TECHNICAL MEMORANDUM

To:	Management **California Production Services, LLC.** 1480 Penman Springs Rd Paso Robles, 93446 California	Date:	04/11/2019
From:	Paul Henderson, CPEng	Ref:	
Subject:	**Water Demand Estimate for California Production Services**		

1. Results Summary

The proposed cannabis cultivation at the 1480 Penman Spring Road property has the following estimated water volumes:

- Proposed annual water usage of 811,952 gal/year (2.49 acre.feet/year), for irrigation
- Previous annual water usage of 238,554 (0.73 acre.feet/year), which is considered as the water offset.

2. Background

Paul Henderson, Environmental Engineer, has been requested by California Production Services to provide a water demand estimate for the proposed cannabis cultivation at the 1480 Penman Springs Rd Property, located within San Luis Obispo County (the County). California Production Services has requested this water demand estimate to satisfy the requirements of the County Cannabis Land Use *Ordinance No. 3358*.

The proposed project is within the Paso Robles Groundwater Basin (PRGWB), a Level of Severity (LOS) III basin. The County requires:

a. An estimate of existing total water demand prior to cannabis-related activities onsite;

b. An estimate of total water demand of the proposed project;

c. A detailed description of how the new water demand would be offset; and

d. An assessment of the proposed water source's ability to support the proposed project.

Listed below are the general specifications of the proposed cultivation, which relate to this water demand estimate:

1. Total canopy area of Greenhouse: 20,691 sf
2. Total canopy area of Hoophouse: 82,764 sf
3. Water supply: one (1) well
4. Irrigation type: Drip/micro (pressure sensitive drip tape)

3. Previous Total Water Demand

The previous use of the site was for housing. The following details have been provided:

- A ‘single wide’ house was removed, and a studio apartment was removed. For the purpose of this estimate the following have been considered:
    - The ‘single wide’ can house 3 people (2 adults and a child)
    - The studio can house 2 adults
    - Totaling 5 people
- Irrigation of approximately 20 trees, which are now established, no longer requiring irrigation.

Table 1 provides the estimated water demand for the previous uses of the property.

Table 1 – Previous Annual Use Water Demand Estimate

Description	No. of Units	gal/unit/day	gal/day average	gal/month	gal/year	Source
Residential use (5 people)	5	85.0	425	12,927	155,125	1
Tree irrigation	20	11.4	229	6,952	83,429	2
Total			**654**	**19,879**	**238,554**	
1 acre.feet = 3.069E-06 gal				**Total =**	**0.73 acre.ft**	

***Sources from* Table 1**

1. https://lao.ca.gov/Publications/Report/3611
   (85 gal/person/day)
2. https://www.mrt.com/lifestyles/article/Formula-calculates-how-much-water-each-tree-needs-7432435.php
   (40 gal twice per week per tree)

4. Estimate of the Total Water Demand of the Project

4.1 Cultivation Operations

California Production Services proposes to cultivate their space over three (3) growing cycles per year, which will consist of:

- Three (3) growing periods of 108 days
- Three (3) harvest and planting (non-growing) periods of 14 days

The cultivation operation will be staggered i.e. different areas of the cultivation will be at different stages in the growth cycle. For this reason it is expected that at any point in time plants at all growth stages will require irrigation (from newly planted to ready for harvest), hence the average irrigation rate is used for the entire cultivation at any point in time. For the purpose of this water demand estimate a conservative weighted average has been selected, noting the mass of a plant and the water demand over the lifecycle may not follow a linear pattern and the exact areas (sf) of plants at the various growth phases cannot be know, and will depend on the operation of the cultivation. For the purposes of a conservative water demand estimate a weighted annual average of 0.75 of the Cal Poly ET_0. The water demand rates used are provided in Table 2.

Figure 1 shows, for a given square foot (sf) of hoophouse cultivation over a 12 month period, the irrigation rate gradually increases through each 108 day growth cycle, then the irrigation ceases during the 14 day harvest, then new plants are planted, and so on. Rates shown as the blue daily use bars in Figure 1 are discussed in Section 4.2.

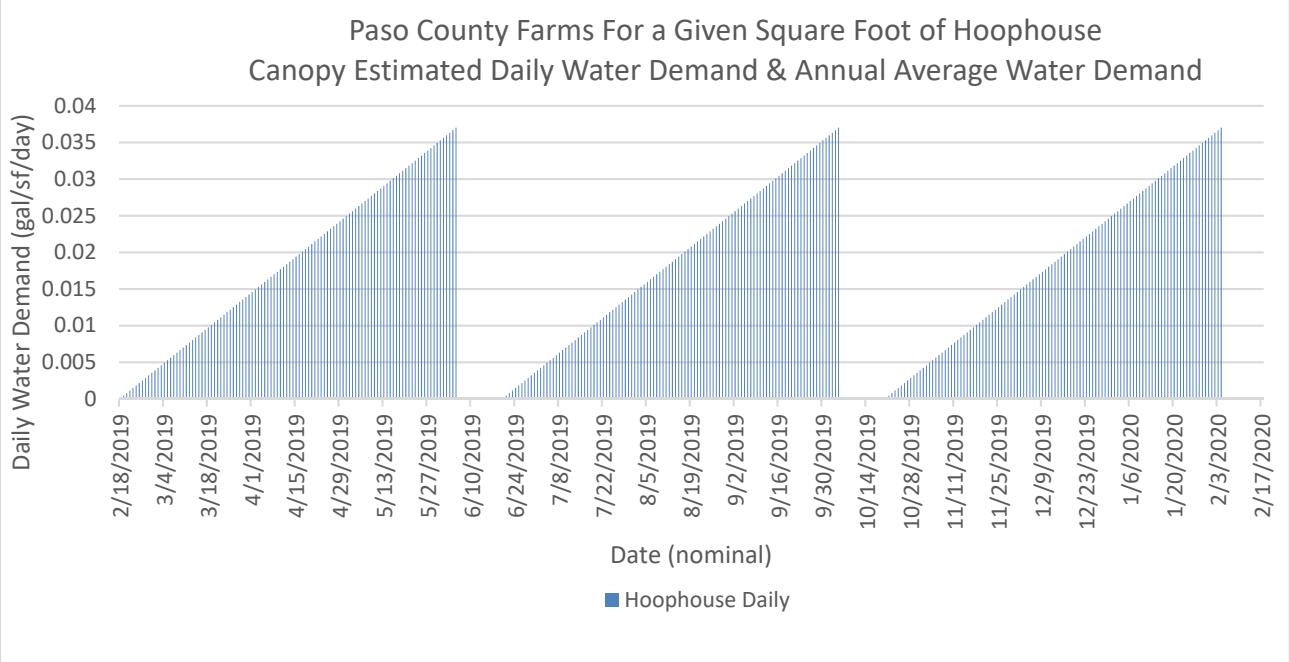

Figure 1 - Annualized Water Demand for a Given Square Foot of Hoophouse Canopy

No water use for facilities is required. California Production Services have advised when labor hire is used portable water for drinking, cleaning and toilets will be brought from outside sources.

4.2 Water Demand Rates

Due to the legal cannabis cultivation industry in California being in its infancy a consensus on cannabis cultivation water demand rates has not been reached in the industry. However, specific site knowledge of California Production Services' operators and generally accepted rates from neighboring Counties and other sources provide sufficient reference rates for the purpose of this water demand estimate. In the case of this water demand estimate the evapotranspiration (ET) rates provided by the Cal Poly BioResource and Agricultural Engineering (BRAE) Department have been utilized (Cal Poly 2019).

The monthly ET rates utilized are derived from an average rate of similar plants (Tomatoes and Peppers, Flowers, Nursery and Christmas Tree). Attachment 2 provides the monthly Cal Poly ET rates for outdoor growing in the Paso Robles region, which lies within Zone 6 of the Cal Poly data, and is shown on the map provided in Attachment 2. The average ET rate from similar plants has been utilized as the reference crop (ET_0) i.e. the outdoor full grown plant values shown in the second column of Table 2.

The rates have been factored down to account for the ET in greenhouses and hoophouses being lower compared to outdoor growing, potentially reducing ET by averages of between 45% or more (Czyzyk, et al. 2014). Sources for the factored down ET rates are provided in Table 2. Detailed daily estimates are provided in Attachment 1.

For this water demand estimate the following ET reductions have been adopted compared to outdoor ET, and applied to the Cal Poly ET rates:

- Greenhouse 30% reduction, or multiply by 0.7
- Hoophouse 40% reduction, or multiply by 0.6

Table 2 - Water Demand Rates

	Outdoor Full Grown Plant (Cal Poly ET_0)	Hoophouse		Greenhouse		Combined
		R-factor	0.7	R-factor	0.6	
		A-factor	0.75	A-factor	0.75	
		multiplier	0.53	multiplier	0.45	
Month	gal/sf/month	gal/sf/month	gal/month	gal/sf/month	gal/month	**gal/month**
January	1.01	0.53	44,016	0.24	4,952	**48,967**
February	0.46	0.24	19,773	0.11	2,224	**21,998**
March	0.32	0.17	13,814	0.08	1,554	**15,368**
April	0.54	0.28	23,430	0.13	2,636	**26,066**
May	1.72	0.90	74,623	0.41	8,395	**83,018**
June	3.35	1.76	145,590	0.79	16,379	**161,969**
July	3.41	1.79	148,028	0.80	16,653	**164,681**
August	1.92	1.01	83,291	0.45	9,370	**92,661**
September	1.62	0.85	70,425	0.38	7,923	**78,348**
October	0.91	0.48	39,682	0.22	4,464	**44,146**
November	0.71	0.37	30,879	0.17	3,474	**34,352**
December	0.84	0.44	36,296	0.20	4,083	**40,379**
Total	16.80	8.82	729,846	3.97	82,106	**811,952**
				acre.feet =	3.0689E-06	2.492
Notes:						
R-factor = Reduction factor used to convert Cal Poly ET_0 for outdoor grown reference crop to indoor growing						
A-factor = Annualized average factor used to allow for crops at different growth stages throughout						
the cultivation i.e. some plants fully grown and some plants just planted.						
Multiplier = product of R-factor & A-factor						

The monthly fluctuation of estimated water demand, based on the Cal Poly ET rates, is depicted in Figure 2. As would be expected, the water demand is significantly higher in the summer months than the winter months.

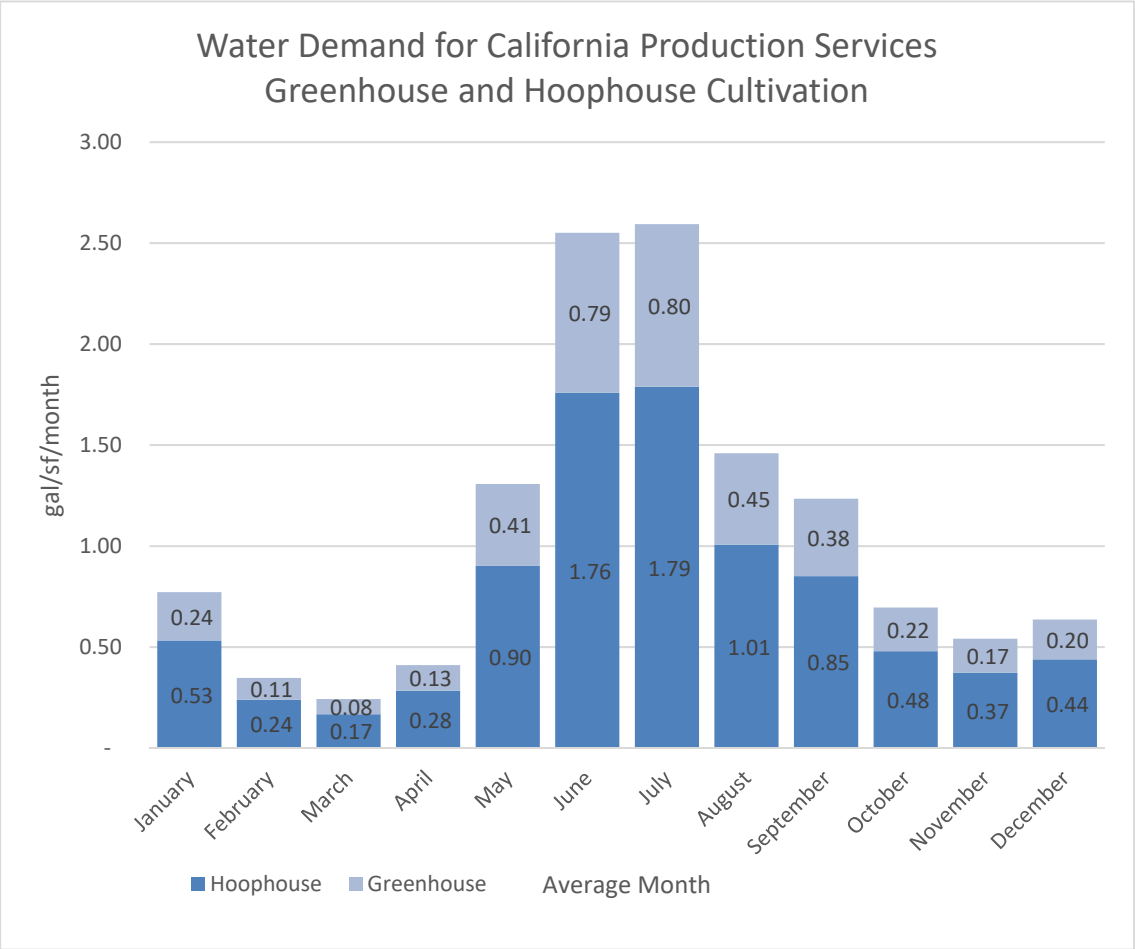

Figure 2 - California Production Services Estimated Monthly Water Demand

5. Description of Water Offset

Pursuant to County *Ordinance No. 3358* Cannabis cultivation and nursery sites located in the Paso Robles Groundwater Basin (PRGWB) must offset their projected water use at a 1:1 ratio, and offsets can be achieved in the PRGWB by:

- Retrofitting plumbing fixtures (toilets, showerheads, clothes washers, and faucet aerators) within the same groundwater basin;
- Removing existing crops on-site; and/or
- Paying a one-time water offset fee.

In this instance California Production Services have elected to pay a one-time water offset fee, giving consideration to ceasing the previous use provided in Section 3 i.e. no longer irrigating trees and removing residential buildings.

6. Ability of Water Source to Support the Project

6.1 Well Information

The proposed cultivation water will be supplied by the property's existing well, which will be the only water source used for the cannabis cultivation. The well tested, completed by Aqua Engineering on 08/02/2016, shows the well has the ability to supply 25 gal/minute, which equates to 36,000 gal/day.

Noting the peak estimated water demand of 164,681 gal for the month of July (31 days) the estimated peak daily rate is 5,312 gal/day, less than 1/10th of the potential supply by the well. The Aqua Engineering well test report is provided in Attachment 3.

6.2 Water Storage Information

Water tanks will be centrally located to the cultivation. Water will be stored in 5 x 5,000-gallon water tanks and be used in the irrigation process, as well as used for back up water storage. If more tanks are required up to 5 more 5,000-gallon water tanks will be added to the site. As per CalFire regulations, a 10,000-gallon steel water tank will be accessible to CalFire, and is located on the hillside above the cultivation. Table 3 summarizes the water storage volume for the project.

Table 3 - Water Storage Volumes

Water Storage	Volume (gal)	Number	Total Volume (gal)
Irrigation Water Storage Tanks	5,000	5	25,000
Steel Fire Fighting Water Tank	10,000	1	10,000
		Total	**35,000**

7. Credentials of Water Demand Estimator

It is understood the County requires the credentials of individuals or organizations providing the water demand estimate. Because Paul Henderson is currently working through his PE in California a more extensive description of credentials is provided below.

Paul Henderson, CPEng can be contacted by:
Email p.b.henderson@hotmail.com
Phone (805) 468-9927

7.1 Professional Certifications and Accreditations

Paul Henderson is a Registered and Chartered Professional Engineer CPEng (Civil and Environmental) in Australia and a Certified Construction Manager in the USA. Paul in in progress of attaining his California PE in Civil Engineering.

- Registered Professional Engineer Queensland, RPEQ (Civil and Environmental), Australia
    - Registration No. 15423
- Chartered Professional Engineer, CPEng (Civil and Environmental), Australia
    - Registration No. 3831969
- Certified Construction Manager, CCM, United States of America

7.2 Education

Paul Henderson holds bachelors degrees, recognized under the Washington Accord, for Environmental Engineering and Environmental Engineering Technology. A link to the Washington Accord has been provided below.
http://www.ieagreements.org/accords/washington/signatories/
Paul Henderson's tertiary education includes:

- BEng (Env) (Honors) - Bachelor of Engineering, Environmental, Australia
- BTech (Env) - Bachelor of Engineering Technology, Environmental, Australia
- Diploma of Civil Engineering, Otago Polytechnic, New Zealand

7.3 Relevant Experience

Paul has many years of experience in hydrologic and hydraulic modeling, including complex water demand analysis and water balance modeling for the mining industry, civil engineering projects and public works infrastructure.

Paul's practical experience in agricultural based employment includes managing and operating irrigation systems. Paul's environmental engineering degrees include significant agricultural engineering portions, in particular water demand analysis and irrigation efficiency for cropping.

8. Bibliography

Cal Poly. 2019. *Irrigation Evaluation Data.* March 26. http://www.itrc.org/etdata/index.html.

California Water Boards. 2019. *Fact Sheet: December 2018 Statewide Conservation Data.* California Water Boards. https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/docs/2019feb/fs020519.pdf.

CSCPD. 2017. *Environmental Impact Report (EIR) for the Commercial Cannabis Cultivation and Manufacturing Regulations and Licensing Program (DRAFT).* Santa Cruz: County of Santa Cruz Planning Department. http://www.sccoplanning.com/Portals/2/County/Planning/env/Cannabis_EIR/Individual%20EIR%20Sections%20PDF%20Files/3.9_Hydro_CannabisEIR_Draft.pdf.

Czyzyk, Kelsey, Shayne Bement, William Dawson, and Khanjan Mehta. 2014. *Quantifying Water Savings with Greenhouse Farming.* University Park, PA: College of Engineering, The Pennsylvania State University.

Attachment 1 – Calculation Data

Attachment 2 – Cal Poly Evapotranspiration Rates

Attachment 3 – Well Test Report