STETSON
ENGINEERS INC.

DRAFT TECHNICAL MEMORANDUM

2171 E. Francisco Blvd., Suite K • San Rafael, California • 94901
TEL: (415) 457-0701 FAX: (415) 457-1638 e-mail: sr@stetsonengineers.com

TO:	**WMA GSA**	DATE:	**April 2021**
FROM:	**Stetson Engineers**	JOB NO:	**2711-04**
RE:	DRAFT **Western Management Area Water Budget**		

INTRODUCTION

The Sustainable Groundwater Management Act (SGMA) requires that a Groundwater Sustainability Plan (GSP) include: "a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored."[1] This Memorandum describes the water budget within the Western Management Area (WMA) of the Santa Ynez River Valley Groundwater Basin, herein referred to as the "Basin."

Two components of the Basin setting have been summarized in the following two related technical memoranda: Hydrogeologic Conceptual Model and Groundwater Conditions. The third major component of the Basin setting, a water budget, is an accounting tool that quantifies inflows (sources) and outflows (sinks) occurring within a groundwater basin (or specified management area) using the following equation:

$$\text{Inflows} - \text{Outflows} = \text{Change in Storage}$$

The water budget is a key component of overall understanding of the Basin and contributes to developing the following GSP elements:

- Identifying data gaps
- Evaluating monitoring requirements
- Evaluating potential projects and management actions

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[1] 23 CCR 354.18.

- Estimating the sustainable yield
- Evaluating undesirable results (negative impacts)
- Informing water management decision making

Annual water budget components for the period 1982-2018 were assembled, compiled, and summarized. Total inflow and outflow components are presented in the water budgets for the historical data period (1982–2018), "current conditions" (2011–2018), and "projected conditions" (2018–2072). These data are evaluated to identify potential long-term trends in groundwater basin supply and demand and estimates of inflows and outflows and groundwater storage changes. The results support interpretation of trends in measured water levels in wells, and a preliminary estimate of sustainable yield based on the perennial or safe yield.

Perennial yield, also referred to as safe yield, is defined as a long-term average annual amount of water which can be withdrawn from a basin under specified operating conditions without inducing a long-term progressive drop in water levels (Stetson, 1992). The estimated perennial yield for the base period is calculated as follows:

Perennial Yield = Average Annual Pumping + Average Annual Change in Storage

Perennial yield can also be defined as pumping but that does not impact the physical or chemical integrity of the groundwater, but as used here relates only to the chronic lowering of groundwater levels for a base period in which precipitation approximates long term average precipitation[2].

Sustainable yield is defined in SGMA as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus that can be withdrawn annually from a groundwater supply without causing an undesirable result." An undesirable result is defined as one or more of the following effects on the six sustainability indicators:

1. Chronic lowering of groundwater levels
2. Reduction of groundwater storage
3. Degraded groundwater quality

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[2] The focus on long-term lowering of groundwater levels is also the focus of DWR's definition of overdraft in Bulletin 118: "Condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions. Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years."

4. Seawater intrusion
5. Land subsidence
6. Depletion of interconnected surface water

Because undesirable results metrics have not yet been defined upon by the GSA, the yield of the WMA groundwater basin will be discussed on a preliminary basis only for the historical period of 1982–2018. The volume of water that can be extracted from the WMA basin on a long-term basis without creating chronic and continued lowering of groundwater levels and depletion of groundwater in storage volumes is presented.

LIST OF ACRONYMS AND ABBREVIATIONS

AF	acre-feet
AFY	acre-feet per year
BCM	Basin Characterization Model
CIMIS	California Irrigation Management Information System
CMA	Central Management Area
EMA	Eastern Management Area
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	Hydrogeologic Conceptual Model
NCCAG	Natural Communities Commonly Associated with Groundwater
SGMA	Sustainable Groundwater Management Act
SWP	State Water Project
SWRCB	State Water Resources Control Board
SYRWCD	Santa Ynez River Water Conservation District
USGS	U.S. Geological Survey
WMA	Western Management Area
WY	Water Year (The 12-month period October 1, for any given year through September 30 of the following year. The water year is designated by the calendar year in which it ends.)

1. WATER BUDGET ELEMENTS

This section summarizes data sources used to construct the water budgets. A conceptual diagram showing the components of surface water and groundwater systems in the Santa Ynez River Valley Groundwater Basin (Basin) is provided in Figure 1-1. Water supply and water use within the Western Management Area (WMA) of the Basin as well as groundwater conditions are dependent upon precipitation. Precipitation, either directly or as streamflow infiltration, recharges the groundwater supplies of the WMA. This Water Budget Technical Memorandum (Memorandum) quantifies groundwater flows into and out of the WMA, including natural conditions (runoff and recharge from precipitation, groundwater flow, and riparian evapotranspiration) and human-made conditions (dam releases, groundwater pumping, and return flows).

1.1. WATER YEAR TYPE CLASSIFICATION

Section 2.2 of the Groundwater Conditions Memorandum ("Classification of Wet and Dry Years") describes how water year types are classified in the WMA. For consistency, the hydrologic year type for the WMA is based on the methodology similar to the 2019 State of California Water Resources Control Board (SWRCB) Order WR 2019-0148. Years are classified based on the rank in the period of record in one of five categories: critically dry (bottom 20th percentile), dry (20th to 40th percentile), below normal (40th to 60th percentile), above normal (60th to 80th percentile), and wet (80th to 100th percentile). **Table 1-1** compares the water year classification of the WMA and SWRCB Order WR 2019-0148 to the annual precipitation at Lompoc City Hall for the years 1982–2018.[3] Consistency between different stations throughout the basin is indicated in **Table 1-1**, except the WMA and SWRCB hydrologic year type based on surface water inflow reflects antecedent soil moisture conditions. For example, the annual precipitation in year 1997 was 81% of average at Lompoc City Hall; however, because the precipitation occurred during a wet climatic trend following wet years 1993 and 1995, the water year is classified with above normal runoff and recharge conditions.

1.2. WATER BUDGET ANALYSIS TIME PERIODS (HISTORICAL, CURRENT, AND PROJECTED)

The historical water budget period, or base period, was selected in coordination with the Central Management Area and Eastern Management Area to be water years 1982 through 2018 (37 years; see Figure 1-2). Water years start on October 1 of the previous year and run

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[3] Lompoc City Hall, Gauge 439, Santa Barbara County Flood Control & Water Conservation District. Water Years 1955–2020. Period of record average is 14.6 inches per year.

TABLE 1-1 ANNUAL PRECIPITATION AND WATER YEAR CLASSIFICATION FOR WMA

			Hydrologic Year Type Classification [1]		
	Lompoc City Hall		WMA	Upper Santa Ynez River	
Water Year	Precipitation (in/year)	% of Average [2]	USGS Gage 11132500 (Salsipuedes Creek)	SWRCB WRO 2019-148	Climatic Trends [3]
1982	11.9	81%	Dry	Below normal	Wet
1983	34.0	231%	Wet	Wet	Wet
1984	8.0	54%	Below normal	Above normal	Dry
1985	9.8	67%	Dry	Dry	Dry
1986	19.3	131%	Above normal	Above normal	Dry
1987	11.2	76%	Dry	Critically Dry	Dry
1988	15.4	105%	Dry	Dry	Dry
1989	6.6	45%	Critically Dry	Critically Dry	Dry
1990	6.6	45%	Critically Dry	Critically Dry	Dry
1991	15.0	102%	Below normal	Above normal	Dry
1992	15.8	107%	Above normal	Wet	Wet
1993	17.7	120%	Wet	Wet	Wet
1994	12.8	87%	Below normal	Below normal	Wet
1995	33.8	229%	Wet	Wet	Wet
1996	12.2	82%	Below normal	Below normal	Wet
1997	12.0	82%	Above normal	Above normal	Wet
1998	34.3	233%	Wet	Wet	Wet
1999	15.2	103%	Above normal	Below normal	Normal
2000	15.1	103%	Above normal	Above normal	Normal
2001	17.8	121%	Wet	Wet	Normal
2002	7.5	51%	Dry	Dry	Normal
2003	11.7	79%	Below normal	Below normal	Normal
2004	8.6	58%	Dry	Dry	Normal
2005	24.9	169%	Wet	Wet	Normal
2006	16.8	114%	Above normal	Above normal	Normal
2007	5.3	36%	Critically Dry	Critically Dry	Normal
2008	13.6	92%	Above normal	Above normal	Normal
2009	10.4	71%	Critically Dry	Dry	Normal
2010	19.5	132%	Below normal	Above normal	Normal
2011	26.8	182%	Wet	Wet	Normal
2012	10.6	72%	Dry	Dry	Dry
2013	7.2	49%	Critically Dry	Critically Dry	Dry
2014	7.2	49%	Critically Dry	Critically Dry	Dry
2015	8.0	55%	Critically Dry	Critically Dry	Dry
2016	11.7	79%	Critically Dry	Dry	Dry
2017	22.5	153%	Above normal	Above normal	Normal
2018	8.3	56%	Critically Dry	Dry	Normal

1 Dry and critically dry years are shaded yellow; wet years are shaded blue; and normal, below normal, and above normal years are unshaded. **Notes:** WMA = Western Management Area; USGS = U.S. Geological Survey; SWRCB = State Water Resources Control Board; WRO = Water Resources Order; in/year = inches per year.

2 Average for period of record (1955–2020) is 14.6 inches per year.

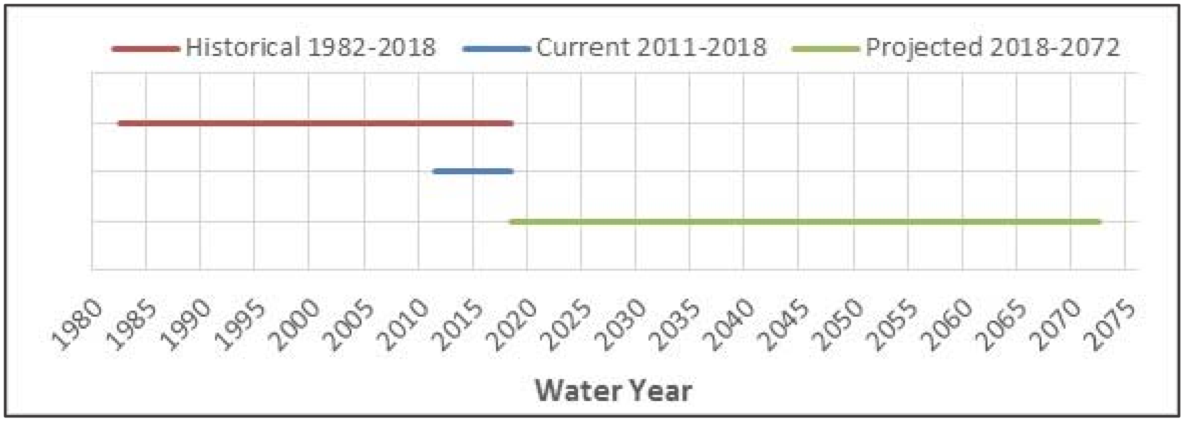
3 GSI 2020.

through September 30th of the current year.[4] This 37-year period meets two SGMA criteria: longer than 10 years and includes the "most recently available information."[5] This period includes two major historical droughts (1985–1991 and 2012–2018), and average precipitation (14.7 inches) is similar to the 65-year average of 14.6 inches per year measured. Thus, the historical period 1982-2018 represents long-term average hydrologic conditions. For example, the average precipitation at the Lompoc City Hall station (is 14.6 inches per year for the period of 1955–2020) and 14.7 inches for the period of 1982–2018, a difference of only 1%. Furthermore, the 37-year period also includes when the Santa Ynez River Water Conservation District (SYRWCD) collected self-reported groundwater pumping data in the Basin. This base period was also coordinated with the other management agencies in the Basin. The historical water budget is presented in Section 2 of this Memorandum.

An eight-year subset of the historical data record was used to represent current conditions (water years 2011–2018). This eight-year period includes "the most recent hydrology, water supply, water demand, and land use information" as required by the regulations[4], including data from January 1, 2015. Current conditions are considered very dry, but includes 2011 which was a wet year. The average annual precipitation for the 8-year period is 12.8 inches per year (87% of average). The current water budget is presented in Section 3.

The projected water budget for the period of 2018–2072 extends 50 years past the 2022 submittal of this Groundwater Sustainability Plan (GSP), for a total of 55 years. The projected water budget is presented in Section 4.

FIGURE 1-2 HISTORICAL, CURRENT, AND PROJECTED WATER BUDGET PERIODS



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[4] Per SGMA regulations, all years refer to water years, start in October 1st of the previous year through September 30th of the current year.

[5] 23 CCR 354.18(c).

1.3. SURFACE WATER AND THE SANTA YNEZ RIVER ALLUVIUM

In addition to groundwater inflows and outflows, GSP regulations state that the "total surface water entering and leaving a basin by water source type" must also be accounted for.[6] This will include the Santa Ynez River, tributaries, and State Water Project (SWP) imports. In addition, as discussed in the Hydrogeologic Conceptual Model (HCM) Memorandum, the Santa Ynez River Alluvium upstream of the Lompoc Narrows is part of the subflow of the river, which is regulated by SWRCB. Because subflow is considered surface water, the Santa Ynez River Alluvium would not be classified as a principal aquifer or managed by a GSP under SGMA. Therefore, the Santa Ynez River Alluvium is considered part of the underflow of the Santa Ynez River and is treated as part of the surface water in the historical, current, and projected water budgets.

1.4. WATER BUDGET DATA SOURCES

The historical and current water budgets were developed using various publicly available data. The projected water budget was developed using the SGMA guidance, further described below. Table 1-2 presents a summary of the data sources employed for developing the historical and current water budgets and a description of each data set's qualitative data rating. Data that is measured is usually rated at a high quality, and data that is estimated is rated low to medium depending upon its source. Each of these data sets is described in further detail in the following sections.

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[6] 23 CCR 354.18(b).

TABLE 1-2 WATER BUDGET DATA SOURCES

Water Budget Component	Data Source(s)	Comment(s)	Qualitative Data Rating
Surface Water Inflow Components			
Santa Ynez River Inflow	USGS	Narrows Gauge	Gauged – High
Tributary Inflow	Correlation with gauged data	Methods described in text	Calibrated Model – Medium
Lompoc Regional Wastewater Reclamation Plant	City of Lompoc	Methods described in text	Metered – High
Imported: SWP	Central Coast Water Authority	—	Metered – High
Groundwater Inflow Components			
Deep Percolation of Precipitation: Overlying and Mountain Front Recharge	USGS BCM Recharge	BCM calibrated to Basin precipitation station data	Calibrated Model – Medium
Streamflow Percolation	Santa Ynez RiverWare Model, USGS BCM	Collaborative Modeling effort: Stetson and GSI	Calibrated Model – Medium
Subsurface inflow	Darcian flux calculation	Collaborative Modeling effort: Stetson and GSI	Estimated – Medium
Irrigation Return Flows	Land use surveys, self-reported pumping data	Basinwide Collaborative Estimation: Stetson and GSI using Yates 2010	Estimated – Low
Percolation of Treated Wastewater	Mission Hills CSD and Lompoc Penitentiary	Received	Metered – High
Percolation from Septic Systems	SYRWCD self-reported data, Santa Barbara County Water Agency return estimates	Methods described in text	Estimated – Low
Surface Water Outflow Components			
Santa Ynez River Outflow	USGS	Methods described in text	Calibrated Model - Medium
Streamflow Percolation	Santa Ynez RiverWare Model, USGS BCM	Collaborative modeling effort: Stetson and GSI	Calibrated Model - Medium
Riparian Evapotranspiration	Aerial photography, NCCAG/NWI data sets, CIMIS weather station	Methods described in text	Estimated – Medium/Low
Groundwater Outflow Components			
Agricultural Irrigation Pumping	Land use surveys, self-reported pumping data	Methods described in text	Estimated – Medium/Low

TABLE 1-2 WATER BUDGET DATA SOURCES (CONTINUED)

Water Budget Component	Data Source(s)	Comment(s)	Qualitative Data Rating
Groundwater Outflow Components (continued)			
Municipal Pumping	Self-reported pumping data	Methods described in text	High/Medium
Rural Domestic/Small Public Water Systems Pumping	SYRWCD self-reported data, DRINC	Methods described in text	Estimated – Medium/Low
Riparian Evapotranspiration	Aerial photography, NCCAG/NWI datasets, CIMIS weather station	Methods described in text	Estimated – Medium/Low
Subsurface Outflow	Darcian flux calculations, groundwater model	Methods described in text	Estimated – Medium

Notes: USGS = U.S. Geological Survey; SWP = State Water Project; BCM = Basin Characterization Model; Stetson = Stetson Engineers; GSI = GSI Water Solutions, Inc.; SYRWCD = Santa Ynez River Water Conservation District; NCCAG = The Natural Communities Commonly Associated with Groundwater (NCCAG) Wetland dataset; NWI = National Wetlands Inventory; CIMIS = California Irrigation Management Information System; DRINC = Drinking Water Information Clearinghouse.

1.4.1. SOURCES OF SURFACE WATER INFLOWS

1.4.1.1. Santa Ynez River

Surface water inflows include both local and imported water entering the WMA. As discussed in Section 1.3, all of the inflow into the Santa Ynez River Alluvium is considered as part of the surface water inflow.[7] The Santa Ynez River Alluvium upstream of the Lompoc Narrows includes fluxes that are associated with groundwater data sources (e.g., subflow, recharge from precipitation), but in Sections 2, 3, and 4 of this Memorandum, all Santa Ynez River Alluvium fluxes will be accounted for as part of the total surface water in the water budget.

The U.S. Geological Survey (USGS) Narrows gauge (ID No. 11133000) measures the flow of Santa Ynez River water entering the Lompoc Plain of the WMA. Santa Ynez River flows in the WMA are substantially influenced by upstream dam and reservoir operations. Downstream releases and spillway flows from Lake Cachuma are controlled and monitored by the U.S.

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[7] The Santa Ynez River Alluvium subarea corresponds to Zone A in the SYRWCD management and annual reports (HCM Memorandum, Figure 3-3). This alluvium is included as part of the Above Narrows area in the SWRCB Order WR 2019-148 (SWRCB 2019).

Bureau of Reclamation at Bradbury Dam. Flows at the Narrows gauge are based on upstream outflows from the Basin's Central Management Area (CMA) and Eastern Management Area (EMA).

1.4.1.2.Tributaries

Watershed drainage areas and average precipitation for Santa Ynez River tributaries to the Santa Ynez River within the WMA are summarized in Table 1-3. In general, the tributaries to the south of the Santa Ynez River receive more precipitation and are on steeper slopes compared with the tributaries to the north of the Santa Ynez River.

Tributary flow was estimated directly using stream gauge data, when available, or by correlation with nearby stream gauge data. Salsipuedes Creek and Miguelito Creek have USGS gauges (ID 11132500 and ID 11134800, respectively; Groundwater Conditions Memorandum Figure 6-1). The tributary in the Lower Santa Ynez River with the longest period of record is Salsipuedes Creek (USGS 11132500), located in the WMA. Flows in ungauged areas and data missing from the Miguelito Creek record are estimated based on the Salsipuedes Creek gauge prorated by drainage area and average annual precipitation, as shown in Table 1-3. This method was also utilized for the development of the County hydrologic model (Stetson 2008).

TABLE 1-3 TRIBUTARY CREEKS OF THE WMA

North of the Santa Ynez River	**Drainage Area (mi^2)**	**Average Annual Precipitation (in/year)[1]**
Santa Rita Creek	4.5	18.6
Cebada Canyon Creek	6.2	17.1
Purisima Canyon Creek	2.6	17.2
Davis Creek	4.6	16.1
Santa Lucia Canyon	9.5	15.1
Unnamed Tributaries	11.7	16.2
South of the Santa Ynez River		
Salsipuedes Creek	51.1	22.6
Miguelito Creek	10.4	22.4
Sloanes/ Le Salle Canyon	7.8	20.1
Lompoc Canyon	1.4	19.6
Bear Creek (La Honda watershed)	2.8	17.3
Unnamed Tributaries	4.75	21.2

Notes: WMA = Western Management Area.

1 PRISM 2014.

1.4.1.3. Lompoc Regional Wastewater Reclamation Plant

The historical discharge from the Lompoc Regional Wastewater Reclamation Plant to Miguelito Creek and Santa Ynez River are reported by the City of Lompoc (see HCM section 4.3.4) and assembled for this water budget.

1.4.1.4.State Water Project Imports

In the WMA, imported State Water Project (SWP) water is delivered to Vandenberg Air Force Base (VAFB). Imported SWP water deliveries were provided by the Central Coast Water Authority for September 1997 through present. Prior to 1997, no water was imported into the Basin.

1.4.2. Sources of Groundwater Inflows

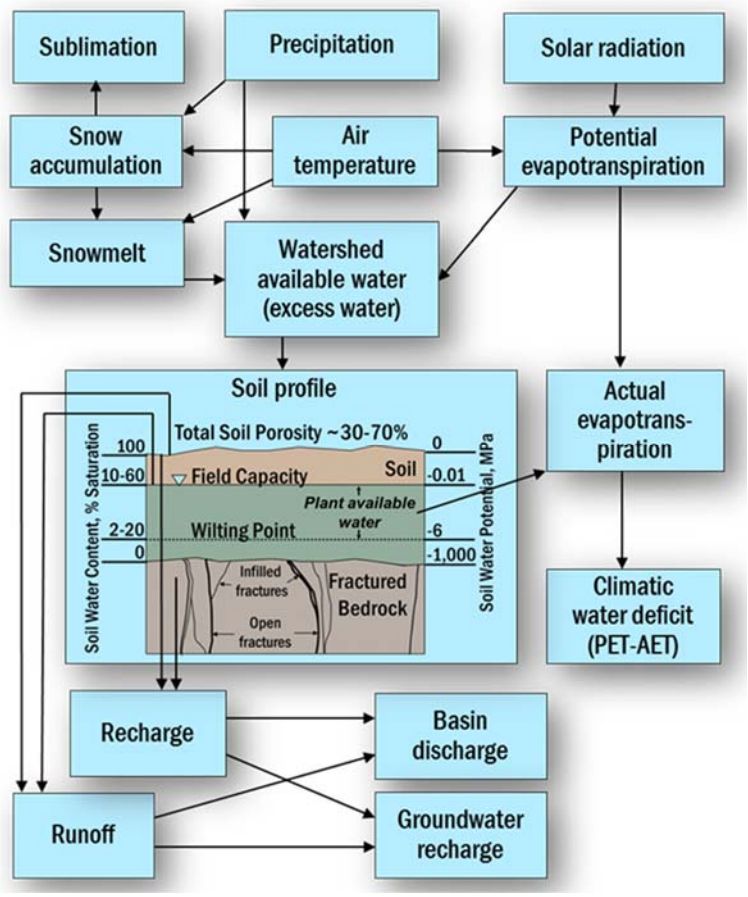
The data sources used for the groundwater budget inflow terms are described below.

1.4.2.1.Recharge from Precipitation

As is typical of a Mediterranean climate, the WMA experiences many months in the summer and fall with no precipitation. The area also goes through periodic dry cycles, with as many as 7 consecutive years with below normal precipitation. Precipitation that infiltrates into the soil zone and eventually recharges the regional groundwater table can be broken into two components: overlying recharge and mountain front recharge (also referred to as mountain block recharge). Overlying recharge occurs from precipitation on the land surface that directly overlies the principal aquifer. Mountain front recharge occurs from subflow from the adjacent bedrock or the older consolidated formations that are not part of the basin. Both types of recharge relate to the amount of precipitation in the drainage basin that infiltrates into the soil and drains to the groundwater aquifer.

Recharge to groundwater from deep percolation of precipitation was determined using the USGS Basin Characterization Model (BCM) for California (Flint and Flint 2017). BCM uses a soil budget based on monthly climate data and soils information to estimate the recharge, as shown on Figure 1-3, which is reproduced from the BCM website https://ca.water.usgs.gov/projects/reg_hydro/basin-characterization-model.html (Flint and Flint 2017):

FIGURE 1-3 BASIN CHARACTERIZATION MODEL



(Note: Santa Ynez River Valley Groundwater Basin does not utilize the snow subroutines in the BCM).

The BCM data are provided statewide on roughly 20-acre cells. This BCM recharge data set is the same data set being used in the EMA (GSI 2020) and CMA. As described in GSI 2020, the BCM recharge data set has been adjusted based on comparison to monthly precipitation records at weather stations across the entire Basin. A correction was applied to the BCM values for each monthly timestep such that the adjusted BCM data exactly matched all recorded weather station monthly precipitation values. These monthly adjustments were also applied to the BCM-generated recharge data sets. The timing of overlying recharge was modified from the BCM output. The BCM recharge output was very concentrated in wet years, but local well hydrographs indicate a more attenuated recharge flux across many years. The average annual recharge from the BCM was utilized and disaggregated based on percentage of rainfall at Lompoc City Hall for any particular year compared to the average rainfall for the period of 1982–2018.

The BCM does not route flows downstream. For areas outside the Basin and not within the major tributaries (i.e., Salsipuedes, Miguelito, Santa Rita, Cebada, Purisima, Davis, and Santa Lucia Creeks), mountain front recharge areas are estimated based on the Salsipuedes Creek gauge prorated by drainage area and average annual precipitation.

1.4.2.2.Percolation of Streamflow to Groundwater

Streamflow percolation, or leakage of surface water to groundwater through the Santa Ynez River streambed, was estimated using the calibrated Santa Ynez River RiverWare flow model (Stetson 2008) for percolation in the Santa Ynez River Alluvium subarea upstream of the Narrows. Below the Narrows, from the Narrows USGS Gauge to the confluence with Miguelito Creek (see Figure 6-2 in the Groundwater Conditions Technical Memorandum), the percolation curve for the SWRCB Water Rights Order (WRO) 2019-0148 is utilized. This curve is used in the WRO to determine the percolation from the surface flow to the groundwater aquifer in the Lompoc Plain. From the confluence of Miguelito Creek with the Santa Ynez River to the Pacific Ocean, the USGS gages nearest the estuary (USGS gages 11135500 and 11135250; see Figure 6-2 in the Groundwater Conditions Technical Memorandum) were utilized to determine the streamflow percolation. Percolation occurring in the tributary channels in the upland areas (Santa Rita Upland, Lompoc Upland, and Lompoc Terrace Subareas) was estimated using results from previous groundwater model studies for the WMA (Bright 1997; HCI 1997).

1.4.2.3.Subsurface Inflow from Adjacent Aquifers

Subflow is estimated using Darcy's Law for the five main subareas into the WMA (the Santa Ynez River Alluvium, Santa Rita Upland, Lompoc Upland, Lompoc Terrace, and the Lompoc Plain). Darcy's law is an equation that quantifies fluid flow through porous media (for example, the movement of water through geologic materials like sand and gravel). The Darcy flow rate is calculated from the permeability of the water-transmitting material, its cross-sectional area, and potential gradient driving the flow as summarized in the equation below:

$$\mathbf{Q = K * I * A} \quad \textbf{(Equation 1)}$$

where

Q = flow in cfs
K = hydraulic conductivity in ft/sec
I = hydraulic gradient in ft/ft
A = cross-sectional area in ft2

Subsurface groundwater inflows occur at the upstream boundary of the WMA along the border with CMA by the Santa Ynez River. This site occurs in a very narrow portion of Santa Ynez River alluvium, bordered by low permeability rocks north and south of the river. The estimated inflows were coordinated with the CMA water budget calculations, and the flows will be updated with results from the numerical groundwater model.

The amount of subflow between the Santa Rita Upland and Buellton Upland is unknown. The USGS (Hamlin 1985) estimated groundwater flow following the surface topography (i.e., south along Santa Rosa Creek) with no subflow estimated between Santa Rosa Creek and Santa Rita Creek. Locally there are anecdotes about groundwater levels being higher within the Santa Rosa Creek drainage compared to the Santa Rita Creek drainage, which indicates there might be some structural impediment to flow near the surface divide between the two upland basins. Results from the AEM geophysics study currently being compiled for the project area is expected to provide additional data, but currently no subsurface inflow is assumed in the upland area from the CMA.

1.4.2.4.Irrigation Return Flows

Irrigation return flow is the excess water from water applied to crops that percolates below the root zone and returns back to the groundwater aquifer. Irrigation return flow is related to the irrigation application efficiency and the plants consumptive use of water. The fraction of applied water utilized to satisfy the crop demand for water (ET) is represented by the application efficiency and expressed as a percent. The remaining fraction of applied water represents the irrigation return flow. For example, if the application efficiency is 60%, then 60% of the applied water is consumed by the crops and 40% percolates past the root zone as return flows. Irrigation return flows can either recharge the groundwater or leave the field as surface water in drains or tail water and discharge to a nearby creek or river. It is assumed that most of the irrigation return flow percolates to groundwater within the WMA, either directly beneath the field or in the field drain. Consistent with the Basin wide assumptions in other parts of the Santa Ynez River Groundwater Basin in the EMA and CMA (Yates, 2010), an application efficiency of 80% is assumed for all crops except vineyards, which are assumed to be irrigated using drip and having an application efficiency of 95%. Accordingly, groundwater recharge from deep percolation of irrigation is assumed to be 20% and 5% of the water applied to most crops and vineyards, respectively. The urban landscape application efficiency is assumed to be 70%, but only 15% is assumed to return to groundwater based on historical estimates (Stetson 1992). Irrigation return flow volumes have been calculated using these efficiencies multiplied by the calculated annual volumes of irrigation water applied to each crop type, based on self-reported pumping data and assumed crop-specific water duty factors.

1.4.2.5.Percolation of Treated Wastewater

There are three wastewater treatment plants within the WMA (see HCM Memorandum, Figure 4-7). The Lompoc Regional Wastewater Reclamation Plant (LRWRP) discharges to surface water and is discussed in Section 1.4.1.3. Mission Hills CSD and Lompoc Penitentiary wastewater treatment plants discharge to percolation ponds that recharge the groundwater table. The measured treated wastewater quantities were obtained from the Mission Hills CSD for the historical period of 1982–2018. From this amount sent to the percolation ponds, an additional 10% was assumed to evaporate and not recharge the aquifer. The wastewater discharge to the percolation ponds at the Lompoc Penitentiary were estimated based on the existing Lompoc groundwater model (HCI 1997).

1.4.2.6.Percolation from Septic Systems

Outside of the sewer service areas within the WMA, domestic wastewater is discharged to septic systems. Return flows from the septic systems recharge the groundwater. The recharge from septic systems is calculated using estimates from previous SYRWCD and County of Santa Barbara (County) studies (Stetson 1992). These previous analyses assumed that 40% of domestic water is used indoors and that 87% of this water will return to the groundwater. After accounting for the 60% for urban irrigation (outdoor water use) with 15% return flow, the total return flow from domestic/rural residential pumping for both indoor and outdoor use is estimated at 44%.

1.4.3. Surface Water Outflows

The data sources used for the surface water budget outflow terms are described below.

1.4.3.1.Santa Ynez River Outflow

Santa Ynez River surface water outflows were calculated as the sum of the Santa Ynez River inflows plus tributary inflows plus discharge from the Lompoc wastewater plant minus streamflow infiltration to groundwater. Each of these terms are described in the sections above.

1.4.3.2.Percolation of Streamflow to Groundwater

The calculation of streamflow percolation to groundwater is discussed in Section 1.4.2.2.

1.4.4. Groundwater Outflows

The data sources used for the groundwater budget outflow terms are described below.

1.4.4.1.Agricultural Irrigation Pumping

The largest source of water for irrigating crops in the WMA is pumped groundwater. Groundwater pumpers located within the SYRWCD boundaries are required to self-report their estimated pumping volumes to SYRWCD for each 6-month period. These estimates are based on multiple methods, including application of water duty factors specified in SYRWCD’s Groundwater Production Information and Instructions pamphlet (SYRWCD 2010); metered pumping records; and metered electricity records. The groundwater users specify which type of water they are using (agricultural, special irrigation [parks, schools, and golf courses], or other [municipal and industrial]). This reported pumping was checked against available land use surveys in 1985, 2014, and 2016 from sources provided by the California Department of Water Resources (DWR).[8] For example, in 2016 a total of 18,550 acre-feet (AF) was reported to the SYRWCD for agricultural pumping from the Lompoc Plain and Lompoc Upland. DWR identified 7,441 acres of irrigated land in the Lompoc Plain and Lompoc Upland in 2016, which would total 18,600 AF using an average crop duty of 2.5 AF per acre. Monthly irrigation pumping was disaggregated from the biannual (6-month) totals using monthly multipliers based on historical average monthly irrigation, precipitation, temperature and monthly crop water demands (HCI 1997).

1.4.4.2.Municipal Pumping

Municipal water in the WMA is extracted by wells from the Lompoc Plain Upper Aquifer and the Lompoc Upland Lower Aquifer (Paso Robles Formation and Careaga formations). The pumping includes all extractions for municipal, industrial, and domestic use that occurs within the City of Lompoc, Vandenberg Village CSD, Mission Hills CSD, and VAFB, including water used for urban landscape irrigation. The measured monthly pumping quantities were obtained from each entity for 1982–2018. This water budget combines the two categories reported to the SYRWCD: “other” water, which includes municipal, industrial, small public water systems, and domestic use, and “special irrigation” water, which refers to urban landscape irrigation. These municipal pumping volumes are reported by SYRWCD in their annual reports.

1.4.4.3.Rural Domestic and Small Public Water Systems Pumping

Besides the entities discussed in above Section 1.4.4.2 Municipal Pumping, the “other” water reported in the SYRWCD annual reports includes all other domestic uses, including rural domestic and small public water systems in the WMA. Pumpage for rural domestic and small public water systems are reported to SYRWCD by subarea (Lompoc Plain, Lompoc Upland, Santa Rita Upland, or Santa Ynez River Alluvium). The biannual pumping quantities of rural domestic and small public water systems were disaggregated using the City of Lompoc monthly average pumping distribution.

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[8] The data were delineated by LandIQ for years 2014 and 2016 from imagery provided by the National Agriculture Imagery Program. The data are derived from a combination of remote sensing, agronomic analysis, and ground verification. The data set provides information for resource planning and assessments across multiple agencies throughout the state and serves as a consistent base layer for a broad array of potential users and multiple end-uses.

1.4.4.4.Riparian Vegetation Evapotranspiration

Riparian evapotranspiration was calculated using three sources to determine acreages of riparian vegetation types occurring within the WMA:

- The Natural Communities Commonly Associated with Groundwater (NCCAG) Wetland data set (https://gis.water.ca.gov/app/NCDatasetViewer/)
- The National Wetlands Inventory (NWI) dataset (https://www.fws.gov/wetlands/Data/Data-Download.html)
- An analysis of color-infrared aerial photos from 2012 that was completed for this study by Stetson Engineers.

Color-infrared aerial photography shows a range of electromagnetic waves that the human eye cannot see and is widely used for interpretation of natural resources. Very intense reds indicate dense, vigorously growing vegetation, which is commonly associated with riparian evapotranspiration related to groundwater use. The infrared aerial photos were the primary method of detecting vegetation along the Santa Ynez River. In the upland areas, the combination of the NCCAG and NWI data sets were relied on. Surface geology and topography data were used to avoid acreage on hillsides, which would be above the regional water table.

The riparian acreage analysis is multiplied by a monthly riparian water duty based on a weather station operated by the California Irrigation Management Information System (CIMIS). The station closest to the WMA is the Lompoc station. CIMIS has daily evaporation data for the station located near Lompoc since July 2010. Table 1-4 shows the monthly average CIMIS data. The riparian water duty factor used is 3.7 feet per year, which is similar to the 4.5 and 4.2 feet per year rates used in the EMA and CMA, respectively.

TABLE 1-4 CIMIS MONTHLY AVERAGE REFERENCE EVAPOTRANSPIRATION (2010–2019)

Month	**Reference Evapotranspiration (inches)**
January	1.7
February	2.2
March	3.4
April	4.5
May	5.2
June	5.3
July	5.4
August	5.0
September	4.1
October	3.2
November	2.1
December	1.6
Total **inches**/year	43.9
Total **feet**/year	3.7

Note: CIMIS = California Irrigation Management Information System.

1.4.4.5.Subsurface Groundwater Outflows

Subsurface groundwater outflow (or subflow) occurs at the downstream end of the WMA to the Pacific Ocean. The outflow site is located geologically in an alluvium-filled channel cut into the non-water-bearing Monterey formation. The only aquifer unit is the Upper Aquifer comprised of the alluvial sediments of the Santa Ynez River. Because of the constriction by the bedrock north and south of the river, the outflow is limited but focused in a narrow channel. The magnitude of the subflow has been calculated using Darcy's law, with estimated values for hydraulic conductivity, the average hydraulic gradient, and outflow plane cross-sectional area (based on saturated thickness estimates). These values will be updated with results from the numerical groundwater model.

A smaller flux of subsurface outflow also flows to the Pacific Ocean from the Lompoc Terrace. The water level elevations along the coast in the Lompoc Terrace are 100 feet higher than sea level, which indicates very low conductivity deposits limit the amount of subflow out of the basin in this location.

2. HISTORICAL WATER BUDGET

The SGMA regulations require that the historical surface water and groundwater budget be based on at least 10 years of the most recent data. The 1982–2018 period was utilized to represent the historical water budget (also referred to as the historical base period) because it represents average conditions with several different dry and wet periods. The surface water and groundwater budgets are determined from the various components, which can vary spatially and temporally within the Basin, and the results summarized and reported as a total for the WMA.

2.1. HISTORICAL SURFACE WATER COMPONENT

The SGMA regulations (Section 354.18) require that the water budget include the total annual volume of surface water entering and leaving the basin, and evaluates their historical and future reliability. The WMA relies on two surface water source types identified in DWR's Best Management Practices (DWR 2016): local and SWP supplies.

2.1.1. Inflows: Local Surface Water (Santa Ynez River and Tributaries) and Imported Surface Water

Local surface water supplies include precipitation runoff within the watershed and Santa Ynez River inflow to the WMA, regulated by SWRCB as outflows from Lake Cachuma. In addition, as discussed in the HCM Memorandum, the Santa Ynez River Alluvium Upper Aquifer, upstream of the Lompoc Narrows (HCM Technical Memorandum Figure 1-4) is part of the subflow of the river, which is regulated by SWRCB.

Imported surface water from the SWP became available after completion of the Coastal Branch pipeline in 1997. The VAFB has an SWP allocation of 5,500 AFY and a drought buffer of 550 AFY for a total of 6,050 AFY.

Table 2-1 summarizes the average, minimum, and maximum inflow from surface water from all sources. The estimated average annual total inflow over the historical base period is approximately 116,290 AFY. The large difference between the minimum and maximum inflows reflects the climatic variability between dry and wet years. The largest components of this average local inflow are releases from Bradbury Dam and flow in the Santa Ynez River upstream of the WMA, which represent about 78% of the average annual surface inflow. Inflow from the Lompoc and Santa Rita Uplands and the Santa Ynez Mountains contributes 14% of the total surface water inflow. The remaining surface flow components make up 8% of the total surface water inflow (Table 2-1).

TABLE 2-1 ANNUAL SURFACE WATER INFLOW, HISTORICAL PERIOD (1982–2018)

Surface Water Inflow Component	**Average**	**Minimum**	**Maximum**
	(Acre-Feet per Year)		
Santa Ynez River Inflow from CMA	91,320	40	699,280
Santa Ynez River Tributary Inflow	16,130	230	114,090
Lompoc Regional Wastewater Reclamation Plant	3,790	2,950	4,720
Imported SWP	1,470	0	4,320
Santa Ynez River Alluvium Subarea (Surface Water Underflow)			
Subflow	800	800	800
Recharge from Precipitation (Overlying and Mountain Front)	1,900	1,400	2,750
Recharge from Agricultural Return Flows to Underflow	860	450	1,250
Recharge from Domestic Return Flows to Underflow	20	0	40
TOTAL	**116,290**	**5,870**	**827,250**

The annual average, minimum, and maximum volumes of imported local surface water during the historical base period (1982–2018) are presented Table 2-1. The average value of 1,470 AFY does not represent the typical SWP imports by the VAFB because deliveries did not start until 1997. The average amount of SWP imports for the period of 1998–2018 was approximately 2,600 AFY. The imported water supply provides approximately zero to 2% of the total volume of surface water that enters the WMA.

2.1.2. Surface Water Outflows

The estimated annual average total surface water outflow leaving the WMA as flow in the Santa Ynez River, within the Santa Ynez River Alluvium Upper Aquifer, and percolation into Lower Aquifer over the historical base period is summarized in Table 2-2. Similar to inflows, the Santa Ynez River surface outflow represents the majority (79%) off the average annual surface flow out of the WMA.

Table 2-2 Annual Surface Water Outflow, 1982-2018 Historical Period (1982–2018)

Surface Water Outflow Component	Average	Minimum	Maximum
	(Acre-Feet per Year)		
Santa Ynez River Outflow to Pacific Ocean	89,190	0	687,050
Net Channel Percolation to Groundwater[1]	14,300	3,500	28,130
Santa Ynez River Alluvium Subarea (Surface Water Underflow)			
Santa Ynez River Underflow Out	1,200	1,200	1,200
River well pumping[2] – Agriculture	4,510	2,340	6,620
River well pumping[2] – Domestic	50	10	100
Riparian Vegetation Evapotranspiration	3,170	3,170	3,170
TOTAL	**112,420**	**10,220**	**726,270**

1) Does not include percolation to Santa Ynez River Alluvium, which is part of the surface water component.
2) River well pumping occurs from wells in the Santa Ynez River Alluvium. The wells pump from the subflow of the Santa Ynez River and are administered by the SWRCB as a surface water diversion.

2.1.3. Summary

As indicated in Tables 2-1 and 2-2, the average surface flow in and out averaged 116,290 AFY and 112,420 AFY, respectively, for the 1982-2018 period. The surface water inflow exceeded outflow by 3,870 AFY.

The surface water budget for the historical period in the WMA is presented on Figure 2-1 and Table 2-3. The inflows and outflows for the Santa Ynez River Alluvium shown in Tables 2-1 and 2-2 are totaled in Figure 2-1 and Table 2-3. The figure shows how flashy the hydrologic system is, with ten wet years showing orders of magnitude more flux of surface water than the other, drier, years. In these wet years, surface water inflows and outflows are extremely large in response to precipitation, compared with the drier years.

2.2. HISTORICAL GROUNDWATER BUDGET

The historical groundwater budget from 1982 through 2018 includes a summary of the estimated groundwater inflows and, groundwater outflows, followed by the change of groundwater in storage and discussion about the sustainable yield of the WMA. The inflows and outflows are for the entire groundwater basin in the WMA, which includes the Lompoc Plain, Lompoc Upland, Santa Rita Upland, and Lompoc Terrace subareas (see HCM Figure 4-1). The water budget for the Burton Mesa subarea is included as inflow into the Lompoc Plain and Lompoc

TABLE 2-3 ANNUAL SURFACE WATER COMPONENTS, HISTORICAL PERIOD (1982–2018), AFY

		Inflows						**Outflows**				
Water Year	**Hydrologic Year Type**	**Santa Ynez River**	**Tributary**	**Lompoc Wastewater**	**Imported SWP**	**River Alluvium Total Inflows**	**Total Inflows**	**Santa Ynez River**	**Net Percolation to Groundwater**	**River Alluvium Total Outflows**	**Total Outflows**	**Inflow - Outflow**
1982	Dry	3,402	2,902	3,583	0	3,289	13,175	1,592	9,517	7,433	18,542	-5,367
1983	Wet	539,648	64,565	3,786	0	4,112	612,111	499,844	28,131	7,286	535,262	76,849
1984	Below normal	26,082	6,168	3,666	0	3,363	39,279	22,370	17,657	7,267	47,295	-8,015
1985	Dry	562	2,297	3,968	0	3,260	10,087	0	8,070	6,957	15,028	-4,940
1986	Above normal	14,906	19,078	4,090	0	3,275	41,350	20,688	19,973	6,723	47,384	-6,034
1987	Dry	1,392	2,896	4,107	0	2,960	11,355	654	9,665	6,800	17,120	-5,765
1988	Dry	1,320	1,688	3,944	0	3,122	10,073	0	8,249	6,813	15,062	-4,989
1989	Critically Dry	109	400	4,019	0	3,014	7,542	0	4,224	7,579	11,804	-4,261
1990	Critically Dry	39	317	3,707	0	3,070	7,134	0	3,888	8,415	12,303	-5,170
1991	Below normal	11,091	9,445	3,616	0	3,293	27,446	13,782	14,458	8,022	36,263	-8,817
1992	Above normal	43,968	12,689	3,691	0	3,602	63,950	47,843	22,267	7,814	77,923	-13,973
1993	Wet	377,397	30,539	3,889	0	3,748	415,572	382,370	22,844	7,698	412,911	2,660
1994	Below normal	10,416	5,068	3,725	0	3,206	22,415	5,071	16,084	7,691	28,846	-6,430
1995	Wet	590,940	114,087	4,017	0	3,822	712,866	504,051	26,319	7,603	537,974	174,893
1996	Below normal	17,646	7,849	4,107	0	3,406	33,007	17,436	15,071	8,480	40,987	-7,979
1997	Above normal	19,711	10,077	4,120	13	3,695	37,616	25,270	16,567	9,901	51,739	-14,123
1998	Wet	699,276	80,355	4,568	3,174	4,238	791,611	687,053	27,616	8,698	723,366	68,245
1999	Above normal	14,156	10,941	4,652	3,339	3,813	36,900	22,503	14,226	9,234	45,964	-9,064
2000	Above normal	32,004	19,256	4,719	4,086	3,788	63,854	44,838	15,155	9,256	69,248	-5,395
2001	Wet	176,979	38,318	4,045	4,316	4,078	227,737	248,894	18,714	9,297	276,905	-49,168
2002	Dry	7,722	2,677	3,824	3,809	3,575	21,606	720	13,469	9,598	23,787	-2,180
2003	Below normal	9,747	6,626	3,746	4,018	3,582	27,719	4,110	17,652	9,170	30,931	-3,213
2004	Dry	6,017	2,917	3,879	4,176	3,628	20,616	875	10,662	9,984	21,522	-906
2005	Wet	404,441	57,620	3,730	3,260	4,442	473,493	432,183	20,239	9,333	461,755	11,738
2006	Above normal	98,411	10,028	3,744	3,337	3,684	119,204	78,283	16,452	8,953	103,687	15,516
2007	Critically Dry	7,714	996	3,993	3,802	3,478	19,983	360	10,735	9,967	21,061	-1,078
2008	Above normal	57,782	16,465	3,921	2,321	3,921	84,410	69,645	12,246	10,011	91,901	-7,491
2009	Critically Dry	2,362	977	3,395	1,377	3,591	11,703	360	7,032	10,171	17,563	-5,860
2010	Below normal	18,906	8,751	3,408	961	3,878	35,904	19,559	18,670	9,991	48,220	-12,316
2011	Wet	130,640	27,575	3,190	2,002	3,721	167,129	125,814	21,914	9,170	156,897	10,232
2012	Dry	3,107	1,753	2,946	2,238	3,625	13,669	720	8,407	10,032	19,159	-5,490
2013	Critically Dry	6,378	624	3,288	2,070	3,652	16,012	0	7,542	11,052	18,594	-2,582
2014	Critically Dry	4,433	430	3,588	145	3,490	12,086	0	8,228	10,584	18,812	-6,727
2015	Critically Dry	3,370	233	3,334	109	3,430	10,475	0	3,495	10,799	14,294	-3,819
2016	Critically Dry	3,823	329	3,324	1,758	3,402	12,637	0	5,776	10,769	16,545	-3,908
2017	Above normal	24,538	19,517	3,439	1,924	3,723	53,142	22,633	19,911	10,988	53,532	-389
2018	Critically Dry	8,527	438	3,338	2,296	3,374	17,974	360	7,967	10,926	19,253	-1,279
Average 1982 - 2018		**91,323**	**16,132**	**3,787**	**1,474**	**3,577**	**116,293**	**89,186**	**14,300**	**8,931**	**112,417**	**3,876**

Upland subareas. The Santa Ynez River Alluvium subarea is included as part of the surface water component.

2.2.1. Groundwater Inflows

Groundwater inflow components include subsurface inflow, deep percolation of direct precipitation and mountain front recharge, streamflow percolation, and return flows from agricultural irrigation and, municipal, and domestic water uses. The annual groundwater inflows during the historical base period are summarized in Table 2-4. During the historical base period, an average of 31,069 AFY of total groundwater inflow occurred. During this time, the groundwater inflow components ranged from 14,420 AFY to 54,610 AFY, due to differences in rainfall in dry and wet years. The three largest groundwater inflow components were recharge from percolation of surface water, recharge from precipitation overlying the groundwater basin, and return flows from agriculture, which account for 46%, 26%, and 12% of the total annual average inflow, respectively. The remaining groundwater components make up 18% of the total groundwater inflow (Table 2-4).

TABLE 2-4 ANNUAL GROUNDWATER INFLOW, HISTORICAL PERIOD (1982–2018)

Groundwater Inflow Component	**Average**	**Minimum**	**Maximum**
	(Acre-Feet per Year)		
Subflow[1]	1,200	1,200	1,200
Recharge from Precipitation – Overlying	7,990	4,830	14,080
Recharge from Precipitation – Mountain Front	2,730	1,320	4,920
Net Channel Percolation from Surface Water[2]	14,300	3,500	28,130
Agricultural Return Flows	3,820	2,970	5,010
Municipal Return Flows[3]	880	520	1,130
Domestic Return Flows	110	80	140
TOTAL	**31,030**	**14,420**	**54,610**

1) Based on subflow at the Lompoc Narrows, flowing from the river alluvium to the Lompoc Plain.
2) Does not include percolation to Santa Ynez River alluvium upstream of the Lompoc Narrows which is part of the surface water component.
3) Does not include return flows from Lompoc Wastewater Reclamation Plant, which is included in the surface water components.

2.2.2. Groundwater Outflows

Groundwater outflow components include total groundwater pumping from all water use sectors, subsurface flow out to the Pacific Ocean, and phreatophyte (riparian vegetation) evapotranspiration. The estimated annual groundwater outflows for the historical base period are summarized in Table 2-5.

TABLE 2-5 ANNUAL GROUNDWATER OUTFLOW, 1982-2018 HISTORICAL PERIOD (1982–2018)

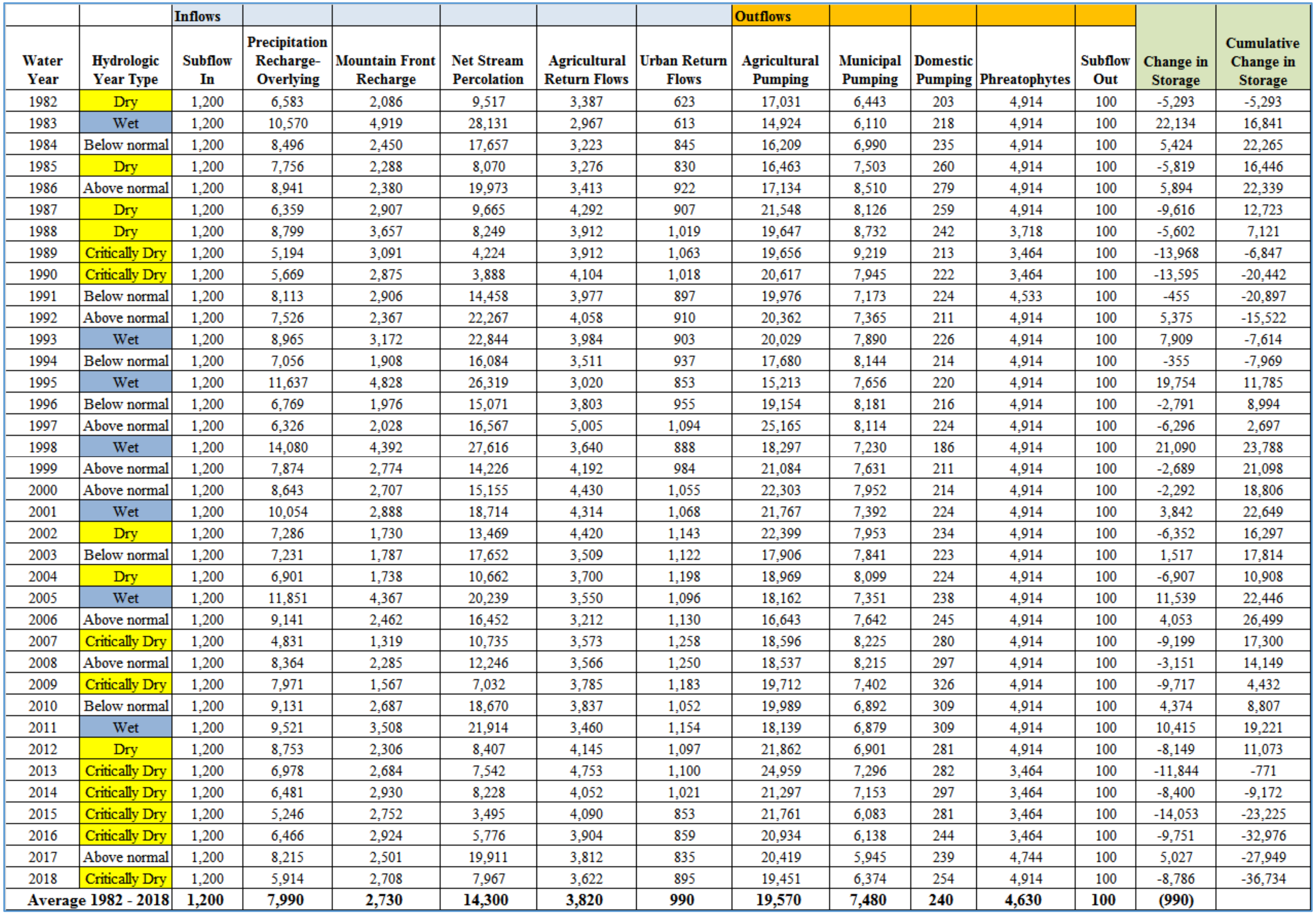
Groundwater Outflow Component	Average	Minimum	Maximum
	(Acre-Feet per Year)		
Pumping – Agriculture	19,570	14,920	25,160
Pumping – Municipal	7,480	5,940	9,220
Pumping – Domestic	240	190	330
Riparian Vegetation Evapotranspiration	4,630	3,460	4,910
Subflow	100	100	100
TOTAL	**32,020**	**24,610**	**39,720**

Groundwater pumping was the largest groundwater outflow component, totaling 85% of all the groundwater outflow. The estimated annual groundwater pumping by water use sector for the historical base period is summarized in Table 2-5 and on Figure 2-2. Agricultural and municipal pumping were the largest components of groundwater pumping, accounting for approximately 72% (agricultural) and 27% (municipal) of total pumping over the historical base period. As indicated on Figure 2-2, total pumping remained steady over the base period. Domestic and small mutual water companies accounted for 1% of total pumping during the historical base period.

2.2.3. Summary and Change in Storage

Annual changes in groundwater in storage were calculated for each year of the historical base period of 1982–2018 (37 years). A summary of the average annual inflows and outflows within the groundwater for the WMA for the historical base period are presented graphically on Figure 2-3. Figure 2-4 shows the magnitude of the average annual flow for each individual water budget component. Recharge from precipitation and agricultural pumping are the two largest fluxes for inflow and outflow, respectively. The results of the water budget during the historical period show that the WMA had more total outflow than total inflow. As shown on Figure 2-3, the average total outflow of approximately 32,000 AFY was about 1,000 AFY more that the average total inflow of approximately 31,000 AFY. The variability of the average inflow and outflow components are presented for each year of the historical period on Figure 2-5, which presents groundwater inflow components above the zero line and outflow components below the zero line. The annual variation on Figure 2-5 shows that the amount of recharge will fluctuate widely depending on precipitation and streamflow (also shown in Table 2-4). These data are also presented in Table 2-6.

TABLE 2-6 ANNUAL GROUNDWATER INFLOWS, OUTFLOWS, AND CHANGE IN STORAGE, HISTORICAL PERIOD (1982–2018), AFY



		Inflows						Outflows						
Water Year	Hydrologic Year Type	Subflow In	Precipitation Recharge-Overlying	Mountain Front Recharge	Net Stream Percolation	Agricultural Return Flows	Urban Return Flows	Agricultural Pumping	Municipal Pumping	Domestic Pumping	Phreatophytes	Subflow Out	Change in Storage	Cumulative Change in Storage
1982	Dry	1,200	6,583	2,086	9,517	3,387	623	17,031	6,443	203	4,914	100	-5,293	-5,293
1983	Wet	1,200	10,570	4,919	28,131	2,967	613	14,924	6,110	218	4,914	100	22,134	16,841
1984	Below normal	1,200	8,496	2,450	17,657	3,223	845	16,209	6,990	235	4,914	100	5,424	22,265
1985	Dry	1,200	7,756	2,288	8,070	3,276	830	16,463	7,503	260	4,914	100	-5,819	16,446
1986	Above normal	1,200	8,941	2,380	19,973	3,413	922	17,134	8,510	279	4,914	100	5,894	22,339
1987	Dry	1,200	6,359	2,907	9,665	4,292	907	21,548	8,126	259	4,914	100	-9,616	12,723
1988	Dry	1,200	8,799	3,657	8,249	3,912	1,019	19,647	8,732	242	3,718	100	-5,602	7,121
1989	Critically Dry	1,200	5,194	3,091	4,224	3,912	1,063	19,656	9,219	213	3,464	100	-13,968	-6,847
1990	Critically Dry	1,200	5,669	2,875	3,888	4,104	1,018	20,617	7,945	222	3,464	100	-13,595	-20,442
1991	Below normal	1,200	8,113	2,906	14,458	3,977	897	19,976	7,173	224	4,533	100	-455	-20,897
1992	Above normal	1,200	7,526	2,367	22,267	4,058	910	20,362	7,365	211	4,914	100	5,375	-15,522
1993	Wet	1,200	8,965	3,172	22,844	3,984	903	20,029	7,890	226	4,914	100	7,909	-7,614
1994	Below normal	1,200	7,056	1,908	16,084	3,511	937	17,680	8,144	214	4,914	100	-355	-7,969
1995	Wet	1,200	11,637	4,828	26,319	3,020	853	15,213	7,656	220	4,914	100	19,754	11,785
1996	Below normal	1,200	6,769	1,976	15,071	3,803	955	19,154	8,181	216	4,914	100	-2,791	8,994
1997	Above normal	1,200	6,326	2,028	16,567	5,005	1,094	25,165	8,114	224	4,914	100	-6,296	2,697
1998	Wet	1,200	14,080	4,392	27,616	3,640	888	18,297	7,230	186	4,914	100	21,090	23,788
1999	Above normal	1,200	7,874	2,774	14,226	4,192	984	21,084	7,631	211	4,914	100	-2,689	21,098
2000	Above normal	1,200	8,643	2,707	15,155	4,430	1,055	22,303	7,952	214	4,914	100	-2,292	18,806
2001	Wet	1,200	10,054	2,888	18,714	4,314	1,068	21,767	7,392	224	4,914	100	3,842	22,649
2002	Dry	1,200	7,286	1,730	13,469	4,420	1,143	22,399	7,953	234	4,914	100	-6,352	16,297
2003	Below normal	1,200	7,231	1,787	17,652	3,509	1,122	17,906	7,841	223	4,914	100	1,517	17,814
2004	Dry	1,200	6,901	1,738	10,662	3,700	1,198	18,969	8,099	224	4,914	100	-6,907	10,908
2005	Wet	1,200	11,851	4,367	20,239	3,550	1,096	18,162	7,351	238	4,914	100	11,539	22,446
2006	Above normal	1,200	9,141	2,462	16,452	3,212	1,130	16,643	7,642	245	4,914	100	4,053	26,499
2007	Critically Dry	1,200	4,831	1,319	10,735	3,573	1,258	18,596	8,225	280	4,914	100	-9,199	17,300
2008	Above normal	1,200	8,364	2,285	12,246	3,566	1,250	18,537	8,215	297	4,914	100	-3,151	14,149
2009	Critically Dry	1,200	7,971	1,567	7,032	3,785	1,183	19,712	7,402	326	4,914	100	-9,717	4,432
2010	Below normal	1,200	9,131	2,687	18,670	3,837	1,052	19,989	6,892	309	4,914	100	4,374	8,807
2011	Wet	1,200	9,521	3,508	21,914	3,460	1,154	18,139	6,879	309	4,914	100	10,415	19,221
2012	Dry	1,200	8,753	2,306	8,407	4,145	1,097	21,862	6,901	281	4,914	100	-8,149	11,073
2013	Critically Dry	1,200	6,978	2,684	7,542	4,753	1,100	24,959	7,296	282	3,464	100	-11,844	-771
2014	Critically Dry	1,200	6,481	2,930	8,228	4,052	1,021	21,297	7,153	297	3,464	100	-8,400	-9,172
2015	Critically Dry	1,200	5,246	2,752	3,495	4,090	853	21,761	6,083	281	3,464	100	-14,053	-23,225
2016	Critically Dry	1,200	6,466	2,924	5,776	3,904	859	20,934	6,138	244	3,464	100	-9,751	-32,976
2017	Above normal	1,200	8,215	2,501	19,911	3,812	835	20,419	5,945	239	4,744	100	5,027	-27,949
2018	Critically Dry	1,200	5,914	2,708	7,967	3,622	895	19,451	6,374	254	4,914	100	-8,786	-36,734
Average 1982 - 2018		**1,200**	**7,990**	**2,730**	**14,300**	**3,820**	**990**	**19,570**	**7,480**	**240**	**4,630**	**100**	**(990)**	

As shown on Figure 2-6, the cumulative change of groundwater in storage during each year and during the overall historical base period indicates an average annual decrease in storage in the WMA. The cumulative change in storage increased in the wet period from 1995 through 2011 for a net surplus, but then decreased from 2012 to 2018, for a net decrease for the entire period. There was about 37,000 AF of accumulated water supply deficiency over the entire 37-year period, which is equal to an average surplus/deficit of 1,000 AFY for the entire WMA.

The cumulative change in storage based on the water budget components is different in magnitude than the cumulative change in storage in SYRWCD's Annual Reports (Figure 2-1 and Figure 2-4 in the Groundwater Conditions Technical Memorandum) because the Annual Report data is based on a portion of the entire WMA. However, the trends shown in both analyses are the same in that there is a net decrease in the cumulative groundwater storage over the 37-year period. The average annual groundwater storage increase or decline during the historical base period—or the difference between outflow and inflow to the WMA—is approximately 1,000 AFY.

Figure 2-6 also shows the change in groundwater storage for the subareas of the WMA, including the Lompoc Plain, Lompoc Upland, Santa Rita Upland, and Lompoc Terrace. The average annual change in storage and cumulative change in storage over the base period for each subarea is shown in Table 2-7 based on this water budget analysis for the WMA.

TABLE 2-7 AVERAGE ANNUAL CHANGE IN GROUNDWATER STORAGE BY SUBAREA IN THE WMA, HISTORICAL PERIOD (1982–2018)

Groundwater Subarea	Average Annual Change in Storage (Acre-feet/year)	Cumulative Change in Storage (Acre-feet)
Lompoc Plain	-640	-23,680
Lompoc Upland	-110	-4,070
Santa Rita Upland	-250	-9,250
Lompoc Terrace	0	0
TOTAL WMA:	-1,000	-37,000

2.3. SUSTAINABLE PERENNIAL YIELD ESTIMATE OF THE BASIN

The water budget for the WMA during the base period indicates that total groundwater outflow was more than the total inflow on average for the years 1982–2018. This indicates that there is a net deficit occurring.

Perennial yield is a long-term average annual amount of water which can be withdrawn from a basin under specified operating conditions (i.e., legal, economic, environmental, and management parameters) without inducing a long-term progressive drop in water levels. The estimated perennial yield for the base period is calculated as follows:

Perennial Yield = Average Annual Pumping + Average Annual Change in Storage

The average annual pumping and change in storage totals for each subarea for the period of 1982–2018 (37 years) are shown in Table 2-8. In addition, the period 2002-2011 (10 years) is another balanced hydrologic period within 1982-2018, with the precipitation at Lompoc averaging 14.5 inches/year, which is within 1% of the long-term average of 14.6 inches/year. This water budget analysis indicates that the perennial yield of the basin is approximately 26,000 – 27,000 AFY. It should be recognized that the definitions of safe/perennial/sustainable yield and overdraft reflect conditions of water supply and use over a long-term period. The historical period of 1982–2018 and 2002-2011 are both representative of long-term average conditions.

**TABLE 2-8 AVERAGE PUMPING AND CHANGE IN STORAGE
FOR PERIODS REPRESENTATIVE OF AVERAGE PRECIPITATION IN THE BASIN**

	Average 1982-2018			Average 2002-2011		
Groundwater Subarea	**Annual Pumping (AFY)**	**Annual Change in Storage (AFY)**	**Perennial Yield: Pumping + Change in Storage (AFY)**	**Annual Pumping**	**Annual Change in Storage (AFY)**	**Perennial Yield: Pumping + Change in Storage (AFY)**
Lompoc Plain	22,800	-640	22,160	21,703	310	22,000
Lompoc Upland	3,130	-110	3,020	3,440	-294	3,150
Santa Rita Upland	1,350	-250	1,100	1,681	-386	1,300
Lompoc Terrace	0	0	0	0	0	0
TOTAL WMA:	**27,280**	**-1,000**	**26,280**	**26,824**	**-369**	**26,450**

When relating the perennial yields in Table 2-8 and the concept of sustainable yields, an evaluation of undesirable results must be performed. The undesirable results as defined in SGMA covers a broader range of criteria than the lowering of water levels and groundwater storage addressed in Table 2-8, and also includes degraded groundwater quality, seawater intrusion, land subsidence, and depletion of interconnected surface water and groundwater dependent ecosystems.

Undesirable results are specific to the local conditions and defined by the GSAs of each instance. In the case of the Lompoc Plain subarea, review of the characteristics of this basin indicate a minor adjustment to the perennial yields in Table 2-7 may be warranted. For example, during the base period about 400 AFY of imported water recharged the Lompoc Plain based on the average imports of 1,500 AFY by the VAFB during the base period and a 25% return flow estimate via the Lompoc Regional Wastewater Reclamation Plant. In addition, the County of Santa Barbara Groundwater Basins Status Report (Santa Barbara County Water Agency, 2014), states:

> Groundwater within the Lompoc Plain is managed in accordance with Water Rights Decision 89-18. Therefore, water levels would not be expected to decline in response to climate but in response to the water available according to the Decision. In fact, water levels in wells from the Lompoc Plain are generally not the lowest of record and show only modest declines in recent years most likely due to releases from Cachuma.

So, while groundwater levels were low in the Lompoc Plain at the end of water year 2018 (the end of the base period), the water levels have since recovered to pre-drought levels by the end of 2020 after an above normal water year in 2019 and additional water rights releases in the year 2020. This ability to quickly recover from droughts indicates that annual basin yield can be increased by managed releases of water from Cachuma Reservoir. The City of Lompoc Groundwater Management Plan (West Yost 2013) comes to a similar conclusion:

> The historical data for the Lompoc Groundwater Basin indicate that long-term groundwater levels are not declining and groundwater quality is not deteriorating with respect to groundwater use by the City, MHCSD, and VVCSD. Correspondingly, the Lompoc Groundwater Basin is not in overdraft. Nevertheless, that status is dependent on the quantity and quality of Santa Ynez River stream flow at the Narrows and Cachuma Project operations under State Board Order 89-18.

Similarly, the yield of the Lompoc Terrace cannot be based strictly on the perennial yield equation because historically this subarea does not have groundwater pumping. So, a previous estimate of 300 AFY is utilized for the perennial yield of the Lompoc Terrace (Stetson, 1992). Table 2-9 summarizes the estimates of perennial yield based on this water budget analysis.

TABLE 2-9 ESTIMATED PERENNIAL YIELDS BY SUBAREA IN THE WMA

Groundwater Subarea	Estimated Sustainable Perennial Yield (AFY)
Lompoc Plain	**22,000- 24,000**
Lompoc Upland	**3,000 - 3,200**
Santa Rita Upland	**1,100 - 1,300**
Lompoc Terrace	**200 - 500**
TOTAL WMA:	**26,300 - 29,000**

While perennial yield is difficult to estimate due to the inherent uncertainties in the estimates of recharge and discharge, this independent analysis is within ten percent of the safe or perennial yield estimate in the SYRWCD Annual Reports of 29,500 AFY for the WMA and the range of perennial yields for the subareas in the City of Lompoc Groundwater Management Plan (West Yost 1995) and County of Santa Barbara groundwater planning documents (Santa Barbara County Water Agency, 2014). The results also support interpretation of trends in measured water levels in wells presented in the groundwater current conditions section. This estimate of sustainable yield based on the perennial yield will be refined with the forthcoming predictive numerical groundwater model scenarios and will then be revisited through the planning and implementation phase of the SGMA process. The next step will be an evaluation of avoiding undesirable results for the sustainable management criteria to further define the sustainable yield for the WMA. This yield estimate will likely be revised based on feedback from the public and the Groundwater Sustainability Agency (GSA). This current yield estimate also does not include any potential conjunctive use programs or projects to increase the recharge into the Basin.

2.4. RELIABILITY OF HISTORICAL SURFACE WATER SUPPLIES

The long-term reliability of the surface water from the local sources, including Bradbury Dam outflows and tributary runoff, is subject to climatic variability and is affected by exports out of the Santa Ynez River watershed to the Santa Barbara County south coast. The most recent drought, from 2012 through 2018, was very severe. The variability of the surface water flow from local and imported sources is summarized in Section 2.1.1 and Table 2-1 and Table 2-3.

The VAFB in the WMA has an SWP allocation of 5,500 AFY and a drought buffer of 550 AFY for a total of 6,050 AFY. This SWP supply is not as reliable as the local groundwater supplies in the WMA. The average import amount for the period of 1998–2018 was approximately 2,600 AFY. During the dry period of 2011–2018, VAFB was only able to import approximately 1,600 AFY, which is a 74% reduction from total possible delivery of 6,050 AFY. VAFB compensates for supply deficits by pumping from adjacent San Antonio groundwater basin. Overall, imported water represents only a small fraction of the total water deliveries (28,600 AFY) in the WMA (less than 6%).

3. CURRENT WATER BUDGET

SGMA regulations require a current water budget be developed based on the most recent hydrology, water supply, water demand, and land use information. For the GSP, the period selected to represent current conditions is water years 2011–2018. This period is a subset of the historical base period of 1982–2018 described in Section 2.

The current water budget period is dominated by a drought period when annual precipitation averaged about 88% of the historical average. As a result, the current water budget period represents drought conditions and is not representative of long-term, balanced conditions needed for sustainability planning purposes. The current period was extended to year 2011 to add a wet year to the current hydrology (see Table 1-1). The current water budget is used to project the future baseline and is based on current water demands and land use information.

Estimates of the surface water and groundwater inflow and outflow, and changes in storage for the current water budget period, are provided in this section.

3.1. CURRENT SURFACE WATER COMPONENT

Similar to the historical surface water inflow and outflow components, the current surface water components include two surface water source types: SWP and local supplies.

3.1.1. Inflows: Local and Imported

Local surface water supplies include surface water flows that enter the WMA from precipitation runoff within the watershed and Santa Ynez River inflow to the WMA, regulated by SWRCB as outflows from Lake Cachuma. In addition, as discussed in the HCM Memorandum, the Santa Ynez River Alluvium Upper Aquifer is part of the subflow of the river, which is regulated by SWRCB. Imported surface water through the SWP became available after completion of the Coastal Branch pipeline in 1997. The VAFB has an SWP allocation of 5,500 AFY and a drought buffer of 550 AFY for a total of 6,050 AFY. Table 3-1 summarizes the average, minimum, and maximum inflow from surface water for all sources. The estimated average annual total inflow over the current period is approximately 38,450 AFY. The largest components of this average local inflow are releases from Bradbury Dam and flow in the Santa Ynez River upstream of the WMA, which represents about 62% of the average annual surface inflow for this period. Inflow from the adjacent tributaries, including Salsipuedes Creek, contribute 17% of the total surface water inflow. The imported water supply provides approximately 4% of the total volume of surface water that enters the WMA in the current period.

TABLE 3-1 ANNUAL SURFACE WATER INFLOW, CURRENT PERIOD (2011–2018)

Surface Water Inflow Component	**Average**	**Minimum**	**Maximum**
	(Acre-Feet per Year)		
Santa Ynez River Inflow from CMA	23,100	3,110	130,640
Santa Ynez River Tributary Inflow	6,360	230	27,570
Lompoc Regional Wastewater Reclamation Plant	3,310	2,950	3,590
Imported SWP	1,570	110	2,300
Santa Ynez River Alluvium Subarea (Surface Water Underflow)			
Subflow	800	800	800
Recharge from Precipitation (Overlying and Mountain Front)	1,600	1,400	2,000
Recharge from Agricultural Return Flows to Underflow	1,120	890	1,250
Recharge from Domestic Return Flows to Underflow	30	30	40
TOTAL	**37,890**	**9,520**	**168,190**

3.1.2. Surface Water Outflows

The estimated annual surface water outflow leaving the WMA as flow in the Santa Ynez River and percolation into the groundwater system over the current water budget period is summarized in Table 3-2.

TABLE 3-2 ANNUAL SURFACE WATER OUTFLOW, CURRENT PERIOD (2011–2018)

Surface Water Outflow Component	**Average**	**Minimum**	**Maximum**
	(Acre-Feet per Year)		
Santa Ynez River Outflow to Pacific Ocean	18,690	0	125,810
Net Channel Percolation to Groundwater[1]	10,400	3,500	21,910
Santa Ynez River Alluvium Subarea (Surface Water Underflow)			
Santa Ynez River Underflow Out	1,200	1,200	1,200
River well pumping[2] – Agriculture	6,100	4,730	6,620
River well pumping[2] – Domestic	70	60	100
Riparian Vegetation Evapotranspiration	3,170	3,170	3,170
TOTAL	**39,630**	**12,660**	**158,810**

1) Does not include percolation to Santa Ynez River Alluvium, which is part of the surface water component.
2) River well pumping occurs from wells in the Santa Ynez River Alluvium. The wells pump from the subflow of the Santa Ynez River and are administered by the SWRCB as a surface water diversion.

3.1.3. Summary

During this period (2011-2018), precipitation was well below average, which resulted in very little surface water flow. The current period of 2011–2018 had about 30% of the total surface flows in the historical period of 1982–2018. The imported water supplies increased as percentage of the overall surface water inflows due to the drought conditions, 1% in the 1982–2018 historical period and 4% in the 2011–2018 current period.

3.2. CURRENT GROUNDWATER BUDGET

The current groundwater budget includes a summary of the estimated groundwater inflows, groundwater outflows, and change in groundwater in storage.

3.2.1. Groundwater Inflows

Groundwater inflow components include subsurface inflow, deep percolation of direct precipitation and mountain front recharge, streamflow percolation, and return flows from agricultural irrigation and, municipal, and domestic water uses. The annual groundwater inflows during the current period are summarized in Table 3-3. During the current period, an average of 26,550 AFY of total groundwater inflow occurred. During this time, the groundwater inflow ranged from 16,560 AFY to 42,050 AFY, due to differences in rainfall in dry and wet years. The largest groundwater inflow component was recharge from channel percolation, which accounts for approximately 39% of the total annual average inflow. The current period of 2011–2018 had 85% of the total groundwater inflows in the historical period of 1982–2018.

TABLE 3-3 ANNUAL GROUNDWATER INFLOW, CURRENT PERIOD (2011–2018)

Groundwater Inflow Component	**Average**	**Minimum**	**Maximum**
	(Acre-Feet per Year)		
Subflow[1]	1,200	1,200	1,200
Recharge from Precipitation – Overlying	7,200	5,250	9,520
Recharge from Precipitation – Mountain Front	2,790	2,310	3,510
Net Channel Percolation from Surface Water[2]	10,400	3,500	21,910
Agricultural Return Flows	3,980	3,460	4,750
Municipal Return Flows[3]	860	730	1,020
Domestic Return Flows	120	110	140
TOTAL	**26,550**	**16,560**	**42,050**

1) Based on subflow at the Lompoc Narrows, flowing from the river alluvium to the Lompoc Plain.
2) Does not include percolation to Santa Ynez River alluvium upstream of the Lompoc Narrows which is part of the surface water component.
3) Does not include return flows from Lompoc Wastewater Treatment Plant, which is included in the surface water components.

3.2.2. Groundwater Outflows

Groundwater outflow components include total groundwater pumping from all water use sectors, subsurface flow out to the Pacific Ocean, and phreatophyte (riparian vegetation) evapotranspiration. The estimated annual groundwater outflows for the current period are summarized in Table 3-4.

TABLE 3-4 ANNUAL GROUNDWATER OUTFLOW, CURRENT PERIOD (2011–2018)

Groundwater Outflow Component	Average	Minimum	Maximum
	(Acre-Feet per Year)		
Pumping – Agriculture	21,100	18,140	24,960
Pumping – Municipal	6,600	5,940	7,300
Pumping – Domestic	270	240	310
Riparian Vegetation Evapotranspiration	4,170	3,460	4,910
Subflow	100	100	100
TOTAL	**32,240**	**27,880**	**37,580**

For the current water budget period, estimated total groundwater outflow components ranged from 27,880 to 37,580 AFY, with an average outflow of 32,240 AFY. This is about the same outflow as the total average groundwater outflows estimated for the historical base period (32,020 AFY average).

Total average annual groundwater pumping in the current period was about 28,000 AFY, an increase of 2.5% compared with the historical baseline period, which was 27,300 AFY. Agricultural, municipal, and domestic sectors accounted for 75%, 24%, and 1% of total pumping, respectively, during the current period.

3.2.3. Summary and Change in Storage

Average groundwater inflows and outflows for the current water budget period are presented on Figure 3-1. Figure 3-2 shows the magnitude of the average annual flow for each individual water budget component during the current period. Precipitation from recharge, channel percolation and agricultural pumping are the largest fluxes. More details regarding the data for each year from 2011 to 2018 are presented in Table 2-5.

The current groundwater budget is directly influenced by the drought conditions from 2012 to 2018, which is one of the driest periods on historical record in the Santa Ynez River Valley. The results of the water budget during the current period show that the WMA experienced more total outflow than inflow. As shown on Figure 3-1, the average total inflow of approximately 26,500 AFY is 5,700 AFY less than the average total outflow of 32,200 AFY. During the current period, the amount of recharge from channel percolation was diminished and at the same time total groundwater pumping was about the same compared with the baseline period. Over the 8-year current water budget period, an estimated net decline of groundwater in storage of approximately

45,600 AFY occurred (Figure 2-6). The annual average groundwater storage decline during the current water budget period was approximately 5,700 AFY.

The short-term depletion of groundwater in storage indicates that the total groundwater outflows exceeded the total inflows during the current period. As summarized in Table 3-4, total groundwater pumping averaged approximately 28,000 AFY during the current period. Due to the drought conditions and short time period analyzed (8 years), the current water budget period is not appropriate for long-term sustainability planning. However, the current water demands are useful to project the future water budget as discussed in the next section.

4. PROJECTED WATER BUDGET

The SGMA regulations require the following regarding projected water budgets:

> "3. Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components."
> "(A) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology…"
> "(B) Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand…"
> "(C) Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate."

4.1. PROJECTED ESTIMATION METHODOLOGY

The future water budget in the WMA was estimated utilizing estimated future population forecasts and projected climatic conditions provided by DWR for the period 2030 through 2072. The effects of climate change were evaluated using DWR-provided climate change factors. This section describes the estimated components of the future water budget that includes land use, water demand, and climate change.

The 2030 and 2070 precipitation and ET climate change factors are available on 6-kilometer resolution grids. The climate data sets have been routed to the subbasins defined by 8-digit Hydrologic Unit Codes (HUCs), and the resulting downscaled hydrologic time series are available on the DWR SGMA Data Viewer (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer). Precipitation and ET data used in this analysis were downloaded from the DWR SGMA Data Viewer for climate grid cells covering the WMA within HUC 18060010, which is the HUC for the Santa Ynez River. These change factors are available on a monthly basis from 1915 to 2011 for the Santa Ynez River watershed. The monthly change factors for the Santa Ynez River watershed were applied to the historical hydrology for the WMA. Mean monthly and annual values were then computed from the subbasin time series to show projected patterns of change under 2030 and 2070 conditions.

4.1.2. Projected Hydrology and Surface Water Supply

DWR has provided SGMA Climate Change Data and published a Guidance for Climate Change Data Use for Groundwater Sustainability Plan Development as the primary source for developing the future water budget.

A common approach to forecast the new water resources balance under climate change conditions in the future is the use of global circulation model (GCM) outputs, downscaled to local geographic scales. There are more than 30 GCMs, each with different ways of representing aspects of the climate system. DWR's Climate Change Technical Advisory Group (CCTAG) has identified the most applicable and appropriate GCMs for water resource planning and analysis in California.

DWR has provided a dataset based on an average of 20 GCMs to project change in precipitation and evapotranspiration around 2030 and 2070. This dataset is identified as the Central Tendency scenario and used in this analysis. The central tendency scenarios were developed using an ensemble of climate models such that the entire probability distribution at the monthly scale was transformed to reflect the mean of the 20[9] climate projections (DWR, 2018). The DWR data set also includes two additional simulation results for extreme climate scenarios under 2070 conditions. Use of the extreme scenarios, which represent Drier/Extreme Warming (2070DEW) and Wetter/Moderate Warming (2070WMW) conditions in GSPs is optional.

Due to the concentration of greenhouse gases in the atmosphere, temperatures under the Central Tendency are estimated to rise by 3° to 7° Fahrenheit between 2020 and 2070 as show in Figure 4-1 showing the range of the GCMs forecasted maximum daily temperatures for Lompoc (https://cal-adapt.org/tools/local-climate-change-snapshot/). Generally, change factors under the Central Tendency scenario have a seasonal pattern with wetter conditions in the winter months, and drier during the spring and fall months when compared to historical conditions. Within the Santa Ynez Basin, streamflow is projected to increase slightly by 0.5 percent in 2030 and 3.8 percent in 2070.

Crops require more water to sustain growth in a warmer climate, and this increased water requirement is characterized in climate models using the rate of ET. Under 2030 conditions, the WMA is projected to experience average annual ET increases of 3.2 percent relative to the baseline period. Under 2070 conditions, annual evapotranspiration is projected to increase by 7.9 percent relative to the baseline period.

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[9] 10 GCMs selected are combined with two emission scenarios for a total of twenty scenarios utilized. The two emissions scenarios include a "middle" scenario (RCP 4.5) with emissions peaking around 2040 and a "business as usual" scenario with emission peaking around 2080 (RCP 8.5).

The seasonal timing of precipitation in the WMA is projected to change. Sharp decreases are projected early fall and late spring precipitation accompanied by increases in winter and early summer precipitation. The WMA is projected to experience minimal changes in total annual precipitation. A slight increase of 0.9% annual precipitation are projected under 2030 conditions relative to the baseline period. Under 2070 conditions, small decreases in annual precipitation are projected by 2 percent.

4.1.3. Projected Water Demand for WMA

Based upon the historical and current water budget, the total water demands within the WMA were estimated for the future period extending for 20 years through the implementation period (2022-2042) and further through 50 years into the future, through 2072.

The average annual pumping for agricultural irrigation in 2018 was 19,500 AFY. For this analysis of projected water demand, no changes in future irrigated acres and type of crops is assumed. However, based on the climate change Central Tendency scenario, described above, irrigation demands will increase by 3.2% by 2030 and 7.9% by 2070. Using these same increases in crop water demand, future projection of agricultural demand in the WMA will increase to 20,124 AFY in 2042 and 21,041 AFY in 2072.

Future M&I and rural domestic demands were estimated based on population estimates for the WMA. The Santa Barbara County Association of Governments Regional Growth Forecasts estimate large increases in population for the Lompoc area (SBCAG, 2007). For example, the population of the City of Lompoc is forecasted to increase to 47,723 by the year 2040, which represents a 10% increase from the current population of 43,200 in 2020.

This analysis assumes an increase in water use by the City of Lompoc of 10% by 2042, which is the same as the population projected percentage increase (SBCAG, 2007). Assuming build-out conditions would be approached after 2040, an increase in water use by the City of Lompoc of only 15% by 2072 compared with 2018 levels is assumed for this analysis. For the remaining municipal and rural domestic demands more modest growth is assumed at 5% by 2042 and 10% by 2072. VAFB import demands also uses these assumptions of 5% more water demand by 2042 and 10% by 2072.

Based on 2018 pumping, total municipal groundwater demands would increase from 6,350 AFY to 6,888 AFY in 2042 and to 7,205 AFY in 2072. Based on 2018 pumping of 250 AFY for domestic use, future projection of the rural domestic demand will increase to 263 AFY in 2042 and 275 AFY in 2072.

The total demand from the WMA groundwater during 2018 and projected values for 2042 and 2072 are presented on Table 4-1. By 2042, at the end of the GSP implementation period, total groundwater demand in the WMA may increase by **4** percent relative to 2018 to 27,274 AFY, and further by a total of **9** percent by 2072 to 28,521 AFY due to a combination of increased temperatures due to climate change and population increases. Using the same increase in demands for each sector, the surface water demands in the Santa Ynez River Alluvium subarea and VAFB imports are similarly projected to increase by 4 and 8 percent in years 2042 and 2072, respectively, as shown in Table 4-1.

TABLE 4-1 PROJECTED WATER DEMAND FOR WMA

	2018 Demand	**Estimated 2042 Demand**	**Estimated 2072 Demand**
	(Acre-Feet per Year)		
Groundwater Demand			
Pumping – Agriculture	19,500	20,124	21,041
Pumping – Municipal	6,350	6,888	7,205
Pumping – Domestic	250	263	275
TOTAL Groundwater Demand	**26,100**	**27,274**	**28,521**
Surface Water Demand			
River well pumping – Agriculture	6,500	6,708	7,014
River well pumping – Domestic	60	63	66
VAFB SWP Imports	2,300	2,415	2,530
TOTAL Surface Water Demand	**8,860**	**9,186**	**9,610**
TOTAL	**34,960**	**36,460**	**38,130**

4.2. Projected Water Supply

The water demands in Table 4-1 will be supplied from the same historical sources of groundwater and surface water in the Santa Ynez River Alluvium subarea. Based on current planning from the Central Coast Water Authority and DWR's Delivery Capability Report, a 58 percent delivery allocation for SWP to the WMA for the projected future period has been assumed. Based on the VAFB's current SWP allocation of 5,500 AFY and a drought buffer of

550 AFY, the total available imports to meet future demands is assumed at 3,509 AFY on average.

The source for surface water supplies, the Santa Ynez River, is projected to continue to be a reliable source of water for the Santa Ynez River Alluvium Subarea due to Cachuma Reservoir operations located about 11 miles upstream of the WMA. The ability to store water in Cachuma Reservoir will help attenuate the effects of the flashier runoff forecasted to occur under the Central Tendency scenario. Downstream water rights releases and releases for endangered steelhead from Bradbury Dam are assumed to be able to mitigate impacts downstream caused by climate change. Detailed climate change studies and impacts to the operations of Cachuma Reservoir are currently not available. However, releases from Cachuma Reservoir did sustain Santa Ynez River underflow during the recent critical drought of 2012-2018 and is expected to provide similar mitigation during future droughts. Although, if climate change does not continue under the Central Tendency scenario but rather is more like the Hot and Dry Climate scenarios, then the water supply for the entire region will be affected and have to be re-evaluated.

Recharge from precipitation which will be affected by climate change to an uncertain degree. Because recharge is the resultant after three key processes including precipitation, runoff, and evapotranspiration, which among themselves have associated uncertainty, the combined uncertainty is compounded. Under the Central Tendency scenario in the WMA, only minor changes for annual precipitation are projected under 2030 conditions relative to the baseline period (a 0.9% increase), and under 2070 conditions, a small decreases in annual precipitation are projected by 2 percent. Recharge from precipitation to the groundwater aquifer is assumed to be affected by climate change by these same percentages of +0.9% by 2042 and 2 percent reduction by 2072. Recharge from streamflow infiltration is assumed to be similar to the projected increases in runoff by 0.5 percent in 2042 and 3.8 percent increase by 2072. Recharge from the water rights releases for the Lompoc Plain is assumed to exist in the future similar to the baseline period 1982-2018.

The net effect of the small percentage changes due to climate change is that the current estimate of perennial yield of 26,300 to 28,000 AFY for the WMA is assumed to be roughly the same for this analysis under climate change conditions.

4.3. SUMMARY OF PROJECTED WATER BUDGET

Groundwater supplies are projected to be about the same under projected future conditions, while overall groundwater demand is projected to increase up to 9 percent by 2072 to 28,521 AFY (Table 2-1) due to a combination of increased temperatures due to climate change and increases in local population. Table 2-2 summarizes the projected total groundwater budget and average change in storage in the future.

TABLE 4-2 PROJECTED GROUNDWATER BUDGET FOR WMA

	Baseline Hydrology and 2018 Demands	Estimated 2042 Hydrology and Demands	Estimated 2072 Hydrology and Demands
Subflow	1,200	1,200	1,200
Recharge from Precipitation- Aerial (Overlying)	7,990	7,990	7,830
Recharge from Precipitation- Mountain Front	2,730	2,730	2,680
Net Channel Percolation from Surface Water	14,300	14,300	14,850
Agricultural Return Flows	3,810	3,930	4,110
Municipal/ Domestic Return Flows	850	920	960
TOTAL Inflows	**30,880**	**31,070**	**31,630**
Pumping - Agriculture	19,500	20,120	21,040
Pumping - Municipal	6,350	6,890	7,210
Pumping - Domestic	250	260	280
Riparian Vegetation Evapotranspiration	4,910	5,070	5,300
Subflow to Pacific Ocean	100	100	100
TOTAL Outflows	**31,110**	**32,440**	**33,930**
TOTAL Inflows - Outflows	**-230**	**-1,370**	**-2,300**

Average groundwater inflows and outflows for the projected future water budget period are presented on Figure 4-2 and Figure 4-3 for years 2042 and 2072, respectively. The results of the water budget during the future period show that the WMA has more total outflow than inflow. As shown on Figure 4-2, in the year 2042 the average total inflow of 31,070 AFY is 1,370 AFY less than the average total outflow of 32,440 AFY. Similarly, as shown on Figure 4-3, in the year 2072 the average total inflow of 31,630 AFY is 2,300 AFY less than the average total outflow of 33,930 AFY. The next steps in the GSP process will be to discuss the potential undesirable results from losing approximately 1,000 to 2,000 AFY in groundwater storage in the future compared to the historical baseline and developing a monitoring system for the GSP.

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