APPENDIX G
WATER SUPPLY DATA

2 September 2014

To	Southern Humboldt Community Park		
Copy to	Kathryn Lobato		
From	Rebecca Crow	Tel	707-443-8326
Subject	Water Supply and Demand Analysis Memorandum	Job no.	8411201//

1 Introduction

1.1 Purpose of this report

The purpose of this technical memorandum is to present a water demand and water supply analysis for existing and proposed new facilities and events hosted in the Southern Humboldt Community Park (SHCP) to determine if the water available on site is sufficient to meet proposed future demands. The Park operations will include a variety of potable and non-potable water uses. This water supply and demand analysis was prepared to to support the utilities and services section of the Environmental Impact Report (EIR) being prepared for the SHCP. This memo is broken into the following sections:

- Water Demand Analysis
- Water Supply Analysis
- Water Storage Analysis
- Supply and Demand Comparison
- Water Supply Options
- Recommendations and Conclusions

There are currently three sources of water in use at the Park: Source 1 (non-potable) is from the South Fork Eel River by a permitted Infiltration Gallery (IG); source 2 (potable) is from a tributary spring; and source 3 (potable) is from a well located in Tooby Memorial Park (TP Well). A fourth source, a groundwater well, (potable) is available in Area 4 but is currently not in use.

1.2 Scope and limitations

This report: has been prepared by GHD for Southern Humboldt Community Park and may only be used and relied on by Southern Humboldt Community Park for the purpose agreed between GHD and the Southern Humboldt Community Park as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Southern Humboldt Community Park arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and contract between GHD and SHCP and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Southern Humboldt Community Park and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has not been involved in the preparation of the Environmental Impact Report and has had no contribution to, or review of the Environmental Impact Report other than in the Water Supply and Demand Analysis. GHD shall not be liable to any person for any error in, omission from, or false or misleading statement in, any other part of the Environmental Impact Report.

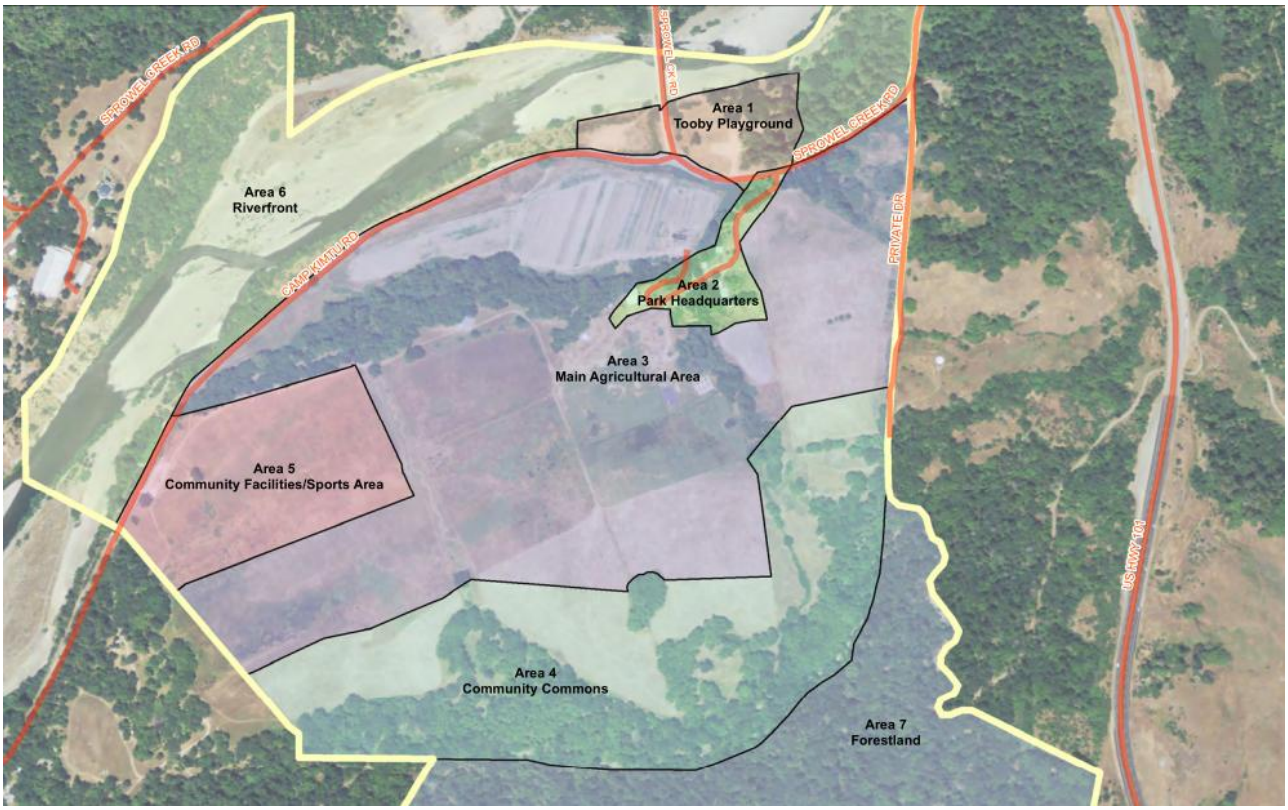
2 Water Demand Analysis

The section of the technical memorandum evaluates the proposed types of water uses, volume of use, and frequency of use for potable and non-potable water demands for existing and proposed future residential and recreation facilities based on the project planning information provided by SHCP. The project was split into seven (7) areas listed below.

- Area 1 – Tooby Memorial Park
- Area 2 – Park Headquarters
- Area 3 – Main Agricultural
- Area 4 – Community Commons
- Area 5 – Community Facilities
- Area 6 – Riverfront
- Area 7 – Forestland

According to the California Department of Public Heath (CDPH), the water system at the Park is classified as “Transient Non-Community Water System”, meaning the water system is not a public water system. See Appendix A for the CDPH Decision Tree for Classification of Water Systems.

Figure 1 Map of Southern Humboldt Community Park Proposed Areas



Within this section, water demands are presented in terms of the project areas as shown in Figure 1, types of uses, and existing and future uses. In section 5 of this memorandum the demand is further broken out by potable and non-potable uses for comparison with available supply.

2.1 Existing Demands

Table 1 below presents estimates of the current water demands at the Park by source, estimated from existing known use. A list of existing facilities is located in Appendix A.

Table 1 Existing Water Demands at SHCP by Source

Source	Peak (gal/mo)	Off-Peak (gal/mo)
1 (IG)	328,015	167
2 (Spring)	31,741	13,262
3 (TP Well)	7,950	7,950
Total	***367,706***	***21,379***

Table 2 below presents estimates of the current water demands at the park by area. For the purpose of this analysis, Peak is defined as May 1 through October 31 (6 months), and Off-Peak is defined as November 1 through April 30 (6 months).

Table 2 Existing Water Demands at SHCP by Area

Area	Source	Peak (gal/mo)	Off-Peak (gal/mo)
1	TP Well	7,950	7,950
2	Spring	33,908	13,428
3	IG	325,848	-
4	-	-	-
5	-	-	-
6	-	-	-
7	-	-	-
Total		***367,706***	***21,379***

2.2 Proposed Demands

2.2.1 New Facilities

Table 3 is a general summary of the existing and proposed facilities that require water at the Park. For a full description of the project facilities see Appendix A. Areas 6 and 7 are not included because there are no existing or proposed facilities that will use water in either area. The construction of proposed new facilities are broken into Phase 1 and Phase 2. Phase 1 includes years 1 through 3, and Phase 2 includes demands after year 3.

Table 3 Existing and Proposed Facilities Requiring Water

Area	Existing Facility	Proposed New Facility-Ph. 1	Proposed New Facility-Ph. 2
1	Caretaker Unit	Restrooms; Drinking Fountain	None
2	Ranch House, Cabin, Bunkhouse, Large Barn, Chicken Coop, Horse Barn	None	Remodel Structures into Offices, Workshop, Community Kitchen, etc.; Greenhouse; Restrooms; Drinking Fountain
3	Crop Irrigation	None	None
4	None	Temporary Sanitation Station Water Hookups; Food Vendor Washing Station Water Hookups; Faucet at Each Camp Site. *(1/2 capacity)*	Temporary Sanitation Station Water Hookups; Food Vendor Washing Station Water Hookups; Faucet at Each Camp Site. *(full capacity)*
5	None	None	Concession Stand with Sink; Restrooms; Drinking Fountain; Four (4) Irrigated Sports Fields.

The water demand for all uses except for irrigation was calculated using typical wastewater flow rates from Metcalf & Eddy “Wastewater Engineering: Treatment and Reuse”, Fourth Ed., 2003. As noted in Appendix B, several factors were increased by 20% to account for water that does not go to the wastewater system, which is a typical practice. A baseline, everyday water demand was calculated for

peak and off-peak months. The baseline water demand includes visitors using facilities at the hiking trails, playground, headquarter offices & spaces, restrooms, and sports fields. The baseline water demand also includes irrigation, livestock, and household use.

2.2.2 Irrigation Calculations

Four sports fields and surrounding areas equaling approximately ten (10) acres are proposed in Area 5. This area will need to be irrigated regularly depending on the time of year. Using historical average and drought precipitation data from Garberville and nearby Richardson's Grove, and average temperature (from Western Regional Climate Center), and applying the Blaney-Criddle Formula from U.S. Department of Agriculture, Soil Conservation Service Technical Release No. 21, an average and drought effective irrigation demand (inch/month) was calculated and converted to a monthly demand (gallon/month). Table 4 summarizes the irrigation demand calculations. For complete calculations, see Appendix B. Irrigation of crops in Area 3 is accounted for under existing uses and is based on historical water use in these areas and is anticiapted to continue at historial rates.

Table 4 Sports Fields Irrigation Demands - Proposed

Month	Number days/mo	Avg. Effective Irrigation Demand (in/mo)	Drought Effective Irrigation Demand (in/mo)	Avg. Monthly Demand (gal/mo)	Drought Monthly Demand (gal/mo)
January	31	0.00	0.00	-	-
February	28	0.00	0.00	-	-
March	31	0.00	0.00	-	-
April	30	0.31	1.72	84,301	467,210
May	31	3.44	4.09	934,900	1,110,719
June	30	5.58	5.81	1,516,173	1,578,078
July	31	7.40	7.43	2,009,929	2,018,435
August	31	6.39	6.67	1,735,919	1,811,978
September	30	4.36	4.77	1,184,701	1,296,234
October	31	0.41	1.77	110,804	481,459
November	30	0.00	0.00	-	-
December	31	0.00	0.00	-	-

The irrigation demand was also analyzed using the minimum areas needing irrigation, which includes the sports fields only. The total of these four fields equals approximately 5.5 acres. This analysis is included as an approach to conserve water in response to the ongoing drought. Table 5 summarizes the minimum field irrigation requirements.

Table 5 Sports Fields Irrigation Demands - Minimum

Month	Number days/mo	Avg. Effective Irrigation Demand (in/mo)	Drought Effective Irrigation Demand (in/mo)	Avg. Monthly Demand (gal/mo)	Drought Monthly Demand (gal/mo)
January	31	0.00	0.00	-	-
February	28	0.00	0.00	-	-
March	31	0.00	0.00	-	-
April	30	0.31	1.72	46,689	258,756
May	31	3.44	4.09	517,777	615,151
June	30	5.58	5.81	839,704	873,989
July	31	7.40	7.43	1,113,162	1,117,873
August	31	6.39	6.67	961,406	1,003,530
September	30	4.36	4.77	656,124	717,895
October	31	0.41	1.77	61,367	266,647
November	30	0.00	0.00	-	-
December	31	0.00	0.00	-	-

2.2.3 Special Events and Phasing

Special events are held at various areas of the Park. These events typically occur during peak months and temporarily increase the water demand. These events include weddings, memorials, fundraisers, private parties, annual community events, medium events of 800 to 2,500 attendees occurring up to five times per year, and one large two-day festival with 5,000 attendees allowed once per year.

The construction of proposed water facilities will be phased as the park develops over the next several years. Phase 1 will occur over years 1 through 3 which includes construction of a new restroom in Area 1, and temporary facilities operated at half capacity in Area 4. Phase 2 will include construction of the remaining proposed facilities after year 3, and temporary facilities operated at full capacity in Area 4. Tables 6 and 7 depict a by-month assessment of the events in each phase used to calculate event driven water demands. Table 8 shows the Phase 1 demand including existing facilities to remain and proposed new Phase 1 uses. Table 9 shows the total Phase 2 water demands, including existing facilities to remain, all proposed new facilities, events, and irrigation.

Table 6 Summary of Events at SHCP [(AREA) – (EVENT) X (FREQUENCY)] – PHASE 1

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2 - Winter Event x 1 4 - Fundraiser x 1	None	None	1 - Egg Hunt x 1 2 - Spring Event x 1	1 - Bike Event x 1 4 - Fundraiser x 1 4 - Group of 10 Camp x 1	1 - Memorial x 1 4 - Wedding x 1 4 - 1,500 Person Event x 1 4 - Group of 10 Camp x 1 4 - Group of 15 Camp x 1 4 - Group of 20 Camp x 1	1 - Wedding x 1 2 - Summer Event x 1 4 - Wedding x 1 4 - 1,250 Person Event x 1 4 - Group of 10 Camp x 1 4 - Group of 15 Camp x 1	4 - Fundraiser x 1 4 - 1,250 Person Event x 1 4 - Group of 10 Camp x 1	1 - Walk in the Park Event x 1 4 - Group of 10 Camp x 1	2 - Fall Event x 1	None	None

Table 7 Summary of Events at SHCP [(AREA) – (EVENT) X (FREQUENCY)] – PHASE 2

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2 - Winter Event x 1 4 - Memorial x 1 4 - Fundraiser x 1	None	4 - Fundraiser x 1 5 - Soccer Tournament x 1	1 - Egg Hunt x 1 2 - Spring Event x 1 4 - Group of 10 Camp x 1	1 - Bike Event x 1 4 - Memorial x 1 4 - Fundraiser x 1 4 - 800 Person Event x 1 4 - Group of 10 Camp x 2	1 - Memorial x 1 4 - Wedding x 1 4 - Private Party x 1 4 - 1,500 Person Event x 1 4 - 5,000 Person Festival x 1 4 - Group of 10 Camp x 2 4 - Group of 15 Camp x 1 4 - Group of 20 Camp x 1	1 - Wedding x 1 2 - Summer Event x 1 4 - Wedding x 1 4 - Private Party x 1 4 - 1,250 Person Event x 1 4 - Group of 10 Camp x 2 4 - Group of 15 Camp x 1 4 - Group of 20 Camp x 1	4 - Wedding x 1 4 - Fundraiser x 1 4 - 1,250 Person Event x 1 4 - Group of 10 Camp x 2 4 - Group of 15 Camp x 1 4 – Group of 20 Camp x 1	1 - Walk in the Park Event x 1 4 - Memorial x 1 4 - Wedding x 1 4 - 800 Person Event x 1 4 - Group of 10 Camp x 1	2 - Fall Event x 1 5 - Soccer Tournament x 1	4 - Fundraiser x 1	None

Table 8 Summary of Post-Project Water Demands at SHCP by Month – PHASE 1

	(gallons/month)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
AREA 1												
Baseline Water Use	9,072	9,072	9,072	9,072	18,402	18,402	18,402	18,402	18,402	18,402	9,072	9,072
Events, Camps, Tournaments	-	-	-	2,640	990	330	330	-	1,980	-	-	-
Irrigation	-	-	-	-	9,863	9,863	9,863	9,863	9,863	9,863	-	-
AREA 2												
Baseline l Water Use	19,094	19,094	19,094	19,094	39,965	39,965	39,965	39,965	39,965	39,965	19,094	19,094
Events, Camps, Tournaments	2,250	-	-	2,250	-	-	4,500	-	-	2,700	-	-
Irrigation	-	-	-	-	20,055	20,055	20,055	20,055	20,055	20,055	-	-
AREA 3												
Baseline Water Use	-	-	-	-	-	-	-	-	-	-	-	-
Events, Camps, Tournaments	-	-	-	-	-	-	-	-	-	-	-	-
Irrigation	-	-	-	-	325,848	325,848	325,848	325,848	325,848	325,848	-	-
AREA 4												
Baseline l Water Use	-	-	-	-	-	-	-	-	-	-	-	-
Events, Camps, Tournaments	240	-	-	-	348	1,768	1,352	1,348	108	-	-	-
/Irrigation	-	-	-	-	-	-	-	-	-	-	-	-
AREA 5												
Baseline Water Use	-	-	-	-	-	-	-	-	-	-	-	-
Events, Camps, Tournaments	-	-	-	-	-	-	-	-	-	-	-	-
Irrigation	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL DEMAND:	***30,656***	***28,166***	***28,166***	***33,056***	***415,470***	***416,230***	***420,314***	***415,480***	***416,220***	***416,832***	***28,166***	***28,166***

Table 9 Summary of Post-Project Water Demands at SHCP by Month – PHASE 2

	(gallons/month)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
AREA 1												
Baseline Water Use	9,072	9,072	9,072	9,072	18,402	18,402	18,402	18,402	18,402	18,402	9,072	9,072
Events, Camps, Tournaments	-	-	-	2,640	990	330	330	-	1,980	-	-	-
Irrigation	-	-	-	-	9,863	9,863	9,863	9,863	9,863	9,863	-	-
AREA 2												
Baseline l Water Use	19,094	19,094	19,094	19,094	39,965	39,965	39,965	39,965	39,965	39,965	19,094	19,094
Events, Camps, Tournaments	2,250	-	-	2,250	-		4,500	-	-	2,700	-	-
Irrigation	-	-	-	-	20,055	20,055	20,055	20,055	20,055	20,055	-	-
AREA 3												
Baseline Water Use	-	-	-	-	-	-	-	-	-	-	-	-
Events, Camps, Tournaments	-	-	-	-	-	-	-	-	-	-	-	-
Irrigation	-	-	-	-	325,848	325,848	325,848	325,848	325,848	325,848	-	-
AREA 4												
Baseline l Water Use	-	-	-	-	-	-	-	-	-	-	-	-
Events, Camps, Tournaments	320	-	240	108	1,176	9,996	1,796	1,916	928	-	240	-
Irrigation	-	-	-	-	-	-	-	-	-	-	-	-
AREA 5												
Baseline Water Use	5,400	5,400	5,400	5,400	14,190	14,190	14,190	14,190	14,190	14,190	5,400	5,400
Events, Camps, Tournaments	-	-	4,200	-	-	-	-	-	-	4,200	-	-
Irrigation (Proposed 10 acres)	-	-	-	467,210	1,110,719	1,578,078	2,018,435	1,811,978	1,296,234	481,459	-	-
TOTAL DEMAND, (Proposed Irrigation in Area 5):	***36,136***	***33,566***	***38,006***	***505,774***	***1,541,207***	***2,016,727***	***2,453,384***	***2,242,216***	***1,727,464***	***916,681***	***33,806***	***33,566***
Irrigation (Reduced 5.5 acres)	-	-	-	258,756	615,151	873,989	1,117,873	1,003,530	717,895	266,647	-	-
TOTAL DEMAND, (Reduced Irrigation in Area 5)	***36,136***	***33,566***	***38,006***	***297,320***	***1,045,639***	***1,312,638***	***1,552,821***	***1,433,768***	***1,149,125***	***701,869***	***33,806***	***33,566***

3 Water Supply Analysis

This section of the technical memorandum presents the evaluation of the capacity of the existing supply sources. Currently, SHCP has access to three (3) water sources, and owns another well located in area 4 of the park (not currently in use). The tables below summarize these sources. The pump at the Infiltration Gallery and the Upland Well (after installation) were assumed to run for twelve (12) hours per day.

Table 10 Existing Water Sources at SHCP

Source No.	Water Source	Permit	Water Rights Filings	Pump	Storage Capacity	Potable	Conditions
1	South Fork Eel River – Infiltration Gallery	CDFW: LSAA (R1-2009-0238)	SWRCB, Statement of Water Diversion and Use: S0243379	Gould's submersible pump 107 GPM (2013)	None	No	Rate of diversion 108 GPM or 10% of streamflow (lesser of the two)
2	Spring – Unnamed Tributary			None. Gravity feed	55,000 gallon tank	Yes	Rate of diversion 1.39 GPM. No draw of water July 2 to October 31 each year
3	Tooby Memorial Park – Well	-		Grundfos submersible pump	None	Yes	Capacity unknown.
4	Upland Park – Well	-	Will apply after use starts	None – to be installed in the future.	None	Yes	Capacity approx. 2.5 GPM

Table 11 Water Source Capacity by Month

Month	No. of Days	Source 1 Capacity (12 hrs/day)	Source 2 Capacity	Source 3 Capacity	Source 4 Capacity (12 hrs/day)
		(gal/mo)			
January	31	2,388,240	62,050	Unknown – Currently supplying "plenty" of water to area 1 caretaker unit and irrigation (approx. 7,950 gal/mo)	55,800
February	28	2,157,120	56,045		50,400
March	31	2,388,240	62,050		55,800
April	30	2,311,200	60,048		54,000
May	31	2,388,240	62,050		55,800
June	30	2,311,200	60,048		54,000
July	31	2,388,240	-		55,800
August	31	2,388,240	-		55,800
September	30	2,311,200	-		54,000
October	31	2,388,240	-		55,800
November	30	2,311,200	60,048		54,000
December	31	2,388,240	62,050		55,800

4 Water Storage Analysis

The Southern Humboldt Community Park currently maintains one 55,000 gallon water storage tank. The tank holds water from the spring (source 2) and is located on an adjacent property APN 221-091-11. Additional water storage tanks, up to 50,000 gallons may be placed at this location for a total of 105,000 gallons of storage.

4.1 Storage Volume Requirements

There are typically three components to estimating required system storage volume. They are the working storage, fire storage, and emergency storage. The water storage needs for each of these are based on the proposed projected water demands developed in Sections 2.3 of this memorandum.

4.1.1. Working Storage

The current 55,000 serves as the Park's working storage. As discussed under the water supply options section below, this storage can meet the SHCP's needs under several water supply options. Additional storage facilities for potable water use during peak summer months, would enhance the system but are not required.

4.1.2. Fire Storage

Fire storage provides water for fighting fires. The annual volume of water used for firefighting is small, but during fires, the rate of use may be very high for several hours. This results in the need to have a relatively large volume of water always in reserve for fighting a fire. Currently, the 55,000 gallon water tank is plumbed with 1 ½" line to hydrant connections. The Park has a fire hydrant connection close to the event site that can be easily accessed during a fire. For the festival, the volunteer fire departments will have engines available on site, and the Park owns a portable 300-gallon fire-suppression water-pumper tank installed on a four-wheel drive truck that can provide access into most areas within park boundaries.

4.1.3. Emergency Storage

The Park is not located within the Town of Garberville, and only three residences are located at the site. If an emergency takes place, there are a total of four water sources that these residences can divert water to use in emergencies should the primary source fail.

5 Supply and Demand Comparison

Table 12 below breaks out each facility requiring water and has the demand for each month including all the events listed in Tables 6 and 7. Each water source capacity is shown at the bottom of the table for comparison.

Table 12 Water Demands by Facility (after year 3)

FACILITY	AREA	NEW (Y/N)	WATER DEMANDS (gal/mo) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	EXISTING SOURCE
MH Caretakers Unit (2bd, 1ba)	1	N	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	Tooby Well
Irrigation	1	N	-	-	-	-	9,863	9,863	9,863	9,863	9,863	9,863	-	-	Tooby Well
Restrooms															
Toilets	1	Y	2,892	2,892	2,892	4,492	8,125	7,725	7,725	7,525	8,725	7,525	2,892	2,892	NA
Sinks	1	Y	1,446	1,446	1,446	2,246	4,063	3,863	3,863	3,763	4,363	3,763	1,446	1,446	NA
Drinking Fountains	1	Y	1,242	1,242	1,242	1,482	3,713	3,653	3,653	3,623	3,803	3,623	1,242	1,242	NA
Main Ranch House (3bd, 2ba)	2														Tank-Spring
Remodel - 2bd, 1ba residence	2	Remodel	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	NA
Remodel - offices, 1/2 ba, kitchen	2	Remodel	3,696	3,096	3,096	3,696	18,576	18,576	19,776	18,576	18,576	19,296	3,096	3,096	NA
Garage (offices)															NA
Cabin (office, 1/2 ba, kitchen)															Tank-Spring
Bunkhouse (2 bd, 1ba)	2	N	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	Tank-Spring
Irrigation	2	N	-	-	-	-	20,055	20,055	20,055	20,055	20,055	20,055	-	-	Tank-Spring
Large Barn (utility sink)	2	N	300	300	300	300	300	300	300	300	300	300	300	300	Tank-Spring
Chicken Coop	2	N	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	Tank-Spring
Horse Barn	2	N	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	Tank-Spring
Restrooms															
Toilets	2	Y	2,446	1,446	1,446	2,446	3,225	3,225	5,225	3,225	3,225	4,425	1,446	1,446	NA
Sinks	2	Y	1,223	723	723	1,223	1,613	1,613	2,613	1,613	1,613	2,213	723	723	NA
Drinking Fountains	2	Y	771	621	621	771	1,553	1,553	1,853	1,553	1,553	1,733	621	621	NA
Crop Irrigation	3	N	-	-	-	-	325,848	325,848	325,848	325,848	325,848	325,848	-	-	Eel River IG
Events Area - 4A															
*Food Vendor Washing	4A	Y	120	-	90	-	600	3,533	458	503	308	-	90	-	NA
*Hand washing	4A	Y	200	-	150	-	360	5,888	763	838	513	-	150	-	NA
Environmental Camp Area - 4B															
*Camp Sites (15 total)	4B	Y	-	-	-	72	144	384	384	384	72	-	-	-	NA
*Hand washing	4B	Y	-	-	-	36	72	192	192	192	36	-	-	-	NA
*Sports Fields (Proposed 10 acres)	5	Y	-	-	-	467,210	1,110,719	1,578,078	2,018,435	1,811,978	1,296,234	481,459	-	-	NA
*Sports Fields (Reduced 5.5 acres)			-	-	-	258,756	615,151	873,989	1,117,873	1,003,530	717,895	266,647	-	-	
Concession Stand w/ Restrooms															
*Stand Sink	5	Y	1,800	1,800	2,400	1,800	5,160	5,160	5,160	5,160	5,160	5,760	1,800	1,800	NA
*Toilets	5	Y	1,800	1,800	3,800	1,800	4,300	4,300	4,300	4,300	4,300	6,300	1,800	1,800	NA
*Sinks	5	Y	900	900	1,900	900	2,150	2,150	2,150	2,150	2,150	3,150	900	900	NA
*Drinking Fountains	5	Y	900	900	1,500	900	2,580	2,580	2,580	2,580	2,580	3,180	900	900	NA
TOTAL, PROPOSED			***36,136***	***33,566***	***38,006***	***505,774***	***1,541,207***	***2,016,727***	***2,453,384***	***2,242,216***	***1,727,464***	***916,681***	***33,806***	***33,566***	
TOTAL, REDUCED			***36,136***	***33,566***	***38,006***	***297,320***	***1,045,639***	***1,312,638***	***1,552,821***	***1,433,768***	***1,149,125***	***701,869***	***33,806***	***33,566***	
Infiltration Gallery Capacity			2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	
Spring Capacity			62,050	56,045	62,050	60,048	62,050	60,048	-	-	-	-	60,048	62,050	
Upland Well Capacity			55,800	50,400	55,800	54,000	55,800	54,000	55,800	55,800	54,000	55,800	54,000	55,800	

*Phase 2 facilities to be implemented after year 3. See Tables 8 and 9 for breakdown of water demands in each phase.

At this time, the Spring supplies water to the 55,000 gallon storage tank. SHCP currently has a forbearance program in place which stops the spring water withdrawals from July 2 to October 31. Table 13 shows a baseline water supply option with no new sources incorporated. Existing water facilities will continue to use their using existing water sources and the Spring (with tank) would supply all new facilities, with the exception of the Infiltration Gallery supplying the irrigation of the sports fields in Area 5. An asterisk (*) indicates facilities to be constructed in Phase 2.

Tables 14 and 15 show a comparison of available water supply with existing and proposed water demands under two scenarios. The first is the Phase 1 uses only, which are the uses without an asterisk in Table 13. As shown in Table 14 there is sufficient supply to meet the near term, Phase 1, needs of the Park with no changes to water supply. Table 15 compares the Phase 1 and 2 water demands to the water supply, which indicates additional supply is needed to meet the long-term demands of the Park.

Table 13 Water Sources for New and Existing Facilities

Facility	Area	As-Is Water Source (No changes to Existing)
MH Caretakers Unit (2bd, 1ba)	1	Tooby Well
Irrigation	1	Tooby Well
Restrooms		
Toilets	1	Tooby Well
Sinks	1	Tooby Well
Drinking Fountains	1	Tooby Well
Temp. Hand washing (for events)	2	Eel River IG
Temp. Food Washing (for events)	2	Tank-Spring
Main Ranch House (3bd, 2ba)		
*Remodel - 2bd, 1ba residence	2	Tank-Spring
*Remodel - offices, 1/2 ba, kitchen	2	Tank-Spring
*Garage (offices)		
*Cabin (office, 1/2 ba, kitchen)		
Bunkhouse (2 bd, 1ba)	2	Tank-Spring
Irrigation	2	Tank-Spring
Large Barn (sink to wash produce)	2	Tank-Spring
Chicken Coop	2	Eel River IG
Horse Barn	2	Eel River IG
Restrooms		
*Toilets	2	Tank-Spring
*Sinks	2	Tank-Spring
*Drinking Fountains	2	Tank-Spring
Crop Irrigation	3	Eel River IG
Events Area - 4A		
Food Vendor Washing	4A	Tank-Spring
Hand washing	4A	Tank-Spring
Environmental Camp Area - 4B		
Camp Sites (15 total)	4B	Tank-Spring
Hand washing	4B	Tank-Spring
*Sports Fields Irrigation	5	Eel River IG
*Concession Stand w/ Restrooms	5	
*Stand Sink	5	Tank-Spring
*Toilets	5	Tank-Spring
*Sinks	5	Tank-Spring
*Drinking Fountain	5	Tank-Spring

Table 14 Current Water Supply and Demand with New and Existing Facilities – PHASE 1

	AS-IS (NO CHANGES TO EXISTING) (gallons/month)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH FORK EEL RIVER INFILTRATION GALLERY												
Demand	2,664	2,264	2,264	2,514	22,505	23,288	23,591	23,130	22,355	22,619	2,264	2,264
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remaining	***2,385,576***	***2,154,856***	***2,385,976***	***2,308,686***	***2,365,735***	***2,287,912***	***2,364,649***	***2,365,110***	***2,288,845***	***2,365,621***	***2,308,936***	***2,385,976***
TOOBY WELL												
Demand	9,072	9,072	9,072	11,712	29,255	28,595	28,595	28,265	30,245	28,265	9,072	9,072
Capacity	currently unknown											
Remaining												
TANK (WITH SPRING)												
Demand	11,334	10,944	10,944	11,244	12,896	13,534	13,915	13,271	12,806	13,094	10,944	10,944
Capacity	62,050	56,045	62,050	60,048	62,050	60,048	-	-	-	-	60,048	62,050
Tank Storage	55,000	55,000	55,000	55,000	55,000	55,000	55,000	41,085	27,814	15,008	27,500	55,000
Remaining	***105,716***	***100,101***	***106,106***	***103,804***	***104,153***	***101,514***	***41,085***	***27,814***	***15,008***	***1,914***	***21,604***	***51,106***

Table 15 Current Water Supply and Demand with New and Existing Facilities – PHASE 2

	AS-IS (NO CHANGES TO EXISTING) (gallons/month)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH FORK EEL RIVER INFILTRATION GALLERY												
Demand	2,464	2,264	2,414	469,510	1,459,318	1,932,325	2,367,557	2,161,174	1,644,950	829,626	2,414	2,264
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remaining	***2,385,776***	***2,154,856***	***2,385,826***	***1,841,690***	***928,922***	***378,875***	***20,683***	***227,066***	***666,250***	***1,558,614***	***2,308,786***	***2,385,976***
TOOBY WELL												
Demand	9,072	9,072	9,072	11,712	29,255	28,595	28,595	28,265	30,245	28,265	9,072	9,072
Capacity	currently unknown											
Remaining												
TANK (WITH SPRING)												
Demand	24,800	22,230	26,670	24,588	53,066	61,886	58,186	53,806	52,818	58,790	22,470	22,230
Capacity	62,050	56,045	62,050	60,048	62,050	60,048	-	-	-	-	60,048	62,050
Tank Storage	55,000	55,000	55,000	55,000	55,000	55,000	55,000	-	-	-	27,500	55,000
Remaining	**92,250**	**88,815**	**90,380**	**90,460**	**63,983**	**53,162**	**(3,186)**	**(53,806)**	**(52,818)**	**(58,790)**	**10,078**	**39,820**

For Phase 2, the proposed new water services will need to be brought on-line.

6 Water Supply Options

Several water supply options were analyzed to help assist the Park in selecting the proper course of action for sourcing water for the long term. Assumptions made for the options include: (a) The pump at the Tooby Park Well has not been rated, so a supply analysis was not done at this source. It is assumed that the Tooby Well is potable and will have enough capacity to supply all the water necessary in Area 1; (b) The water from Tooby Well and Upland Well is potable; (c) The water used for irrigation and livestock in Area 2 has been changed to the Infiltration Gallery non-potable source for all options in order to maximize potable water throughout the Park; (d) For irrigation of the sports fields, a drought year was chosen.

- *Option 1*: Connect the Upland Well to the 55,000 gallon storage tank in addition to the Spring source. This will keep supplying potable water to the park during the forbearance months of July through October.
- *Option 2*: Connect the Upland Well to the 55,000 gallon storage tank in addition to the Spring source. This will keep supplying potable water to the park during the forbearance months of July through October. Also install dual-piping to the new facilities in Areas 2 and 5 with the Spring / Upland Well supplying potable water to hand washing sinks and drinking fountains, and the Infiltration Gallery supplying non-potable water to the toilets. This assumes all existing facilities will remain on their current water sources, i.e. the remodeled residential structures will still receive Spring water.
- *Options 3*: Add more storage (32,000 gallons) to the Spring water source, and use the Upland Well for all event area potable water and the concession stand with restrooms in Area 5.
- *Option 4*: Construct an on-site water treatment facility for the water from the South Fork Eel River Infiltration Gallery and supply the treated water to all the new facilities. During forbearance months, the tank will be refilled with treated water from the South Fork Eel River. The Upland Well is not used in this option.

As discussed above, for Phase 1, no new water supply configurations are needed to meet demands so no options were evaluated. For Phase 1, the Park does not need to make any changes to water sources for the first 3 years. See Table 14 for Phase 1 supply and demand data.

Table 16 lists all existing and new facilities requiring water. The proposed water source for each listed facility for all four options is shown.

Table 16 Water Supply Options for Phase 2 by Facility

Facility	Area	Option 1	Option 2	Option 3	Option 4
MH Caretakers Unit (2bd, 1ba)	1	Tooby Well	Tooby Well	Tooby Well	Tooby Well
Irrigation	1	Tooby Well	Tooby Well	Tooby Well	Tooby Well
Restrooms	1				
Toilets	1	Tooby Well	Tooby Well	Tooby Well	Tooby Well
Sinks	1	Tooby Well	Tooby Well	Tooby Well	Tooby Well
Drinking Fountains	1	Tooby Well	Tooby Well	Tooby Well	Tooby Well
Main Ranch House (3bd, 2ba)	2				
Remodel - 2bd, 1ba residence	2	Tank-Spring & Well	Tank-Spring & Well	Tank-Spring	Tank-Spring
Remodel - offices, 1/2 ba, kitchen	2	Tank-Spring & Well	Tank-Spring & Well	Tank-Spring	Tank-Spring
Garage (offices)					
Cabin (office, 1/2 ba, kitchen)					
Bunkhouse (2 bd, 1ba)	2	Tank-Spring & Well	Tank-Spring & Well	Tank-Spring	Tank-Spring
Irrigation	2	Eel River IG	Eel River IG	Eel River IG	Eel River IG
Large Barn (sink to wash produce)	2	Tank-Spring & Well	Tank-Spring & Well	Tank-Spring	Tank-Spring
Chicken Coop	2	Eel River IG	Eel River IG	Eel River IG	Eel River IG
Horse Barn	2	Eel River IG	Eel River IG	Eel River IG	Eel River IG
Restrooms	2				
Toilets	2	Tank-Spring & Well	Eel River IG	Tank-Spring	Eel River IG
Sinks	2	Tank-Spring & Well	Tank-Spring & Well	Tank-Spring	Treated Eel River IG
Drinking Fountains	2	Tank-Spring & Well	Tank-Spring & Well	Tank-Spring	Treated Eel River IG
Crop Irrigation	3	Eel River IG	Eel River IG	Eel River IG	Eel River IG
Events Area - 4A	4A				
Food Vendor Washing	4A	Tank-Spring & Well	Tank-Spring & Well	Upland Well	Treated Eel River IG
Hand washing	4A	Tank-Spring & Well	Tank-Spring & Well	Upland Well	Treated Eel River IG
Environmental Camp Area - 4B	4B				
Camp Sites (15 total)	4B	Tank-Spring & Well	Tank-Spring & Well	Upland Well	Treated Eel River IG
Hand washing	4B	Tank-Spring & Well	Tank-Spring & Well	Upland Well	Treated Eel River IG
Sports Fields Irrigation	5	Eel River IG	Eel River IG	Eel River IG	Eel River IG
Concession Stand w/ Restrooms	5				
Stand Sink	5	Tank-Spring & Well	Tank-Spring & Well	Upland Well	Treated Eel River IG
Toilets	5	Tank-Spring & Well	Eel River IG	Upland Well	Eel River IG
Sinks	5	Tank-Spring & Well	Tank-Spring & Well	Upland Well	Treated Eel River IG
Drinking Fountains	5	Tank-Spring & Well	Tank-Spring & Well	Upland Well	Treated Eel River IG

Lastly, Table 17 shows a summary of the demand and capacity of each source by month for each option. For all options listed, when a deficit is shown, the existing storage tank will need to be filled with another potable source (e.g. the Upland Well, imported purchased potable water, etc.). At any given time, it has been determined that there is enough potable water in the park to meet the demands.

Table 17 Water Supply Options by Source

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
OPTION 1 (gallons)												
South Fork Eel River Infiltration Gallery (Proposed, 10 Acres Irrigation)												
Demand	2,264	2,264	2,264	469,474	1,458,886	1,926,245	2,366,603	2,160,145	1,644,401	829,626	2,264	2,264
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remaining	***2,385,976***	***2,154,856***	***2,385,976***	***1,841,726***	***929,354***	***384,955***	***21,637***	***228,095***	***666,799***	***1,558,614***	***2,308,936***	***2,385,976***
South Fork Eel River Infiltration Gallery (Minimum, 5.5 Acres Irrigation)												
Demand	2,264	2,264	2,264	261,020	963,318	1,222,156	1,466,040	1,351,697	1,066,062	614,814	2,264	2,264
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remaining	***2,385,976***	***2,154,856***	***2,385,976***	***2,050,180***	***1,424,922***	***1,089,044***	***922,200***	***1,036,543***	***1,245,138***	***1,773,426***	***2,308,936***	***2,385,976***
Tooby Well												
Demand	9,072	9,072	9,072	11,712	29,255	28,595	28,595	28,265	30,245	28,265	9,072	9,072
Capacity						*currently unknown*						
Remaining												
Tank (with Spring & Upland Well)												
Demand	24,800	22,230	26,670	24,588	53,066	61,886	58,186	53,806	52,818	58,790	22,470	22,230
Capacity	117,850	106,445	117,850	114,048	117,850	114,048	55,800	55,800	54,000	55,800	114,048	117,850
Tank Storage	55,000*	55,000	55,000	55,000	55,000	55,000	55,000	52,614	54,608	55,000	55,000	55,000
Remaining	***38,050***	***139,215***	***146,180***	***144,460***	***119,783***	***107,162***	***52,614***	***54,608***	***55,790***	***52,010***	***143,588***	***150,620***

*Refill tank in January

OPTION 2 (gallons)												
South Fork Eel River Infiltration Gallery (Proposed, 10 Acres Irrigation)												
Demand	6,510	5,510	7,510	473,720	1,466,411	1,933,770	2,376,128	2,167,670	1,651,926	840,351	5,510	5,510
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remaining	***2,381,730***	***2,151,610***	***2,380,730***	***1,837,480***	***921,829***	***377,430***	***12,112***	***220,570***	***659,274***	***1,547,889***	***2,305,690***	***2,382,730***
South Fork Eel River Infiltration Gallery (Minimum, 5.5 Acres Irrigation)												
Demand	6,510	5,510	7,510	265,266	970,843	1,229,681	1,475,565	1,359,222	1,073,587	625,539	5,510	5,510
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remaining	***2,381,730***	***2,151,610***	***2,380,730***	***2,045,934***	***1,417,397***	***1,081,519***	***912,675***	***1,029,018***	***1,237,613***	***1,762,701***	***2,305,690***	***2,382,730***
Tooby Well												
Demand	9,072	9,072	9,072	11,712	29,255	28,595	28,595	28,265	30,245	28,265	9,072	9,072
Capacity						*currently unknown*						
Remaining												
Tank (with Spring & Upland Well)												
Demand	20,554	18,984	21,424	20,342	45,541	54,361	48,661	46,281	45,293	48,065	19,224	18,984
Capacity	117,850	106,445	117,850	114,048	117,850	114,048	55,800	55,800	54,000	55,800	114,048	117,850
Tank Storage	55,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000*	55,000*
Remaining	***152,296***	***142,461***	***151,426***	***148,706***	***127,308***	***114,687***	***62,139***	***64,519***	***63,707***	***62,735***	***94,824***	***126,366***

*Refill tank in November and December, if necessary

Table 17 Water Supply Options by Source, Continued

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
OPTION 3 (gallons)												
South Fork Eel River Infiltration Gallery (Proposed, 10 Acres Irrigation)												
Demand	2,264	2,264	2,264	469,474	1,458,886	1,926,245	2,366,603	2,160,145	1,644,401	829,626	2,264	2,264
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remaining	***2,385,976***	***2,154,856***	***2,385,976***	***1,841,726***	***929,354***	***384,955***	***21,637***	***228,095***	***666,799***	***1,558,614***	***2,308,936***	***2,385,976***
South Fork Eel River Infiltration Gallery (Minimum, 5.5 Acres Irrigation)												
Demand	2,264	2,264	2,264	261,020	963,318	1,222,156	1,466,040	1,351,697	1,066,062	614,814	2,264	2,264
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remaining	***2,385,976***	***2,154,856***	***2,385,976***	***2,050,180***	***1,424,922***	***1,089,044***	***922,200***	***1,036,543***	***1,245,138***	***1,773,426***	***2,308,936***	***2,385,976***
Tooby Well												
Demand	9,072	9,072	9,072	11,712	29,255	28,595	28,595	28,265	30,245	28,265	9,072	9,072
Capacity						*currently unknown*						
Remaining												
Tank (with Spring. Existing 55,000 gal + Proposed 32,000 gal)												
Demand	19,080	16,830	16,830	19,080	37,700	37,700	42,200	37,700	37,700	40,400	16,830	16,830
Capacity	62,050	56,045	62,050	60,048	62,050	60,048	-	-	-	-	60,048	62,050
Tank Storage	87,000*	87,000	87,000	87,000	87,000	87,000	87,000	44,800	71,100	-	29,000*	58,000*
Remaining	***65,970***	***126,215***	***132,220***	***127,968***	***111,349***	***109,348***	***44,800***	***7,100***	***(30,600)[1]***	***(40,400)[2]***	***14,218***	***39,220***
Upland Well												
Demand	5,720	5,400	9,840	5,508	15,366	24,186	15,986	16,106	15,118	18,390	5,640	5,400
Capacity	55,800	50,400	55,800	54,000	55,800	54,000	55,800	55,800	54,000	55,800	54,000	55,800
Remaining	***50,080***	***45,000***	***45,960***	***48,492***	***40,434***	***29,814***	***39,814***	***39,694***	***38,882***	***37,410***	***48,360***	***50,400***

*Refill tank in November, December, and January
1. Refill tank with water from Upland Well; 2. Refill tank with water from Upland Well and imported purchased potable water

OPTION 4 (gallons)												
Treated South Fork Eel River Infiltration Gallery (Proposed, 10 Acres Irrigation)												
Demand	12,104	10,454	14,654	479,314	1,479,466	1,946,825	2,390,483	2,180,725	1,664,981	856,386	10,454	10,454
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remaining	***2,376,136***	***2,146,666***	***2,373,586***	***1,831,886***	***908,774***	***364,375***	***(2,243)[1]***	***207,515***	***646,219***	***1,531,854***	***2,300,746***	***2,377,786***
Treated South Fork Eel River Infiltration Gallery (Minimum, 5.5 Acres Irrigation)												
Demand	12,104	10,454	14,654	270,860	983,898	1,242,736	1,489,920	1,372,277	1,086,642	641,574	10,454	10,454
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remaining	***2,376,136***	***2,146,666***	***2,373,586***	***2,040,340***	***1,404,342***	***1,068,464***	***898,320***	***1,015,963***	***1,224,558***	***1,746,666***	***2,300,746***	***2,377,786***
Tooby Well												
Demand	9,072	9,072	9,072	11,712	29,255	28,595	28,595	28,265	30,245	28,265	9,072	9,072
Capacity						*currently unknown*						
Remaining												
Tank (with Spring)												
Demand	14,960	14,040	14,280	14,748	32,486	41,306	34,306	33,226	32,238	32,030	14,280	14,040
Capacity	62,050	56,045	62,050	60,048	62,050	60,048	-	-	-	-	60,048	62,050
Tank Storage	55,000	55,000	55,000	55,000	55,000	55,000	55,000	20,694	-	-	27,500*	55,000*
Remaining	***102,090***	***97,005***	***102,770***	***100,300***	***84,563***	***73,742***	***20,694***	***(12,532)[2]***	***(32,238)[2]***	***(32,030)[2]***	***18,268***	***48,010***

*Refill tank in November and December
1. Use backup water from the Spring; 2. Refill tank with water from the Treated Infiltration Gallery

7 Recommendations and Conclusions

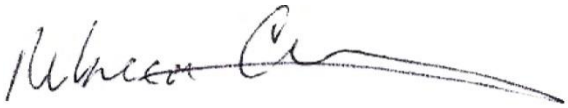
The current configuration with the Spring supplying all the potable water to Area 2, will not meet the demands during peak summer months once Phase 2 water demands come online. However, there is more than enough water in the park to meet the demands as shown in the options evaluted in the last section.

Option 2 is the preferred water supply configuration because it utilizes existing infrastructure, which results in minimum ground disturbance during construction and as a result is also likely the most cost effective. Option 2 also maximizes the use of potable water sources for potable needs, as the Eel River infiltration gallery source can be used for toilet flushing. This option also includes refilling of the 55,000 gallon existing tank from the Upland Well during the months of July through October, which improves the system's overall reliaibility.

It is assumed that if additional events beyond those included in this analysis or if the events occur in an alternate time of year (during the forebareance months), the Park will import purchased potable water in portable/temporary storage tanks for said events. If events occur in a different area, as long as the same source is used, it should not affect the supply.

For Phase 1, there is enough potable and non-potable water supply with the Park's current water sources and service configurations.

Regards,



Rebecca Crow
Project Manager

Appendices

Appendix A - (Supporting Documents)

- Decision Tree for Classification of Water Systems (CDPH)
- Proposed Project Site Map
- List of Facilities

  Area 1

  Area 2

  Area 3

  Area 4

  Area 5

  Area 6/7

Appendix B - (Supporting Calculations)

- Existing Water Demand Calculations - GHD
- Post-Project Weekday Water Demands
- Post-Project Weekend Water Demands
- Estimated Number of Visitors - SHCP
- Event Water Demand Calculations (Phase 1 and 2)
- Demand Calendar (Phase 1 and 2)
- Demand Calendar (Total/Summary)
- Irrigation Calculations
  - Effective Irrigation Demand Calculations
  - Blaney-Criddle Formula (SCS Technical Release No. 21)
  - Temperatures and Precipitation Data
- Water Source Capacity Calculations

GHD Inc

718 Third Street
Eureka, CA 95501

T: 707 443 8326 F: 707 444 8330 E: eureka@ghd.com

\\ghdnet\ghd\US\Eureka\Projects\12556 Southern Humboldt Community Park\8411201 SHCP WaterSupplyDemandAnalysis\04-Technical Work\03 SumMemo-Recommend\Technical Memo-rcedit.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	Stephanie Gould, EIT	Rebecca Crow, PE		Rebecca Crow, PE		9/2/2014

www.ghd.com

Appendices

Appendix A - (Supporting Documents)

- Decision Tree for Classification of Water Systems (CDPH)
- Proposed Project Site Map
- List of Facilities

  Area 1

  Area 2

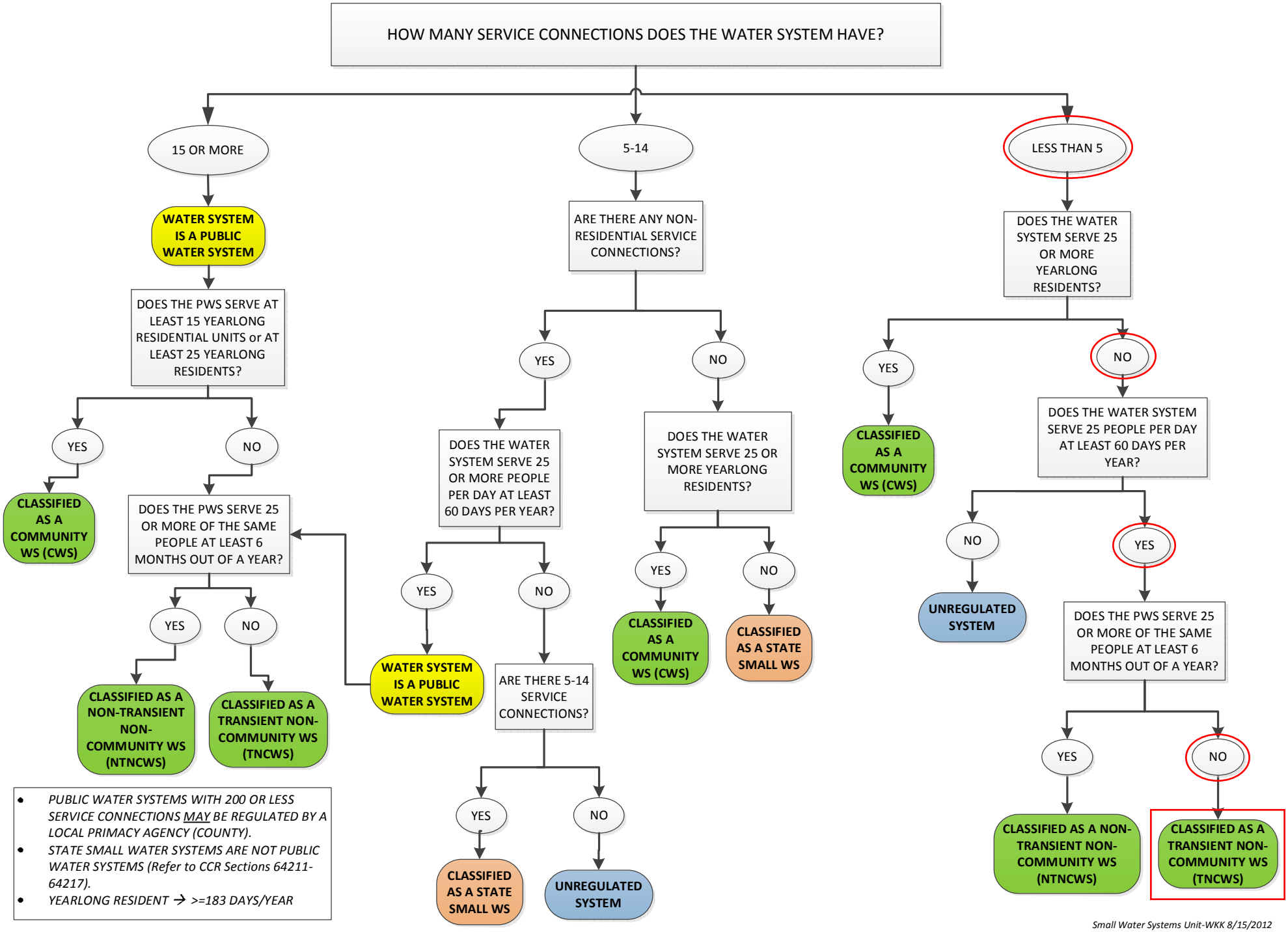
  Area 3

  Area 4

  Area 5

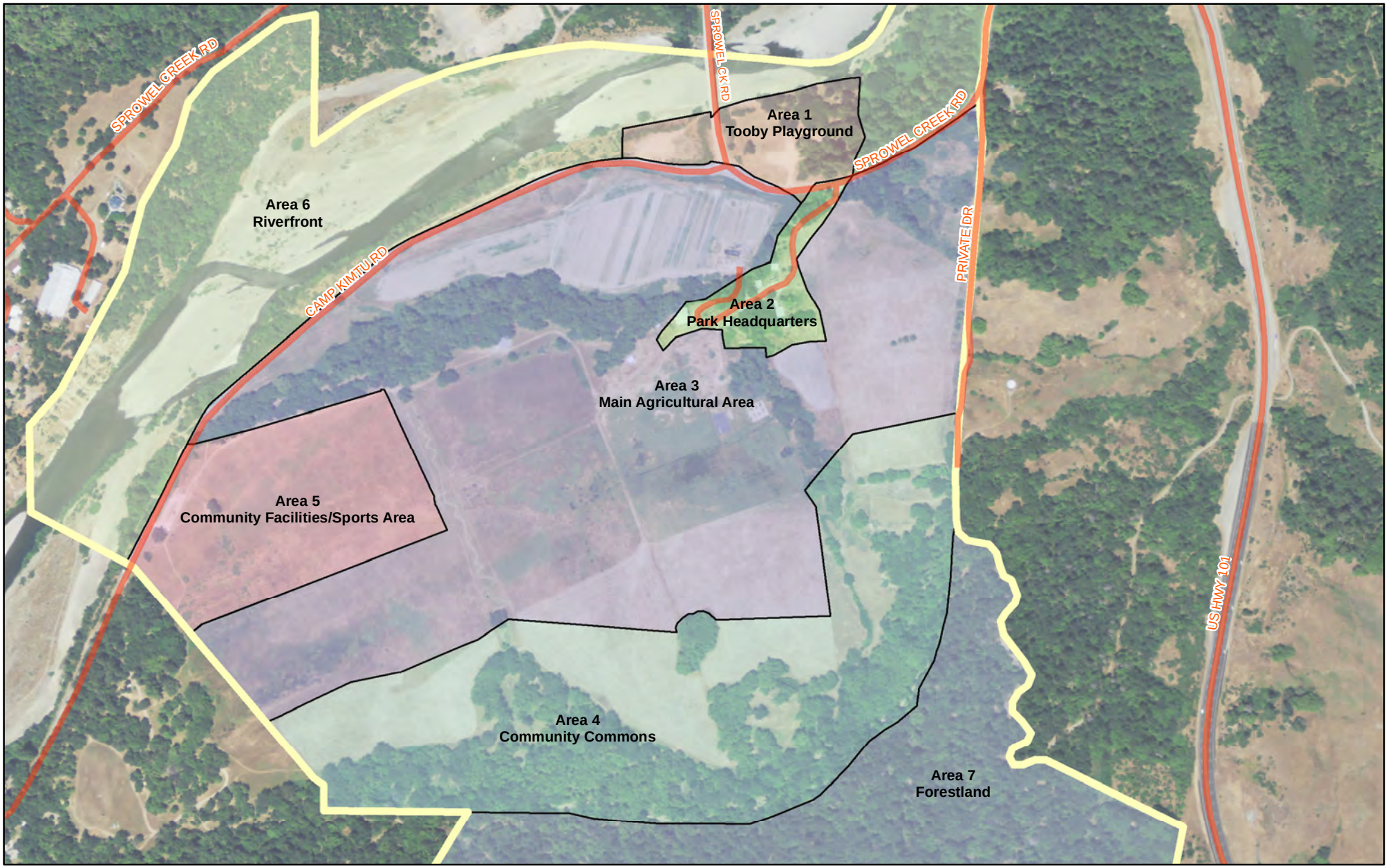
  Area 6/7

DECISION TREE FOR CLASSIFICATION OF WATER SYSTEMS



- *PUBLIC WATER SYSTEMS WITH 200 OR LESS SERVICE CONNECTIONS MAY BE REGULATED BY A LOCAL PRIMACY AGENCY (COUNTY).*
- *STATE SMALL WATER SYSTEMS ARE NOT PUBLIC WATER SYSTEMS (Refer to CCR Sections 64211-64217).*
- *YEARLONG RESIDENT → >=183 DAYS/YEAR*

Small Water Systems Unit-WKK 8/15/2012



Paper Size ANSI A

0 150 300 600

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California I FIPS 0401 Feet

N

Roads and Streets

SHCP Property Boundary

Southern Humboldt Community Park
Environmental Impact Report

Job Number 12556 11 001
Revision 2
Date 18 Oct 2012

Proposed Project
Site Map

Figure 2

G:\12556 Southern Humboldt Community Park\12556-11-001 EIR Proj Mgmt Assistance\08-GIS\Maps\Figures\F2_ProposedProject.mxd

718 3rd St Eureka CA 95501 **T** 707 443 8326 **F** 707 444 8330 **E** rebecaa.crowl@ghd.com **W** www.ghd.com

Data source: USDA, NAIP Aerial Imagry. Created by:amshows

FACILITY	EXISTING, NO CHANGE	EXISTING, MODIFICATIONS	PROPOSED
Area 1 - Tooby Memorial Park - 8.2 acres			
Residential Facilities			
Residence(s), caretaker (mobile home)	X		
Agricultural Facilities			
None			
Recreational/Community Facilities			
Playground		X	
Picnic area		X	
BBQ pits	X		
Benches		X	
Trails		X	
Boat ramp (non-paved, non-motorized)			X
Gazebo/shade structure			X
Kiosks (informational)		X	
Restrooms (portable)	X		
Restrooms (permanent)			X
Signage, gateway		X	
Signage, wayfinding/interpretive		X	
Transportation/Parking			
Parking area, permanent - daily use		X	
Parking area, unpaved regular use - seasonal events and sports		X	
Fencing for public areas for safety		X	
Intermittent use ranch service roads	X		
Proposed Park Uses			
Farmer's market		X	
Events, small (800 and under)	X		
Parties (under 100 attendance)	X		
Weddings, memorials, parties	X		
Workshops and classes	X		
Sporting tournaments (sports, bikes, disc golf)			X
Hiking, bicycling, equestians	X		

FACILITY	EXISTING, NO CHANGE	EXISTING, MODIFICATIONS	PROPOSED
Area 2 - Park Headquarters - 6.0 acres			
Residential Facilities			
Residence(s), 3 bdrm ranch/caretaker house		X	
Residence(s), 2 bdrm bunkhouse (rental/farm-worker housing)	X		
Residence(s), 1 bdrm cabin	X		
Agricultural Facilities			
Agricultural storage	X		
2 barns/stable/horse barn/chicken coops	X		
Farm stand	X		
Greenhouses	X		
Old slaughterhouse and scale house	X		
Fencing for animals - ag		X	
Temporary fencing for animal protection/control	X		
Recreational/Community Facilities			
Community center w/ kitchen (includes daycare)			X
Benches		X	
Equestrian facility	X		
Skate park	X		
Performance stage (temporary)			X
Trails		X	
Kiosks (informational)		X	
Restrooms (portable)	X		
Restrooms (permanent)			X
Signage, gateway		X	
Signage, wayfinding/interpretive		X	
Transportation/Parking			
Parking area, permanent - daily use		X	
Parking area, unpaved regular use - seasonal events and sports	X		
Parking area, unpaved temporary - event use		X	
Fencing for public areas for safety			X
Park HQ main entrance (unpaved)			X
Intermittent use ranch service roads	X		
Proposed Park Uses			
Agricultural processing		X	
Agricultural production (includes forest mgmt)		X	
Animal boarding		X	
Cottage industry		X	
Farmer's market		X	
Livestock grazing	X		
Equestrian activities and events		X	
Events, midsize (attendance 800-2500)			X
Events, small (800 and under)			X
Parties (under 100 attendance)	X		
Weddings, memorials, parties			X
Workshops and classes			X
Camping (farm related)			X
Sporting tournaments (sports, bikes, disc golf)			X
Hiking, bicycling, equestians	X		

FACILITY	EXISTING, NO CHANGE	EXISTING, MODIFICATIONS	PROPOSED
Area 3 - Main Agricultural - 127.1 acres			
Residential Facilities			
None			
Agricultural Facilities			
Greenhouses		X	
Fencing for animals - ag		X	
Temporary fencing for animal protection/control	X		
Recreational/Community Facilities			
Benches		X	
Disc golf course	X		
Labyrinth (weddings and memorials)	X		
Trails		X	
Restrooms (portable)		X	
Signage wayfinding/interpretive		X	
Transportation/Parking			
Parking area, unpaved regular use - seasonal events and sports		X	
Parking area, unpaved temporary - event use		X	
Fencing for public areas for safety		X	
Intermittent use ranch service roads	X		
Proposed Park Uses			
Agricultural processing		X	
Agricultural production (includes forest mgmt)		X	
Animal boarding		X	
Cottage industry			X
Livestock grazing	X		
Equestrian activities and events			X
Weddings, memorials, parties		X	
Workshops and classes			X
Camping (farm related)	X		
Sporting tournaments (sports, bikes, disc golf)			X
Hiking, bicycling, equestians	X		
Restoration, watershed/ecosystem/habitat			X

FACILITY	EXISTING, NO CHANGE	EXISTING, MODIFICATIONS	PROPOSED
Area 4 - Community Commons - 56.4 acres			
Residential Facilities			
None			
Agricultural Facilities			
Temporary fencing for animal protection/control	X		
Recreational/Community Facilities			
Picnic area			X
BBQ pits			X
Benches		X	
Camping site area (tent platforms, picnic tables, portable toilets)			X
Disc golf course	X		
Fenced dog park			X
Bike park			X
Performance stage (temporary)		X	
Trails		X	
Restrooms (portable)		X	
Signage, wayfinding/interpretive		X	
Transportation/Parking			
Parking area, unpaved temporary - event use			X
Fencing for public areas for safety		X	
Roads, new vehicular/pedestrian bridge			X
Intermittent use ranch service roads	X		
Proposed Park Uses			
Agricultural processing		X	
Agricultural production (includes forest mgmt)		X	
Animal boarding		X	
Livestock grazing	X		
Events, festival (attendance 2500-5000)			X
Events, midsize (attendance 800-2500)			X
Events, small (800 and under)			X
Parties (under 100 attendance)	X		
Weddings, memorials, parties		X	
Workshops and classes			X
Specialty camp area			X
Camping (farm related)			X
Sporting tournaments (sports, bikes, disc golf)			X
Hiking, bicycling, equestians	X		
Restoration, watershed/ecosystem/habitat		X	

FACILITY	EXISTING, NO CHANGE	EXISTING, MODIFICATIONS	PROPOSED
Area 5 - Community Facilities - 16.0 acres			
Residential Facilities			
None			
Agricultural Facilities			
None			
Recreational/Community Facilities			
Playground			X
Picnic area		X	
BBQ pits			X
Benches		X	
Bleachers			X
Skate park			X
Sports field(s), multipurpose (baseball/soccer) 130,000 sqft.			X
Sports field(s), soccer 45,000 sqft.			X
Sports field(s), multipurpose (soccer/football) 70,000 sqft.			X
Sports field(s), multipurpose (softball, baseball/ soccer) 80,000 sqft.			X
Multipurpose recreational building 12,000 sqft., gymnasium, administration offices			X
Trails		X	
Concession stands/storage			X
Gazebo/shade structure			X
Kiosks (informational)		X	
Restrooms (portable)	X		
Restrooms (permanent)			X
Signage, gateway		X	
Signage, wayfinding/interpretive		X	
Transportation/Parking			
Parking area, permanent - daily use		X	
Parking area, unpaved regular use - seasonal events and sports		X	X
Fencing for public areas for safety		X	
Roads, new or substantial improved (unpaved)			X
Intermittent use ranch service roads	X		
Proposed Park Uses			
Events, midsize (attendance 800-2500)		X	
Workshops and classes	X		
Sporting tournaments (sports, bikes, disc golf)			X
Hiking, bicycling, equestians	X		

FACILITY	EXISTING, NO CHANGE	EXISTING, MODIFICATIONS	PROPOSED
Area 6 - Riverfront - 77.0 acres			
Residential Facilities			
None			
Agricultural Facilities			
None			
Recreational/Community Facilities			
Picnic area			X
Trails		X	
Signage, wayfinding/interpretive		X	
Transportation/Parking			
Parking area, permanent - daily use		X	
Parking area, unpaved regular use - seasonal events and sports		X	
Parking area, unpaved temporary - event use		X	
Intermittent use ranch service roads	X		
Proposed Park Uses			
Workshops and classes			X
Hiking, bicycling, equestians	X		
Restoration, watershed/ecosystem/habitat			X
Area 7 - Forestland - 115.0 acres			
Residential Facilities			
None			
Agricultural Facilities			
None			
Recreational/Community Facilities			
Benches			X
Disc golf course	X		
Trails		X	
Signage, wayfinding/interpretive		X	
Transportation/Parking			
None			
Proposed Park Uses			
Agricultural production (includes forest mgmt)	X		
Sporting tournaments (sports, bikes, disc golf)			X
Hiking, bicycling, equestians	X		
Restoration, watershed/ecosystem/habitat		X	

Appendix B - (Supporting Calculations)

- Existing Water Demand Calculations - GHD
- Post-Project Weekday Water Demands
- Post-Project Weekend Water Demands
- Estimated Number of Visitors - SHCP
- Event Water Demand Calculations (Phase 1 and 2)
- Demand Calendar (Phase 1 and 2)
- Demand Calendar (Total/Summary)
- Irrigation Calculations
  - Effective Irrigation Demand Calculations
  - Blaney-Criddle Formula (SCS Technical Release No. 21)
  - Temperatures and Precipitation Data
- Water Source Capacity Calculations

APPENDIX B
EXISTING WATER DEMAND CALCULATIONS - GHD

EXISTING FACILITIES										
	Water Source	No. of Units Peak	No. of Units Off-Peak	Units	Quantities of WW flow* (gal/unit/day)	WW Generation (gal/day)	Water Demand (1.2 x WW Flow) (gal/day)	Peak Monthly Demand (gal/mo)	Off-Peak Monthly Demand (gal/mo)	Assumptions
AREA 1										
MH Caretakers Unit (2bd, 1ba)	3	1	1	Occupants	97	97	116	2950	2950	For a 1 person household - typical flowrate of 97 gal/capita/d
Landscaping	3	1	1	Area			164	5000	5000	From SHCP, 60,000 gal/year
AREA 2										
Main Ranch House (3bd, 2ba)	2	2	2	Occupants	76	152	182	5548	5548	For a 2 person household - typical flowrate of 76 gal/capita/d
Bunkhouse (2 bd, 1ba)	2	2	2	Occupants	76	152	182	5548	5548	For a 2 person household - typical flowrate of 76 gal/capita/d
Landscaping	2	10000	0	SqFt			603	18333	0	22 G/SQFT/YR - 6 months irrigation, from SHCP
Landscaping Backup	1							2000	0	From SHCP, 12,000 gal per year
Large Barn (utility sink)	2	5	1	Person	1	5	6	183	37	
Chicken Coop	2	100	100	Chickens			10	304	304	10 GPD for 100 chickens
Horse Barn	2	4	4	Horses			60	1825	1825	60 GPD for 4 horses
Livestock Backup	1							167	167	From SHCP, 2,000 gal/year
AREA 3										
Crop Irrigation	1	8	0	Acres			10713	325848	0	From SHCP. Tomato crops - 120 day growing cycle (6 months)
AREA 4										
None										
AREA 5										
None										
AREA 6										
None										
AREA 7										
None										

APPENDIX B
POST-PROJECT WEEKDAY WATER DEMANDS

*averaged 17 weekdays per month	No. of Units Peak	No. of Units Off-Peak	Units	Quantities of WW flow* (gal/unit/day)	WW Generation (gal/day)	Water Demand (1.2 x WW Flow) (gal/day)	Peak Monthly Demand (gal/mo)	Off-Peak Monthly Demand (gal/mo)	Assumptions
AREA 1									
MH Caretakers Unit (2bd, 1ba)	1	1	Occupants	97	97	116.4	1979	1979	For a 1 person household - typical flowrate of 97 gal/capita/d
Restrooms			Visitors						
Toilets	88	30		2	175	175	2975	1020	Picnic park with flush toilets
Sinks	88	30		1	88	88	1488	510	
Drinking Fountains	88	30		0.5	44	53	893	306	
Landscaping	1	1	Area			329	5589	0	From SHCP
						Potable Total:	4359	2795	
						Non-Potable Total:	8564	1020	
AREA 2									
Main Ranch House (3bd, 2ba)									For a 2 person household - typical flowrate of 76 gal/capita/d
Remodel - 2bd, 1ba residence	2	2	Occupants	76	152	182.4	3101	3101	
Remodel - offices, 1/2 ba, kitchen Garage (offices) Cabin (office, 1/2 ba, kitchen)	30	5	Persons	12	360	432	7344	1224	Remodel existing structures to offices, meeting rooms, workshops, kitchen, 1/2 bathrooms
Bunkhouse (2 bd, 1ba)	2	2	Occupants	76	152	182.4	3101	3101	For a 2 person household - typical flowrate of 76 gal/capita/d
Landscaping	10000	0	SqFt			603	10247	0	22 G/SQFT/YR - 6 months irrigation
Landscaping Backup							1118	0	From SHCP
Large Barn (utility sink to wash produce)	1	0	Acres			60	1014	0	1 acre of root vegetables washed (over 6 months) 1/4 gal/sqft.
Chicken Coop	1	1	100 Chickens	10			170	170	
Horse Barn	1	1	4 Horses	60			1020	1020	
Livestock Backup							93	93	From SHCP
Restrooms	0		Visitors						Picnic park with flush toilets
Toilets	37.5	15		2	75	75	1275	510	
Sinks	37.5	15		1	37.5	38	638	255	
Drinking Fountains	37.5	15		0.5	18.75	23	383	153	
						Potable Total:	27017	9024	
						Non-Potable Total:	2486	603	
AREA 3									
Crop Irrigation	8	0	Acres			10713	182118	0	From SHCP. Tomato crops - 120 day growing cycle (6 months)
AREA 4									
Events Area - 4A	Only Used During Special Events, See Table X								
Temp. Sanitation Station									
Food Vendors									
Washing Station									
Environmental Camp Area - 4B			Site						
Camp Sites (15 total)	15								Hose bib fountain at each camp site - 4 campers/site @ peak,
Temp. Sanitation Station	Only Used During Special Events, See Table X								2 campers/site @ off-peak
Washing Station									
AREA 5									
Sports Fields (Irrigated 10 acres)	See Table X for Irrigation Water Demand								
Concession Stand w/ Restrooms			Visitors						
Stand Sink	50	25		2	100	120	2040	1020	
Toilets	50	25		2	100	100	1700	1020	Picnic park with flush toilets
Sinks	50	25		1	50	50	850	510	
Drinking Fountains	50	25		1	50	60	1020	510	
						Potable Total:	3910	2040	
						Non-Potable Total:	1700	1020	
AREA 6									
None									
AREA 7									
None									

APPENDIX B
POST-PROJECT WEEKEND WATER DEMANDS

*averaged 13 weekend days/month	No. of Units Peak	No. of Units Off-Peak	Units	Quantities of WW flow* (gal/unit/day)	WW Generation (gal/day)	Water Demand (1.2 x WW Flow) (gal/day)	Peak Monthly Demand (gal/mo)	Off-Peak Monthly Demand (gal/mo)	Assumptions
AREA 1									
MH Caretakers Unit (2bd, 1ba)	1	1	Occupants	97	97	116.4	1513	1513	For a 1 person household - typical flowrate of 97 gal/capita/d
Restrooms			Visitors						
Toilets	175	60		2	350	350	4550	1872	Picnic park with flush toilets
Sinks	175	60		1	175	175	2275	936	
Drinking Fountains	175	60		1	175	210	2730	936	
Landscaping	1	1	Area			329	4274	0	From SHCP
						Potable Total:	6518	3385	
						Non-Potable Total:	8824	1872	
AREA 2									
Main Ranch House (3bd, 2ba)									For a 2 person household - typical flowrate of 76 gal/capita/d
Remodel - 2bd, 1ba residence	2	2	Occupants	76	152	182.4	2371	2371	
Remodel - offices, 1/2 ba, kitchen Garage (offices) Cabin (office, 1/2 ba, kitchen)	60	10	Persons	12	720	864	11232	1872	Remodel existing structures to offices, meeting rooms, workshops, kitchen, 1/2 bathrooms
Bunkhouse (2 bd, 1ba)	2	2	Occupants	76	152	182.4	2371	2371	For a 2 person household - typical flowrate of 76 gal/capita/d
Landscaping	10000	0	SqFt			603	7836	0	22 G/SQFT/YR - 6 months irrigation
Landscaping Backup							855	0	From SHCP
Large Barn (utility sink to wash produce)	1	0	Acres			60	776	0	1 acre of root vegetables washed (over 6 months) 1/4 gal/sqft.
Chicken Coop	1	1	100 Chickens	10			130	130	
Horse Barn	1	1	4 Horses	60			780	780	
Livestock Backup							71	71	From SHCP
Restrooms			Visitors						Picnic park with flush toilets
Toilets	75	30		2	150	150	1950	936	
Sinks	75	30		1	75	75	975	468	
Drinking Fountains	75	30		1	75	90	1170	468	
						Potable Total:	27641	8460	
						Non-Potable Total:	2876	1007	
AREA 3									
Crop Irrigation	8	0	Acres			10713	139267	0	From SHCP. Tomato crops - 120 day growing cycle (6 months)
AREA 4									
Events Area - 4A	Only Used During Special Events, See Table X								
Temp. Sanitation Station									
Food Vendors									
Washing Station									
Environmental Camp Area - 4B			Site						
Camp Sites (15 total)	15								Hose bib fountain at each camp site - 4 campers/site @ peak,
Temp. Sanitation Station	Only Used During Special Events, See Table X								2 campers/site @ off-peak
Washing Station									
AREA 5									
Sports Fields (Irrigated 10 acres)	See Table X for Irrigation Water Demand								
Concession Stand w/ Restrooms			Visitors						
Stand Sink	100	25		2	200	240	3120	780	
Toilets	100	25		2	200	200	2600	780	Picnic park with flush toilets
Sinks	100	25		1	100	100	1300	390	
Drinking Fountains	100	25		1	100	120	1560	390	
						Potable Total:	5980	1560	
						Non-Potable Total:	2600	780	
AREA 6									
None									
AREA 7									
None									

APPENDIX B
POST-PROJECT TOTAL WATER DEMANDS

	Peak Monthly Demand (gal/mo)	Off-Peak Monthly Demand (gal/mo)
AREA 1		
MH Caretakers Unit (2bd, 1ba)	3,492	3,492
Restrooms		
Toilets	7,525	2,892
Sinks	3,763	1,446
Drinking Fountains	3,623	1,242
Landscaping	9,863	-
Potable Total:	10,877	6,180
Non-Potable Total:	17,388	2,892
AREA 2		
Main Ranch House (3bd, 2ba)		
Remodel - 2bd, 1ba residence	5,472	5,472
Remodel - offices, 1/2 ba, kitchen		
Garage (offices)		
Cabin (office, 1/2 ba, kitchen)	18,576	3,096
Bunkhouse (2 bd, 1ba)	5,472	5,472
Landscaping	18,082	-
Landscaping Backup	1,973	-
Large Barn (utility sink to wash produce)	1,790	-
Chicken Coop	300	300
Horse Barn	1,800	1,800
Livestock Backup	164	164
Restrooms		
Toilets	3,225	1,446
Sinks	1,613	723
Drinking Fountains	1,553	621
Potable Total:	54,657	17,484
Non-Potable Total:	5,362	1,610
AREA 3		
Crop Irrigation	325,848	-
AREA 4		
Events Area - 4A		
Food Vendor Washing	-	-
Handwashing	-	-
Environmental Camp Area - 4B		
Camp Sites (15 total)	-	-
Handwashing	-	-
AREA 5		
Sports Fields (Irrigated 10 acres)	See Irrigation Table	
Concession Stand w/ Restrooms		
Stand Sink	5,160	1,800
Toilets	4,300	1,800
Sinks	2,150	900
Drinking Fountains	2,580	900
Potable Total:	9,890	3,600
Non-Potable Total:	4,300	1,800
AREA 6		
None		
AREA 7		
None		

APPENDIX B
EVENT WATER DEMAND CALCULATIONS
PHASE 1

	No. of Units	Units	Quantities of WW flow* (gal/unit/event)	WW Generation (gal/event)	Water Demand (1.2 x WW Flow) (gal/event)	No. of Events/Yr	Potable Event Water Demand (gal/yr)	Non-Potable Event Water Demand (gal/yr)	Comments	Use Assumptions
Area 1										
Egg Hunt	400	Attendees	6.5	2,600	2,640	1	1,040	1,600	For Tooby Park events: water use in restrooms (toilets, sinks, drinking fountains)	*Potable* : 2.0 gal/person for sinks, 0.6 gal/person for drinking fountain *Non-Potable* : 4.0 gal/person for toilets
Bicycling Event	150	Attendees	6.5	975	990	1	390	600		
Walk in the Park	300	Attendees	6.5	1,950	1,980	1	780	1,200		
Wedding	50	Attendees	6.5	325	330	1	130	200		
Memorial	50	Attendees	6.5	325	330	1	130	200		
						Totals:	2,470	3,800		
Area 2										
Spring Events	250	Attendees	2.00	500	550	1	550	-	For Park Headquarters Events: water use for temporary sanitation station (handwashing station outside of portable toilets, and wash area for food service).	*Potable* : 1.0 gal/person/day for food service, 1.0 gal/person/day for handwashing
Summer Events	500	Attendees	2.00	1,000	1,100	1	1,100	-		
Fall Events	300	Attendees	2.00	600	660	1	660	-		
Winter	250	Attendees	2.00	500	550	1	550	-		
						Totals:	2,860	-		
Area 3										
No Special Events in this Area										
Area 4										
Events Area - 4A										
Weddings	125	Attendees	0.75	94	100	2	200	-	For Community Commons events: water use for temporary sanitation station (handwashing station outside of portable toilets, and wash area for food service).	*Potable* : 0.30 gal/person/day for food service vendors, 0.5 gal/person/day for handwashing
Memorials	-	Attendees	0.75	-	-	-	-	-		
Fundraisers	300	Attendees	0.75	225	240	3	720	-		
Private Parties	-	Attendees	0.75	-	-	-	-	-		
						Small Event Totals:	920	-		
Medium Events (800 people)	-	Attendees	0.75	-	-	-	-	-		
Medium Events (1000-1500 people)	1,250	Attendees	0.75	938	1,000	2	2,000	-		
Medium Events (2000 people)	1,500	Attendees	0.75	1,125	1,200	1	1,200	-		
						Medium Event Totals:	3,200	-		
Festival (2-day)	-	Attendees	0.75	-	-	-	-	-		
Environmental/Educational Camp Area - 4B										
Groups of 10	3	Campsite	12.0	36	36	15 (5/year x 3 days)	540	-	For Env/Edu Camp events: water use for temporary handwashing station outside portable toilets, and water spigot at each camp site	*Potable* : 8.0 gal/campsite/day for campsites, 4.0 gal/campsite/day for handwashing
Groups of 15	4	Campsite	12.0	48	48	6 (2/year x 3 days)	288	-		
Groups of 20	6	Campsite	12.0	72	72	3 (1/year x 3 days)	216	-		
						Group Totals:	1,044	-		
Area 5										
Sports Tournaments	0	Attendees	8.0	-	-	-	-	-	For Sports Facilities events: water use in restrooms (toilets, sinks, drinking fountain) and concession stand sink	*Potable* : 2.0 gal/person for sinks, 1.2 gal/person for drinking fountain, 1.2 gal/person for concession stank sink *Non-Potable* : 4.0 gal/person for toilets

APPENDIX B
EVENT WATER DEMAND CALCULATIONS
PHASE 2

	No. of Units	Units	Quantities of WW flow* (gal/unit/event)	WW Generation (gal/event)	Water Demand (1.2 x WW Flow) (gal/event)	No. of Events/Yr	Potable Event Water Demand (gal/yr)	Non-Potable Event Water Demand (gal/yr)	Comments	Use Assumptions
Area 1										
Egg Hunt	400	Attendees	6.5	2,600	2,640	1	1,040	1,600	For Tooby Park events: water use in restrooms (toilets, sinks, drinking fountains)	*Potable* : 2.0 gal/person for sinks, 0.6 gal/person for drinking fountain *Non-Potable* : 4.0 gal/person for toilets
Bicycling Event	150	Attendees	6.5	975	990	1	390	600		
Walk in the Park	300	Attendees	6.5	1,950	1,980	1	780	1,200		
Wedding	50	Attendees	6.5	325	330	1	130	200		
Memorial	50	Attendees	6.5	325	330	1	130	200		
						Totals:	2,470	3,800		
Area 2										
Spring Events	250	Attendees	8.5	2,125	2,250	1	1,250	1,000	For Park Headquarters Events: water use in restrooms (toilets, sinks, drinking fountains), community kitchen, utility sink in large barn	*Potable* : 2.0 gal/person for sinks, 0.6 gal/person for drinking fountain, 2.4 gal/person for food service/community kitchen *Non-Potable* : 4.0 gal/person for toilets
Summer Events	500	Attendees	8.5	4,250	4,500	1	2,500	2,000		
Fall Events	300	Attendees	8.5	2,550	2,700	1	1,500	1,200		
Winter	250	Attendees	8.5	2,125	2,250	1	1,250	1,000		
						Totals:	6,500	5,200		
Area 3										
No Special Events in this Area										
Area 4										
Events Area - 4A										
Weddings	125	Attendees	0.75	94	100	4	400	-	For Community Commons events: water use for temporary sanitation station (handwashing station outside of portable toilets, and wash area for food service).	*Potable* : 0.30 gal/person/day for food service vendors, 0.5 gal/person/day for handwashing
Memorials	100	Attendees	0.75	75	80	3	240	-		
Fundraisers	300	Attendees	0.75	225	240	5	1,200	-		
Private Parties	150	Attendees	0.75	113	120	2	240	-		
						Small Event Totals:	2,080	-		
Medium Events (800 people)	800	Attendees	0.75	600	640	2	1,280	-		
Medium Events (1000-1500 people)	1,250	Attendees	0.75	938	1,000	2	2,000	-		
Medium Events (2000 people)	1,500	Attendees	0.75	1,125	1,200	1	1,200	-		
						Medium Event Totals:	4,480	-		
Festival (2-day)	5,000	Attendees	0.75	3,750	4,000	1 event x 2 days	8,000	-		
Environmental/Educational Camp Area - 4B										
Groups of 10	3	Campsite	12.0	36	36	30 (10/year x 3 days)	1,080	-	For Env/Edu Camp events: water use for temporary handwashing station outside portable toilets, and water spigot at each camp site	*Potable* : 8.0 gal/campsite/day for campsites, 4.0 gal/campsite/day for handwashing
Groups of 15	4	Campsite	12.0	48	48	9 (3/year x 3 days)	432	-		
Groups of 20	6	Campsite	12.0	72	72	9 (3/year x 3 days)	648	-		
						Group Totals:	2,160	-		
Area 5										
Sports Tournaments	250	Attendees	8.0	2,000	2,100	4 (2 days x 2 events)	4,400	4,000	For Sports Facilities events: water use in restrooms (toilets, sinks, drinking fountain) and concession stand sink	*Potable* : 2.0 gal/person for sinks, 1.2 gal/person for drinking fountain, 1.2 gal/person for concession stank sink *Non-Potable* : 4.0 gal/person for toilets

APPENDIX B
PROPOSED WATER DEMANDS PHASE 1

PHASE 1				Water Demand (gal/mo)												
Facility	**Area**	**Water Source**	**New Facility (Y/N) [Phase]**	***January***	***February***	***March***	***April***	***May***	***June***	***July***	***August***	***September***	***October***	***November***	***December***
MH Caretakers Unit (2bd, 1ba)	1	Tooby Well	N	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492
Landscaping	1	Tooby Well	N	-	-	-	-	9,863	9,863	9,863	9,863	9,863	9,863	-	-
Restrooms																
Toilets	1	Tooby Well	Y [1]	2,892	2,892	2,892	4,492	8,125	7,725	7,725	7,525	8,725	7,525	2,892	2,892
Sinks	1	Tooby Well	Y [1]	1,446	1,446	1,446	2,246	4,063	3,863	3,863	3,763	4,363	3,763	1,446	1,446
Drinking Fountains	1	Tooby Well	Y [1]	1,242	1,242	1,242	1,482	3,713	3,653	3,653	3,623	3,803	3,623	1,242	1,242
Temporary Handwashing (for events)	2	Eel River IG	N	250			250			500			300		
Temporary Food Washing (for events)	2	Tank-Spring	N	300			300			600			360		
Main Ranch House (3bd, 2ba)	2	Tank-Spring	N	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472
Remodel - 2bd, 1ba residence	2		Remodel [2]												
Remodel - offices, 1/2 ba, kitchen															
Garage (offices)															
Cabin (office, 1/2 ba, kitchen)	2		Remodel [2]	-	-	-	-	-	-	-	-	-	-	-	-
Bunkhouse (2 bd, 1ba)	2	Tank-Spring	N	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472
Landscaping	2	Eel River IG	N	-	-	-	-	20,055	20,055	20,055	20,055	20,055	20,055	-	-
Large Barn (utility sink to wash produce)	2	Tank-Spring	N	-	-	-	-	1,790	1,790	1,790	1,790	1,790	1,790	-	-
Chicken Coop	2	Eel River IG	N	300	300	300	300	300	300	300	300	300	300	300	300
Horse Barn	2	Eel River IG	N	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964
Restrooms																
Toilets	2		Y [2]												
Sinks	2		Y [2]												
Drinking Fountains	2		Y [2]												
Crop Irrigation	3	Eel River IG	N	-	-	-	-	325,848	325,848	325,848	325,848	325,848	325,848	-	-
Events Area - 4A																
Food Vendor Washing	4A	Tank-Spring	Y [1/2 capac-1]	90	-	-	-	90	488	413	465	-	-	-	-
Handwashing	4A	Tank-Spring	Y [1/2 capac-1]	150	-	-	-	150	813	688	775	-	-	-	-
Environmental Camp Area - 4B																
Camp Sites (15 total)	4B	Tank-Spring	Y [1/2 capac-1]	-	-	-	-	72	312	168	72	72	-	-	-
Handwashing	4B	Tank-Spring	Y [1/2 capac-1]	-	-	-	-	36	156	84	36	36	-	-	-
Sports Fields (Proposed 10 acres)	5		Y [2]												
Sports Fields (Minimum 5.5 acres)	5		Y [2]												
Concession Stand w/ Restrooms																
Stand Sink	5		Y [2]												
Toilets	5		Y [2]												
Sinks	5		Y [2]												
Drinking Fountains	5		Y [2]												

APPENDIX B
PROPOSED WATER DEMANDS PHASE 2

PHASE 2				Water Demand (gal/mo)												
Facility	**Area**	**Water Source**	**New Facility (Y/N)**	***January***	***February***	***March***	***April***	***May***	***June***	***July***	***August***	***September***	***October***	***November***	***December***
MH Caretakers Unit (2bd, 1ba)	1	Tooby Well	N	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492	3,492
Landscaping	1	Tooby Well	N	-	-	-	-	9,863	9,863	9,863	9,863	9,863	9,863	-	-
Restrooms															
Toilets	1	Tooby Well	Y [1]	2,892	2,892	2,892	4,492	8,125	7,725	7,725	7,525	8,725	7,525	2,892	2,892
Sinks	1	Tooby Well	Y [1]	1,446	1,446	1,446	2,246	4,063	3,863	3,863	3,763	4,363	3,763	1,446	1,446
Drinking Fountains	1	Tooby Well	Y [1]	1,242	1,242	1,242	1,482	3,713	3,653	3,653	3,623	3,803	3,623	1,242	1,242
Main Ranch House (3bd, 2ba)															
Remodel - 2bd, 1ba residence	2	Tank-Spring	Remodel [2]	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472
Remodel - offices, 1/2 ba, kitchen Garage (offices) Cabin (office, 1/2 ba, kitchen)	2	Tank-Spring	Remodel [2]	3,696	3,096	3,096	3,696	18,576	18,576	19,776	18,576	18,576	19,296	3,096	3,096
Bunkhouse (2 bd, 1ba)	2	Tank-Spring	N	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472	5,472
Landscaping	2	Eel River IG	N	-	-	-	-	20,055	20,055	20,055	20,055	20,055	20,055	-	-
Large Barn (utility sink to wash produce)	2	Tank-Spring	N	-	-	-	-	1,790	1,790	1,790	1,790	1,790	1,790	-	-
Chicken Coop	2	Eel River IG	N	300	300	300	300	300	300	300	300	300	300	300	300
Horse Barn	2	Eel River IG	N	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964
Restrooms															
Toilets	2	Tank-Spring	Y [2]	2,446	1,446	1,446	2,446	3,225	3,225	5,225	3,225	3,225	4,425	1,446	1,446
Sinks	2	Tank-Spring	Y [2]	1,223	723	723	1,223	1,613	1,613	2,613	1,613	1,613	2,213	723	723
Drinking Fountains	2	Tank-Spring	Y [2]	771	621	621	771	1,553	1,553	1,853	1,553	1,553	1,733	621	621
Crop Irrigation	3	Eel River IG	N	-	-	-	-	325,848	325,848	325,848	325,848	325,848	325,848	-	-
Events Area - 4A															
Food Vendor Washing	4A	Tank-Spring	Y [full capac-2]	120	-	90	-	360	3,533	458	503	308	-	90	-
Handwashing	4A	Tank-Spring	Y [full capac-2]	200	-	150	-	600	5,888	763	838	513	-	150	-
Environmental Camp Area - 4B															
Camp Sites (15 total)	4B	Tank-Spring	Y [full capac-2]	-	-	-	72	144	384	384	384	72	-	-	-
Handwashing	4B	Tank-Spring	Y [full capac-2]	-	-	-	36	72	192	192	192	36	-	-	-
Sports Fields (Irrigated 10 acres, Proposed)	5	Eel River IG	Y [2]	-	-	-	467,210	1,110,719	1,578,078	2,018,435	1,811,978	1,296,234	481,459	-	-
Sports Fields (Irrigated 5.5 acres, Minimum)	5	Eel River IG	Y [2]	-	-	-	258,756	615,151	873,989	1,117,873	1,003,530	717,895	266,647	-	-
Concession Stand w/ Restrooms															
Stand Sink	5	Tank-Spring	Y [2]	1,800	1,800	2,400	1,800	5,160	5,160	5,160	5,160	5,160	5,760	1,800	1,800
Toilets	5	Tank-Spring	Y [2]	1,800	1,800	3,800	1,800	4,300	4,300	4,300	4,300	4,300	6,300	1,800	1,800
Sinks	5	Tank-Spring	Y [2]	900	900	1,900	900	2,150	2,150	2,150	2,150	2,150	3,150	900	900
Drinking Fountains	5	Tank-Spring	Y [2]	900	900	1,500	900	2,580	2,580	2,580	2,580	2,580	3,180	900	900

APPENDIX B
PROPOSED WATER DEMANDS SUMMARY

	Water Demand (gal/mo)											
	January	*February*	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*October*	*November*	*December*
PHASE 1 (years 1-3)												
TOTAL TOOBY WELL												
Demand	9,072	9,072	9,072	11,712	29,255	28,595	28,595	28,265	30,245	28,265	9,072	9,072
Capacity	Currently Unknown											
Remain	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL SPRING (TANK)												
Demand	11,334	10,944	10,944	11,244	12,896	13,534	13,915	13,271	12,806	13,094	10,944	10,944
Capacity	62,050	56,045	62,050	60,048	62,050	60,048	-	-	-	-	60,048	62,050
Tank Storage	55,000	55,000	55,000	55,000	55,000	55,000	55,000	41,085	27,814	15,008	27,500	55,000
Remain	***105,716***	***100,101***	***106,106***	***103,804***	***104,153***	***101,514***	***41,085***	***27,814***	***15,008***	***1,914***	***21,604***	***51,106***
TOTAL EEL RIVER IG												
Demand	2,664	2,264	2,264	2,514	22,505	23,288	23,591	23,130	22,355	22,619	2,264	2,264
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remain	**2,385,576**	**2,154,856**	**2,385,976**	**2,308,686**	**2,365,735**	**2,287,912**	**2,364,649**	**2,365,110**	**2,288,845**	**2,365,621**	**2,308,936**	**2,385,976**
PHASE 2 (years 3+)												
TOTAL TOOBY WELL												
Demand	9,072	9,072	9,072	11,712	29,255	28,595	28,595	28,265	30,245	28,265	9,072	9,072
Capacity	Currently Unknown											
Remain	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL SPRING (TANK)												
Demand	24,800	22,230	26,670	24,588	53,066	61,886	58,186	53,806	52,818	58,790	22,470	22,230
Capacity	62,050	56,045	62,050	60,048	62,050	60,048	-	-	-	-	60,048	62,050
Tank Storage	55,000	55,000	55,000	55,000	55,000	55,000	55,000	-	-	-	27,500	55,000
Remain	***92,250***	***88,815***	***90,380***	***90,460***	***63,983***	***53,162***	***(3,186)***	***(53,806)***	***(52,818)***	***(58,790)***	***10,078***	***39,820***
TOTAL EEL RIVER IG												
Demand	2,264	2,264	2,264	469,474	1,458,886	1,926,245	2,366,603	2,160,145	1,644,401	829,626	2,264	2,264
Capacity	2,388,240	2,157,120	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240	2,388,240	2,311,200	2,388,240	2,311,200	2,388,240
Remain	**2,385,976**	**2,154,856**	**2,385,976**	**1,841,726**	**929,354**	**384,955**	**21,637**	**228,095**	**666,799**	**1,558,614**	**2,308,936**	**2,385,976**

Assumptions:

1. Temporary handwashing stations located in the park headquarters area 2, events area 4A, and the environmental camp area 4B for Phase 1 do not need to contain potable water.
2. The pump at the Tooby Park Well has not been rated, so a supply analysis was not done here. It is assumed that the well will have enough capacity to supply all water in Area 1.
3. The water from the Tooby Park Well is potable.
4. All water used for irrigation and landscaping in Area 2 is being supplied from the SF Eel River Infiltration Gallery.
5. The Upland Well was not analyzed in this particular comparison. See Alternatives Table.
6. See Events Table for Phase 1 to see which events per area were analyzed.

APPENDIX B
EFFECTIVE IRRIGATION DEMAND CALCULATIONS

Garberville	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average temperature, t (°F)	43.7	46.6	49.4	52.7	58.4	63.9	69.6	69.8	66.2	57.5	48.3	43.4	
Average Total Precip (in.)	11.29	9.09	7.54	3.84	1.37	0.36	0.03	0.44	0.77	3.69	8.88	10.70	58.00
Average total Precip %	19%	16%	13%	7%	2%	1%	0%	1%	1%	6%	15%	18%	100%
Min. Precip (in)	4.89	3.94	3.27	1.66	0.59	0.16	0.01	0.19	0.33	1.60	3.85	4.63	25.12
Max. Precip (in)	21.06	16.96	14.07	7.16	2.56	0.67	0.06	0.82	1.44	6.88	16.57	19.96	108.21
Monthly % of daytime hours, p	6.75	6.72	8.32	8.93	10.01	10.09	10.22	9.55	8.39	7.75	6.73	6.54	
Monthly consumptive factor, f	2.95	3.13	4.11	4.71	5.85	6.45	7.11	6.67	5.55	4.46	3.25	2.84	
k_t	0.44	0.49	0.54	0.60	0.70	0.79	0.89	0.89	0.83	0.68	0.52	0.44	
k_c	0.49	0.57	0.73	0.85	0.90	0.92	0.92	0.91	0.87	0.79	0.67	0.55	
Climatic coefficient, k	0.22	0.28	0.39	0.51	0.63	0.73	0.82	0.81	0.72	0.54	0.35	0.24	
Consumptive use, u (in/mo)	0.64	0.88	1.62	2.39	3.66	4.69	5.82	5.42	4.02	2.40	1.14	0.68	
Days per month	31	28	31	30	31	30	31	31	30	31	30	31	

Irrigation System Efficiency = 80%
Pasture effective root zone (ft) = 2 Input (blue colored)
Crop Depth Factor = 0.92 Output (red colored)

Month	r_t Average Rainfall (in/mo)	r_t Drought Rainfall (in/mo)	u Consumptive Use (ET) (in/mo)	r_e Average Effective Rainfall (in/mo)	r_e Drought Effective Rainfall (in/mo)	u-r_e Average Irrigation Demand (in/mo)	u-r_e Drought Irrigation Demand (in/mo)	(u-r_e)*eff Avg. Effective Irrigation Demand (in/mo)	(u-r_e)*eff Drought Effective Irrigation Demand (in/mo)	Effective Irrigation Demand (in/day)	Drought Effective Irrigation Demand (in/day)
Jan	11.29	4.89	0.64	0.64	0.64	0.00	0.00	0.00	0.00	0.00	0.00
Feb	9.09	3.94	0.88	0.88	0.88	0.00	0.00	0.00	0.00	0.00	0.00
Mar	7.54	3.27	1.62	1.62	1.62	0.00	0.00	0.00	0.00	0.00	0.00
Apr	3.84	1.66	2.39	2.14	1.01	0.25	1.38	0.31	1.72	0.01	0.06
May	1.37	0.59	3.66	0.91	0.39	2.75	3.27	3.44	4.09	0.11	0.13
Jun	0.36	0.16	4.69	0.23	0.05	4.47	4.65	5.58	5.81	0.19	0.19
Jul	0.03	0.01	5.82	-0.10	-0.12	5.92	5.95	7.40	7.43	0.24	0.24
Aug	0.44	0.19	5.42	0.31	0.08	5.11	5.34	6.39	6.67	0.21	0.22
Sep	0.77	0.33	4.02	0.53	0.20	3.49	3.82	4.36	4.77	0.15	0.16
Oct	3.69	1.60	2.40	2.07	0.98	0.33	1.42	0.41	1.77	0.01	0.06
Nov	8.88	3.85	1.14	1.14	1.14	0.00	0.00	0.00	0.00	0.00	0.00
Dec	10.70	4.63	0.68	0.68	0.68	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	58.00		33.36	11.04	7.54	22.32	25.82	27.90	32.28	0.91	1.05

Effective Rainfall calculated from Irrigation Water Requirements Technical Release No. 21
U.S. Dept. of Agriculture, Soil Conservaiton Service Engineering Division, April 1967
Appendix A ftp://ftp.wcc.nrcs.usda.gov/wntsc/waterMgt/irrigation/NEH15/ch2.pdf
r_t= monthly mean rainfall
f = adjustment factor
D = net depth of application
r_e = effective rainfall
u = average monthly consumptive use

$$f = (0.531714 + 0.295164D - 0.057697D^2 + 0.003804D^3)$$

$$r_e = \left(0.70917 r_t^{0.82416} - 0.11556\right)(10)^{0.02426\,u}\,(f)$$

Month	# days/mo	Avg. Effective Irrigation Demand (in/mo)	Drought Effect. Irrigation Demand (in/mo)	Proposed Sports Field - 10 Acres 435,600 sqft (avg) gal	Proposed Sports Field - 10 Acres 435,600 sqft (drought) gal	Minimum Sports Field - 5.5 Acres 241,249 sqft (avg) gal	Minimum Sports Field - 5.5 Acres 241,249 sqft (drought) gal
Jan	31	0.00	0.00	-	-	-	-
Feb	28	0.00	0.00	-	-	-	-
Mar	31	0.00	0.00	-	-	-	-
Apr	30	0.31	1.72	84,301	467,210	46,689	258,756
May	31	3.44	4.09	934,900	1,110,719	517,777	615,151
Jun	30	5.58	5.81	1,516,173	1,578,078	839,704	873,989
Jul	31	7.40	7.43	2,009,929	2,018,435	1,113,162	1,117,873
Aug	31	6.39	6.67	1,735,919	1,811,978	961,406	1,003,530
Sep	30	4.36	4.77	1,184,701	1,296,234	656,124	717,895
Oct	31	0.41	1.77	110,804	481,459	61,367	266,647
Nov	30	0.00	0.00	-	-	-	-
Dec	31	0.00	0.00	-	-	-	-

Appendix A Blaney-Criddle Formula (SCS Technical Release No. 21)

Because of the historical and in some cases legal significance of the Blaney-Criddle equation described in Technical Release No. 21 (SCS 1970), that method is presented in this appendix. The following material is taken directly from Technical Release No. 21. The reference crop methods presented in sections 623.0203 and 623.0204 have proven to be more accurate than this version of the Blaney-Criddle formula. Thus, the reference crop and appropriate crop coefficient techniques are recommended.

Disregarding many influencing factors, consumptive use varies with the temperature, length of day, and available moisture regardless of its source (precipitation, irrigation water, or natural ground water). Multiplying the mean monthly temperature (t) by the possible monthly percentage of daytime hours of the year (p) gives a monthly consumptive-use factor (f). It is assumed that crop consumptive use varies directly with this factor when an ample water supply is available. Expressed mathematically,

$$u = kf$$
$$U = \text{sum of } kf = KF$$

where:

- U = Consumptive use of the crop in inches for the growing season.
- K = Empirical consumptive-use crop coefficient for the growing season. This coefficient varies with the different crops being irrigated.
- F = Sum of the monthly consumptive-use factors for the growing season (sum of the products of mean monthly temperature and monthly percentage of daylight hours of the year).
- u = Monthly consumptive use of the crop in inches.
- k = Empirical consumptive-use crop coefficient for a month (also varies by crops).
- f = Monthly consumptive-use factor (product of mean monthly temperature and monthly percentage of daylight hours of the year).

$$f = \frac{t \times p}{100}$$

where:

- t = Mean monthly air temperature in degrees Fahrenheit.
- p = Monthly percentage of annual daylight hours. Values of p for 0 to 65 degrees north latitude are shown in table 2A–1.

Note: Value of t, p, f, and k can also be made to apply to periods of less than a month.

Following are modifications made in the original formula:

$$k = k_t \times k_c$$

where:

- k = a climatic coefficient which is related to the mean air temperature (t),
- k_t = .0173t - .314. Values of k_t for mean air temperatures from 36 to 100 degrees are shown in table 2A–4.
- k_c = A coefficient reflecting the growth stage of the crop. Values are obtained from crop growth stage coefficient curves as shown in figures 2A–1 through 2A–25 at the back of this appendix.

The consumptive-use factor (F) may be computed for areas for which monthly temperature records are available, if the percentage of hours that is shown in table 2A–1 is used. Then the total crop consumptive use (U) is obtained by multiplying F by the empirical consumptive-use crop coefficient (K). This relationship allows the computation of seasonal consumptive use at any location for those crops for which values of K have been experimentally established or can be estimated.

Table 2A–1 Monthly percentage of daytime hours (p) of the year for northern latitudes

Latitude N	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
65°	3.52	5.13	7.96	9.97	12.72	14.15	13.59	11.18	8.55	6.53	4.08	2.62
64°	3.81	5.27	8.00	9.92	12.50	13.63	13.26	11.08	8.56	6.63	4.32	3.02
63°	4.07	5.39	8.04	9.86	12.29	13.24	12.97	10.97	8.56	6.73	4.52	3.36
62°	4.31	5.49	8.07	9.80	12.11	12.92	12.73	10.87	8.55	6.80	4.70	3.65
61°	4.51	5.58	8.09	9.74	11.94	12.66	12.51	10.77	8.55	6.88	4.86	3.91
60°	4.70	5.67	8.11	9.69	11.78	12.41	12.31	10.68	8.54	6.95	5.02	4.14
59°	4.86	5.76	8.13	9.64	11.64	12.19	12.13	10.60	8.53	7.00	5.17	4.35
58°	5.02	5.84	8.14	9.59	11.50	12.00	11.96	10.52	8.53	7.06	5.30	4.54
57°	5.17	5.91	8.15	9.53	11.38	11.83	11.81	10.44	8.52	7.13	5.42	4.71
56°	5.31	5.98	8.17	9.48	11.26	11.68	11.67	10.36	8.52	7.18	5.52	4.87
55°	5.44	6.04	8.18	9.44	11.15	11.53	11.54	10.29	8.51	7.23	5.63	5.02
54°	5.56	6.10	8.19	9.40	11.04	11.39	11.42	10.22	8.50	7.28	5.74	5.16
53°	5.68	6.16	8.20	9.36	10.94	11.26	11.30	10.16	8.49	7.32	5.83	5.30
52°	5.79	6.22	8.21	9.32	10.85	11.14	11.19	10.10	8.48	7.36	5.92	5.42
51°	5.89	6.27	8.23	9.28	10.76	11.02	11.09	10.05	8.47	7.40	6.00	5.54
50°	5.99	6.32	8.24	9.24	10.68	10.92	10.99	9.99	8.46	7.44	6.08	5.65
49°	6.08	6.36	8.25	9.20	10.60	10.82	10.90	9.94	8.46	7.48	6.16	5.75
48°	6.17	6.41	8.26	9.17	10.52	10.72	10.81	9.89	8.45	7.51	6.24	5.85
47°	6.25	6.45	8.27	9.14	10.45	10.63	10.73	9.84	8.44	7.54	6.31	5.95
46°	6.33	6.50	8.28	9.11	10.38	10.53	10.65	9.79	8.43	7.58	6.37	6.05
45°	6.40	6.54	8.29	9.08	10.31	10.46	10.57	9.75	8.42	7.61	6.43	6.14
44°	6.48	6.57	8.29	9.05	10.25	10.39	10.49	9.71	8.41	7.64	6.50	6.22
43°	6.55	6.61	8.30	9.02	10.19	10.31	10.42	9.66	8.40	7.67	6.56	6.31
42°	6.61	6.65	8.30	8.99	10.13	10.24	10.35	9.62	8.40	7.70	6.62	6.39
41°	6.68	6.68	8.31	8.96	10.07	10.16	10.29	9.59	8.39	7.72	6.68	6.47
40°	6.75	6.72	8.32	8.93	10.01	10.09	10.22	9.55	8.39	7.75	6.73	6.54
39°	6.81	6.75	8.33	8.91	9.95	10.03	10.16	9.51	8.38	7.78	6.78	6.61
38°	6.87	6.79	8.33	8.89	9.90	9.96	10.11	9.47	8.37	7.80	6.83	6.68
37°	6.92	6.82	8.34	8.87	9.85	9.89	10.05	9.44	8.37	7.83	6.88	6.74
36°	6.98	6.85	8.35	8.85	9.80	9.82	9.99	9.41	8.36	7.85	6.93	6.81
35°	7.04	6.88	8.35	8.82	9.76	9.76	9.93	9.37	8.36	7.88	6.98	6.87
34°	7.10	6.91	8.35	8.80	9.71	9.71	9.88	9.34	8.35	7.90	7.02	6.93
33°	7.15	6.94	8.36	8.77	9.67	9.65	9.83	9.31	8.35	7.92	7.06	6.99
32°	7.20	6.97	8.36	8.75	9.62	9.60	9.77	9.28	8.34	7.95	7.11	7.05
31°	7.25	6.99	8.36	8.73	9.58	9.55	9.72	9.24	8.34	7.97	7.16	7.11
30°	7.31	7.02	8.37	8.71	9.54	9.49	9.67	9.21	8.33	7.99	7.20	7.16
29°	7.35	7.05	8.37	8.69	9.50	9.44	9.62	9.19	8.33	8.00	7.24	7.22
28°	7.40	7.07	8.37	8.67	9.46	9.39	9.58	9.17	8.32	8.02	7.28	7.27
27°	7.44	7.10	8.38	8.66	9.41	9.34	9.53	9.14	8.32	8.04	7.32	7.32
26°	7.49	7.12	8.38	8.64	9.37	9.29	9.49	9.11	8.32	8.06	7.36	7.37
25°	7.54	7.14	8.39	8.62	9.33	9.24	9.45	9.08	8.31	8.08	7.40	7.42
24°	7.58	7.16	8.39	8.60	9.30	9.19	9.40	9.06	8.31	8.10	7.44	7.47
23°	7.62	7.19	8.40	8.58	9.26	9.15	9.36	9.04	8.30	8.12	7.47	7.51
22°	7.67	7.21	8.40	8.56	9.22	9.11	9.32	9.01	8.30	8.13	7.51	7.56
21°	7.71	7.24	8.41	8.55	9.18	9.06	9.28	8.98	8.29	8.15	7.55	7.60

Table 2A–1 Monthly percentage of daytime hours (p) of the year for northern latitudes—Continued

Latitude N	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20°	7.75	7.26	8.41	8.53	9.15	9.02	9.24	8.95	8.29	8.17	7.58	7.65
19°	7.79	7.28	8.41	8.51	9.12	8.97	9.20	8.93	8.29	8.19	7.61	7.70
18°	7.83	7.31	8.41	8.50	9.08	8.93	9.16	8.90	8.29	8.20	7.65	7.74
17°	7.87	7.33	8.42	8.48	9.04	8.89	9.12	8.88	8.28	8.22	7.68	7.79
16°	7.91	7.35	8.42	8.47	9.01	8.85	9.08	8.85	8.28	8.23	7.72	7.83
15°	7.94	7.37	8.43	8.45	8.98	8.81	9.04	8.83	8.27	8.25	7.75	7.88
14°	7.98	7.39	8.43	8.43	8.94	8.77	9.00	8.80	8.27	8.27	7.79	7.93
13°	8.02	7.41	8.43	8.42	8.91	8.73	8.96	8.78	8.26	8.29	7.82	7.97
12°	8.06	7.43	8.44	8.40	8.87	8.69	8.92	8.76	8.26	8.31	7.85	8.01
11°	8.10	7.45	8.44	8.39	8.84	8.65	8.88	8.73	8.26	8.33	7.88	8.05
10°	8.14	7.47	8.45	8.37	8.81	8.61	8.85	8.71	8.25	8.34	7.91	8.09
9°	8.18	7.49	8.45	8.35	8.77	8.57	8.81	8.68	8.25	8.36	7.95	8.14
8°	8.21	7.51	8.45	8.34	8.74	8.53	8.78	8.66	8.25	8.37	7.98	8.18
7°	8.25	7.53	8.46	8.32	8.71	8.49	8.74	8.64	8.25	8.38	8.01	8.22
6°	8.28	7.55	8.46	8.31	8.68	8.45	8.71	8.62	8.24	8.40	8.04	8.26
5°	8.32	7.57	8.47	8.29	8.65	8.41	8.67	8.60	8.24	8.41	8.07	8.30
4°	8.36	7.59	8.47	8.28	8.62	8.37	8.64	8.57	8.23	8.43	8.10	8.34
3°	8.40	7.61	8.48	8.26	8.58	8.33	8.60	8.55	8.23	8.45	8.13	8.38
2°	8.43	7.63	8.49	8.25	8.55	8.29	8.57	8.53	8.22	8.46	8.16	8.42
1°	8.47	7.65	8.49	8.23	8.52	8.25	8.53	8.51	8.22	8.48	8.19	8.45
0°	8.50	7.67	8.49	8.22	8.49	8.22	8.50	8.49	8.21	8.49	8.22	8.50

Seasonal consumptive-use coefficients

Consumptive-use coefficients (K) have been determined experimentally at numerous localities for most crops grown in the western states. Consumptive-use values (U) were measured, and these data were correlated with temperature and growing season. Crop consumptive-use coefficients were then computed by the formula:

$$K = \frac{U}{F}$$

The computed coefficients varied somewhat because of the diverse conditions, such as soils, water supply, and methods, under which the studies were conducted. These coefficients were adjusted where necessary after the data were analyzed. The resulting coefficients are believed to be suitable for use under normal conditions.

While only very limited investigations of consumptive use have been made in the Eastern or humid-area States, studies made thus far fail to indicate that there should be any great difference between the seasonal consumptive-use coefficients used there and those used in the Western States.

Table 2A–2 shows the values of seasonal consumptive-use crop coefficients currently proposed by Blaney-Criddle for most irrigated crops. Ranges in the values of these coefficients are shown. The values, however, are not all inclusive limits. In some circumstances, K values may be either higher or lower than shown.

Monthly or short-time consumptive-use coefficients

Although seasonal coefficients (K) as reported by various investigators show some variation for the same crops, monthly or short-time coefficients (k) show even greater variation. These great variations are influenced by a number of factors that must be considered when computing or estimating short-time coefficients. Although these factors are numerous, the most important are temperature and the growth stage of the crop.

Table 2A–2 Seasonal consumptive-use crop coefficients (K) for irrigated crops

Crop	Length of normal growing season or period 1/	Consumptive-use coefficient (K) 2/
Alfalfa	Between frosts	0.80 to 0.90
Bananas	Full year	.80 to 1.00
Beans	3 months	.60 to .70
Cocoa	Full year	.70 to .80
Coffee	Full year	.70 to .80
Corn (maize)	4 months	.75 to .85
Cotton	7 months	.60 to .70
Dates	Full year	.65 to .80
Flax	7 to 8 months	.70 to .80
Grains, small	3 months	.75 to .85
Grain, sorghum	4 to 5 months	.70 to .80
Oilseeds	3 to 5 months	.65 to .75
Orchard crops:		
Avocado	Full year	.50 to .55
Grapefruit	Full year	.55 to .65
Orange and lemon	Full year	.45 to .55
Walnuts	Between frosts	.60 to .70
Deciduous	Between frosts	.60 to .70
Pasture crops:		
Grass	Between frosts	.75 to .85
Ladino whiteclover	Between frosts	.80 to .85
Potatoes	3 to 5 months	.65 to .75
Rice	3 to 5 months	1.00 to 1.10
Soybeans	140 days	.65 to .70
Sugar beet	6 months	.65 to .75
Sugarcane	Full year	.80 to .90
Tobacco	4 months	.70 to .80
Tomatoes	4 months	.65 to .70
Truck crops, small	2 to 4 months	.60 to .70
Vineyard	5 to 7 months	.50 to .60

1/ Length of season depends largely on variety and time of year when the crop is grown. Annual crops grown during the winter period may take much longer than if grown in the summertime.

2/ The lower values of K for use in the Blaney-Criddle formula, U=KF, are for the more humid areas, and the higher values are for the more arid climates.

Growing season

In using the Blaney-Criddle formula for computing seasonal requirements, the potential growing season for the various crops is normally considered to extend from frost to frost or from the last killing frost in the spring to the end of a definite period thereafter. For most crops, this is adequate for seasonal use estimates, but a refinement is necessary to more precisely define the growing season when monthly or short-time use estimates are required. In many areas records are available from which planting, harvesting, and growth dates can be determined. These records should be used where possible. In other areas temperature data may be helpful for estimating these dates. Table 2A–3 gives some guides that can help determine these dates.

The spring frost date corresponds very nearly with a mean temperature of 55 degrees, so it is obvious that many of the common crops use appreciable amounts of water before the last frost in the spring and may continue to use water after the first front in the fall.

Climate coefficient (k_t)

While it is recognized that a number of climatological factors affect consumptive use by crops, seldom is complete climatological data on relative humidity, wind movement, sunshine hours, or pan evapotranspiration available for a specific site. Thus, it is necessary to rely on records of temperature that are widely available.

In 1954, J.T. Phelan attempted to correlate the monthly consumptive-use coefficient (k) with the mean monthly temperature (t). It was noted that a loop effect occurred in the plotted points—the computed values of (k) were higher in the spring than in the fall for the same temperature. The effects of this loop were later corrected by the development of a crop growth stage coefficient (k_c). The relationship between (k) and (t) was adopted for computing values of (k_t), the temperature coefficient. This relationship is expressed as $k_t = .0173t - .314$. Table 2A–4 gives values of k_t for temperatures ranging from 36 to 100 degrees Fahrenheit.

Table 2A–3 A guide for determining planting dates, maturity dates, and lengths of growing seasons as related to mean air temperature

Crops	Earliest moisture—Use or planting date as related to mean air temperature	Latest moisture—Use or maturing date as related to mean air temperature	Growing season days
Perennial crops			
Alfalfa	50° mean temp.	28° frost	Variable
Grasses, cool	45° mean temp.	45° mean temp.	Variable
Orchards, deciduous	50° mean temp.	45° mean temp.	Variable
Grapes	55° mean temp.	50° mean temp.	Variable
Annual crops			
Beans	60° mean temp.	32° frost	90 — 100
Corn	55° mean temp.	32° frost	140 — Max.
Cotton	62° mean temp.	32° frost	240 — Max.
Grain, spring	45° mean temp.	32° frost	130 — Max.
Potatoes, late	60° mean temp.	32° frost	130 — Max.
Sorghum, grain	60° mean temp.	32° frost	130 — Max.
Sugar beets	28° frost	28° frost	180 — Max.
Wheat, winter			
(fall season)		45° mean temp.	
(spring season)	45° mean temp.		

Crop growth stage coefficients (k_c)

As previously stated, another factor that causes consumptive use to vary widely throughout the growing season is the plant itself. Stage of growth is a primary variable that must be recognized because it is obvious that plants in the rapid growth stage use water at a more rapid rate than will new seedlings. It is also obvious that these variations in consumptive use throughout the growing season will be greater for annual crops than for perennial crops, such as alfalfa, permanent pasture grasses, and orchards.

Table 2A–4 Values of the climate coefficients (k_t) for various mean air temperatures (t)[1]

t (°F)	k_t	t (°F)	k_t	t (°F)	k_t
36	.31	58	.69	80	1.07
37	.33	59	.71	81	1.09
38	.34	60	.72	82	1.11
39	.36	61	.74	83	1.12
40	.38	62	.76	84	1.14
41	.40	63	.78	85	1.16
42	.41	64	.79	86	1.17
43	.43	65	.81	87	1.19
44	.45	66	.83	88	1.21
45	.46	67	.85	89	1.23
46	.48	68	.86	90	1.24
47	.50	69	.88	91	1.26
48	.52	70	.90	92	1.28
49	.53	71	.91	93	1.30
50	.55	72	.93	94	1.31
51	.57	73	.95	95	1.33
52	.59	74	.97	96	1.35
53	.60	75	.98	97	1.36
54	.62	76	1.00	98	1.38
55	.64	77	1.02	99	1.40
56	.66	78	1.04	100	1.42
57	.67	79	1.05		

1 Values of (k_t) are based on the formula, $k_t = .0173\ t - .314$ for mean temperatures less than 36°, use $k_t = .300$.

To recognize these variations in consumptive use, crop growth stage coefficients (k_c) have been introduced into the formula. Values of these coefficients are calculated from research data. Where values of k_c are plotted against time or stage of growth, curves similar to those shown in figures 2A–1 through 2A–25 result. Such curves are used to obtain values of k_c that, when used with appropriate values of k_t will permit a determination of values of monthly or short-time consumptive-use coefficients (k).

Also, the value of k_c might to some extent be influenced by factors other than the characteristics of the plant itself. For this reason, it is not expected that these curves can be used universally. They should, however, be valid over a considerable area and certainly should be of value in areas where no measured consumptive-use data are available.

For annual crops, such as corn, values of k_c are best plotted as a function of a percentage of the growing season. Figure 2A–7 shows the suggested values of k_c for corn.

For perennial crops, values of k_c generally are best plotted on a monthly basis. Figure 2A–1 shows the plotting of such values for alfalfa. Crop growth stage coefficient curves for all crops for which data are available are in this appendix.

Assumptions in applying the formula

To apply results of a consumptive-use-of-water study in one area to other areas, certain assumptions must be made. If sufficient basic information is available locally, such actual data should be used; however, sufficient detail of the needed data is rarely available. Where necessary information is unavailable, the following assumptions must be made in applying the consumptive-use formula to transfer data between areas:

- Seasonal consumptive use (U) of water varies directly with the consumptive-use factor (F).
- Crop growth and yields are not limited by inadequate water at any time during the growing season.

- Growing periods for alfalfa, pasture, orchard crops, and natural vegetation, although usually extending beyond the frost-free periods, are usually indicated by such periods. Yields of crops dependent only upon vegetative growth vary with the length of the growing period.

Application to specific areas

The application of the Blaney-Criddle formula to specific areas can best be illustrated by examples. Two have been chosen for this purpose. The first is an annual crop, corn, grown in a humid area, Raleigh, North Carolina. The second is a perennial crop, alfalfa, grown in an arid area, Denver, Colorado.

Corn at Raleigh, North Carolina

The procedure for estimating the average daily, monthly, and seasonal consumptive use by corn at this location is shown in sample calculation 2A–1. The average length of the growing season for corn grown near Raleigh is 120 days beginning about April 20.

The estimate is made on a monthly basis, the months and fractions thereof being shown in column 1. The midpoint date for each month or fraction is shown in column 2. The accumulated number of days from the planting date, April 20, to the midpoint of each month or period is shown in column 3. The percentage of the 120-day growing season represented by these midpoint dates is shown in column 4. Thus:

$$\text{column 4} = \frac{\text{column 3}}{120}$$

Mean monthly air temperature values, shown in column 5, are taken from Weather Bureau records. The mean temperature is assumed to occur on the 15th day of each month. The mean air temperature for a part of a month can be obtained mathematically or graphically by assuming that the increase or decrease in temperature between the 15th day of any consecutive month is a straight-line relationship. For example, at Raleigh, the mean monthly air temperature for April is 60.6 degrees and that for May is 69.2 degrees. The mean air temperature for the midpoint date is calculated as follows:

$$60.6° + \frac{10 \text{ days } (69.2° - 60.6°)}{30 \text{ days}} = 63.5°$$

Sample calculation 2A–1 Estimate of average daily, monthly, and seasonal consumptive-use by corn (harvested for grain) at Raleigh, North Carolina, latitude 35°47' N

(1) Month or period	(2) Midpoint of period	(3) Accum. days to midpoint	(4) Percent of growing season	(5) Mean air temp., t (°F)	(6) Daylight hours, p (%)	(7) Cons. use factor, f	(8) Climatic coeff., k_t	(9) Growth stage coeff., k_c	(10) Cons. use coeff., k	(11) Monthly cons. use, u (in)	(12) Daily cons. use, u (in/d)
April 20											
	April 25	5	4.2	63.5	3.05	1.94	.79	.46	.36	.70	.070
May											
	May 15	25	20.8	69.2	9.79	6.77	.88	.59	.52	3.52	.114
June											
	June 15	56	46.7	76.9	9.81	7.54	1.02	1.02	1.04	7.84	.261
July											
	July 15	86	71.7	79.4	9.98	7.92	1.06	1.05	1.11	8.79	.284
August											
	Aug. 9	111	92.5	78.3	5.52	4.32	1.04	.91	.95	4.10	.228
Aug. 18											
Season total										24.95 inches	

Raleigh is located at latitude 35°47' N. The monthly percentages of daylight hours, shown in column 6, are taken from table 2A–1. For parts of a month, the values of these percentages can be obtained in a similar manner as that described for mean air temperature. For example, at Raleigh, the monthly percentage of daylight hours for April is 8.84 and that for May is 9.79. For the period April 20 through April 30, the monthly percentage of daylight hours is calculated as:

$$\left(8.84\% + \frac{10 \text{ days}(9.79\% - 8.84\%)}{30 \text{ days}}\right)\frac{10 \text{ days}}{30 \text{ days}} = 3.05\%$$

The values of consumptive use factors (f) shown in column 7 are the product of t and p divided by 100. Values of the climatic coefficient (k_t) shown in column 8 are taken from table 2A–4. Values of the crop growth stage coefficient (k_c) shown in column 9 are taken from the curve shown in figure 2A–7. The values of the monthly consumptive-use coefficient (k) shown in column 10 are the product of k_t and k_c. Values of monthly consumptive use (u) shown in column 11 are the product of values of k and f. The average daily rates of consumptive use shown in column 12 are the monthly values of u (column 11) divided by the number of days in the month.

Alfalfa in Denver, Colorado

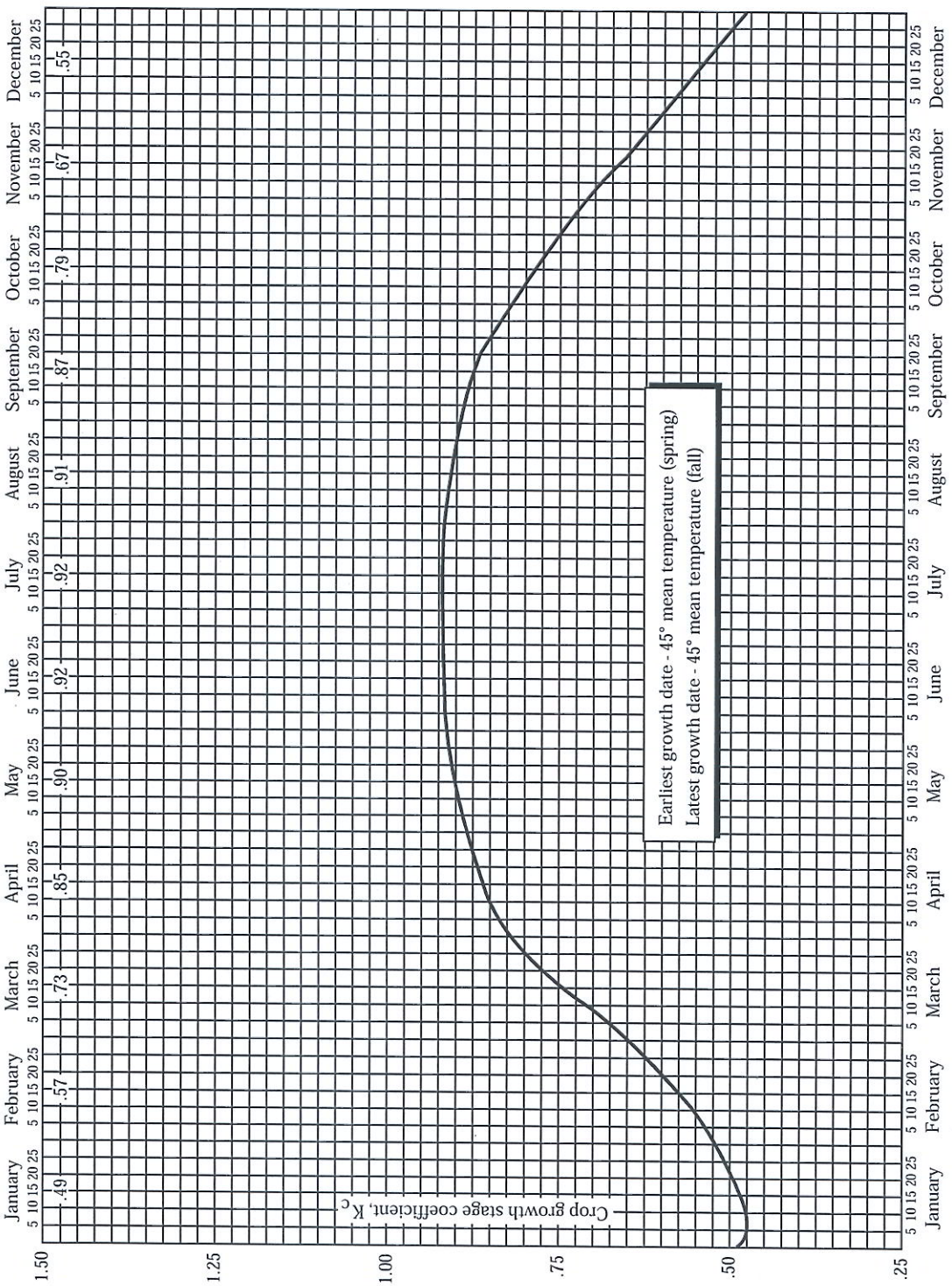
The procedure for estimating the average daily, monthly, and seasonal consumptive use by alfalfa in this location is shown in sample calculation 2A–2. The growing season for alfalfa grown near Denver is considered to be that period from the date corresponding to 50° mean temperature in the spring to the date corresponding to 28° frost in the fall. This period is from April 24 to October 25.

The procedure illustrated by sample calculation 2A–2 is the same as that described for corn in sample calculation 2A–1. The values of the crop growth stage coefficient (k_c) shown in column 8 are taken from the curve for alfalfa shown in figure 2A–1.

Sample calculation 2A–2 Estimate of average daily, monthly, and seasonal consumptive use by alfalfa at Denver, Colorado

(1) Month or period	(2) Midpoint of period	(3) Days in period	(4) Mean air temp, t (°F)	(5) Daylight hours, p (%)	(6) Cons. use factor, f	(7) Climatic coeff., k_t	(8) Growth stage coeff., k_c	(9) Cons. use coeff., k	(10) Monthly cons. use, u (in/mo)	(11) Daily cons. use, u (in/d)
April 24										
	April 27	6	51.1	1.87	0.96	0.57	1.03	0.59	0.57	0.095
May										
	May 15	31	56.3	9.99	5.62	0.66	1.08	0.71	3.99	0.129
June										
	June 15	30	66.4	10.07	6.69	0.84	1.13	0.95	6.36	0.212
July										
	July 15	31	72.8	10.20	7.43	0.95	1.11	1.05	7.80	0.252
August										
	August 15	31	71.3	9.54	6.80	0.92	1.06	0.98	6.66	0.215
September										
	Sept. 15	30	62.7	8.39	5.26	0.77	0.99	0.76	4.00	0.133
October										
	Oct. 12	25	53.5	6.31	3.38	0.61	0.91	0.56	1.89	0.076
Oct. 25										
Seasonal total									31.27 inches	

Figure 2A-15 Crop growth stage coefficient curve for pasture grasses



RICHARDSON GROVE ST PK, CALIFORNIA (047404)

Period of Record Monthly Climate Summary

Period of Record : 11/9/1961 to 8/31/2012

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	50.1	54.6	59.5	64.3	71.5	78.0	86.1	86.6	83.2	70.3	55.7	49.3	67.4
Average Min. Temperature (F)	37.3	38.5	39.5	41.0	45.3	49.9	53.1	52.9	49.3	44.7	40.9	37.5	44.2
Average Total Precipitation (in.)	13.20	10.34	8.87	4.53	1.88	0.64	0.06	0.37	0.91	3.88	9.64	13.69	68.01
Average Total SnowFall (in.)	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 98.6% Min. Temp.: 98.7% Precipitation: 99.6% Snowfall: 99.3% Snow Depth: 98.9%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

NOAA Atlas 14, Volume 6, Version 2
GARBERVILLE
Station ID: 04-3320
Location name: Redway, California, US*
Latitude: 40.1000°, Longitude: -123.8000°
Elevation:
Elevation (station metadata): 340 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular | PF graphical | Maps & aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.166 (0.147–0.190)	0.195 (0.172–0.224)	0.236 (0.207–0.271)	0.269 (0.234–0.313)	0.317 (0.265–0.383)	0.355 (0.290–0.441)	0.396 (0.313–0.505)	0.438 (0.336–0.578)	0.498 (0.364–0.690)	0.546 (0.383–0.788)
10-min	0.238 (0.210–0.273)	0.280 (0.247–0.321)	0.338 (0.296–0.388)	0.386 (0.336–0.448)	0.455 (0.380–0.550)	0.509 (0.415–0.631)	0.567 (0.449–0.724)	0.628 (0.481–0.829)	0.714 (0.521–0.989)	0.783 (0.549–1.13)
15-min	0.288 (0.254–0.330)	0.339 (0.298–0.389)	0.408 (0.358–0.470)	0.467 (0.406–0.542)	0.550 (0.459–0.665)	0.616 (0.502–0.764)	0.686 (0.543–0.875)	0.760 (0.582–1.00)	0.864 (0.630–1.20)	0.947 (0.664–1.37)
30-min	0.403 (0.355–0.461)	0.474 (0.417–0.543)	0.571 (0.501–0.657)	0.653 (0.568–0.758)	0.769 (0.642–0.930)	0.861 (0.702–1.07)	0.959 (0.759–1.22)	1.06 (0.814–1.40)	1.21 (0.881–1.67)	1.33 (0.928–1.91)
60-min	0.560 (0.494–0.641)	0.659 (0.580–0.755)	0.794 (0.697–0.913)	0.907 (0.789–1.05)	1.07 (0.892–1.29)	1.20 (0.976–1.48)	1.33 (1.06–1.70)	1.48 (1.13–1.95)	1.68 (1.23–2.33)	1.84 (1.29–2.65)
2-hr	0.873 (0.770–1.00)	1.03 (0.906–1.18)	1.24 (1.09–1.42)	1.41 (1.23–1.64)	1.65 (1.38–2.00)	1.84 (1.50–2.29)	2.04 (1.62–2.60)	2.25 (1.72–2.96)	2.53 (1.85–3.51)	2.76 (1.93–3.98)
3-hr	1.14 (1.01–1.31)	1.34 (1.18–1.54)	1.61 (1.41–1.85)	1.83 (1.59–2.13)	2.14 (1.79–2.59)	2.38 (1.94–2.95)	2.63 (2.08–3.36)	2.89 (2.21–3.81)	3.25 (2.37–4.50)	3.53 (2.47–5.08)
6-hr	1.80 (1.59–2.06)	2.12 (1.87–2.43)	2.54 (2.23–2.92)	2.89 (2.51–3.35)	3.36 (2.81–4.07)	3.73 (3.04–4.62)	4.11 (3.25–5.24)	4.50 (3.45–5.94)	5.04 (3.67–6.98)	5.46 (3.82–7.87)
12-hr	2.70 (2.38–3.09)	3.21 (2.83–3.68)	3.89 (3.41–4.47)	4.44 (3.86–5.16)	5.21 (4.35–6.30)	5.80 (4.73–7.20)	6.42 (5.08–8.19)	7.05 (5.40–9.30)	7.93 (5.78–11.0)	8.62 (6.04–12.4)
24-hr	3.94 (3.53–4.48)	4.75 (4.26–5.41)	5.82 (5.20–6.65)	6.70 (5.94–7.71)	7.90 (6.79–9.38)	8.84 (7.45–10.7)	9.80 (8.07–12.1)	10.8 (8.66–13.7)	12.2 (9.39–16.1)	13.3 (9.90–18.1)
2-day	5.48 (4.92–6.24)	6.69 (5.99–7.62)	8.24 (7.37–9.41)	9.49 (8.42–10.9)	11.2 (9.59–13.2)	12.4 (10.5–15.0)	13.7 (11.3–17.0)	15.0 (12.0–19.1)	16.7 (12.9–22.1)	18.1 (13.5–24.7)
3-day	6.67 (5.98–7.59)	8.17 (7.32–9.31)	10.1 (9.02–11.5)	11.6 (10.3–13.4)	13.6 (11.7–16.2)	15.1 (12.8–18.3)	16.6 (13.7–20.6)	18.1 (14.6–23.1)	20.1 (15.5–26.6)	21.7 (16.2–29.6)
4-day	7.48 (6.71–8.51)	9.19 (8.23–10.5)	11.4 (10.1–13.0)	13.1 (11.6–15.0)	15.3 (13.2–18.2)	17.0 (14.3–20.5)	18.6 (15.3–23.1)	20.3 (16.3–25.8)	22.4 (17.3–29.7)	24.1 (18.0–32.9)
7-day	9.38 (8.41–10.7)	11.5 (10.3–13.1)	14.1 (12.6–16.1)	16.2 (14.4–18.6)	18.9 (16.3–22.5)	20.9 (17.7–25.4)	22.9 (18.9–28.4)	24.9 (20.0–31.7)	27.5 (21.2–36.4)	29.5 (22.0–40.3)
10-day	10.8 (9.72–12.3)	13.2 (11.9–15.1)	16.2 (14.5–18.5)	18.6 (16.5–21.4)	21.7 (18.6–25.7)	23.9 (20.1–28.9)	26.1 (21.5–32.3)	28.3 (22.7–36.0)	31.1 (24.0–41.2)	33.3 (24.8–45.5)
20-day	14.3 (12.9–16.3)	17.6 (15.8–20.1)	21.6 (19.3–24.7)	24.6 (21.8–28.3)	28.5 (24.5–33.8)	31.2 (26.3–37.8)	33.8 (27.8–41.9)	36.3 (29.2–46.2)	39.5 (30.5–52.3)	41.8 (31.2–57.1)
30-day	17.4 (15.6–19.8)	21.4 (19.2–24.4)	26.2 (23.4–29.9)	29.8 (26.4–34.3)	34.2 (29.4–40.6)	37.4 (31.5–45.2)	40.3 (33.2–49.9)	43.1 (34.5–54.8)	46.5 (35.8–61.4)	48.9 (36.5–66.7)
45-day	22.7 (20.4–25.8)	27.9 (25.0–31.8)	34.1 (30.4–38.9)	38.5 (34.2–44.4)	44.0 (37.8–52.2)	47.7 (40.2–57.8)	51.2 (42.2–63.4)	54.4 (43.6–69.2)	58.2 (44.9–77.0)	60.9 (45.5–83.2)
60-day	27.0 (24.2–30.7)	33.2 (29.7–37.8)	40.3 (36.0–46.0)	45.5 (40.3–52.3)	51.6 (44.4–61.3)	55.8 (47.0–67.5)	59.5 (49.0–73.8)	63.0 (50.5–80.1)	67.1 (51.8–88.7)	69.9 (52.2–95.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

APPENDIX B

WATER SOURCE CAPACITY CALCULATIONS

SF Eel Flowrate =	152	cfs
	68217.6	gpm
10% streamflow =	6821.76	gpm
	Use 108 gpm	

Source	Capacity (gpm)	Capacity (gpd)	Capacity (gal/mo)	Potable (Y/N)
1	107.0	77,040	2,343,300	N
*2	1.4	2,002	60,882	Y
3		-	-	Y
4	2.5	1,800	54,750	Y

*No draw allowed July 2 - Oct 31

Month	No. of Days	Source 1 Capacity (pump 12 hrs/day)	Source 2 Capacity	Source 4 Capacity (pump 12 hrs/day)
January	31	2,388,240	62,050	55,800
February	28	2,157,120	56,045	50,400
March	31	2,388,240	62,050	55,800
April	30	2,311,200	60,048	54,000
May	31	2,388,240	62,050	55,800
June	30	2,311,200	60,048	54,000
July	31	2,388,240	-	55,800
August	31	2,388,240	-	55,800
September	30	2,311,200	-	54,000
October	31	2,388,240	-	55,800
November	30	2,311,200	60,048	54,000
December	31	2,388,240	62,050	55,800

GHD Inc

718 Third Street
Eureka, CA 95501

T: 707 443 8326 F: 707 444 8330 E: eureka@ghd.com

\\ghdnet\ghd\US\Eureka\Projects\12556 Southern Humboldt Community Park\8411201 SHCP WaterSupplyDemandAnalysis\04-Technical Work\03 SumMemo-Recommend\Technical Memo-rcedit.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	Stephanie Gould, EIT	Rebecca Crow, PE		Rebecca Crow, PE		9/2/2014

www.ghd.com