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Technical Memorandum

Date: March 3, 2017

From: Spencer Harris, HG 633

To:Los Osos Groundwater Basin Management CommitteeMorro Bay National Estuary Program

SUBJECT: Basin Yield Metric response to reduced long-term precipitation in the Los Osos Groundwater Basin.

Dear Mr. Miller:

Cleath-Harris Geologists (CHG) has evaluated the response of the Basin Yield Metric (BYM) to reduced precipitation in the Los Osos groundwater basin. The purpose of this effort is to understand how reduced precipitation would affect basin sustainable yield, and what the corresponding level of groundwater production would be at 80 percent of the BYM (BYM 80), which is the target for safe operation of the basin, as recommended in the Los Osos Basin Plan (LOBP; ISJ Group, 2015).

Background

The Los Osos Basin Management Committee (BMC) and Morro Bay National Estuary Program (Morro Bay NEP) have requested an analysis to evaluate the BYM under 2016 conditions and LOBP program combination U+AC if average annual precipitation were reduced from the current long-term average. The LOBP evaluated a variety of programs related to basin management, and program combination U+AC was recommended for immediate implementation.

The BYM compares the actual amount of groundwater pumped in a given year with the sustainable yield of the basin under then-current conditions. For example, the BYM for 2016 is a ratio expressed as follows:

Calendar Year 2016 Groundwater Production *100 Calendar Year 2016 Sustainable Yield

Groundwater production in the numerator is based on measured and estimated values, while sustainable yield in the denominator is based on a value simulated using the basin model. The LOBP established the BYM target at 80 percent or less, so that at least 20



percent of the yield of the basin can be used as a buffer against uncertainty. Climate variability is one of the sources of uncertainty.

Sustainable yield in the equation above is not simply a volume of water, but is also the distribution of groundwater pumping across the basin that maintains a stationary seawater front, with no active well producing water with chloride concentrations above 250 milligrams per liter (mg/l). Evaluation of sustainable yield for various LOBP water supply program combinations was conducted using the basin model, and model results are listed in LOBP Table 46: Most Likely Program Combinations (attached).

CHG performed a climate change analysis of the Los Osos groundwater basin sustainable yield under 2012 basin conditions and population buildout conditions (Model Results for Los Osos Climate Ready Water Utilities Project, Appendix B *in* USEPA, 2013). The analysis included a sustainable yield evaluation in response to global warming, which simulated air temperature rise, sea level rise, and reduced precipitation. Baseline, midcentury, and late-century scenarios were analyzed under two levels of global greenhouse gas emissions.

Most global climate models reviewed during the USEPA study indicated a reduction in the long-term precipitation rate. The average annual precipitation value used in the basin model is equivalent to the long-term precipitation rate through cycles of dry, normal, and wet years. The basin model simulates the average annual precipitation rate across multiple years until a steady-state condition is achieved. The historical long-term precipitation rate used in the basin model is equivalent to an average annual precipitation of 17.5 inches (USEPA, 2013).

2016 Basin Yield Metric

Water supply infrastructure at year-end 2016, for the purposes of estimating sustainable yield, include the following LOBP programs:

- Los Osos Wastewater Project
- Urban Water Reinvestment Program (Program U)
- Infrastructure Program A
- Partial completion of infrastructure Program C

The sustainable yield of program combination U+A is 2,650 acre-feet per year (AFY). Program C was also partially completed in 2016 with the construction of the first expansion well (Golden State Water Company's Los Olivos Well No. 5). The contribution of Program C to basin sustainable yield is the difference between the yield of program combination U+A (2,650 AFY) and program combination U+AC (3,000 AFY), which is 350 AFY. Close to one-third, or 110 AFY of the sustainable yield contribution



from Program C was developed in 2016, bringing the simulated total estimated sustainable yield for year-end 2016 conditions to 2,760 AFY (confirmed using basin model with long-term average precipitation).

The estimated basin groundwater production in 2016 is 2,160 acre-feet, which includes 1,005 acre-feet of measured community purveyor production and 1,155 acre-feet of other estimated production (golf course, community park, memorial park, non-purveyor domestic, and agriculture). Using the equation above, the corresponding BYM for 2016 is 78 percent, which does not exceed the LOBP target of 80 percent, although not all of the infrastructure programs used for the 2016 sustainable yield estimate and related BYM calculation were operational during 2016. For comparison, the 2015 BYM was 89 percent (CHG, 2016).

The actual distribution of pumping in 2016 was not sustainable due to drought and excess Lower Aquifer pumping in the Western Area (confirmed using basin model). As previously mentioned, sustainable yield values incorporate both pumping volume and location.

Program Combination U+AC Basin Yield Metric

LOBP program combination U+AC refers to the following elements:

- Los Osos Wastewater Project
- LOBP Urban Water Reinvestment Program (U)
- Basin Infrastructure Program A
- Basin Infrastructure Program C

The difference between year-end 2016 infrastructure and U+AC infrastructure is that the U+AC programs include two additional expansion wells. These expansion wells are located in the eastern Central Area, toward Los Osos Creek (LOBP Figure 55: Basin Infrastructure Program Map, attached).

With the above programs in place, the estimated sustainable yield of the basin is 3,000 AFY. Basin demand under no further development is estimated at 2,230 AFY (LOBP Table 46: Most Likely Program Combinations, attached), which would result in a BYM of 74 percent. The basin groundwater production value which meets the BYM 80 target, and is linked to the 3,000 AFY sustainable yield, is 2,400 AFY.



Basin Model Input

Precipitation and groundwater production were the two primary model inputs adjusted in simulations performed for the BYM response analysis. A third related component, groundwater recharge from Los Osos Creek, was maintained below a maximum value. Each of these items are discussed below.

Precipitation Adjustments

Most global circulation models reviewed for the Los Osos Climate Ready Water Utilities Project predict reduced average annual precipitation in the Morro Bay area (USEPA, 2013). Projections of changes in precipitation were derived from the results of global circulation models for Intergovernmental Panel on Climate Change (IPCC) Scenario A2 (medium high emissions) and Scenario B1 (lower emissions).

IPCC emission scenario results from four global circulation models are available from Cal-Adapt (http://www.cal-adapt.org). These results have been used to characterize climate change projections in California. The four models are a subset of 16 global circulation models contained in the EPA Climate Resilience Evaluation and Awareness Tool (CREAT) used for the Los Osos Climate Ready Water Utilities Project (CREAT Version 1.0). A comparison of model results provided by CREAT and Cal-Adapt indicates that the four models used by Cal-Adapt include some of the lowest long-term precipitation rate projections.

Among the four Cal-Adapt models, the Centre National de Recherches Meteorologiques (CNRM) global circulation model provided the lowest overall long-term precipitation rate projections, which would be considered worst-case for analysis of impacts due to low precipitation. The lowest average annual precipitation is estimated at 67 percent of the long-term average of 17.5 inches per calendar year (Table 1). For correlation purposes, the BYM response analysis was performed using 100 percent, 90 percent, 80 percent, and 67 percent of the long-term average precipitation. Table 1 presents the average monthly precipitation for each precipitation reduction scenario. Precipitation reductions were calculated by multiplying long-term precipitation values by the percent of long-term average for each scenario.



	Precipitation Reduction Scenarios					
Manth	(percent of long-term average precipitation)					
wonth	100% of average	90% of average	80% of average	67% of average		
		Inches of p	recipitation			
January	3.57	3.21	2.86	2.39		
February	3.77	3.39	3.02	2.53		
March	3.29	2.96	2.63	2.20		
April	1.10	0.99	0.88	0.74		
May	0.43	0.39	0.34	0.29		
June	0.08	0.07	0.06	0.05		
July	0.01	0.01	0.01	0.01		
August	0.05	0.05	0.04	0.03		
September	0.24	0.22	0.19	0.16		
October	0.82	0.74	0.66	0.55		
November	1.40	1.26	1.12	0.94		
December	2.72	2.45	2.18	1.82		
Annual	17.5	15.7	14.0	11.7		

Table 1Precipitation Reduction Scenarios

Groundwater Production Adjustments

The volume and physical distribution of purveyor groundwater production was adjusted for each model scenario to provide the sustainable yield value. Annual production from domestic and agricultural wells was assumed to remain constant at current (2016) production levels and distribution. No significant increase in future private well production is anticipated by the LOBP.

Declines in purveyor groundwater production, and the associated declines in customer water use, also reduce the amount of recycled water available for recharge in the basin. Reductions in available recycled water from San Luis Obispo County's LOWRF have been simulated by a corresponding reduction in recycled water disposal volumes applied to the Broderson leach field, which is located south of Highland Drive and west of Broderson Avenue in Los Osos.

Recharge from Los Osos Creek

Recharge to the groundwater basin comes directly or indirectly from precipitation. Stream flow in Los Osos Creek, which originates as precipitation in the watershed, directly recharges the creek valley alluvial deposits, which, in turn, recharge the Upper and Lower Aquifers in the Eastern Area. The amount of potential recharge available



from Los Osos Creek under reduced precipitation scenarios is a key assumption for the BYM response analyses.

County stream gage #751 is located on Los Osos Creek at the Los Osos Valley Road bridge. The gage measures runoff from the portion of the watershed upstream of Los Osos Valley Road, which covers an area of 7.27 square miles. Stream flow records are available for 19 years between 1976 and 2002 (attached, San Luis Obispo County, 2005). Table 2 presents the available annual flow records for Los Osos Creek.

Runoff Year	Stream Flow ¹	Precipitation ²
with flow		
record	(acre-feet)	(inches)
1976	110	7.57
1977	0	13.24
1978	8,810	30.08
1979	1,240	19.01
1980	3,890	22.33
1981	1,630	12.9
1982	2,390	21.01
1984	2,110	10.57
1985	1,920	10.56
1986	11,850	17.83
1994	497	11.63
1995	19,270	41.8
1996	1,740	16.24
1997	3,020	19.51
1998	7,340	36.53
1999	505	13.73
2000	2,540	20.97
2001	2,470	15.95
2002	0	10.25
Average	3,750	18.5

Table 2Los Osos Creek Stream Flow Records

The historical recharge to groundwater from Los Osos Creek stream seepage, during years with flow records listed in Table 2, is estimated to average 600 AFY, based on a review of groundwater production records and comparison with the stream seepage estimate for 2012 (610 AFY, LOBP Figure 73: 2012 Water Balance, attached).

¹ Stream flow gage #751. Some years have partial records (see attachment). Stage data is available for recent years, but no rating curve is available, and no associated flow records have been published (CHG, 2015).

² Rain gage #152 (Morro Bay Fire Department), adjusted for the Los Osos area through correlation with local rain gages.



Groundwater production in the creek valley, where stream seepage occurs, averaged 790 AFY for the years listed in Table 2, similar to 2012 production (800 AFY).

The stream gage is located one mile downstream of where Los Osos Creek enters the groundwater basin (attached Figure 1). The seepage capacity of the creek bed between the basin boundary and the stream gage has been documented at up to 10 cubic feet per second, and an estimated two thirds of groundwater recharge from Los Osos Creek occurs along this reach (CHG, 2014). Therefore, the estimated average surface flow entering the groundwater basin for the years listed in Table 2 would be 4,150 AFY (3,750 AFY measured at stream gage plus 400 AFY of seepage upstream of the gage).

A maximum 800 acre-feet of groundwater recharge from Los Osos Creek is assumed to be available for sustainable yield scenarios. This value is based on maintaining the 600 AFY of historical recharge, and adding up to 200 AFY of recharge that would be partially offset by in-lieu groundwater recharge from recycled water use in the Los Osos Creek valley (196 AFY, LOBP Table 32: Urban Water Reinvestment program Recycled Water Uses, attached). In-lieu recharge in the creek valley would occur when recycled water is used for memorial park and agricultural irrigation to reduce groundwater pumping.

Stream flow entering the groundwater basin on Los Osos Creek will decline as long-term precipitation is reduced. The lowest projected average annual precipitation is 11.7 inches (Table 1), or 63 percent of the average precipitation for years with stream flow records in Table 2. By comparison, less than 20 percent of the 4,150 AFY average stream flow entering the groundwater basin during those years would be needed to provide 800 AFY of recharge to the basin. Sufficient available stream flow is expected under reduced precipitation scenarios to support 800 AFY of groundwater recharge from Los Osos Creek.

BYM Response Analysis Results

The basin model was used to evaluate BYM response to reduced precipitation. The model utilizes the U.S. Geological Survey's SEAWAT program, which was developed to simulate three-dimensional, variable-density, transient groundwater flow in porous media. SEAWAT combines MODFLOW (modular flow) and MT3D (mass transport) code, and adds variable fluid density capability specifically for seawater intrusion simulations.

Several scenarios were analyzed for the two infrastructure programs considered: year-end 2016 infrastructure and for LOBP infrastructure program combination AC. These two programs were selected for analysis by the BMC to represent current infrastructure (year-end 2016), and the most effective program combination (AC) identified in the LOBP for use with the current population. Prior to analyzing year-end 2016 infrastructure



scenarios, a pre-LOWRF scenario was also prepared to evaluate the sustainability of groundwater production during drought, immediately prior to LOWRF operation.

2016 Infrastructure Scenarios

A pre-LOWRF operation scenario was prepared with septic systems in place and with the actual 2016 production distribution. The purpose of this evaluation was to determine whether the basin model predicted continued increases in the chloride metric through fall 2016.

The chloride metric is one of the measures of effectiveness for basin management, and tracks changes in Lower Aquifer water quality related to seawater intrusion mitigation. In 2016, despite a calculated BYM of below 80 percent, the chloride metric continue to rise, indicating continued advance of seawater intrusion. The pre-LOWRF scenario was a performed to test whether the basin model would simulate a chloride metric rise under 2016 conditions. The results indicated that the pre-LOWRF scenario was not sustainable, therefore the continuation of historical increases in the chloride metric during 2016 would be expected, even with the BYM below 80 percent.

The estimated sustainable yield for year-end 2016 infrastructure was analyzed using the current long-term precipitation rate and reduced precipitation scenarios. A long-term precipitation rate is appropriate for simulating sustainable yield because multiple years of basin pumping and recharge are involved. Table 3 below presents the results of the BYM analyses, with groundwater production shown for each basin area/aquifer. Basin areas and aquifers are shown in the attached Figure 1 and Figure 2 from the Los Osos Groundwater Monitoring Program 2015 Annual Report (CHG, 2016).



(67%)

NC

NC

1,870

750

116

1,500

Sustainable Vield for 2016 Scenarios						
	SUSTAINABLE YIELD SCENARIO					
	Infrastructure and % of long-term average precipitation					
BASIN AREA	2016 (100%)	2016 (90%)	2016 (80%)	2016 (67		
	Simulated Sustainable Yield (acre-feet per year)					
Upper Western	100	NC ¹	NC	NC		
Lower Western	190	50	30	0		
Upper Central	690	NC	650	560		
Lower Central	860	730	520	290		

NC

NC

2,490

1,370

87

1,990

NC

NC

2,220

1,000

97

1,780

Table 3Sustainable Yield for 2016 Scenarios

 $^{1}NC = No$ Change in value from 100 percent long-tem average precipitation scenario.

130

790

2,760

1,640

78

2,210

 2 Purveyor total (simulated) = Basin total - 1,120 AFY for golf, private domestic, and agricultural uses.

³ BYM based on 2016 basin groundwater production of 2,160 AFY

U+AC Infrastructure Scenarios

Eastern Alluvium

Eastern Lower BASIN TOTAL

(SUSTAINBLE YIELD) PURVEYOR TOTAL²

2016 BYM³

BYM 80 PRODUCTION

The estimated sustainable yield for LOBP program combination U+AC was analyzed for the current long-term precipitation rate and reduced precipitation scenarios. Table 4 below presents the results of the analyses, with production shown for each basin area/aquifer.



	SUSTAINABLE YIELD SCENARIO Infrastructure and % of long-term average precipitation					
BASIN AREA	AC (100%)	AC (90%)	AC (80%)	AC (67%)		
	Simulated Sustainable Yield (acre-feet per year)					
Upper Western	100	NC ¹	NC	NC		
Lower Western	110	70	20	0		
Upper Central	790	720	670	560		
Lower Central	1,080	830	580	290		
Eastern Alluvium	130	NC	NC	NC		
Eastern Lower	790	NC	NC	NC		
BASIN TOTAL (SUSTAINBLE YIELD)	3,000	2,640	2,290	1,870		
PURVEYOR TOTAL ²	1,880	1,520	1,170	750		
BYM ³	74	84	97	119		
BYM 80 Production	2,400	2,110	1,830	1,500		

 Table 4

 Sustainable Yield for U+AC Scenarios

 1 NC = No Change in value from 100 percent long-tem average precipitation scenario.

²Purveyor total (simulated) = Basin total - 1,120 AFY for golf, private domestic, and agricultural uses.

³ BYM based on projected demand (i.e. groundwater production) of 2,230 AFY (LOBP Table 46).

Discussion

Interpretation of the results of basin model scenarios is discussed below with respect to the BYM response analysis and pumping distribution.

BYM Response to Reduced Precipitation

For year-end 2016 infrastructure scenarios, the decline in sustainable yield and the BYM 80 value is essentially proportional to the decline in precipitation. For the U+AC scenarios, there is a slightly greater decline in sustainable yield and the BYM 80 value than the actual decline in precipitation. Table 5 shows these correlations.



Infrastructure Program Combinations	Percent of Long-Term Precipitation ¹	BYM 80 (AFY)	Percent BYM 80
	100	2,210	100
2016	90	1,990	90
	80	1,780	80
	67	1,500	68
	100	2,400	100
U+AC	90	2,100	88
	80	1,830	76
	67	1,500	62

Table 5BYM 80 Sensitivity to Reduced Precipitation

¹17.5 inches average annual precipitation

Pumping Distribution

As stated previously, sustainable yield is not just the amount of groundwater that can be pumped, but is also the distribution of groundwater pumping across the basin that maintains a stationary seawater front, with no active well producing water with chloride concentrations above 250 mg/l. This means the location of pumping, both vertically and horizontally in the basin, is an important aspect of any BYM.

The results of basin model scenarios show that with decreased precipitation, groundwater production in the Lower Aquifer must be reduced to avoid seawater intrusion (Tables 3 and 4). Central Area expansion well production must also be reduced, however, to avoid exceeding the available recharge (800 AFY) from Los Osos Creek.

Potential increases to the purveyor water supply from the addition of two more expansion wells under LOBP Program C will vary based on precipitation projections. Water supply increases range from 190 AFY for continued long-term precipitation, to no increase (0 AFY) for 67 percent of long-term precipitation. At 67 percent precipitation, the year-end 2016 and U+AC scenarios result in identical BYM 80 values, because neither of the two additional expansion wells included in the U+AC program combination can be used without exceeding the available recharge from Los Osos Creek.



Upper aquifer pumping is not reduced to the extent that Lower Aquifer pumping is reduced (Tables 3 and 4). This is mainly due to production declines required at mixed aquifer wells (those screened in both the Upper and Lower Aquifer) to help mitigate Lower Aquifer seawater intrusion. Most upper aquifer wells continue pumping at maximum capacity.

References

- Cleath-Harris Geologists, 2014, <u>Recycled Water Discharges to Los Osos Creek</u>, Technical Memorandum prepared for the ISJ Group dated March 18, 2014.
- Cleath-Harris Geologists, 2016, <u>Los Osos Basin Plan Groundwater Monitoring Program</u> <u>2015 Annual Report</u>, prepared in association with Wallace Group, September 2016.

https://www.slocountywater.org/site/Water%20Resources/LosOsos/pdf/Los%20Osos%2 0BMC%202015%20Annual%20Report%20Final.pdf

ISJ Group, 2015, <u>Updated Basin Plan for the Los Osos Groundwater Basin</u>, January 2015.

https://www.slocountywater.org/site/Water%20Resources/LosOsos/pdf/Los%20Osos%2 0Groundwater%20Basin%20Plan%20January%202015.pdf

San Luis Obispo County Public Works Department, 2005, <u>Hydrologic Report, Water</u> <u>Years 2001-2002 and 2002-2003</u>, May 16, 2005.

https://www.slocountywater.org/site/Water%20Resources/Reports/pdf/Hydrologic%20Report%202002.pdf

San Luis Obispo County Public Works Department stream gage and rain gage sites <u>https://wr.slocountywater.org/list.php</u>

USEPA, 2013, <u>Climate Resilience Evaluation and Awareness Tool Exercise with Los</u> <u>Osos Water Purveyors and the Morro Bay National Estuary Program</u> (EPA 817-B-13-003, June 2013).

https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100KKZX.TXT



ATTACHMENTS



2015 Los Osos Groundwater Basin Plan Update:

Table 32: Urban Water Reinvestment Program Recycled Water Uses Table 46: Most Likely Program, Combinations Figure 55: Basin Infrastructure Program Map Figure 73: Water Balance 2012 Baseline

CHAPTER 9: WATER REINVESTMENT PROGRAM

9.3 Urban Water Reinvestment Program

The Water Reinvestment Program set forth in this chapter is divided into two parts. The first part, known as the Urban Water Reinvestment Program, is intended to beneficially use all recycled water produced by the LOWWP under the Existing Population Scenario. The second part, known as the Agricultural Water Reinvestment Program, is intended to use all marginal recycled water produced under the Buildout Population Scenario. Although a limited quantity of agricultural reuse is planned as part of the Urban Water Reinvestment Program, the bulk of agricultural reuse will occur under the Agricultural Water Reinvestment Program.

The proposed uses of recycled water under the Urban Water Reinvestment Program are listed in Table 32. Not all potential uses will start at the commencement of LOWWP operations, or occur in their full quantities. For example, irrigation at Sea Pines Golf Course is likely to occur only if the Monarch Grove subdivision connects to the LOWWP. Any produced water that is not used for one of the potential uses listed in Table 32 will likely be reinvested in agricultural reuse. In addition, the quantity of water produced by the LOWWP may vary from 780 AFY, requiring reinvestment of either more or less recycled water for the various potential uses. Despite these uncertainties, the Urban Water Reinvestment Program is expected to deliver all recycled water produced by the LOWWP to one of the categories of reuse shown in Table 32.

Table 32. Urban Water Reinvestment Program Recycled Water Uses					
Potential Use	Quantity (AFY)	Percent of Total			
Broderson Leach Fields	448	57.4			
Bayridge Estates Leach Fields	33	4.2			
Urban Reuse	63	8.1			
Sea Pines Golf Course	40	5.1			
Los Osos Valley Memorial Park	<mark>50</mark>	6.4			
Agricultural Reuse	146	18.7			
Total	780	100			

Some of the recycled water to be reinvested pursuant to the Urban Water Reinvestment Program—e.g., that delivered to the schools and community park will offset water that would have otherwise been produced from the Basin and sold by the Purveyors to their potable water customers. The County will deliver recycled water to users within the LOCSD and GSWC service areas pursuant to agreements with the Purveyors, in order to prevent a loss of water utility revenue while still facilitating the reinvestment of recycled water in the Basin. The agreements between the County, LOCSD and GSWC will determine the respective obligations of the parties.

LOCSD and GSWC will each follow their required processes for the establishment of rates or tariffs for recycled water service. For LOCSD, that will involve commissioning a rate study and following the process of Proposition 218. For

BASIN PLAN FOR THE LOS OSOS GROUNDWATER BASIN

For the Existing Population Scenario, it is apparent that certain programs must be completed in order to achieve a sustainable Basin, including the Urban Water Use Efficiency Program, Urban Water Reinvestment Program and Basin Infrastructure Program A. In addition, the Parties must implement either Basin Infrastructure Program B or C or the Supplemental Water Program at 250 AFY. It is clear that Basin Infrastructure Program D is unnecessary to achieve a sustainable Basin under the Existing Population Scenario. A summary of the most likely combinations is presented in Table 46, along with the expected Basin Yield Metric, Water Level Metric and Chloride Metric that would result from each. These combinations were selected for further consideration because they are expected to satisfy the Basin Plan goals, with relatively lower costs than other combinations.

Table 46. Most Likely Program Combinations						
Combination	Water Demand†	Sustainable Yield _x †	Basin Yield Metric	Water Level Metric‡	Chloride Metric*	
Existing Population Scenario						
E+U+AB	2,230	3,170	70	10	60	
E+U+AC	2,230	3,000	74	10	65	
E+U+A+S	1,980	2,650	75	10	65	
Buildout Population Scenario						
E+UG+ABC	2,380	3,350	72	9	70	
E+U+ABCD	2,880	3,500	82	8	85	
E+UG+ABCD	2,380	3,500	68	10	60	
E+U+A+S	2,130	2,650	80			

[†] Expressed in AFY. [‡] Expressed in feet msl. ^{*} Expressed in mg/l.

For the Buildout Population Scenario, the selection of a combination would depend heavily on whether the Supplemental Water Program were implemented under the Existing Population Scenario. If a groundwater desalination plant were previously constructed to produce 250 AFY (the assumed level for the Existing Population Scenario), then it would be reasonable for the Parties to simply install additional desalination capacity (500 AFY, for a total of 750 AFY of produced water) to achieve a sustainable Basin under Combination E+U+A+S.

If, on the other hand, the Supplemental Water Program were not to have been initiated under the Existing Population Scenario, the Parties would be unlikely to construct and operate a new desalination facility for the Buildout Population Scenario, because the costs associated with such a facility would exceed those of implementing further portions of the Basin Infrastructure Program. In order to achieve a sustainable Basin in that circumstance, the Parties would need to implement the Urban Water Use Efficiency Program, Urban Water Reinvestment Program and Basin Infrastructure Programs A, B and C. The Parties would also need to implement either Basin Infrastructure Program D or the Agricultural Water

CHAPTER 10: BASIN INFRASTRUCTURE PROGRAM







San Luis Obispo County Public Works Hydrologic Report, Water Years 2001-2002 and 2002-2003:

Los Osos Creek Stream Flow

SOURCE: SAN LUIS OBISPO COUNTY PUBLIC WORKS HYDROLOGY REPORT (2005)

Stream Flow

Stream Gage Name: Los Osos Creek (#6) Water Planning Area: 3

<u>Water</u> Year [†]	Annual Stream Flow (acre-feet)		<u>Water</u> Year [†]	Annual Stream Flow (acre-feet)	
1976	110	1	1990		9
1977	0	_	1991		10
1978	8,810		1992		11
1979	1,240		1993		12
1980	3,890	2	1994	497	
1981	1,630		1995	19,270	
1982	2,390	3	1996	1,740	
1983		4	1997	3,020	
1984	2,110		1998	7,340	
1985	1,920		1999	505	
1986	11,850	5	2000	2,540	
1987		6	2001	2,470	
1988		7	2002	0	
1989		8	2003	NA	13



From Annual Stream Flow Records				
3,769 AFY				
2,110 AFY				
0 AFY				
19,270 AFY				

¹ gage put into operation in February

² missing data for one day in February

6-12 no data available for this time period

¹³ Data not available at the time the report was published

³ missing data for various days in February, March, and April

⁴ only visual observations were available for this year

⁵ missing data for the end of February and beginning of March

(notations as recorded in San Luis Obispo County stream flow log books)



[†] October 1 - September 30



Los Osos Groundwater Monitoring Program 2015 Annual Report

Figure 1: Basin Location and Plan Areas Figure 5: Basin Aquifers





Cross-section alignment shown in Figure 1

Explanation

- Perched Aquifer Water level
- ▼ Upper Aquifer Water level
- Lower Aquifer Water level

Figure 5 Basin Aquifers Los Osos Groundwater Basin 2015 Annual Report

Cleath-Harris Geologists