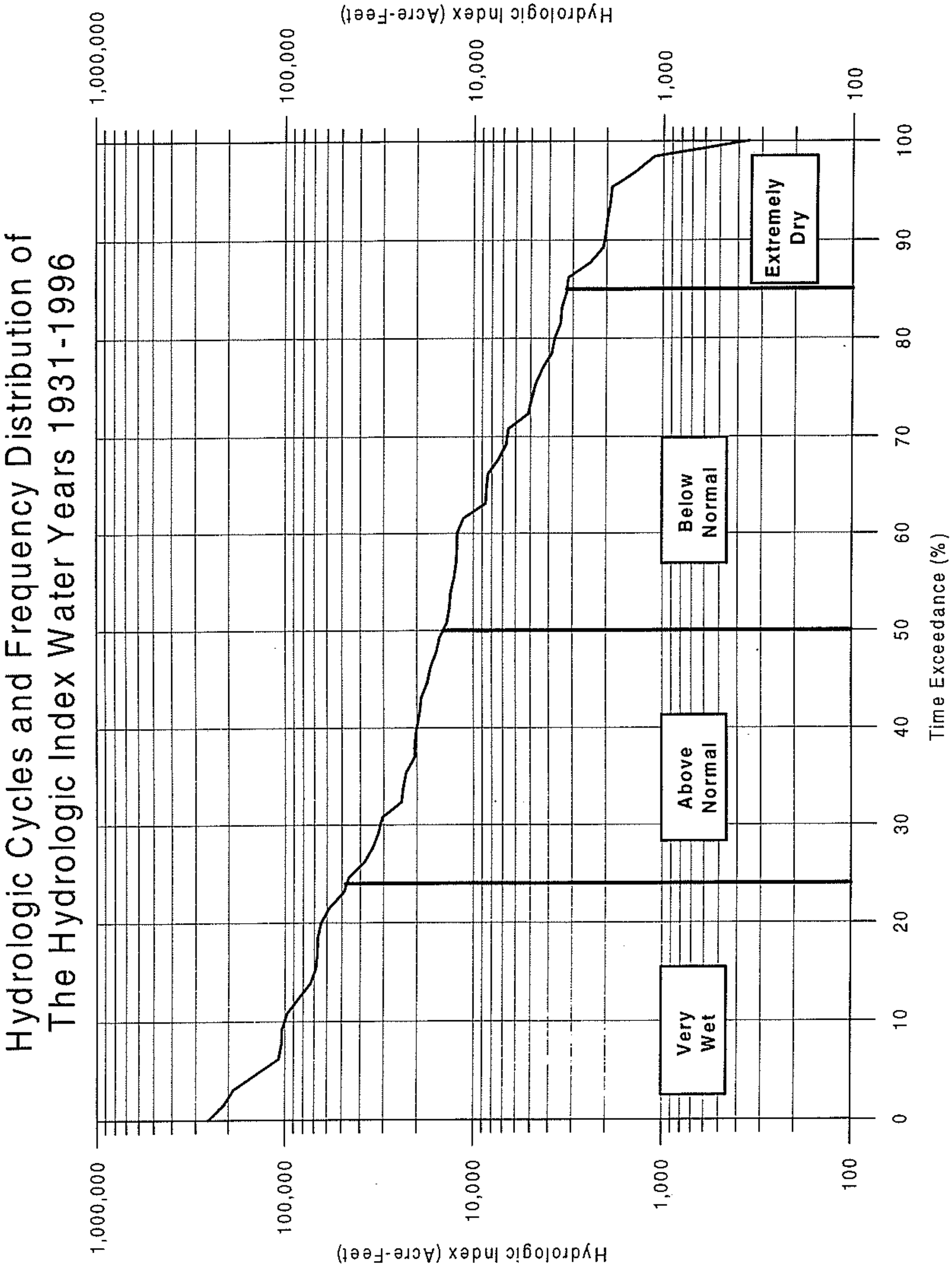

Hydrologic Cycles and Frequency Distribution of
The Hydrologic Index Water Years 1931-1996
Very Wet
Above Normal
Below Normal
Extremely Dry
Time Exceedance (%)
0
10
20
30
40
50
60
70
80
90
100
Hydrologic Index (Acre-Feet)
1,000,000
100,000
10,000
1,000
100

Figure C-2

Flow Diagram of Settlement Agreement Minimum Flows

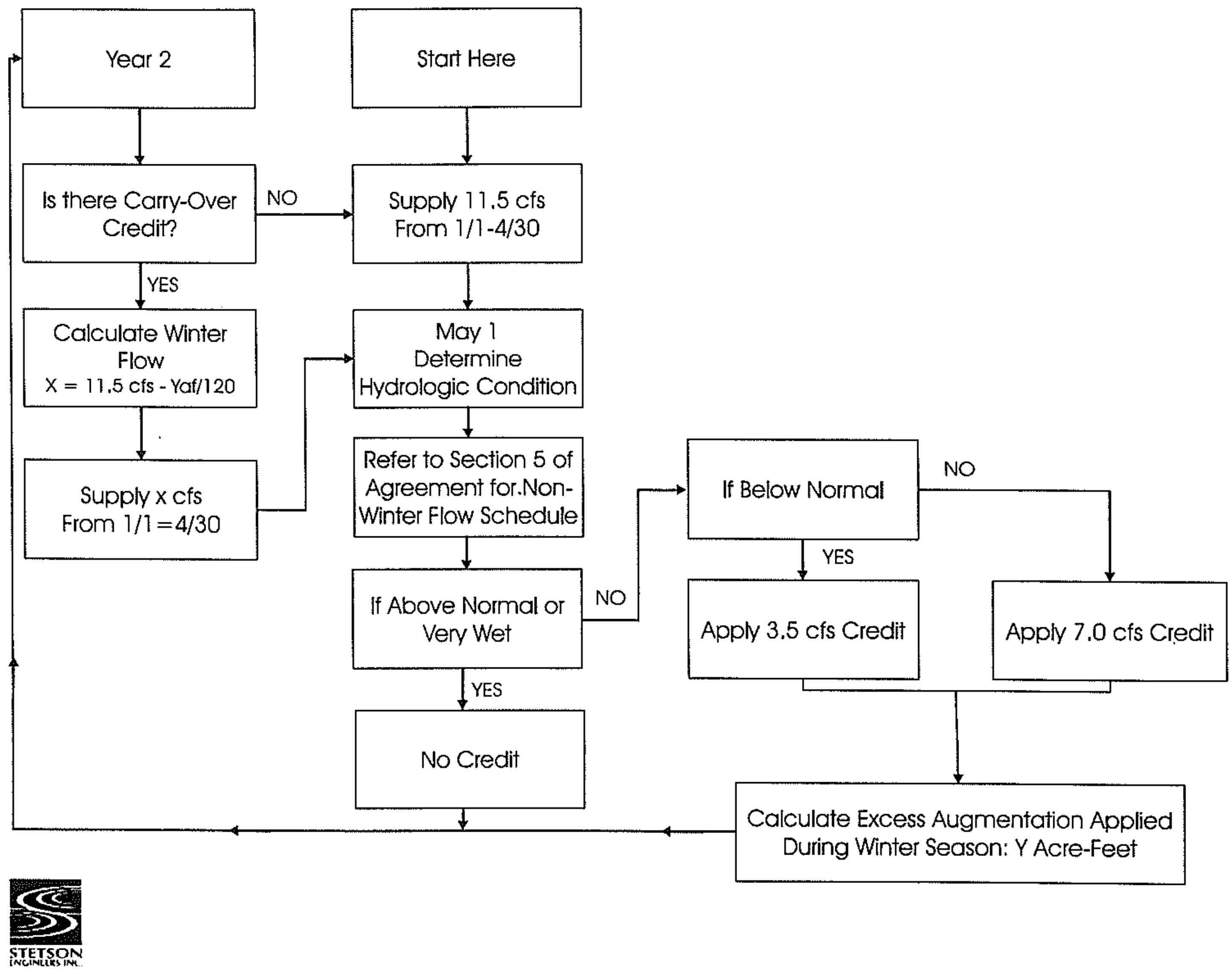


TABLE C-1

CALCULATION OF THE HYDROLOGIC INDEX
SANTA MARGARITA RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)		(10)
	Classification	Aguanga	Calculated	Wildomar	Calculated			Water Year		
	based on	Streamflow	Vail Inflow	Precipitation	Murrieta Flow	Hydrologic	Water Year	Classification		Over/Under-
Water	Majority	Oct-Apr Sum	Oct-Apr Sum	Oct-Apr Sum	Oct-Apr Sum	Index	Classification	Corrected for		Estimate
Year	WY Class	(AF)	(AF)	(in)	(AF)	(AF)		Anteceedent	Flag	
1931	Below Normal		1,512	9.87	2,066	4,334	Below Normal	Below Normal	0	
1932	Above Normal		14,778	18.30	44,975	67,143	Very Wet	Very Wet	1	Overestimate
1933	Below Normal		3,311	9.43	7,290	12,256	Below Normal	Below Normal	0	
1934	Extremely Dry		1,391	7.52	1,395	3,482	Below Normal	Below Normal	1	Overestimate
1935	Below Normal		3,365	16.38	2,325	7,372	Below Normal	Below Normal	0	
1936	Below Normal		3,445	10.64	15,354	20,522	Above Normal	Above Normal	1	Overestimate
1937	Very Wet		34,392	25.21	52,065	103,653	Very Wet	Very Wet	0	
1938	Very Wet		29,210	20.19	60,418	104,233	Very Wet	Very Wet	0	
1939	Above Normal		6,713	14.53	35,925	45,994	Above Normal	Above Normal	0	
1940	Above Normal		5,577	11.28	5,495	13,860	Below Normal	Above Normal	0	
1941	Very Wet		20,888	27.07	66,156	97,489	Very Wet	Very Wet	0	
1942	Above Normal		8,485	9.86	0	12,728	Below Normal	Above Normal	0	
1943	Very Wet		12,412	19.26	66,013	84,632	Very Wet	Very Wet	0	
1944	Above Normal		6,588	13.52	24,425	34,308	Above Normal	Above Normal	0	
1945	Above Normal		5,882	12.91	14,864	23,687	Above Normal	Above Normal	0	
1946	Above Normal		4,004	9.92	6,377	12,382	Below Normal	Above Normal	0	
1947	Below Normal		2,432	8.13	8,594	12,242	Below Normal	Below Normal	0	
1948	Below Normal		1,721	7.71	850	3,432	Below Normal	Below Normal	0	
1949	Below Normal		2,443	8.02	1,475	5,138	Below Normal	Below Normal	0	
1950	Extremely Dry		1,256	6.34	0	1,884	Extremely Dry	Extremely Dry	0	
1951	Extremely Dry		942	4.27	0	1,414	Extremely Dry	Extremely Dry	0	
1952	Very Wet		11,007	19.52	32,419	48,929	Very Wet	Very Wet	0	
1953	Below Normal		1,407	8.84	1,772	3,882	Below Normal	Below Normal	0	
1954	Above Normal		4,580	12.12	13,196	20,065	Above Normal	Above Normal	0	
1955	Below Normal		1,064	9.22	3,328	4,924	Below Normal	Below Normal	0	
1956	Extremely Dry		1,074	6.79	2,126	3,738	Below Normal	Below Normal	1	Overestimate
1957	Extremely Dry		740	9.61	16,526	17,635	Above Normal	Above Normal	1	Overestimate

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)		(10)
	Classification	Aguanga	Calculated	Wildomar	Calculated			Water Year		
	based on	Streamflow	Vail Inflow	Precipitation	Murrieta Flow	Hydrologic	Water Year	Classification		Over/Under-
Water	Majority	Oct-Apr Sum	Oct-Apr Sum	Oct-Apr Sum	Oct-Apr Sum	Index	Classification	Corrected for		Estimate
Year	WY Class	(AF)	(AF)	(in)	(AF)	(AF)		Anteceedent	Flag	
1958	Very Wet	8,669	11,961	26.00	49,581	67,522	Very Wet	Very Wet	0	
1959	Below Normal	716	987	5.24	1,693	3,174	Extremely Dry	Extremely Dry	1	Underestimate
1960	Extremely Dry	809	1,116	9.84	414	2,087	Extremely Dry	Extremely Dry	0	
1961	Extremely Dry	171	235	5.09	0	353	Extremely Dry	Extremely Dry	0	
1962	Below Normal	1,438	1,983	15.59	19,873	22,848	Above Normal	Below Normal	0	
1963	Below Normal	181	249	8.37	4,326	4,700	Below Normal	Below Normal	0	
1964	Extremely Dry	541	746	8.13	0	1,119	Extremely Dry	Extremely Dry	0	
1965	Below Normal	1,058	1,460	12.35	22,013	24,203	Above Normal	Below Normal	0	
1966	Above Normal	4,673	6,447	19.19	63,527	73,197	Very Wet	Very Wet	1	Overestimate
1967	Above Normal	7,082	9,770	15.55	17,364	32,020	Above Normal	Above Normal	0	
1968	Below Normal	1,018	1,404	11.79	4,602	6,708	Below Normal	Below Normal	0	
1969	Very Wet	17,107	23,601	29.40	176,676	212,077	Very Wet	Very Wet	0	
1970	Above Normal	1,183	1,632	11.42	16,878	19,325	Above Normal	Above Normal	0	
1971	Below Normal	896	1,236	7.67	580	2,435	Extremely Dry	Extremely Dry	1	Underestimate
1972	Below Normal	853	1,177	6.19	4,802	6,568	Below Normal	Below Normal	0	
1973	Above Normal	3,107	4,287	15.37	9,426	15,856	Above Normal	Above Normal	0	
1974	Below Normal	1,234	1,702	11.21	18,028	20,582	Above Normal	Above Normal	1	Overestimate
1975	Below Normal	935	1,290	12.84	6,482	8,417	Below Normal	Below Normal	0	
1976	Below Normal	964	1,330	10.39	11,484	13,478	Below Normal	Below Normal	0	
1977	Extremely Dry	510	704	7.00	968	2,024	Extremely Dry	Extremely Dry	0	
1978	Very Wet	11,723	16,174	31.24	118,004	142,264	Very Wet	Very Wet	0	
1979	Very Wet	8,404	11,594	21.46	51,097	68,488	Very Wet	Very Wet	0	
1980	Very Wet	26,114	36,027	27.82	134,267	188,308	Very Wet	Very Wet	0	
1981	Above Normal	4,198	5,791	7.32	2,655	11,342	Below Normal	Below Normal	1	Underestimate
1982	Above Normal	6,313	8,709	14.83	24,945	38,009	Above Normal	Above Normal	0	
1983	Very Wet	11,271	15,549	24.20	34,932	58,256	Very Wet	Very Wet	0	
1984	Above Normal	4,173	5,757	8.17	0	8,636	Below Normal	Below Normal	1	Underestimate

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)		(10)
Water Year	Classification based on Majority WY Class	Aguanga Streamflow Oct-Apr Sum (AF)	Calculated Vail Inflow Oct-Apr Sum (AF)	Wildomar Precipitation Oct-Apr Sum (in)	Calculated Murrieta Flow Oct-Apr Sum (AF)	Hydrologic Index (AF)	Water Year Classification	Water Year Classification Corrected for Anteceedent	Flag	Over/Under-Estimate
1985	Above Normal	3,590	4,953	9.54	11,543	18,972	Above Normal	Above Normal	0	
1986	Above Normal	5,174	7,139	11.64	2,547	13,255	Below Normal	Above Normal	0	
1987	Below Normal	1,567	2,162	7.75	0	3,243	Below Normal	Below Normal	0	
1988	Below Normal	1,831	2,526	17.33	4,756	8,545	Below Normal	Below Normal	0	
1989	Below Normal	934	1,289	6.65	51	1,984	Extremely Dry	Extremely Dry	1	Underestimate
1990	Below Normal	927	1,279	5.45	0	1,918	Extremely Dry	Extremely Dry	1	Underestimate
1991	Very Wet	8,775	12,106	14.39	46,117	64,277	Very Wet	Very Wet	0	
1992	Above Normal	2,886	3,982	16.38	24,608	30,580	Above Normal	Above Normal	0	
1993	Very Wet	37,668	51,968	31.12	179,812	257,763	Very Wet	Very Wet	0	
1994	Above Normal	4,574	6,310	10.97	7,533	16,999	Above Normal	Above Normal	0	
1995	Very Wet	14,874	20,521	22.55	77,346	108,127	Very Wet	Very Wet	0	
1996	Above Normal	3,424	4,724	8.73	8,081	15,167	Above Normal	Above Normal	0	
									13	

1) Water year based on October 1 to September 30.

2) Water Year classification based on majority of HSPF, Run 93, and natural flow at Vail Lake. — Overestimate 7

3) Total October through April streamflow at Aguanga — Underestimate 6

4) Calculated Vail Inflow based on streamflow at Aguanga

5) Total October through April Precipiation at Wildomar

6) Calculated Streamflow at Murrieta based on Wildomar Precipitation

7) Hydrologic Index - 150% Total Calculated Vail Inflow and Calculated Murrieta Flow (4) + (6) +.5*(4)

8) Water Year Classification based on 85%, 50% and 24% of column (7)

9) Water Year Classification corrected for Antecedent Conditions

10) Overestimate/Underestimate of required streamflow at the Gorge

EXHIBIT "A"

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IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN and For the County of San Diego

RANCHO SANTA MARGARITA
a corporation

Plaintiff

vs.

N. R. Vail, Mary Vail Wilkinson, Mahlon Vail, Edward N. Vail, Margaret Vail Bell, The Vail Company, an association of persons transacting business under that common name, N. R. Vail, Mary Vail Wilkinson, Mahlon Vail, Edward N. Vail and Margaret Vail Bell, as Trustees of said Vail Company, Mahlon Vail, Executor of the Estate of Margaret R. Vail, Deceased, and Laura Perry Vail, Executrix of the Estate of William Banning Vail, Deceased.

Defendants.

Guy Bogart, Lucy Parkman Bogart and Fred Reinhold, Executors of the will of Murray Schloss, deceased, and Philip Playtor,

Interveners.

-No. 42850

STIPULATED JUDGMENT

This cause came on regularly for trial in the above entitled court and department thereof on Monday, October 18, 1926, at the hour of 10:00 o'clock A. M., before the court, Honorable L. D. Jennings, Judge, presiding; Messrs. Hunsaker, Britt & Cosgrove appearing as attorneys for the plaintiff, Messrs. Haas & Dunnigan, Messrs. Ward, Ward & Ward, Messrs. Stephens & Stephens, and Messrs. O'Melveny, Milliken & Tuller, appearing as attorneys for defendants, and Walter Gould Lincoln, Esq., appearing as attorney for intervenors. The introduction of evidence, oral and documentary, being completed, arguments, oral and in writing, having been submitted, the court having considered the same and being fully advised in the premises, findings of fact and conclusions of law having been signed by the court and filed with the clerk thereof, and judgment on said findings and conclusions having been signed and entered; defendants and each of them thereon appealed from said judgment and from each part thereof, but said interveners did not appeal from said judgment; the Supreme Court of said State of California upon said appeal having reversed said judgment and directed a new trial upon certain issues designated in the opinion of said court reported Rancho Santa Margarita, a corporation, vs. Margaret R. Vail, et al., L. A. No. 15078, 11 Cal. (2nd) 501, and said plaintiff and defendants having stipulated to the entry of the following judgment,

Now, therefore, IT IS ORDERED, ADJUDGED AND DECREED that:

Section First: The plaintiff, Rancho Santa Margarita, a corporation, and defendants, N. R. Vail, Mary Vail Wilkinson, Mahlon Vail, Edward N. Vail, Margaret Vail Bell, the Vail Company, an association of persons transacting business under that common name, N. R. Vail, Mary Vail Wilkinson, Mahlon Vail, Edward N. Vail and Margaret Vail Bell, as Trustees of said Vail Company, Mahlon Vail, Executor of the estate of Margaret R. Vail, Deceased, and Laura Perry Vail, Executrix of the Estate of William Banning Vail, Deceased, and interveners, Guy Bogart, Lucy Parkman Bogart and Fred Reinhold, Executors of the Will of Murray Schloss, Deceased, and Philip Playtor, have and each has rights in and to the waters of the Temecula-Santa Margarita River and its tributaries, and in and to the use of said waters for all beneficial and useful purposes on their respective lands herein more specifically described.

Section Second: The plaintiff is entitled to take and use upon the whole or any part of its lands lying within the Rancho Santa Margarita y Las Flores, San Diego County, California, sixty-six and two-thirds per cent (66-2/3%) of the water of said Temecula-Santa Margarita River and all its tributaries which naturally, when not artificially diverted or abstracted, flows and descends in the channel thereof at that certain joint gaging station hereinafter in this judgment designated as Measuring Station No. Six (6).

Section Third: Defendants are entitled to take and use upon the whole or any part of their lands hereinafter mentioned, thirty-three and one-third per cent (33-1/3%) of the water of said Temecula-Santa Margarita River and all its tributaries which naturally, when not artificially diverted or abstracted, flows and descends in the channel thereof at that certain joint gaging station hereinafter designated Measuring Station No. Six (6).

The lands of the defendants herein referred to consist of those certain lands in Riverside County, California, known as Pauba Grant, Lost A, B, C, and D of Little Temecula Grant, or Rancho as shown on the Wolf partition map of Little Temecula Grant as described in the final decree of partition in the case of William Wold vs. Ramona Wolf, being Case No. 5756 in the Superior Court of San Diego County, State of California, said final decree of partition being recorded in Book 199 of Deeds, page 464, et seq., records of San Diego County, California, the southeasterly approximately one-half of Temecula Grant, excluding therefrom the town site of the unincorporated city of town of Temecula and the various parcels of land owned by persons other than the defendants herein, as shown by map entitled "Triangulation Map of Pauba Ranch and Vicinity, Riverside County" received in evidence in this case and marked "Plaintiff's Exhibit No. U-4", which exhibit has been incorporated into and constitutes a part of the Transcript on Appeal in this action, (reference is hereby made to said Transcript and to said Exhibit No. U-4 and by such reference said exhibit is incorporated into and constitutes a part of this judgment), Santa Rosa Grant, and Vail governments lands, which said Vail government lands, approximately four hundred sixty (460) acres in area, are more particularly described as: Those certain lands lying within sections twenty-one (21), twenty-seven (27), twenty-eight (28) and twenty-nine (29) of Township Eight (8) south, Range Two (2) west, S. B. B. M., Riverside County, California, and being more particularly identified as Lots Nineteen (19), Twenty (20), Twenty-one (21), Twenty-six (26), Twenty-seven (27), Thirty (30) and Thirty-one (31) of Block Fifteen (15), and those portions of Lots Seventeen (17) and Eighteen (18) of said Block Fifteen (15) lying without but contiguous to the southeasterly boundary of Lot D of said Little Temecula Grant.

Section Fourth: The intervenor Philip Playtor is entitled to take and use upon the whole or any part of his lands riparian to said Temecula-Santa Margarita River, as hereinafter delineated and defined, one (1) miner's inch continuous flow of the waters of said Temecula-Santa Margarita River. The lands of said Philip Playtor riparian to said river are described as follows: The northwest one-quarter ($NW\frac{1}{4}$) of the southeast one-quarter ($SE\frac{1}{4}$) and the south one-half ($S\frac{1}{2}$) of the south one-half ($S\frac{1}{2}$) of section thirty-three (33) and the southwest one-quarter ($SW\frac{1}{4}$) of the southwest one-quarter ($SW\frac{1}{4}$) of section thirty-four (34), Township Eight (8) South, Range Three (3) West, S. B. M., Riverside County, California.

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Section Fifth: The interveners Guy Bogart, Lucy Parkman Bogart and Fred Reinhold, as executors under the will of Murray Schloss, deceased, own certain real property in San Diego County, California, of which approximately twenty (20) acres are riparian to a certain tributary of said Temecula-Santa Margarita River by the name of Stone Creek and are susceptible of practical and profitable irrigation with the water of said creek, said approximately twenty (20) acres being described as follows: The south one-half ($S\frac{1}{2}$) of the northeast one-quarter ($NE\frac{1}{4}$) of the northeast one-quarter ($NE\frac{1}{4}$) of section four (4) Township Nine (9) South, Range Three (3) west, S. B. M., San Diego County, in said state. Said interveners are entitled to take from the surface and subsurface waters of said Stone Creek and use the same on said twenty (20) acres riparian to said Stone Creek, throughout said dry or irrigation season of each calendar year and from the 1st day of May of each year until the 31st day of October of the same calendar year, the entire flow of the waters of said Stone Creek and all its tributaries which naturally, when not artificially diverted or abstracted, flows or descends in the channel thereof to and upon said twenty (20) acre parcel; and are entitled to take from said Stone Creek, during the rainy or winter season of each year, for use upon said twenty (20) acres of riparian land for all beneficial purposes, five (5) miner's inches continuous flow.

Section Sixth: The waters of said stream and its tributaries herein apportioned to the interveners shall be deducted from the fractional part of the waters of said stream herein allotted to plaintiff.

Section Seventh: For the purpose of dividing among, and allocating to, the parties of this action, the waters of the Temecula-Santa Margarita River and its tributaries, at the places and in the amounts specified in this judgment, the plaintiff and the defendants immediately shall establish, and thereafter shall maintain jointly (unless established and/or maintained by U. S. Geological Survey, Division of Water Resources State Department of Public Works, or other public body), stream-flow (automatically registering) gaging stations at the following three locations on the Temecula-Santa Margarita River:

Station No. One (1): The upper end of Nigger Canyon at or near the present location of the Nigger Canyon gaging station;

Station No. Three (3): The upper end of Temecula Gorge, immediately downstream from the confluence of Murrieta Creek, at or near the present location of the Temecula Gorge gaging station;

Station No. Six (6): The Narrows, at or near the present location of the Ysidora gaging station.

And plaintiff and defendants shall establish and maintain jointly (unless established and/or maintained by U. S. Geological Survey, Division of Water Resources State Department of Public Works, or other public body), gaging stations for measuring (and automatically registering) the surface flow of said stream, or any of its tributaries, at any point thereon where the plaintiff, the defendants, or the interveners, or any of them, hereafter may construct or maintain appliances for the diversions of the surface flow of said stream, or any of its tributaries. (The cost of establishing and maintaining joint gaging stations as are required hereunder, including the taking of measurements and observations thereof, shall be borne equally by the plaintiff and the defendants.)

Each party shall establish and maintain meters to determine and automatically register the amount of the underground waters abstracted or diverted by such party from the underground waters of Temecula-Santa Margarita River and/or its tributaries by means of wells, either artesian or pumped (except windmill wells and/or domestic use wells of the parties and/or their tenants); such meters shall be of a type which will meet the approval of both plaintiff and defendants or the approval of either party and the engineer in charge of the Los Angeles office of the U. S. Geological Survey, and shall be installed and maintained in such manner and place as to be available for inspection by either plaintiff or defendants at all times.

Section Eighth: Whenever the total normal flow of said Temecula-Santa Margarita River (when not artificially diverted or abstracted) measured at gaging station No. Three (3) exceeds the total normal flow measured at Gaging Station No. Six (6), then and in that instance the flow of said stream at said Gaging Station No. Three (3) shall be considered as the total flow of said stream, and at such time the apportionments and allotments herein provided for shall be predicated upon the flow of said stream at said Gaging Station No. Three (3).

Section Ninth: For the purpose of apportioning to defendants thirty-three and one-third per cent (33-1/3%) of the waters of said stream as in Section Third provided, it shall be deemed that an amount of water equal to one-half (1/2) the surface flow at Station No. Six (6) or Station No. Three (3), wherever the flow is the greater (as provided in Section Eighth), pumped and/or diverted from the subsurface and/or surface waters of said river at points upstream from said Station No. Three (3), shall constitute thirty-three and one-third per cent (33-1/3%) of the waters of said stream.

It is recognized that the practical operation of the various pumping plants upon the defendants' lands for irrigation makes it difficult, if not impossible, for defendants to abstract and divert each day an amount of water the exact equivalent of the proportion of the stream flow measured at Station No. Six (6) or Station No. Three (3) to which defendants are entitled under this decree. Accordingly, whenever it is observed that defendants are abstracting and diverting, or have abstracted and diverted surface and/or underground waters in amounts in excess of that to which they are entitled hereunder, defendants, upon learning or being informed of such fact, thereupon shall reduce their diversions below the amount to which they are entitled under this decree, and shall continue such reduced diversions for the same period of time as near as is practicable and in an amount equivalent to the amount of water which defendants had diverted in excess of that to which they were entitled under this decree.

Section Tenth: In addition to the thirty-three and one-third per cent (33-1/3%) of the waters of said stream herein in Section Third allotted to defendants, they may also divert or abstract from the underground waters of said Temecula-Santa Margarita River, but not from the surface waters of said stream, at the places, during the times and upon the conditions hereinafter in this Section specifically set forth, but not otherwise, a specified amount of subsurface water herein in this judgment referred to as "Storage Water". The amount of Storage Water which the defendants may divert or abstract during any irrigation season shall be determined by the elevation of water (When not artificially disturbed) on May 1st of each year in a certain well located on defendants' land known as Windmill Well, in accordance with the following table:

Depth to water below ground surface as shown in casing of Windmill Well on May 1st	Amount of Storage Water defendants may divert and apply to beneficial use during irrigation season
20 feet or less	1,500 acre feet
30 feet	1,125 acre feet
40 feet	750 acre feet
50 feet	375 acre feet
60 feet or more	No acre feet

At depths to water intermediate to those above stated proportionate quantities of
water may be taken.

The spreading of flood water which does not involve
surface impoundment (either temporary or otherwise) but which may raise the level
of water in the underground basin in which said Windmill Well is drilled and upon
which said well is located, shall not be considered as an artificial disturbance of
the elevation of water in said Windmill Well. Storage water may be directed and
used only upon said lands of defendants hereinbefore described and not elsewhere.

For the purpose of indicating the places at which said Storage Water may be
pumped, reference is hereby made to "Plaintiff's Exhibit No. 265". Said Exhibit
by reference has been incorporated into and constitutes a part of the Transcript
on Appeal in this action. Reference is hereby made to said Transcript and to
said Exhibit No. 265 and by such reference said Exhibit is incorporated into and
constitutes a part of this judgment.

Shown upon said Exhibit No. 265, and extending in a generally northerly and
southerly direction, is a certain line of wells (hereafter referred to as the E
line of wells) desiganted on said Exhibit as E-3, E-2 North, E-1 North, E-1 South
and E-2 South.

Easterly thereof, shown upon said Exhibit, and extending in a generally north-
westerly and southeasterly direction, is a certain line of wells (hereafter referred
to as the P. V. line of wells) designated on said Exhibit as P.V.9, P.V.6, and
P.V.6X. Immediately adjacent to said P.V. line of wells and parallel thereto, is
a certain highway commonly known as Old Warners Ranch Road (now not in common use).

(a) Not more than Thirty per cent (30%) of said Storage Water which defendants
are entitled to pump during any irrigation season may be pumped from that portion
of defendants' lands lying between a line drawn through said E line of wells and
extended across said underground basin, and a line drawn through said P.V. line
of wells and extended across said basin.

(b) At least seventy per cent (70) of said Storage Water which defendants
are entitled to pump during any irrigation season shall be pumped from that portion
of defendants' lands lying easterly of a line drawn through said P. V. line of
wells and extended across said underground basin.

The well hereinbefore described as Windmill Well is situated on Pauba Grant
South Sixty-seven degrees fifteen minutes (S 67 deg. 15 min.) East of B.M.11 a

distance of approximately eleven hundred (1100) feet, and South forty-seven degrees twenty minutes (S 47 deg. 20 min) West of B.M. 12 a distance of approximately fifteen hundred eighty (1580) feet, said bench marks being designated as Nos. 11 and 12 on said Exhibit No. 265.

Should said Windmill Well collapse or otherwise cease to be available or useful for the purpose of determining ground water elevations in the vicinity thereof, then another well shall be drilled by the defendants in the same general location, at approximately the same ground surface elevation above sea level, but not to exceed a distance of one hundred (100) feet from the location of said Windmill Well. Such new well shall be approximately the same depth and diameter of casing as said Windmill Well. In event the parties hereto are unable to agree upon location, depth and diameter of casing of such well, these matters, upon petition of the parties hereto or either of them, shall be determined by order of this court.

For the purpose of determining defendants' total diversions of the waters of the Temecula-Santa Margarita River and its tributaries (meaning thereby to include both the allotment of thirty-three and one third per cent (33-1/3%) of the waters of the river as defined in Section Third, and the additional Storage Water as defined in this Section Tenth hereof), any water abstracted or diverted by defendants from the underground waters of said river (including underground basins of percolating water within the watershed of said river and its tributaries) by use of wells or pumps or other means of diversion, whether now existing or hereafter established, except as hereinafter in this section provided, shall be added to any surface diversions by the defendants from the waters of said river. Such abstractions by the defendants of the underground waters of the Temecula-Santa Margarita River are, and for all purposes of this judgment shall be (except as hereinafter provided) considered as diversions of the waters of said river, and are and shall be chargeable against the fractional part of the surface flow of said stream and the additional amount of Storage Waters herein allotted to defendants.

Water abstracted or diverted from said underground Water of said river which shall not be subject to the provisions of this section are as follows:

1. Windmill wells maintained by defendants for the purpose of supplying water for cattle.

2. Water used by defendants or their tenants for domestic use exclusively

3. Waters which defendants may pump directly into the surface flow of said stream pursuant to the requirements of Section Eleventh hereof.

Section Eleventh:

Part 1. During the irrigation season of each year, to wit, May 1 to October 31, inclusive, excepting as otherwise in Part 1 of this Section permitted, defendants shall cause to be maintained at Gaging Station No. Three (3) a constant flow of water of not less than three (3) cubic feet per second (one (1) cubic foot per second being the equivalent of fifty (50) miner's inches.).

The surface flow at said Station No. Three (3) may be permitted to fall below three (3) cubic feet per second during said irrigation season upon the following conditions and not otherwise:

1. Said surface flow shall not be permitted to fall below three (3) cubic feet per second for any continuous period of more than ten (10) days:

2. An interval of at least ten (10) days shall elapse between periods during which said surface flow falls below three (3) cubic feet per second:

3. Defendants shall contribute to the surface flow at Station No. Three (3), by means of pumping from Temecula Alluvial Basin, or otherwise, an amount of water equal to the amount that the actual flow during said period was less than the required flow of three (3) second feet;

4. Such contributions shall be made at the same rate and over the same period (as near as practicable) as the rate at which said surface flow was less than Three (3) second feet;

5. Such contributions shall be made immediately following the period in which said required flow of three (3) second feet was not maintained;

6. Defendants by means of pumping underground waters directly into the surface flow of the stream or otherwise during any period in which said required flow of three (3) second feet was not maintained, shall always maintain a constant surface flow at Station No. Three (3) of not less than two (2) second feet.

Part II: In the event that, during the irrigation season of any year, to wit, May 1 to October 31, inclusive, the irrigation of crops on said lands of defendants reasonably requires more water than they otherwise are entitled to take under this decree, defendants may abstract and divert underground waters only, in amounts in excess of that to which they are otherwise entitled hereunder. Such excessive diversions may be made upon the following conditions and not otherwise:

1. Excessive diversions shall not continue for a period to exceed eight (8) days consecutively;

2. Following any period of excessive diversion, an interval shall elapse before any further period of excessive diversion, which interval shall not be less than the number of days during the period of excessive diversions immediately preceding;

3. Defendants shall reduce their diversions below the amount to which they are otherwise entitled under this decree, such reductions to be in an amount not less than the amount of water which defendants have diverted in excess of that to which they are otherwise entitled under this decree;

4. Such reductions of their diversions shall be made by defendants immediately following the period during which such excessive diversions were made and shall be completed within ten (10) days thereafter;

5. Defendants, at least one (1) day in advance of the commencement of such diversions, shall advise plaintiff in writing of their requirement and of their intention to avail themselves of the privilege of excessive diversions afforded under part II of this Section.

Parts I and II of this Section Eleventh are complementary one of the other and not inconsistent one with the other and hereafter shall be so construed. The purpose of Part I is to require defendants to maintain a constant flow at Station No. Three (3) of not less than three (3) cubic feet per second excepting under the conditions stated when the flow may be permitted to fall below three (3) cubic feet per second but not below two (2) cubic feet per second, and when such diminution of the stream flow occurs the amount of such diminution shall be contributed by the defendants by pumping directly into the surface flow of the stream from the Temecula Alluvial Basin or otherwise. Part II permits defendants under the conditions stated to use for short periods amounts of water in excess of their allotment but requires them to contribute shortly thereafter the amount of such excessive diversions by reducing (in an amount not less than the amount of such excessive diversions) the amount of the diversions to which they are otherwise entitled. No part of such excessive diversions is required to be contributed by defendants through direct pumping from the subsurface waters of the Temecula Alluvial Basin into the surface flow of the stream if, during the period of such excessive diversions, the constant stream flow at Station No. Three (3) equals or exceeds three (3) second feet.

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Section Twelfth: Defendants at all times shall be entitled to divert from the Temecula-Santa Margarita River and its tributaries, and to apply to beneficial use upon their said lands, an amount of water equal to one-half the amount which the plaintiff is entitled to divert from said river and its tributaries and apply to beneficial use upon its lands.

For the purpose of determining the amount of water which defendants are entitled to divert and apply to such beneficial use, computations of the amount of water diverted and applied to beneficial use by each of the parties hereto shall be made monthly, based on joint measurements maintained as herein required. In event said measurements disclose that the amount of water which defendants are entitled to divert and apply to beneficial use pursuant to the provisions of this judgment is less than one-half the amount being applied to beneficial use by plaintiff, thereupon defendants shall be entitled to increase their diversions and applications to beneficial use to an amount sufficient to make defendants' diversions and applications to beneficial use equal to one-half the amount diverted and applied by plaintiff; provided, however, that such additional diversions and applications, if and when made, shall be in addition to diversions made under Sections Third and Tenth hereof, and shall be made by defendants during the irrigation season in which such right accrues, or in the first subsequent season, or part in the same season and the remainder in the first subsequent season, and such diversion, if any, shall be made by pumping from the underground basin at points easterly from said P. V. line of wells.

Section Thirteenth: Each of the parties hereto shall have the right to construct dams or reservoirs on its or their respective lands or elsewhere, for the purpose of intercepting or impounding or conserving such party's share of the flood waters of said river and its tributaries; provided, however, in the event any such dam or reservoir is hereafter constructed by defendants for such purpose, the rights of defendants to abstract and divert Storage Water pursuant to Section Tenth hereof shall cease and terminate.

Defendants shall not make, during any irrigation season, any surface diversions of the waters of said river at the Bridge Pumping Plant, The Cantarini Pumping Plant or the Tule Pumping Plant referred to in the findings herein, or at any other point on said Temecula-Santa Margarita River below the point of Rising Water as shown on said Exhibit No. 265.

Section Fourteenth: The plaintiff, Rancho Santa Margarita, a corporation, shall have and recover of and from the defendants, its costs and disbursements herein taxed at Six Thousand Thirty-six and 62/100 Dollars ($6,036.62).

Dated at San Diego, California, this 26 day of December, 1940.

Gordon Thompson

Judge

Records indicate that this judgment was recorded in San Diego and Riverside Counties on 26 December 1940.

Assumptions and Realities in the SMR

	Assumptions	Reality
Vbmp	0.6”?	1.02” (70% greater)
Natural Runoff	10%?	Range from 7%-27%
Habitat Impacts	No impact?	<u>Sub-Regional Scale*</u> 95% less days of flow from site compared to pre-development condition <u>Watershed Scale</u> 40% of flow days are from storms under 1” in pre-development condition
Downstream Water Use	No impact?	<u>Sub-Regional Scale*</u> Average Loss of 30% of volume of runoff Loss of 7 ac-ft, per sq. mi., per year <u>Watershed Scale</u> XX% of volume is from storms under 1”

* Continuous simulation based on HSPF, Assumed 640 acres natural grass on B soils converted to 70% urban impervious

Assumptions and Realities in the SMR

	Assumptions	Reality
What Constitutes MEP?	85% Storm Retention most effective way to reduce pollution and protect uses	Current proposal leaves water above the 85% storm untreated, and loss of flow can itself constitute "water pollution." A mix of onsite infiltration and biofiltration may be more protective of downstream beneficial uses in the unique circumstances of the SMR Basin. 85% Retention is not "industry standard" as suggested by NRDC.
Impact of Urbanization on Flows in SMR	Urban runoff from impervious surfaces leaves the SMR with more water than it would "naturally" receive.	River Data from 1925-2008 suggest that the amount of runoff reaching the Temecula Gorge has been relatively constant. The increased runoff associated with impervious surfaces appears to have offset the losses associated with GW mining and Vail Dam.

Assumptions and Realities in the SMR

	Assumptions	Reality
Impact on Downstream Water Rights	Reductions in runoff will not harm CPEN/FPUD ability to fully utilize their water rights	Large scale development/redevelopment has the potential to reduce flows reaching Camp Pendleton
The CWRMA and Base Flow	CPEN is made whole for increased infiltration via the CWRMA Agreement	The CWRMA only addresses Base Flow. The majority of the water that replenishes CPEN's groundwater basins comes from storm flows. The CWRMA does not replace Storm Flows lost to infiltration or reuse in the upper basin

Assumptions and Realities in the SMR

	Assumptions	Reality
Federal Standard for Stormwater Capture	The Federal Standard requires capture of the 95th percentile storm under all circumstances.	The Federal standard requires 95th percentile storm capture unless hydrologic conditions indicate natural site conditions would yield less than 95% infiltration in a pre-development condition. No requirement to retain/infiltrate beyond Delta V.
Infiltration versus Retention Standards	CPEN is harmed equally by the retention versus infiltration standard	Retention or infiltration of the 85th percentile storm at every new or redeveloped property will reduce the hydrograph beyond that which would occur "naturally." However, retention is worse because the water in many cases is entirely lost to the hyrologic system.

Assumptions and Realities in the SMR

	Assumptions	Reality
Retrofit of Existing Properties	Retrofit will not cause any adverse effect on downstream flows because the 85^{th} percentile retention standard is not mandated	Language in the existing permit is ambiguous and can be read to require retrofit projects to meet the EPA/NRDC proposed VBMP.

Land Use:	Runoff Coefficient		
	Low	High	Midpoint
Unimproved areas	0.10	0.30	0.20
Residential (suburban)	0.25	0.40	0.33
Residential multiunit, detached	0.40	0.60	0.50
Neighborhood business area	0.50	0.70	0.60
Light industrial	0.50	0.80	0.65

Source: Viessman & Lewis, Introduction to Hydrology, 4th edition, HarperCollins College Publishers: New York, 1996.

Example Comparing RB's Permit Requirements with Delta-V Alternative

- A 100-acre parcel is planned to be developed into a multi-family residential community
- Prior to development, the runoff coefficient is 0.20
- After development, the runoff coefficient will be 0.50
- This example compares runoff quantities from the 85th percentile, 24-hour storm, assuming it has a depth of 1 inch:
  - -Pre-development runoff = 0.2 inches or 1.7 acre-feet
  - -Post-development runoff = 0.5 inches or 4.2 acre-feet
- Design Capture Volume (DCV) as defined by permit = runoff from the 85th percentile, 24-hour storm. For this site, DCV is 4.2 acre-feet.
- The Delta-V approach would require that LID retain the difference between pre- and post-development runoff, such that the natural hydrology of the site is maintained[1]:
  - -DCV for Delta-V = 4.2 ac-ft – 1.7 ac-ft = 2.5 acre-feet
- The permit as written would alter the natural hydrology by retaining an additional 1.7 acre-feet of runoff per event. Multiplied by multiple sites, with many events per year over many years, this is a significant quantity of water over time, which should be quantified in more detailed studies.
- The Delta-V approach ensures that (1) the natural hydrology is maintained, i.e. the quantity of runoff is the same as under pre-development conditions, and (2) water quality objectives are met by treating the remainder of runoff for the 85th percentile, 24-hour storm using traditional BMPs.

[1] The Delta-V approach would require LID to retain the difference between pre- and post-development runoff. Runoff from the 85th percentile, 24-hour storm which is not retained by LID would be treated and released using traditional BMPs.

Impact of Retro-Fitting Developed Sites with LID

- An existing 100-acre, multi-family residential community will be outfitted with LID to comply with the permit
- The runoff coefficient of the site is 0.50
- This example uses runoff quantities from the 85th percentile, 24-hour storm, assuming it has a depth of 1 inch:
    - -Existing runoff = 0.5 inches or <u>4.2 acre-feet</u>
- Design Capture Volume (DCV) as defined by permit = runoff from the 85th percentile, 24-hour storm. For this site, DCV is <u>4.2 acre-feet</u>.
- After LID is implemented, 4.2 acre-feet of rainfall will be captured and retained per event, potentially removing that 4.2 acre-feet from the surface water flows as they exist today.
- This would alter the existing hydrology by potentially removing significant quantities of water from the surface water system.
- In order to quantify the total impact to Camp Pendleton's water supply, detailed studies are needed.
- Questions that must be answered by further study include:
    - -How many total acres of existing development will be retrofitted with LID?
    - -What are the actual runoff coefficients of sites to be outfitted with LID?
    - -What is the seasonal variation of those runoff coefficients?
    - -Will LID retention and infiltration be feasible during extended wet conditions?
    - -What are the locations of planned LID facilities, and how does runoff from those sites contribute to surface water flows leaving the upper watershed?
-

Impact of Using Different Design Storms for Design Capture Volume

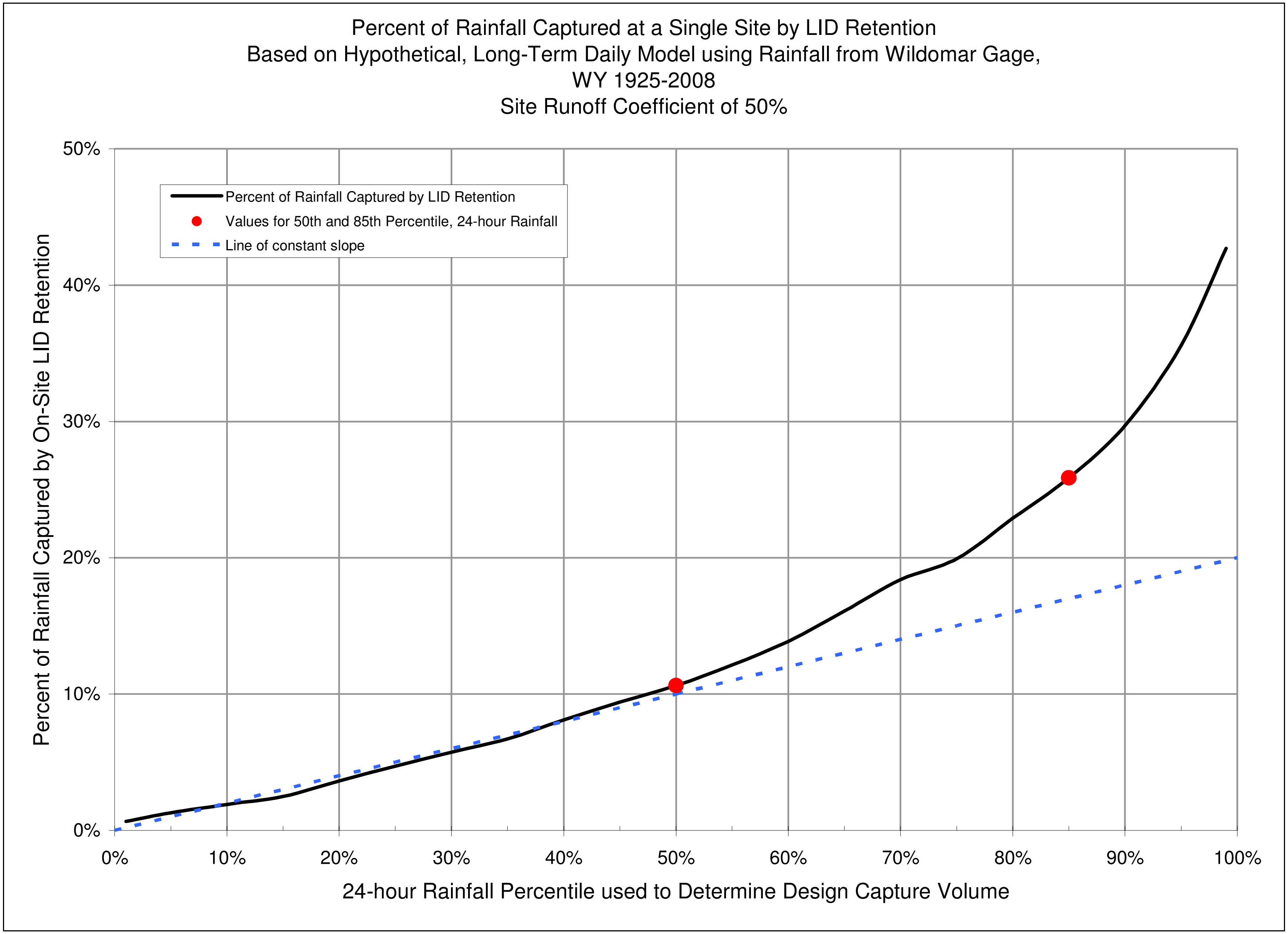
- A hypothetical, daily model of LID capture was created to simulate long-term retention by LID at a single site.
- The site is assumed to have a runoff coefficient of 0.50 for every storm, regardless of antecedent conditions. This is a simplification which allows us to make a relative comparison between design storm percentiles.
- The table below presents the percent of rainfall that is retained by LID for different percentiles of the 24-hour storm
- The figure shows the data from the table in graphical format
- The slope of the line begins to increase at about the 50th percentile storm

	24-hour Storm Percentile	Corresponding 24-hour Rainfall Depth[1] (in)	Percent of Rainfall that is Retained by LID[2]
	1%	0.01	1%
	5%	0.02	1%
	10%	0.03	2%
	15%	0.04	2%
	20%	0.06	4%
	25%	0.08	5%
	30%	0.10	6%
	35%	0.12	7%
	40%	0.15	8%
	45%	0.18	9%
	50%	0.21	11%
	55%	0.25	12%
	60%	0.30	14%
	65%	0.37	16%
	70%	0.45	18%
	75%	0.51	20%
	80%	0.64	23%
*	85%	0.80	26%
	90%	1.06	30%
	95%	1.64	36%
	99%	2.90	43%

*Design storm as defined by current Permit

Notes:

1. Based on rainfall data from 1914-2008 at Wildomar station (Riverside County Flood Control Network)
2. Based on retention and runoff from a single site assuming a 50% runoff coefficient for all storms; also assumes that LID retention and infiltration is feasible in wet conditions.


Percent of Rainfall Captured at a Single Site by LID Retention
Based on Hypothetical, Long-Term Daily Model using Rainfall from Wildomar Gage,
WY 1925-2008
Site Runoff Coefficient of 50%
Percent of Rainfall Captured by LID Retention
Values for 50th and 85th Percentile, 24-hour Rainfall
Line of constant slope
Percent of Rainfall Captured by On-Site LID Retention
0%
10%
20%
30%
40%
50%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
24-hour Rainfall Percentile used to Determine Design Capture Volume

Wayne Chiu - Fwd: LID (non-retention) Sizing Methods

From: Chiara Clemente
To: Chiu, Wayne
Date: 10/29/2010 9:47 AM
Subject: Fwd: LID (non-retention) Sizing Methods
Attachments: Sizing of a Bioswale (w_att).pdf; Permit Language.docx

>>> "Padres, Claudio" <CMPadres@rcflood.org> 10/28/2010 1:32 PM >>>
Ben,

As we discussed in our last meeting, there are several significant problems with the performance criteria in the errata for *non-retention* LID BMPs. Below is a comparison of the two methods:

	Ventura	South OC
Implementation of performance criteria	'Equivalent Pollutant and Volume reduction' is undefined, un-implementable, and un-enforceable.	'hold' .75 times VBMP: is clear, implementable, and enforceable – this is why we agreed to it previously.
WQ Protection	Less Protective (see next column)	Results in BMPs over 30 times larger than Ventura Method*, which in turn will: • treat much more water, and • result in much more incidental volume loss through infiltration, surface wetting, and evapotranspiration. • Result in much greater pollutant removal. Because we all recognize the importance of these benefits, we had agreed to this sizing method, even knowing that it was very conservative.
LID Manual	Completely inconsistent with our LID BMP Design Manual	Based on our agreements leading to the public release, we have been finalizing our LID BMP Design Manual based on the non-retention sizing methodology in South OC. We are vested in that approach.

*See attached calculations for background on the size comparison.

It is highly appropriate that the performance standard for non-retention BMPs be restored to the 0.75 x VBMP standard as shown on the attached 'permit language' word document. This change (compared to the errata) will result in better protection of water quality, better and clearer implementation, and further it maintains the Copermittees' ability to implement the pending LID BMP Design Manual within this watershed.

Additionally, in our discussions prior to the public release we offered 1 x VBMP as an *additional* safety factor to only facilitate the change to infiltration. If the infiltration language does not remain as originally drafted (infiltration), that safety factor is not appropriate and should be restored to the 0.75 factor.

Please give me a call at your earliest convenience, and we can discuss this further.
Best regards,

Claudio M. Padres, PE
Senior Civil Engineer
Watershed Protection Division - NPDES

Riverside County Flood Control
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Sizing of a Bioswale

Assumptions:

Project: 1-acre commercial development (95% Impervious)

Location: Temecula

24-hour 85th percentile storm volume: 1.02”

Peak hourly intensity (in/hr) for a 24-hour storm: 14% of storm volume
(per Riverside County Hydrology Manual)

Runoff Coefficient C: 0.81

V_{BMP}: 2977 Ft^3 (See attachment 1)

Sizing Method: Flow

Per South OC Method

“HOLD 0.75 TIMES VBMP” (Requirements based on Volume)

Swale Volume = 0.75 x V_{BMP}

Swale Volume = **2,233 ft^3**

Per Ventura Method

“TREAT 1.5 TIMES VBMP” (Requirements based on Flow)

Need to calculate the Flow Rate (Q) that will treat a volume of 1.5 x V_{BMP}.

1.5 x V_{BMP} = 4466 ft^3

*Q= C x I x A => need to find **I** to be able to calculate **Q.***

To produce 4466 ft^3 of runoff, you would need a storm depth of 1.53”
(See attachment 2)

24-hour peak hourly intensity (I) = 14% of storm volume = 0.14 x 1.53

I= 0.21 inches/hour

Q = C x I x A = 0.81 x 0.21 x 1(acre) = 0.17 cfs

Swale Volume = 71.40 ft^3 (See attachment 3)

BMP Design Volume, V_{BMP}, Santa Ana/ Santa Margarita	Legend:	Required Entries Calculated Cells

Company Name		Date	
Designed by		County/City Case No	

Test Case: 1-acre commercial in Temecula (95% impervious)

Enter the Area Tributary to this Feature $A_T =$ 1 acres

Slope value from Design Volume Curve in Appendix A

Site Location

Township	
Range	
Section	

24-hour 85th % Storm Volume = 1.02 inches

Calculate the Impervious Percentage

Total Impervious Area in the Area Tributary to the Feature	$A_{IMP} =$	0.95	acres
Total Area Tributary to the Feature	$A_T =$	1	acres
Impervious Percentage	i =	95%	

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$ C = 0.81

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 85% Unit Storage Volume $V_U = S_C \times C$ $V_u =$ 0.82 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\,(ft^3) = \frac{V_U\,(in\text{-}ac/ac) \times A_T\,(ac) \times 43{,}560\,(ft^2/ac)}{12\,(in/ft)}$$

$V_{BMP} =$ 2,977 ft^3

Notes:

Attachment 2

BMP Design Volume, V_{BMP}, Santa Ana/ Santa Margarita	Legend:		Required Entries / Calculated Cells

Company Name		Date	
Designed by		County/City Case No	

Test Case: 1-acre commercial in Temecula (95% impervious)

Enter the Area Tributary to this Feature $A_T =$ 1 acres

Slope value from Design Volume Curve in Appendix A

Site Location

Township	
Range	
Section	

24-hour 85th % Storm Volume = 1.53 inches

Calculate the Impervious Percentage

Total Impervious Area in the Area Tributary to the Feature	$A_{IMP} =$	0.95	acres
Total Area Tributary to the Feature	$A_T =$	1	acres
Impervious Percentage	i =	95%	

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$ C = 0.81

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 85% Unit Storage Volume $V_U = S_C \times C$ $V_u =$ 1.23 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

$V_{BMP} =$ 4,465 ft^3

Notes:

Attachment 3

Design Procedure - Bioswale	Legend:	Required Entries / Calculated Cells

Company Name: | Date:

Designed by: | County/City Case No.:

Test Case: 1-acre commercial in Temecula (95% impervious)

Sized per Ventura Methodology

Enter the area tributary to the swale, max = 10-acres — A_T = 1.0 acres

Enter Q_{BMP} from Flow Worksheet — Q_{BMP} = 0.17 cfs

Enter Swale Slope, Sideslopes and depth of flow

Mannings roughness (n) = 0.20 unitless

Enter side slope of proposed swale — Side Slope (z) = 4

Max z = 4:1 (slopes must be 4:1 or flatter)

Enter longitudinal slope of the swale — slope (s) = 0.01

s_{min} = 0.002, s_{max} = 0.020

Enter depth, d, of flow in the swale — Depth of flow (d) = 5 inches

maximum 3 - 5 inches

Determine bottom width of swale

The simplified manning equation below will solve for the bottom width, b of the swale

$$b\ min = \frac{Q_{BMP}\,(n)}{1.49(d^{5/3})(s^{1/2})}$$

b min = 1.0 ft

Enter proposed swale bottom width, Minimum = 2 ft — b design = 2.0 ft

$$d\ design = \left(\frac{Q_{BMP}\,(n)}{1.49(b\ design)(s^{1/2})}\right)^{3/5} \times \left(\frac{12\ in}{1\ ft}\right)$$

d design = 3.3 inches

Check Velocity, V

Calculate cross sectional area of the swale

Area (A) = d (b+ zd) — A = 0.84 sq ft

Calculate the velocity of the swale, max = 1 foot/sec

$$V = \frac{Q_{BMP}}{A}$$

V = 0.20 fps

Calculate Minimum Length and Minimum Top Width

Design Length (L) = V (ft/s) x 7 min contact time x (60 sec/min) — L min = 85 ft

Minimum Top Width, T_W

T_W min = b design + d design (z)(2) — T_W min = 4.17 ft

Use pulldowns

Underdrains provided for C or D type soils or slopes < 0.5%? — No

Check Dams provided for steep slopes? — N/A

Volume = 71.40 ft^3

If the swale has been designed correctly, there should be no error messages on the spreadsheet.

Page # 33-34 Section F.1.d.(4)(c)(ii) - If onsite [*infiltration]** LID BMPs are technically infeasible per section F.1.d.(7)(b), other LID BMPs may treat any volume that is not retained onsite. Due to the flow through design of non-retention LID BMPs, the total volume of the BMP, including pore spaces and pre-filter detention volume, must be sized to hold at least 0.75 times the portion of the design capture volume that is not retained onsite by LID retention BMPs. ~~provided that the other LID BMPs are sized to achieve equivalent storm water volume and pollutant load reduction as if the entire design capture volume were retained onsite.~~ The LID BMPs must be designed for an appropriate surface loading rate to prevent erosion, scour and channeling within the BMP.

**The issue of 'retention' versus 'infiltration' is another independent point of contention. The proposed changes are appropriate regardless of the outcome of the retention/infiltration discussion.*

From: Jungreis CIV Jeremy N <jeremy.jungreis@usmc.mil>
To: <cclemente@waterboards.ca.gov>, Ben Neill <BNeill@waterboards.ca.gov>, W...
CC: Carlisle LtCol Kevin T <kevin.carlisle@usmc.mil>, Boughman CIV Paul R <p...
Date: 11/3/2010 2:41 PM
Subject: Draft Language for Hearing on 10 November
Attachments: Draft Memo 3 November 2010.doc; Assumptions and Realities of Riverside MS4 Permit.ppt; LID_examples_10-27-2010.doc; Hydrologic Points to R9-MS4 Order.pdf

Chiara:

Per our discussion of a short time ago, please find attached in the Memo entitled "3 November 2010," answers to the questions posed by your staff last Wednesday. The memo also contains proposed language that would, if adopted, eliminate the possibility of harm to downstream water uses as the result of volumetric losses associated with implementation of the proposed 85th percentile retention standard.

As reflected in the information previously provided to Board staff (also attached), we believe that we have been responsive in demonstrating the possibility of harm to downstream water uses associated with implementation of the proposed permit. As you have requested, we will endeavor to further refine the answers provided in the 3 November memo, and provide you with additional data regarding hydrologic implications before the November 10 Board meeting. However, we believe that our actions thus far demonstrate due diligence and a good faith effort to reach a mutually beneficial resolution based on available data. We continue to believe that a comprehensive study of the entire hydrograph is needed to determine what amount of onsite retention versus treatment is the best means of assuring that downstream beneficial uses are protected.

Best Regards,

Jeremy Jungreis

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Draft Memorandum 102910.2

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STETSON ENGINEERS INC.

TO:	Camp Pendleton Office of Water Resources	DATE:	November 3, 2010
FROM:	Stetson Engineers	JOB NO:	2199-5001

RE: Impact to Water Resources on Camp Pendleton from RWQCB Tentative Order No. R9-2010-0016

INTRODUCTION

Stetson Engineers has performed a cursory review the Santa Margarita River hydrology and potential impacts from RWQCB Tentative Order No. R9-2010-0016. Generally, the implementation of LID as dictated in the tentative order may negatively impact the water resources available to Camp Pendleton and reduce the ability to fully exercise its water rights and protect its riparian ecosystems. The tentative order would cause impacts in the tributary areas of the Santa Margarita River upstream of Camp Pendleton's boundary in Riverside County. The purpose of this technical memorandum is to identify the potential impacts to Camp Pendleton's water rights and identify alternative language in the tentative order that could be adopted to mitigate future negative impacts to the Base's water supply caused by the wide-spread implementation of LID.

Alternative Language

Stetson advocates using the approach known as "Delta-V" for sizing LID facilities for projects greater than 1 acre. The Delta-V approach ensures that LID facilities are sized such that pre-development hydrology is maintained. The Design Capture Volume (DCV) for LID as currently defined by the permit is the runoff volume from the 85th percentile, 24-hour storm. The Delta-V approach would require that LID retain the difference between pre- and post-development runoff. That is, LID facilities would be required to retain the runoff in excess of that under pre-development conditions, rather than the entire runoff volume of the storm. However, the remaining runoff volume would still be required to be treated with traditional treatment control BMPs. The Delta-V approach would be required for projects with a size greater than 1 acre. Lacking detailed hydrologic analysis, the 1 acre threshold was chosen to be consistent with the State General Construction Permit requirements. Following collection and analysis of detailed data sets, the 1-acre threshold could be adjusted at the next permit renewal cycle if retention at the Delta-V level combined with biofiltration of residual runoff is found not to remove pollutants to the maximum extent practicable.

To implement this change, the following alternative language is proposed, with additions shown in red:

Add to Section F.1.d.(4):

(c) LID BMPs sizing criteria:

(i) For Priority Development Projects with a total area less than or equal to 1 acre, LID BMPs must be sized and designed to ensure onsite retention without runoff, of the volume of runoff produced from a 24-hour 85th percentile storm event ("design capture volume"); For Priority Development Projects greater than 1 acre, LID BMPs must be sized and designed to ensure onsite retention without runoff of the volume of runoff produced from a 24-hour 85th percentile storm event that is in excess of the runoff that would otherwise occur from the pre-development site. Conventional treatment control BMPs, such as biofiltration or other natural treatment systems, must be implemented to treat the remaining runoff from the site.

(ii) If onsite retention LID BMPs are technically infeasible per section F.1.d.(7)(b), other LID BMPs may treat any volume that is not retained onsite provided that the other LID BMPs are sized ~~to hold the design storm volume that is not infiltrated~~ to achieve equivalent storm water ~~volume and~~ pollutant load reduction ~~as if the entire design capture volume were retained onsite~~. The LID BMPs must be designed for an appropriate surface loading rate to prevent erosion, scour and channeling within the BMP.

Edit and Add to F.1.d.(7):

Technical infeasibility may result from conditions including, but not limited to:

(i) Locations that cannot meet the infiltration and groundwater protection requirements in section F.1.c.(6) for large, centralized infiltration BMPs. Where infiltration is technically infeasible, the project must still examine the feasibility of other onsite LID BMPs;
(ii) Insufficient demand for storm water outdoor reuse;
(iii) Smart growth and infill or redevelopment locations where the density and/or nature of the project would create significant difficulty for compliance with the LID BMP requirements; and
(iv) Other site, geologic, soil, or implementation constraints identified in the Copermittees updated SSMP document.
(v) Reduction in site runoff that negatively impacts downstream water availability.

Edit Errata language in Section F.1.C.(8):

Rain water harvesting and outdoor water reuse, where feasible ~~must~~ may be encouraged as part ~~if~~ of the site design and construction to reduce pollutants in storm water discharges to the MEP.

Edit the original language in F.3.D.(4):

(4) Each Copermittee must consider the results of the evaluation in prioritizing work plans for the following year in accordance with Sections G.1 and J. Highly feasible projects expected to benefit water quality should be given a high priority to implement source control and treatment control BMPs. Where feasible, ~~the~~ retrofit projects may be designed in accordance with the SSMP requirements for conventional treatment control BMPs. ~~within sections F.1.d.(3) through F.1.d.(8).~~

~~and the Hydromodification requirements in Section F.1.h.~~

Edit the Errata Page # C-7 - Add the following definition:

Low Impact Development Best Management Practices (LID BMPs) - LID BMPs include schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States through storm water management and land development strategies that emphasize conservation and the use of on-site natural features integrated with engineered, small-scale hydrologic controls to more closely reflect pre-development hydrologic functions. LID BMPs include retention practices that do not allow runoff such as infiltration, rain water harvesting for outdoor use, ~~and~~ reuse (outdoor), and evapotranspiration. Infiltration BMPs should be given priority over other LID BMPs during design of facilities. LID BMPs also include flow-through practices such as biofiltration that may have some discharge of storm water following treatment. Reuse or rainwater harvesting for indoor applications that may result in exportation of water from the Santa Margarita River Basin shall demonstrate compliance with California Water Code Sections 1200 through 1225.

Hydrologic Questions and Further Studies

Following an October 27, 2010 meeting with the RWQCB, the following questions were posed by the Camp Pendleton and the RWQCB Staff:

- What is the runoff coefficient for this watershed (understanding that this is based on a 5-year storm)?
- What is the annual runoff amount?
- What is the runoff percentage for the 85th percentile, 24-hour storm?
- What is the largest storm that would still likely have no runoff – the threshold storm?

To be properly answered with a high degree of certainty, each of these questions requires in-depth study that includes numerical modeling and use of hourly rainfall data to quantify the response. The limited period of time since the errata language requiring retention of the 85th percentile storm onsite was released has constrained the ability of Camp Pendleton to analyze the questions posed in a comprehensive manner. Implementation of the tentative order, depending on the final requirements, should include a requirement for the collection of hydrologic data so the questions outlined above may be addressed. The following section outlines each of these questions and the value for continuing studies.

What is the runoff coefficient for the Santa Margarita River watershed?

The runoff coefficient varies depending on land use, soil type, rainfall intensity, slope, vegetative cover, and antecedent conditions. Additionally, the runoff coefficient will vary from pre-developed to post-developed conditions based on anthropogenic changes to groundwater levels. For example, pre-development areas of rising or elevated groundwater levels would naturally support increased runoff, resulting in a higher runoff coefficient and lower infiltration rate. Post-development conditions in the Santa Margarita River watershed are characterized by lower groundwater levels that increase infiltration and reduce runoff. Given the same site, the runoff coefficient may vary between pre- and postdevelopment conditions.

The following are a list of factors, and a short description of the issues, that would need to be addressed to answer this question.

Antecedent conditions -	What are the soil conditions during the design rainstorm? Flood analysis may typically assume saturated soils that maximize the run-off coefficient. While calculating the design flow runoff, unsaturated soils will dictate a lower runoff coefficient than saturated soils. The seasonal timing of storms will lead to different antecedent conditions for similar storm events; the frequency of storms within short (i.e. month-long) periods also affects runoff conditions.
Time -	An analysis of the watershed on an annual or event driven rainfall event will affect the runoff coefficient. Generally, runoff coefficients are less during the beginning of the rainy season and greater at the end. An annual runoff coefficient would differ from an event-specific runoff coefficient.
Site Conditions -	The soils are site-specific and will greatly affect the runoff coefficient. Runoff from granitic basement rock is greater than runoff from unsaturated alluvium. While a watershed runoff coefficient may be desired, it would vary from site to site. Runoff is also affected by site slope, with greater slopes generally leading to higher runoff percentages. In addition, vegetative cover affects runoff: bare soils generate more runoff than ground covered with thick vegetation.

EXAMPLE SITE SPECIFIC RUNOFF COEFFICIENTS FOR 5- TO 10-YEAR STORM EVENTS

Land Use:	Runoff Coefficient		
	Low	High	Midpoint
Unimproved areas	0.10	0.30	0.20
Residential (suburban)	0.25	0.40	0.33
Residential multiunit, detached	0.40	0.60	0.50
Neighborhood business area	0.50	0.70	0.60
Light industrial	0.50	0.80	0.65

Source: Viessman & Lewis, Introduction to Hydrology, 4th edition, HarperCollins College Publishers: New York, 1996.

What is the annual runoff amount?

The annual runoff is dependent on groundwater levels, antecedent conditions, precipitation, land use, soils type, and other factors that influence the runoff coefficient. It varies depending on the type of hydrologic condition: more runoff during heavy precipitation years and less runoff during drier years. The precipitation varies depending on natural and anthropogenic (eg. global warming) variations in hydrologic cycles. Precipitation in the Santa Margarita River watershed is controlled by northern Pacific storms, southern tropical storms, and to a lesser degree, summer monsoonal rains. As these storm cycles change from year to year, the annual runoff from the related precipitation also varies. For instance, given the same amount of rainfall, high intensity southern tropical storms may generate more runoff, on an annual basis, than more frequent and less intense northern pacific storms.

What is the runoff percentage for the 85th percentile, 24-hour storm?

The runoff percentage (eg. coefficient) for the 85th percentile, 24-hour storm, varies depending on soil type, land use, antecedent conditions, rainfall intensity, and other factors described in the response to the previous questions. Generally, runoff from a developed area on top of basement rock (or saturated alluvium) will generate more runoff than from an undeveloped area that overlies unsaturated alluvial sediments. The runoff percentage is a site-specific number that should be determined based on soils, groundwater levels, slope, vegetative cover, and rainfall intensity. Example site-specific runoff coefficients are shown in the previous table. The watershed-wide runoff coefficient could be estimated by using streamflow, precipitation, geology, and land use data to calculate the watershed-wide runoff coefficient.

The runoff measured by the USGS at the Santa Margarita River at Temecula Gage varied over the last 10 years between 3,350 AFY (WY2002) and 86,300 AFY (WY2005). During a longer period of record from 1974 through 2009, the flow from at the Temecula gage has varied from a minimum of 1,570 AFY (WY 1987) to 132,400 AFY (WY 1993). While variability of runoff is related to hydrologic conditions, land use and other anthropenic changes also impact the amount of runoff measured at the Temecula gage. A relationship between precipitation and runoff, for varying antecedent conditions and changes in land use over time, could be developed through detailed studies.

What is the largest storm that would still likely have no runoff – the threshold storm?

The development of a threshold storm based on runoff is site specific, but would vary depending on soils, antecedent conditions, rainfall intensity, level of development, etc. When soils are saturated, the runoff from a site located on basement complex rock will be greater than a site that overlies unsaturated alluvium. Similarly, runoff during pre-developed conditions may be greater than runoff during developed conditions due to elevated groundwater levels and saturated stream channels. Estimating the impact of water development projects such as Vail Dam, Lake Skinner, and Diamond Valley Lake would be required to determine what level of storm would result in zero runoff from the watershed. Runoff from the site-level perspective is also affected by natural and anthropengic impacts that would need to be accounted for in analysis of the hydrology.

Data obtained from a detailed study that related precipitation versus runoff, given changing land use conditions discussed in the previous section, could be used to identify the threshold storm. The results of the study would likely identify the threshold storm for varying hydrologic condtions.

Conclusions That Can Be Made from Existing Data

Analysis of tentative Order No. R9-2010-0016 indicates that retention of the 85% percentile, 24-hour storm, will cause a reduction of downstream surface flow. This result has been preliminarily identified in Stetson's previous October 11, 2010 memorandum regarding Hydrologic Points Related to Tentative Order R9-2010-0016. The greatest impact to water resources downstream of the Temecula Gorge will occur during dry hydrologic conditions when limited water supplies are available to meet both domestic water supply and habitat requirements. A preliminary estimation of streamflow impacts due to the tentative order, based on a range of hydrologic conditions, will be prepared based on available datasets for the Board Hearing on November 10th.

Assumptions and Realities in the SMR

	Assumptions	Reality
Vbmp	0.6"?	1.02" (70% greater)
Natural Runoff	10%?	Range from 7%-27%
Habitat Impacts	No impact?	Sub-Regional Scale* 95% less days of flow from site compared to pre-development condition Watershed Scale 40% of flow days are from storms under 1" in pre-development condition
Downstream Water Use	No impact?	Sub-Regional Scale* Average Loss of 30% of volume of runoff Loss of 7 ac-ft, per sq. mi., per year Watershed Scale XX% of volume is from storms under 1"

* Continuous simulation based on HSPF, Assumed 640 acres natural grass on B soils converted to 70% urban impervious

Assumptions and Realities in the SMR

	Assumptions	Reality
What Constitutes MEP?	85% Storm Retention most effective way to reduce pollution and protect uses	Current proposal leaves water above the 85% storm untreated, and loss of flow can itself constitute "water pollution." A mix of onsite infiltration and biofiltration may be more protective of downstream beneficial uses in the unique circumstances of the SMR Basin. 85% Retention is not "industry standard" as suggested by NRDC.
Impact of Urbanization on Flows in SMR	Urban runoff from impervious surfaces leaves the SMR with more water than it would "naturally" receive.	River Data from 1925-2008 suggest that the amount of runoff reaching the Temecula Gorge has been relatively constant. The increased runoff associated with impervious surfaces appears to have offset the losses associated with GW mining and Vail Dam.

Assumptions and Realities in the SMR

	Assumptions	Reality
Impact on Downstream Water Rights	Reductions in runoff will not harm CPEN/FPUD ability to fully utilize their water rights	Large scale development/redevelopment has the potential to reduce flows reaching Camp Pendleton
The CWRMA and Base Flow	CPEN is made whole for increased infiltration via the CWRMA Agreement	The CWRMA only addresses Base Flow. The majority of the water that replenishes CPEN's groundwater basins comes from storm flows. The CWRMA does not replace Storm Flows lost to infiltration or reuse in the upper basin

Assumptions and Realities in the SMR

	Assumptions	Reality
Federal Standard for Stormwater Capture	The Federal Standard requires capture of the 95^{th} percentile storm under all circumstances.	The Federal standard requires 95^{th} percentile storm capture unless hydrologic conditions indicate natural site conditions would yield less than 95% infiltration in a pre-development condition. No requirement to retain/infiltrate beyond Delta V.
Infiltration versus Retention Standards	CPEN is harmed equally by the retention versus infiltration standard	Retention or infiltration of the 85^{th} percentile storm at every new or redeveloped property will reduce the hydrograph beyond that which would occur "naturally." However, retention is worse because the water in many cases is entirely lost to the hyrologic system.

Assumptions and Realities in the SMR

	Assumptions	Reality
Retrofit of Existing Properties	Retrofit will not cause any adverse effect on downstream flows because the 85^{th} percentile retention standard is not mandated	Language in the existing permit is ambiguous and can be read to require retrofit projects to meet the EPA/NRDC proposed VBMP.

Land Use:	Runoff Coefficient		
	Low	High	Midpoint
Unimproved areas	0.10	0.30	0.20
Residential (suburban)	0.25	0.40	0.33
Residential multiunit, detached	0.40	0.60	0.50
Neighborhood business area	0.50	0.70	0.60
Light industrial	0.50	0.80	0.65

Source: Viessman & Lewis, Introduction to Hydrology, 4th edition, HarperCollins College Publishers: New York, 1996.

Example Comparing RB's Permit Requirements with Delta-V Alternative

- A 100-acre parcel is planned to be developed into a multi-family residential community
- Prior to development, the runoff coefficient is 0.20
- After development, the runoff coefficient will be 0.50
- This example compares runoff quantities from the 85th percentile, 24-hour storm, assuming it has a depth of 1 inch:
  - -Pre-development runoff = 0.2 inches or 1.7 acre-feet
  - -Post-development runoff = 0.5 inches or 4.2 acre-feet
- Design Capture Volume (DCV) as defined by permit = runoff from the 85th percentile, 24-hour storm. For this site, DCV is 4.2 acre-feet.
- The Delta-V approach would require that LID retain the difference between pre- and post-development runoff, such that the natural hydrology of the site is maintained[1]:
  - -DCV for Delta-V = 4.2 ac-ft – 1.7 ac-ft = 2.5 acre-feet
- The permit as written would alter the natural hydrology by retaining an additional 1.7 acre-feet of runoff per event. Multiplied by multiple sites, with many events per year over many years, this is a significant quantity of water over time, which should be quantified in more detailed studies.
- The Delta-V approach ensures that (1) the natural hydrology is maintained, i.e. the quantity of runoff is the same as under pre-development conditions, and (2) water quality objectives are met by treating the remainder of runoff for the 85th percentile, 24-hour storm using traditional BMPs.

[1] The Delta-V approach would require LID to retain the difference between pre- and post-development runoff. Runoff from the 85th percentile, 24-hour storm which is not retained by LID would be treated and released using traditional BMPs.

Impact of Retro-Fitting Developed Sites with LID

- An existing 100-acre, multi-family residential community will be outfitted with LID to comply with the permit
- The runoff coefficient of the site is 0.50
- This example uses runoff quantities from the 85^{th} percentile, 24-hour storm, assuming it has a depth of 1 inch:
  - -Existing runoff = 0.5 inches or 4.2 acre-feet
- Design Capture Volume (DCV) as defined by permit = runoff from the 85^{th} percentile, 24-hour storm. For this site, DCV is 4.2 acre-feet.
- After LID is implemented, 4.2 acre-feet of rainfall will be captured and retained per event, potentially removing that 4.2 acre-feet from the surface water flows as they exist today.
- This would alter the existing hydrology by potentially removing significant quantities of water from the surface water system.
- In order to quantify the total impact to Camp Pendleton's water supply, detailed studies are needed.
- Questions that must be answered by further study include:
  - -How many total acres of existing development will be retrofitted with LID?
  - -What are the actual runoff coefficients of sites to be outfitted with LID?
  - -What is the seasonal variation of those runoff coefficients?
  - -Will LID retention and infiltration be feasible during extended wet conditions?
  - -What are the locations of planned LID facilities, and how does runoff from those sites contribute to surface water flows leaving the upper watershed?
-

Impact of Using Different Design Storms for Design Capture Volume

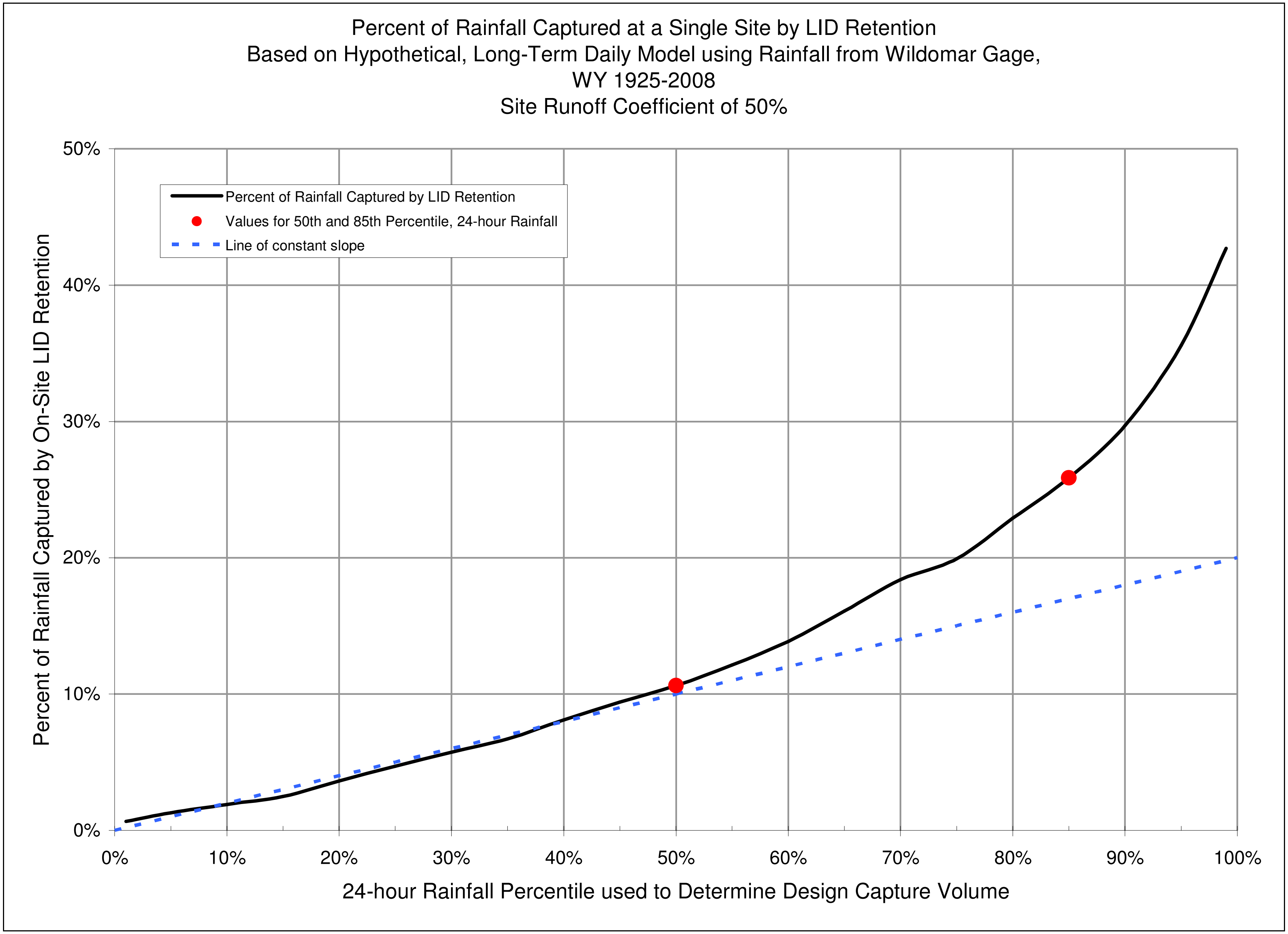
- A hypothetical, daily model of LID capture was created to simulate long-term retention by LID at a single site.
- The site is assumed to have a runoff coefficient of 0.50 for every storm, regardless of antecedent conditions. This is a simplification which allows us to make a relative comparison between design storm percentiles.
- The table below presents the percent of rainfall that is retained by LID for different percentiles of the 24-hour storm
- The figure shows the data from the table in graphical format
- The slope of the line begins to increase at about the 50th percentile storm

	24-hour Storm Percentile	Corresponding 24-hour Rainfall Depth[1] (in)	Percent of Rainfall that is Retained by LID[2]
	1%	0.01	1%
	5%	0.02	1%
	10%	0.03	2%
	15%	0.04	2%
	20%	0.06	4%
	25%	0.08	5%
	30%	0.10	6%
	35%	0.12	7%
	40%	0.15	8%
	45%	0.18	9%
	50%	0.21	11%
	55%	0.25	12%
	60%	0.30	14%
	65%	0.37	16%
	70%	0.45	18%
	75%	0.51	20%
	80%	0.64	23%
*	85%	0.80	26%
	90%	1.06	30%
	95%	1.64	36%
	99%	2.90	43%

*Design storm as defined by current Permit

Notes:

1. Based on rainfall data from 1914-2008 at Wildomar station (Riverside County Flood Control Network)
2. Based on retention and runoff from a single site assuming a 50% runoff coefficient for all storms; also assumes that LID retention and infiltration is feasible in wet conditions.


Percent of Rainfall Captured at a Single Site by LID Retention
Based on Hypothetical, Long-Term Daily Model using Rainfall from Wildomar Gage,
WY 1925-2008
Site Runoff Coefficient of 50%
Percent of Rainfall Captured by LID Retention
Values for 50th and 85th Percentile, 24-hour Rainfall
Line of constant slope
Percent of Rainfall Captured by On-Site LID Retention
50%
40%
30%
20%
10%
0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
24-hour Rainfall Percentile used to Determine Design Capture Volume

MEMORANDUM

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TO:	Jeremy Jungreis	DATE:	October 11, 2010
FROM:	Stetson Engineers	JOB NO:	2197-5000-5001AC

RE: Hydrologic Points Related to Tentative Order R9-2010-0016

The San Diego Regional Water Quality Control Board (RWQCB) has published Tentative Order R9-2010-0016, entitled "Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer Systems (MS4s) Draining the County of Riverside, the Incorporated Cities of Riverside County, and the Riverside County Flood Control and Water Conservation District within the San Diego Region". The Order introduces Low-Impact Development (LID) site design as an option for new development, redevelopment and retrofit projects to comply with the Order. Specifically, the Order requires that "LID BMPs must be sized and designed to ensure onsite retention without runoff, of the volume of runoff produced from a 24-hour 85th percentile storm event" (p 33).

The Order does not specifically address the quantities of water that may be lost from streamflow. However, by specifying the 85th percentile, 24-hour rainfall event as the standard for on-site retention (p. 33), this assures that significant amounts of rainfall may be captured and potentially affect water resources for domestic and environmental uses on Camp Pendleton. The following are topics that require discussion in order to understand the impact of R9-2010-0016 to Camp Pendleton's ability to meet its existing and future water requirements.

I. Hydrogeologic Setting – Upper v. Lower Groundwater Basins

II. Hydrology of the Santa Margarita River and its tributaries (Fig 1)

III. Order Requirements – Runoff from the 85% 24-Hour Rainfall/Capture Requirements

IV. Occurrence of Precipitation – Impact of antecedent conditions - Dry v. Wet Years

IV. Example during Wet (WY 2003) and Dry (WY 2006) conditions (Figs 2 and 3)

V. Impacts from Retrofit and Future Development

VI. Impact to CPEN Water Supply – Reliance on Stormflows

VII. Preferred Changes to Existing Order.

FIGURE 1. NON-AUGMENTED FLOW AT THE SANTA MARGARITA RIVER GORGE

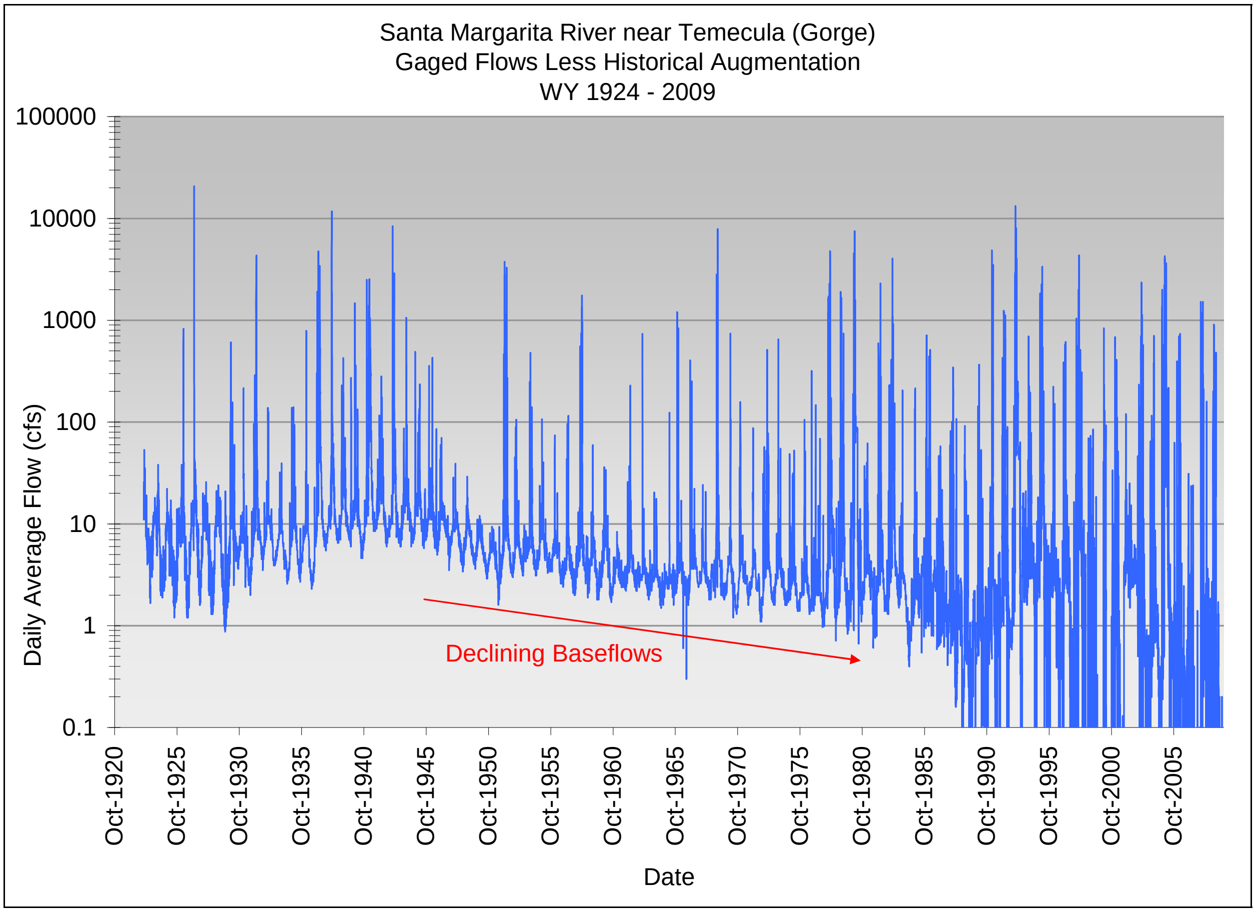
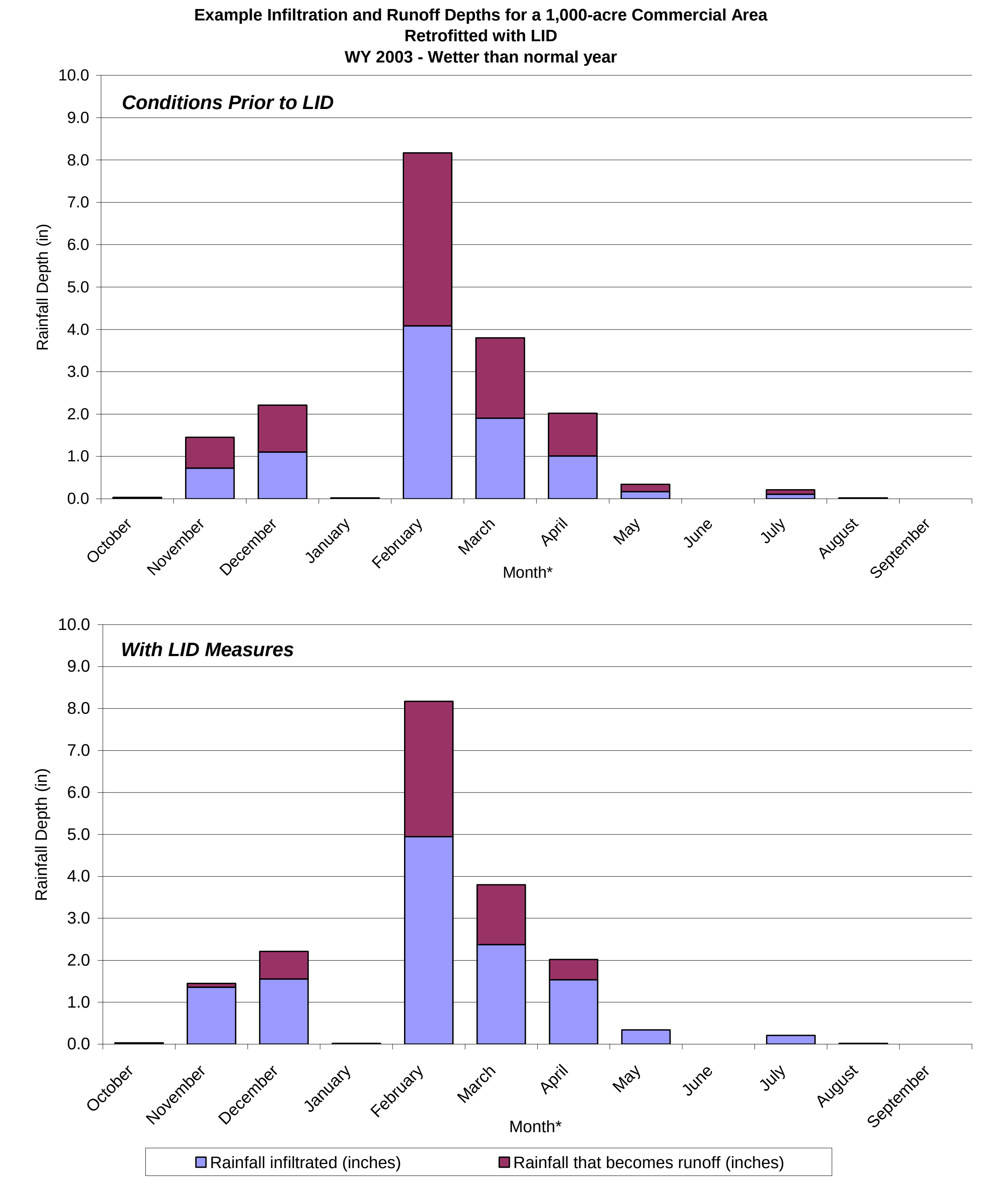


FIGURE 1. INFILTRATION AND RUNOFF DEPTHS FOR 1,000-ACRE COMMERCIAL AREA FOR WY 2003



*Data presented here are monthly sums computed from the daily precipitation values used in this analysis

FIGURE 2. INFILTRATION AND RUNOFF DEPTHS FOR 1,000-ACRE COMMERCIAL AREA FOR WY 2006