EXHIBIT H

Water Availability Analysis

Hibbard Ranch
c/o James Bushey
Henry Road
Napa, CA 94558

_____
James Bushey

Prepared by:

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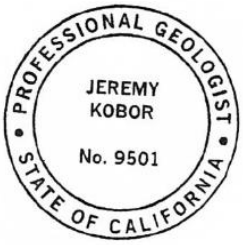

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September 26th, 2019

Contents

Introduction 1

Limitations 1

Hydrogeologic Conditions 3

Well Data 3

Geologic Cross Section 5

Project Recharge Area 6

Water Demand 7

Existing Use 7

Proposed Use 10

Groundwater Recharge Analysis 10

Comparison of Water Demand and Groundwater Recharge 12

Well Interference Analysis 12

Summary 12

Appendix A: Well Completion Reports
Appendix B: Napa County Groundwater Recharge Analysis

Introduction

Hibbard Ranch is seeking permits to expand an existing vineyard on Henry Road in Upper Carneros Creek (Napa County APN 050-380-014). The proposed project will plant an additional 34 acres of vineyard on the parcel. Most of the existing and proposed vineyards are irrigated using surface water stored in an onsite reservoir. However, some blocks of vineyard are irrigated using water from two onsite wells near the north edge of the property.

The project parcel is located approximately five miles west of the City of Napa in the County of Napa's Hillside groundwater zone (Figure 1). This Water Availability Analysis (WAA) was developed based on the guidance provided in the Napa County Department of Planning, Building, & Environmental Services' Water Availability Analysis Guidance Document formally adopted by the Napa County Board of Supervisors in May 2015. The WAA includes the following elements: estimates of existing and proposed water uses within the project recharge area, compilation of drillers' logs from the area and characterization of local hydrogeologic conditions, analyses to estimate groundwater recharge relative to proposed uses (Tier 1), and a screening analysis of the potential for well interference at neighboring wells located within 500-ft of the project well (Tier 2).

Limitations

Groundwater systems of Napa County and the Coast Range are typically complex, and available data rarely allows for more than general assessment of groundwater conditions and delineation of aquifers. Hydrogeologic interpretations are based on the drillers' reports made available to us through the California Department of Water Resources, available geologic maps and hydrogeologic studies, and professional judgment. This analysis is based on limited available data and relies significantly on interpretation of data from disparate sources of disparate quality. Existing and proposed future water use on and near the project site is estimated based on information received from the applicant and on regionally-appropriate water duties for the observed and expected uses. The recharge estimates presented below are based on established soil water balance modeling techniques for calculating infiltration recharge and they do not account for the role of surface water/groundwater interaction or bedrock geology in controlling recharge and groundwater availability.

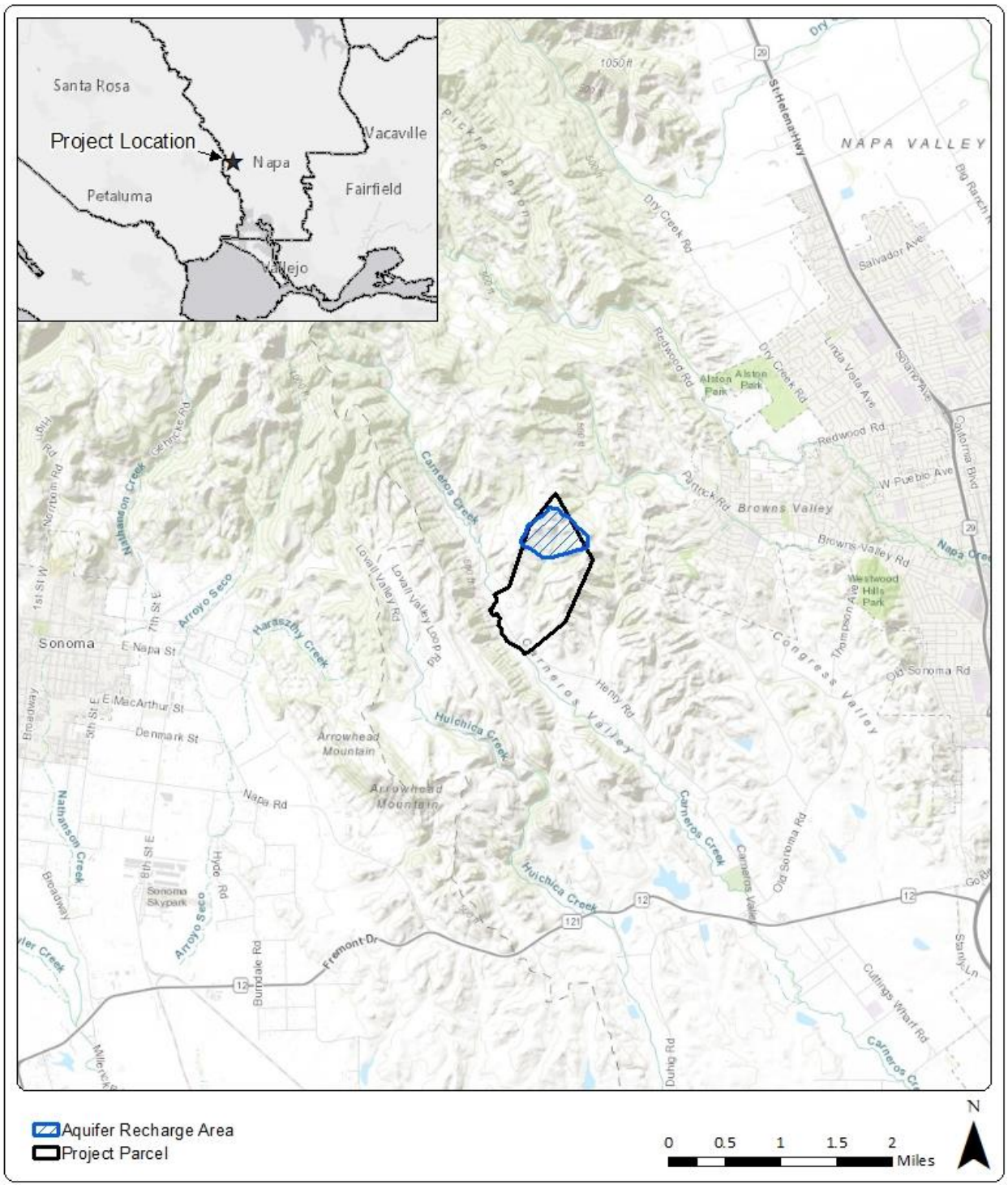

Figure 1: Project location map.

Hydrogeologic Conditions

The project parcel is located along the eastern side of the Carneros Valley. Most of the parcel, including the northern portion where the project wells are located, is underlain by a large block of the Late Jurassic to Late Cretaceous-aged Great Valley Sequence (map unit KJgv) (Figure 2). This unit consists of marine shale, sandstone, and conglomerate (Wagner and Gutierrez, 2010). The Great Valley Sequence is bounded by a northwest to southeast trending fault running through the western portion of the project parcel. This fault serves as the contact between the Great Valley Sequence and the Miocene-aged marine sandstone and mudstone (map unit Tms). While this fault is located on the project parcel, it is approximately 0.7 miles from the two project wells, a considerable distance in the low-permeability Great Valley Sequence.

In general, rocks of the Great Valley Sequence have a very low primary porosity and groundwater occurs primarily in fractures. These materials are considered low-yielding and wells typically produce only a few gallons per minute (gpm) owing to the highly deformed and well-lithified nature of the rocks (LSCE, 2013). Dry holes are also common within this formation.

Well Data

Well Completion Reports for wells near the project parcel were obtained from the California Department of Water Resources' Well Completion Report Map Application. The subset of these logs which could be accurately georeferenced based on parcel and location sketch information is discussed below and has been compiled in Appendix A. Well Completion Reports were not available for the two project wells. Details about these wells have been supplied by the applicant.

Both wells on the project parcel were completed in 2002. The first (Well 1) was completed to a depth of 270 feet and screened between 40 and 260 feet. At the time of completion, it had an estimated yield of 35 gpm and a static water level of 40 feet. The construction and conditions of the second well (Well 2) are very similar. This well was drilled to a depth of 230 feet and screened between 70 and 230 feet. At the time of completion, the well had an estimated yield of 30 gpm and a static water level of 48 feet (Table 1). Both wells are drilled in black, grey, and green shale consistent with the Great Valley Sequence.

Well Completion Reports could be accurately georeferenced for fourteen other nearby wells (Figure 2). These wells were typically completed to depths of 200 – 400 feet, with two extending to 600 feet (Wells 6 and 14). At the time of completion, most wells had static water levels of 30 – 60 feet and estimated yields of 15 – 50 gpm. However, four test holes did not encounter useable quantities of water and two successful wells have estimated yields of only one gpm. This may suggest that groundwater conditions within the Great Valley Sequence vary significantly over relatively short distances. At the time of drilling, many wells had pressure heads of between 10 and 15 feet indicating that groundwater likely occurs under confined conditions.

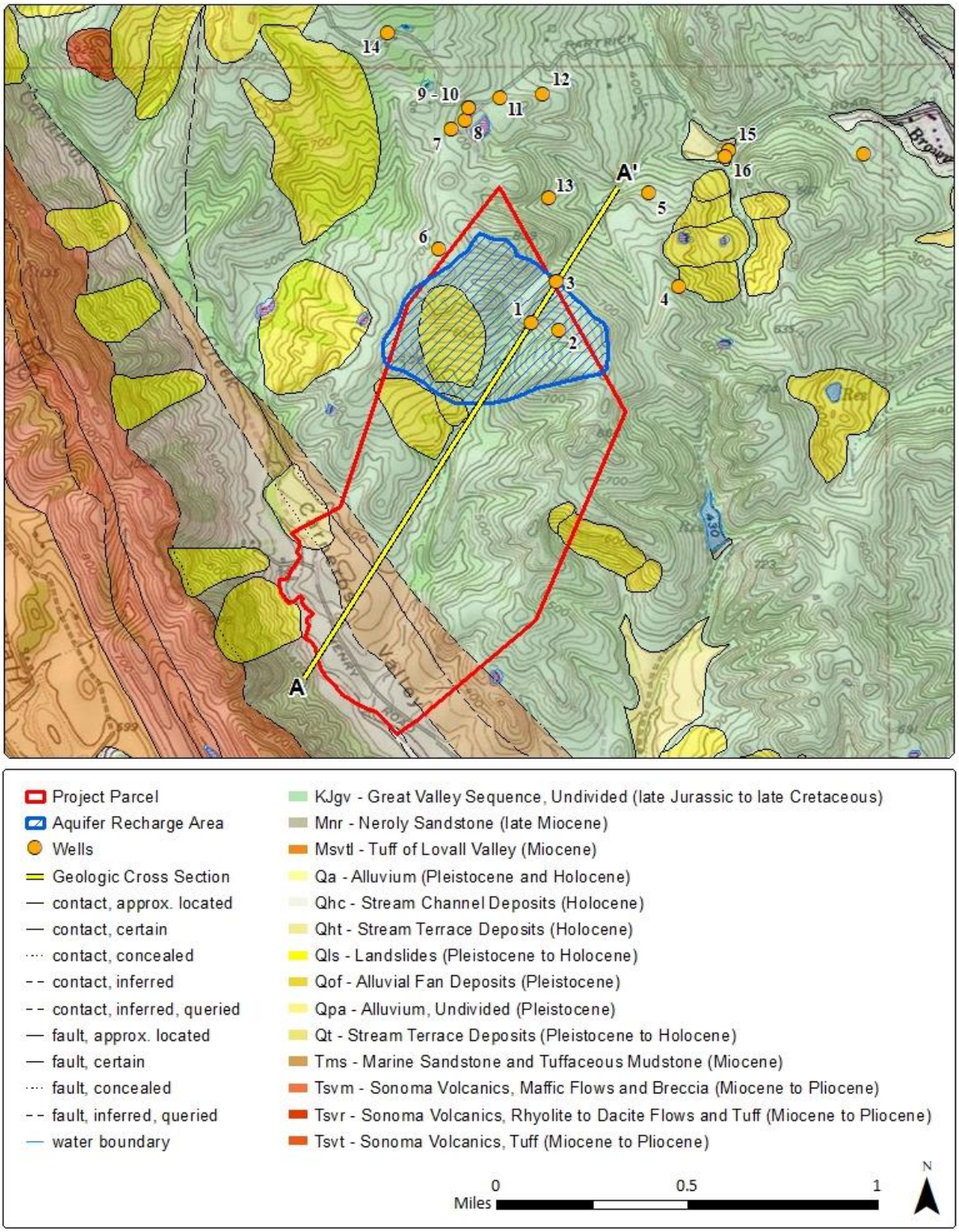

Figure 2: Surficial geology and locations of wells in the vicinity of the project parcel. Surficial geology based on data from the Preliminary Geologic Map of the Napa and Bodega Bay 30' x 60' Quadrangle (Wagner and Gutierrez, 2010). Note that the locations of Wells 3 – 5 have been reported by the applicant but that it could not be determined which Well Completion Report corresponds to which well.

Table 1: Well completion details for wells in the vicinity of the project parcel.

Well ID	1	2	3	4	5	6	7	8
Year Filed	2002	2002	2009	2009	2009	2004	2004	2000
Depth (ft)	270	230	300	240	200	600	360	260
Estimated Yield (gpm)	35	30	15	50	25	0	1	38
Static Water Level (ft)	40	48	60	50	40	N/A	Unk.	4
Top of Casing (ft)	40	70	80	60	40	Test Hole	Test Hole	38
Bottom of Casing (ft)	260	230	300	240	200	Test Hole	Test Hole	158
Geologic Map Unit	KJgv	KJgv	KJgv	KJgv	KJgv	KJgv	KJgv	KJgv

Well ID	9	10	11	12	13	14	15	16
Year Filed	2007	2015	1999	2004	2012	2010	1991	1991
Depth (ft)	360	300	400	400	217	600	300	220
Estimated Yield (gpm)	1 - 2	40	75	15	20	1	0	0
Static Water Level (ft)	Unk.	58	34	40	20	142	N/A	N/A
Top of Casing (ft)	60	70	27	50	37	118	Test Hole	Test Hole
Bottom of Casing (ft)	360	270	367	400	217	558	Test Hole	Test Hole
Geologic Map Unit	KJgv	KJgv	KJgv	KJgv	KJgv	KJgv	KJgv	KJgv

Geologic Cross Section

A geologic cross-section oriented southwest to northeast is shown in Figure 3 (see Figure 2 for location). Elevations along this cross-section range from close to 300 feet near Carneros Creek to more than 700 feet near the project wells. Little information is available about the geology near these wells but the few available Well Completion Reports indicate a relatively homogenous mixture of shale and sandstone. From the limited information available, static water levels suggest that groundwater elevations mimic surface topography.

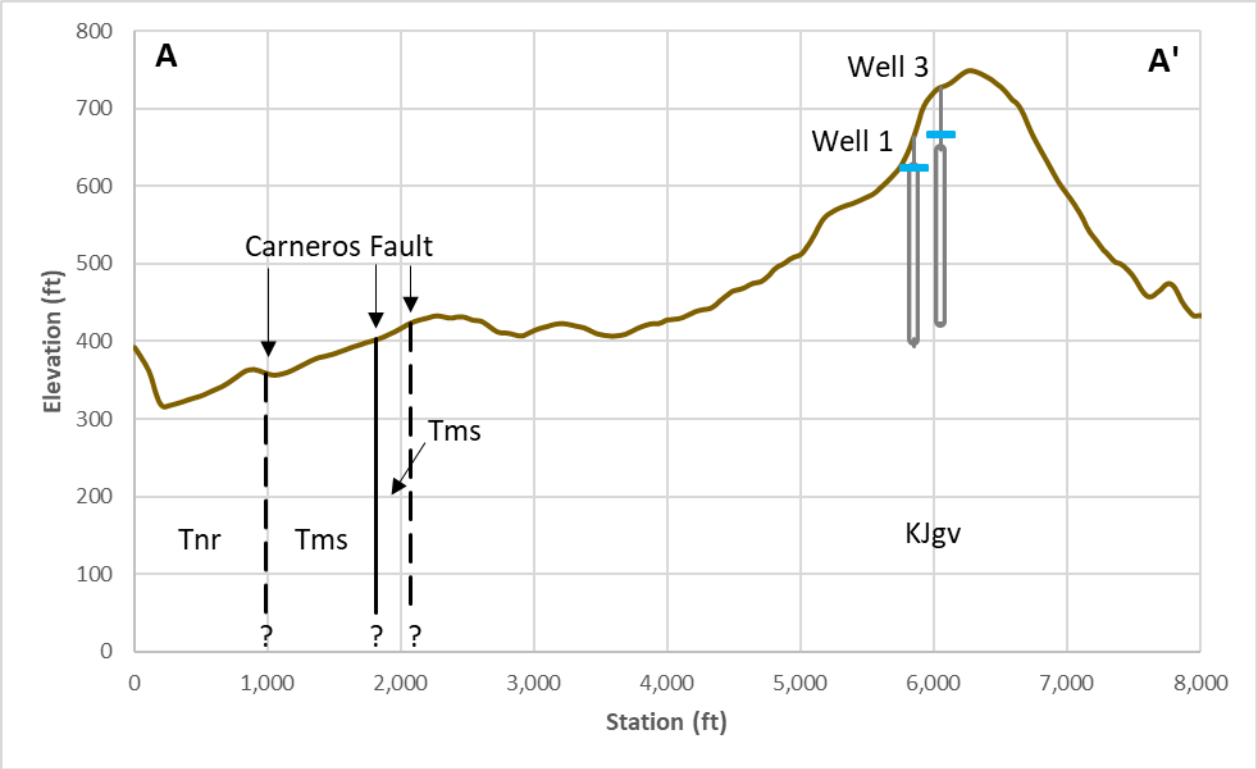

Figure 3: Hydrogeologic cross section A -A' through the project parcel (see Figure 2 for location and geologic map units). Note that the faults are shown as vertical however the actual orientation of the faults is unknown.

Project Recharge Area

The project aquifer is conceptualized to lie entirely within the Great Valley Sequence. Given the relative uniformity of static water levels in the vicinity of the project well, the area recharging this aquifer was defined based on surface topography and drainage patterns. The northern, eastern, and western boundaries of the recharge area are defined by prominent ridgelines which likely function as groundwater divides. The southern boundary is defined by two spur ridges which define the drainage the project well is located in. The total area of the project recharge area is 110 acres, all of which is underlain by the Great Valley Sequence. Given the clay-rich nature of the Great Valley Sequence and the occurrence of pressure heads in wells, the aquifer is likely confined or semi-confined.

Water Demand

Within the project recharge area, water demand was estimated for both the existing and proposed conditions. Uses on the project parcel were determined using site details provided by the project applicant and verified using satellite imagery. Uses on other neighboring parcels within the project recharge area were determined using satellite imagery and the County of Napa's Public Winery Database. Irrigation rates for vineyards on the project parcel were estimated using data provided by the project applicant. All other water use rates were estimated using data from the County of Napa's Water Availability Analysis Guidance Document dated May 12, 2015.

Existing Use

In the existing condition, there are 102.9 acres of vineyard on the project parcel. Most of these are irrigated using surface water stored in a larger reservoir near the western edge of the project parcel. Only 4.6 acres of vineyard, mostly along the eastern edge of the project parcel, are irrigated using groundwater from the project well (Figure 4). These vineyards are irrigated with groundwater due to specific language in the property's water right which prohibits irrigation with surface water in these sections.

For the 2011 – 2016 growing seasons, the applicant estimates that these vineyards were irrigated at an average rate of 0.19 acre-ft/acre/yr. This rate was estimated by dividing the net volume of water depleted from the storage reservoir by the total acreage of vineyard on the project parcel irrigated with surface water. Irrigation rates for vineyard blocks irrigated with groundwater were assumed to be equivalent. It should be noted that water is conserved using a series of subsurface drains which return excess irrigation water back to the pond. As such, the gross irrigation rate may be higher than net use.

Portions of a neighboring parcel to the east (APN 050-030-025) are also included in the project recharge area. To be conservative, all uses on this parcel were included in the water use calculations. Based on satellite imagery dated September 1st, 2018, this neighboring parcel contains approximately 6.0 acres of vineyard, 0.6 acres of orchard, a primary residence, and a pool. It also contains a winery. Per the County's Public Winery Database, this winery is permitted to produce up to 10,000 gallons per year, have two full-time employees, and have up to 110 guests per year at marketing events. This winery/residence has significant landscaping beyond what is included in the water use estimates for either the primary residence or winery landscaping. As such, water use for this landscaping has been calculated separately.

In total, estimated existing groundwater water use within the project recharge area is estimated to be 7.78 acre-ft/yr (Table 2). Of this, 0.87 acre-ft/yr comes from the project parcel (Table 3) and the remainder comes from the neighboring parcel to the east (Table 4).

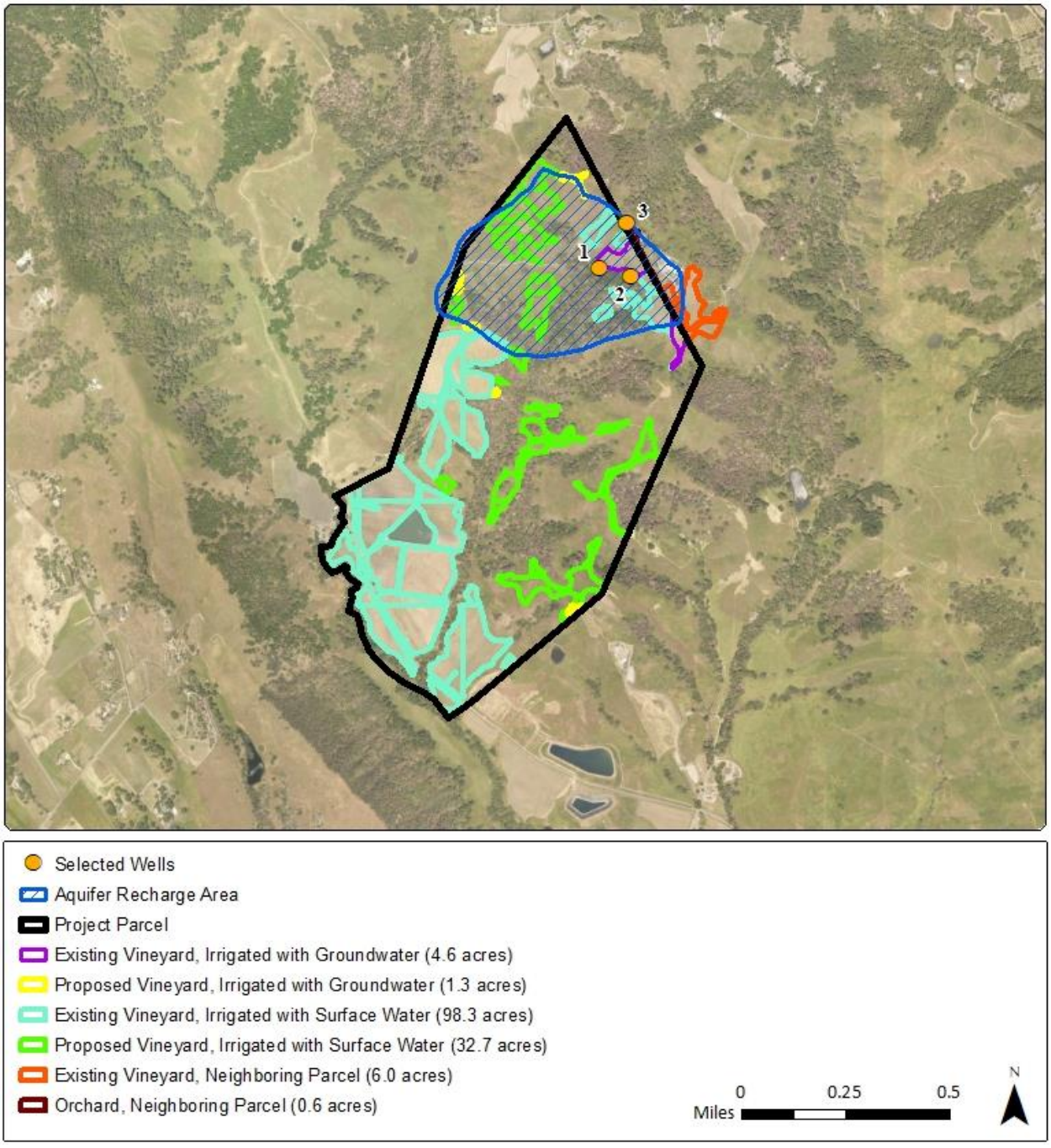

Figure 4: Location of water uses on project parcel and neighboring parcel to the east (APN 050-030-025).

Table 2: Estimated groundwater use within the project recharge are in the existing and proposed conditions.

	Existing Condition (acre-ft/yr)	Proposed Condition (acre-ft/yr)
Project Parcel	**0.87**	**1.12**
Irrigation Use	0.87	1.12
Neighboring Parcels	**6.91**	**6.91**
Residential Use	1.21	1.21
Irrigation Use	5.40	5.40
Winery Use	0.27	0.27
Employee/Guest Use	0.03	0.03
Total	**7.78**	**8.03**

Table 3: Estimated groundwater uses on the project parcel in the existing condition.

	# of Units	Use per Unit	Annual Water Use (AF/yr)
Agricultural Use			**0.87**
Vineyard	4.6 Acres	0.19 AF/acre/yr	0.87
Total			**0.87**

Table 4: Estimated groundwater uses on neighboring parcels within the project recharge area in the existing and proposed conditions.

	# of Units	Use per Unit	Annual Water Use (AF/yr)
Residential Use			**1.21**
Residences, Primary	1 Residence	0.75 AF/Residence	0.75
Pools	1 Pool	0.10 AF/Pool	0.10
Lawn, Additional	19000 sq. ft.	0.10 AF/10,000 sq. ft.	0.19
Other Landscaping, Addtl.	34000 sq. ft.	0.05 AF/10,000 sq. ft.	0.17
Agricultural Use			**5.40**
Vineyard	6 Acres	0.50 AF/acre/yr	3.00
Orchard, Irrigated	0.6 Acres	4.00 AF/acre/yr	2.40
Winery Use			**0.27**
Process Water	10000 Gallons	2.15 AF/100,000 gal.	0.22
Domestic & Landscaping	10000 Gallons	0.50 AF/100,000 gal.	0.05
Guest & Employee Use			**0.03**
Events w/ On-Site Catering	110 Guests	15 gal./Guest	0.01
Full-Time Employees	2 Employees	15 gal./shift @ 250 shifts/yr	0.02
Total			**6.91**

Proposed Use

In the proposed condition, an additional 34.0 acres of vineyard will be planted on the project parcel. Of this, 1.3 acres will be irrigated using groundwater. Sufficient water is stored in the pond to irrigate all of the proposed vineyard. However, due to language in the property's water right, water from the reservoir may not be used in certain sections. No other water uses are proposed as part of this project.

The project is estimated to increase groundwater use on the parcel by 0.25 acre-ft/yr to 1.12 acre-ft/yr (Table 5). Total water use within the project recharge area is estimated to increase to 8.03 acre-ft/yr.

Table 5: Estimated proposed water demand from the project parcel.

	# of Units	Use per Unit	Annual Water Use (AF/yr)
Agricultural Use			**1.12**
Vineyard	5.9 Acres	0.19 AF/acre/yr	1.12
Total			**1.12**

Groundwater Recharge Analysis

Groundwater recharge within the project recharge area was estimated using a Soil Water Balance (SWB) of Napa County developed by OEI. This model implements the U.S. Geologic Survey's SWB modeling software and produces a spatially distributed estimate of annual recharge. This model operates on a daily timestep and calculates runoff based on the Natural Resources Conservation Service (NRCS) curve number approach and Actual Evapotranspiration (AET) and recharge based on a modified Thornthwaite-Mather soil-water-balance approach (Westenbroek et al., 2010). Details of this model are included in Appendix B.

Groundwater recharge was simulated for two water years. The first, Water Year 2010, was selected to represent average year conditions because annual precipitation totals across most of Napa County were close to their long-term 30-year averages. The second, Water Year 2014, was selected to represent drought conditions because annual precipitation totals were between 41 and 73% of long-term 30-year averages for much of Napa County.

During Water Year 2010, precipitation averaged 35.1 inches across the project recharge area and actual evapotranspiration (AET) averaged 21.6 inches. Simulated groundwater recharge varied from 3.8 to 11.2 inches across the recharge area, with a spatial average of 8.4 inches. During Water Year 2014, precipitation averaged 22.5 inches across the project recharge area and actual evapotranspiration averaged 16.5 inches. Groundwater recharge varied from close to zero to 5.4 across the recharge area with a spatial average of 3.1 inches (Table 6). Averaged across the project parcel, the water budget is similar to the average across the recharge area with recharge averaging 8.1 inches in Water Year 2010 and 2.8 inches in Water Year 2014 (Table 7).

Groundwater recharge estimates can also be expressed as a total volume by multiplying the estimated recharge rate by a representative area. For the 110-acre project recharge area, these calculations yield and estimated total recharge of 28.4 acre-ft/yr during the drought conditions of water year 2014 and of 77.0 acre-ft/yr for the average water year of 2010 (Table 8). For the 439 acre-project parcel, these calculations yield an estimated total recharge of 296.3 AF/yr of recharge for Water Year 2010 and 102.4 AF/yr in Water Year 2014.

Table 6: Summary of water balance results for the project recharge area estimated by the SWB model.

	2010 Normal Year		2014 Dry Year	
	inches	% of precip	inches	% of precip
Precipitation	35.1	-	22.5	-
AET	21.6	62%	16.5	73%
Runoff	5.8	17%	7.0	31%
Δ Soil Moisture	-0.7	-2%	-4.1	-18%
Recharge	8.4	24%	3.1	14%

Table 7: Summary of water balance results for the project parcel estimated by the SWB model.

	2010 Normal Year		2014 Dry Year	
	inches	% of precip	inches	% of precip
Precipitation	35.2	-	22.5	-
AET	22.0	63%	16.9	75%
Runoff	5.8	16%	6.9	31%
Δ Soil Moisture	-0.7	-2%	-4.1	-18%
Recharge	8.1	23%	2.8	12%

Water budget estimates are available for several nearby watersheds including Dry Creek and Napa Creek. Average annual recharge for these two watersheds is estimated to be 6% and 11% of average annual precipitation (LSCE, 2013). Regional estimates are also available for the Napa River watershed, the Santa Rosa Plain, Sonoma Valley, and the Green Valley Creek watershed. Comparisons to these water budgets are useful for determining the overall reasonableness of the results although one would not expect precise agreement owing to significant variations in climate, land cover, soil types, and underlying hydrogeologic conditions. It should also be noted that the project recharge area comprises a small, upland area where recharge may be higher and more spatially variable than on a watershed scale. These regional analyses estimated that mean annual recharge was equivalent to between 7% and 28% of mean annual precipitation (Farrar et. al., 2006; Flint and Flint 2014, Kobor and O'Connor, 2016; Wolfenden and Hevesi, 2014). The

simulated water year 2010 groundwater recharge for the project recharge area represents approximately 24% (Tables 6 & 7) of the precipitation which is near the upper end of the range of these regional estimates.

Comparison of Water Demand and Groundwater Recharge

The total proposed groundwater use for the project recharge area is estimated to be 8.0 acre-ft/yr, 1.1 acre-ft/yr of which will originate on the project parcel. Groundwater use in the project recharge area is equivalent to 10% of the estimated average water year groundwater recharge of 46.3 acre-ft/yr and 28% of the estimated dry water year recharge of 11.2 acre-ft/yr (Table 8). Water use on the project parcel is equivalent to <1% of the estimated recharge occurring on the project parcel during average water years and 1% of the estimated recharge during dry water years such as 2014. Given the magnitude of these surpluses, water use associated with the proposed vineyard expansion is highly unlikely to result in reductions in groundwater levels or depletion of groundwater resources over time.

Table 8: Comparison of proposed water use to average and dry year groundwater recharge for the project recharge area and for the project parcel.

Domain	Total Proposed Demand (ac-ft/yr)	Average Water Year (2010)			Dry Water Year (2014)		
		Recharge (ac-ft/yr)	Recharge Surplus (ac-ft/yr)	Demand as % of Recharge	Recharge (ac-ft/yr)	Recharge Surplus (ac-ft/yr)	Demand as % of Recharge
Project Recharge Area	8.0	77.0	69.0	10%	28.4	20.4	28%
Project Parcel	1.1	296.3	295.2	<1 %	102.4	101.3	1%

Well Interference Analysis

There are no neighboring wells within 500 feet of the either of the project wells (Wells 1 & 2). The nearest well, Well 3, is located approximately 670 feet northeast of Well 1 and 660 feet north of Well 2. Based on the WAA guidance document, a Tier 2 well interference analysis is not required given that all non-project wells are located greater than 500-feet from the project wells.

Summary

Application of the Soil Water Balance model (SWB) to the project parcel revealed that average water year recharge was approximately 8.1 inches/yr or 296.3 acre-ft/yr. During drought conditions, recharge was significantly lower at 2.8 inches/yr or 102.4 acre-ft/yr. The total proposed groundwater use on the project parcel is estimated to be 1.1 acre-ft/yr. This represents less than 1% of the mean annual recharge indicating that the project is unlikely to result in declines in groundwater elevations or depletion of groundwater resources over time. The nearest neighboring well is located more than 500-ft from either of the project wells indicating that a Tier 2 well interference analysis is not required.

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APPENDIX A

WELL COMPLETION REPORTS

Well 1

CUSTOMER #: S101
NAME: Sattui Vineyards
STREET: Henry Road
CITY: Napa
WELL LOCATION: #1

HOME PHONE:
WORK PHONE:
OTHER PHONE:

COMMENTS:

WELL #: A P #: 050-380-014
CLASS: 1 DEPTH: 270'
CASING SIZE AND TYPE: 6" pvc
CASING DEPTH: 260'
PERF: 40'-260' SEAL: 27'
STATIC LEVEL: 40'
DRAWDOWN: 140' AFTER: 2 hours
YIELD: 35 gpm TESTED: air
TEST PIPE SETTING: 4"-260'
EQUIPMENT: TH60
WELL DRILLED DATE: 11/06/02
WELL CLEANED DATE:
CLEANED WELL FROM:
BOOSTER PUMP:
STORAGE TANK:

BACKFLOW MAKE PSI:
BF SERIAL #: BF MODEL:

LOCATION:

PURPOSE:
WELL LOG:
0 - 3 topsoil
3 - 30 gray brown rock
30 - 50 gray rock stringers gray hard shale
50 - 70 gray rock stringers hard gray shale
70 - 90 gray & black rock soft
90 - 110 gray rock stringers hard gray shale
110 - 130 gray & black rock soft
130 - 150 hard gray shale stringers white rock
150 - 210 hard gray shale stringers gray black&white rock

PUMP MAKE: Grundfos
PUMP TYPE: submersible
PUMP MODEL 16S30-24
HP: 3 VOLT 230 PH: 1
PUMP SERIAL #: P1031GUS
WARRANTY:
PUMP INSTALL DATE: 05/04/03
PUMP SETTING: 231'
CHECK VALVE(S): 1
PUMP SAVER: 233
PIPE SIZE: 1 1/4" TYPE / SCH: galv
WIRE: #10-3wg
PRESSURE TANK:
TANK INSTALL DATE:
OPEN DISCHARGE DATE:
LAB WORK Boron 1.1

METER #:
BF SIZE:

GENERAL INFORMATION:
11-06-02 draw&deliver boron sample
06-04-03 finish panel at 1st well,install plumbing&panel at upper well concrete riser
06-05-03 finish riser at upper well,finish electrical,test both wells, leave lower well running

Well 1, Cont.

210 - 260 hard gray shale stringers white&black rock

260 - 270 soft & hard gray shale

#1

Well 2

CUSTOMER #: S101
NAME: V. Sattui Vineyards
STREET: Henry Road
CITY: Napa
WELL LOCATION:
first well past gate#2

#2

HOME PHONE:
WORK PHONE:
OTHER PHONE:

COMMENTS:

WELL #:
CLASS: 1
CASING SIZE AND TYPE: 6" PVC
CASING DEPTH: 230'
PERF: 70'-230'
STATIC LEVEL: 48'
DRAWDOWN: 200'
YIELD: 30 gpm
TEST PIPE SETTING:
EQUIPMENT: TH60
WELL DRILLED DATE: 07/04/02
WELL CLEANED DATE:
CLEANED WELL FROM:
BOOSTER PUMP:
STORAGE TANK:

A.P.#: 050-380-014
DEPTH: 250'
SEAL: 24'
AFTER: 3 hrs
TESTED: air

PUMP MAKE: Grundfos
PUMP TYPE: submersible
PUMP MODEL: 16S30-24
H.P.: 3 VOLT 230 PH: 1
PUMP SERIAL #: P10318US
WARRANTY:
PUMP INSTALL DATE: 06/03/03
PUMP SETTING: 210'
CHECK VALVE(S): 1
PUMP SAVER:
PIPE SIZE: 1 1/4" TYPE / SCH: galv
WIRE: #10-3wg
PRESSURE TANK:
TANK INSTALL DATE:
OPEN DISCHARGE DATE:
LAB WORK: irrigation(free?)

BACKFLOW MAKE
BF SERIAL #:
PSI:
BF MODEL:
METER #:
BF SIZE:

LOCATION:

PURPOSE:
WELL LOG:
0 - 3 topsoil
3 - 30 brown clay & soil
30 - 50 hard gray shale
50 - 70 hard shale gray
70 - 90 hard shale stringers black & gray rock
90 - 110 hard shale stringers green black gray rock
110 - 130 hard gray shale stringers gray rock
130 - 150 hard gray shale stringers gray rock
150 - 170 hard gray shale

GENERAL INFORMATION:
07-08-02 irrigation sample
06-03-03 remove steel casing&pad,set pump&do plumbing
remove concrete&casing at other well,install goose neck at well heads

Well 2, Cont.

170 - 190 hard gray shale

190 - 210 hard gray shale

#2

210 - 230 hard gray shale

230 - 250 hard & soft gray shale

Well 3

File with DWR

Page ___ of ___

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 1073673

DWR USE ONLY — DO NOT FILL IN

OS NO SIN

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

Owner's Well No. 6-2-09

Date Work Began 6-2-09, Ended 6-8-09

Local Permit Agency Napa County

Permit No. E09-00193 Permit Date 6-1-09

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD rotary FLUID Mud

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0 80	clay
80 210	Shale, broken up sandstone
210 300	Shale, hard layers of rock

TOTAL DEPTH OF BORING 300 (Feet)

TOTAL DEPTH OF COMPLETED WELL 300 (Feet)

WELL LOCATION

Address 30 Irene

City Napa

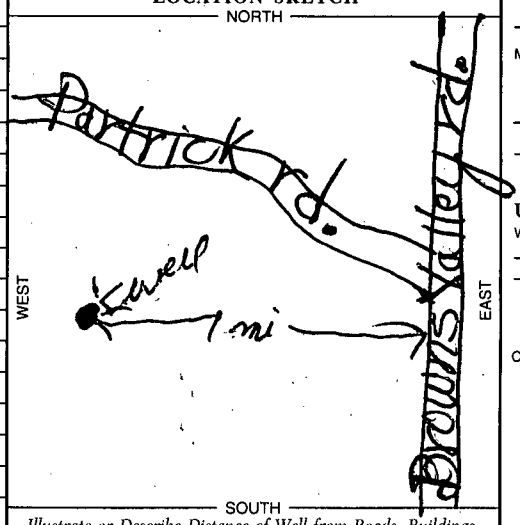
County Napa

APN Book ___ Page ___ Parcel 050-030-025

Township ___ Range ___ Section ___

Lat ___ N DEG. MIN. SEC. Long ___ W DEG. MIN. SEC.

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR

___ Deepen

___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

USES (✓)

WATER SUPPLY

X Domestic ___ Public

X Irrigation ___ Industrial

___ MONITORING

___ TEST WELL

___ CATHODIC PROTECTION

___ HEAT EXCHANGE

___ DIRECT PUSH

___ INJECTION

___ VAPOR EXTRACTION

___ SPARGING

___ REMEDIATION

___ OTHER (SPECIFY)

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 80 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 60 (Ft.) & DATE MEASURED 6-8-09

ESTIMATED YIELD * 15 (GPM) & TEST TYPE AIR LIFT

TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0 25	11"	X				PLASTIC	5"	200	
25 80	8"	X				"	"	"	
80 300	8"	FACT				PERF "	"	"	5/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0 25	X			
25 300	WELL PACK			

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Pulliam Well Drilling (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2877 Piedmont Av. CITY Napa STATE Ca. ZIP 94558

Signed Bill Pulliam C-57 LICENSED WATER WELL CONTRACTOR

DATE SIGNED 6-18-09 C-57 LICENSE NUMBER 748677

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

OSP 03 78836

Well 4

File with DWR

Page ___ of ___

Owner's Well No. ___

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 1073674

DWR USE ONLY — DO NOT FILL IN

D S N D S W

STATE WELL NO./STATION NO.

LATITUDE ___ LONGITUDE ___

APN/TRS/OTHER ___

Date Work Began 5-25-09 Ended 6-1-09

Local Permit Agency Napa County

Permit No. E08-00507 Permit Date 9-11-08

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD rotary FLUID Mud

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0 60	Clay
60 180	Shale Broken up Sandstone
180 240	Shale

TOTAL DEPTH OF BORING 240 (Feet)

TOTAL DEPTH OF COMPLETED WELL 240 (Feet)

WELL LOCATION

Address Same

City Napa

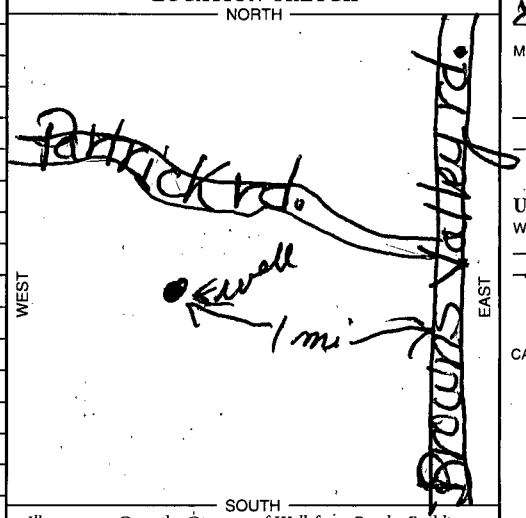
County Napa

APN Book ___ Page ___ Parcel 050-030-025

Township ___ Range ___ Section ___

Lat ___ N DEG. MIN. SEC. Long ___ W DEG. MIN. SEC.

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

USES (✓)

WATER SUPPLY
X Domestic ___ Public
X Irrigation ___ Industrial

___ MONITORING
___ TEST WELL
___ CATHODIC PROTECTION
___ HEAT EXCHANGE
___ DIRECT PUSH
___ INJECTION
___ VAPOR EXTRACTION
___ SPARGING
___ REMEDIATION
___ OTHER (SPECIFY)

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 60 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 50 (Ft.) & DATE MEASURED 6-1-09

ESTIMATED YIELD * 50 (GPM) & TEST TYPE AIR LIFT

TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN 200 (Ft.)

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0 53	11"	X				PLASTIC	5"	200	
53 60	8"	X				"	"	"	
60 240	8"		FACT			PERF	"	"	3/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0 53	X			
53 240				GRAVEL PACK

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Pulliam Well Drilling (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2877 Piedmont Av. CITY Napa STATE Ca ZIP 94558

Signed Bill Pulliam C-57 LICENSED WATER WELL CONTRACTOR

DATE SIGNED 6-18-09

C-57 LICENSE NUMBER 748677

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

OSP 03 78836

Well 5

File with DWR

Page ___ of ___

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 1073675

DWR USE ONLY — DO NOT FILL IN

0 S N 0 5 W

STATE WELL NO./STATION NO.

LATITUDE | LONGITUDE

APN/TRS/OTHER

Owner's Well No. ___

Date Work Began 5-19-09 Ended 5-22-09

Local Permit Agency Napa County

Permit No. E08-00830 Permit Date 9-11-08

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD rotary FLUID Mud

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0 50	Clay
50 150	Shale, streaks of broken up shale & sandstone
150 200	Shale

TOTAL DEPTH OF BORING 200 (Feet)

TOTAL DEPTH OF COMPLETED WELL 200 (Feet)

WELL LOCATION

Address Same

City Same

County Napa

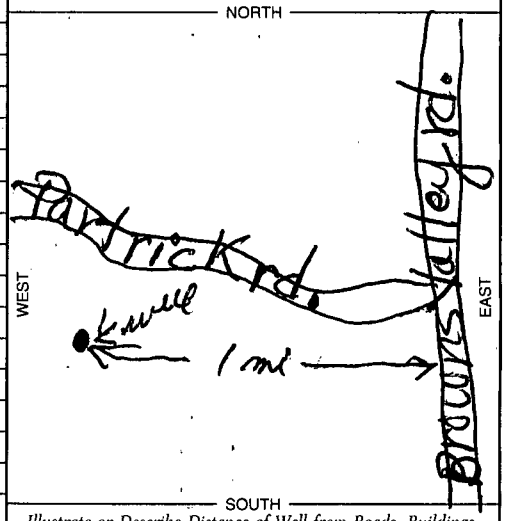
APN Book ___ Page ___ Parcel 050-030-025

Township ___ Range ___ Section ___

Lat ___ N DEG. MIN. SEC. Long ___ W DEG. MIN. SEC.

LOCATION SKETCH

NORTH



SOUTH

*Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR

___ Deepen

___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

USES (✓)

WATER SUPPLY

X Domestic ___ Public

X Irrigation ___ Industrial

___ MONITORING

___ TEST WELL

___ CATHODIC PROTECTION

___ HEAT EXCHANGE

___ DIRECT PUSH

___ INJECTION

___ VAPOR EXTRACTION

___ SPARGING

___ REMEDIATION

___ OTHER (SPECIFY)

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 50 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 40 (Ft.) & DATE MEASURED 5-22-09

ESTIMATED YIELD * 25 (GPM) & TEST TYPE Air Lift

TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN 180 (Ft.)

** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0 25	11"	X				PLASTIC	5"	200	
25 40	8"	X				"	"	"	
40 200	8"					FACT PREF	"	"	3/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0 25	X			
25 200	WELL	PACK		

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Fulljam Well Drilling (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2877 Piedmont Rd. Napa, Ca. 94558

ADDRESS CITY STATE ZIP

Signed Bill Fulljam C-57 LICENSED WATER WELL CONTRACTOR

6-18-09 DATE SIGNED

748677 C-57 LICENSE NUMBER

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

OSP 03 78836

Well 6

File with DWR

Page 1 of 1

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. e012096

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./ STATION NO. 05N05W02

LATITUDE

LONGITUDE

APN/TRS/OTHER

Owner's Well No. TW#1-'04

Date Work Began 4/27/2004, Ended 5/4/2004

Local Permit Agency Napa County Environmental Mgmt

Permit No. 96-12655 Permit Date 4/28/2004

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL — HORIZONTAL — ANGLE — (SPECIFY)

DRILLING METHOD ROTARY FLUID AIR

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	35	BROWN CLAY
35	175	70%SHALE/ 30% CLAY
175	240	60% CLAY/ 40% SHALE
240	265	50% SHALE/ 50% CLAY
265	280	SANDSTONE
280	400	60% SHALE/ 40% CLAY
400	600	60% CLAY/ 40% SHALE
		BACKFILLED TEST HOLE WITH PEA GRAVEL
		TO 30'. INSTALLED CONCRETE TO 3'.
		TOPPED WITH NATURAL MATERIAL.

TOTAL DEPTH OF BORING 600 (Feet)

TOTAL DEPTH OF COMPLETED WELL (Feet)

WELL LOCATION

Address 1727 Partrick Road

City Napa CA

County Napa

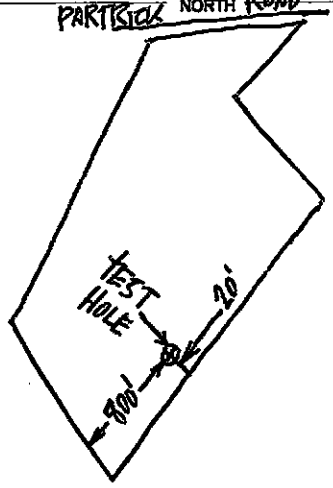
APN Book 50 Page 010 Parcel 13

Township Range Section

Latitude DEG. MIN. SEC.

DEG. MIN. SEC.

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR

— Deepen

— Other (Specify)

— DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG"

PLANNED USES (✓)

WATER SUPPLY

— Domestic — Public

— Irrigation — Industrial

— MONITORING

✓ TEST WELL

— CATHODIC PROTECTION

— HEAT EXCHANGE

— DIRECT PUSH

— INJECTION

— VAPOR EXTRACTION

— SPARGING

— REMEDIATION

— OTHER (SPECIFY)

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL (Ft.) & DATE MEASURED

ESTIMATED YIELD * (GPM) & TEST TYPE

TEST LENGTH (Hrs.) TOTAL DRAWDOWN (Ft.)

May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	600	9								

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	3			✓	SOIL
3	30	✓			CONCRETE
30	600			✓	PEA GRAVEL

ATTACHMENTS (✓)

— Geologic Log

— Well Construction Diagram

— Geophysical Log(s)

— Soil/Water Chemical Analysis

— Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME HUCKFELDT WELL DRILLING
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2110 Penny Lane ADDRESS — Napa CITY — CA STATE — 94559 ZIP

Signed WELL DRILLER/AUTHORIZED REPRESENTATIVE — 05/11/04 DATE SIGNED — 439-746 C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Well 7

ORIGINAL
File with DWR

Page 1 of 1

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. e012097

DWR USE ONLY — DO NOT FILL IN
05N05W02
STATE WELL NO./ STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. TW#2-'04
Date Work Began 4/30/2004, Ended 5/4/2004
Local Permit Agency Napa County Environmental Mgmt
Permit No. 96-12659 Permit Date 5/3/2004

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL — HORIZONTAL — ANGLE — (SPECIFY)
DRILLING METHOD ROTARY FLUID AIR

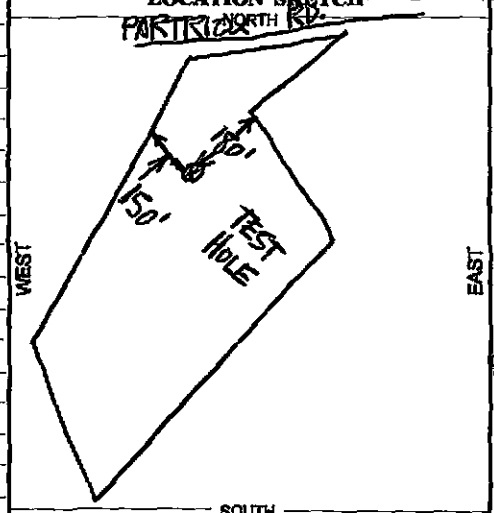
DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0 – 25	BROWN CLAY
25 – 40	85% CLAY/ 15% SHALE
40 – 70	GRAY SANDY CLAY
70 – 90	HARD SHALE
90 – 125	SANDSTONE
125 – 215	SHALE
215 – 240	SHALE & CLAY
240 – 260	SHALE
260 – 265	SANDSTONE
265 – 360	SHALE & CLAY
	BACKFILLED TEST HOLE WITH PEA GRAVEL TO 36'. INSTALLED BENTONITE CHIPS TO 28'. CONCRETE TO 3'. TOPPED WITH NATURAL MATERIAL.

TOTAL DEPTH OF BORING 360 (Feet)
TOTAL DEPTH OF COMPLETED WELL ____ (Feet)

WELL LOCATION

Address 1727 Partrick Road
City Napa CA
County Napa
APN Book 50 Page 010 Parcel 13
Township ____ Range ____ Section ____
Latitude ____ DEG. MIN. SEC. ____ DEG. MIN. SEC.

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)
✓ NEW WELL
MODIFICATION/REPAIR
— Deepen
— Other (Specify)
— DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)
WATER SUPPLY
— Domestic — Public
— Irrigation — Industrial
MONITORING —
TEST WELL ✓
CATHODIC PROTECTION —
HEAT EXCHANGE —
DIRECT PUSH —
INJECTION —
VAPOR EXTRACTION —
SPARGING —
REMEDIATION —
OTHER (SPECIFY) —

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 150 (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ____ (Ft.) & DATE MEASURED ____
ESTIMATED YIELD * 1 (GPM) & TEST TYPE air lift
TEST LENGTH 1 (Hrs.) TOTAL DRAWDOWN N/A (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0 – 360	9								

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0 – 3			✓	SOIL
3 – 28	✓			CONCRETE
28 – 36		✓		CHIPS
36 – 360			✓	PEA GRAVEL

ATTACHMENTS (✓)
— Geologic Log
— Well Construction Diagram
— Geophysical Log(s)
— Soil/Water Chemical Analysis
— Other ____
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME HUCKFELDT WELL DRILLING
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
2110 Penny Lane ADDRESS — Napa CITY — CA STATE — 94559 ZIP
Signed ____ WELL DRILLER/AUTHORIZED REPRESENTATIVE — 05/06/04 DATE SIGNED — 439-746 C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

WW

Well 8

Owner's Copy

Page 1 of 1

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

Owner's Well No. _____ No. 781561

Date Work Began 6-15-00, Ended 6-19-00

Local Permit Agency Napa County Environmental Mgmt.

Permit No. 96-11458 Permit Date 2-29-00

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD rotary FLUID air

DEPTH FROM SURFACE FT.	to FT.	DESCRIPTION *Describe material, grain size, color, etc.*
0	22	brown clay
22	45	shale
45	60	sandstone
60	120	shale
120	135	sandstone
135	260	shale & clay

TOTAL DEPTH OF BORING: 260 (Feet)

TOTAL DEPTH OF COMPLETED WELL 158 (Feet)

WELL OWNER

Name Donald Cutler

Mailing Address 1717 Partrick Rd.

CITY Napa STATE CA ZIP 94558

WELL LOCATION

Address same

City

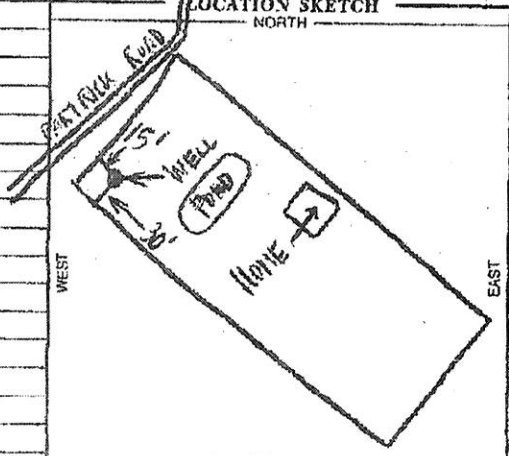
County Napa

APN Book 50 Page 010 Parcel 18

Township ___ Range ___ Section ___

Latitude ___ DEG. MIN. SEC. NORTH Longitude ___ DEG. MIN. SEC. WEST

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR

___ Deepen

___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY

X Domestic ___ Public

X Irrigation ___ Industrial

___ MONITORING

___ TEST WELL

___ CATHODIC PROTECTION

___ HEAT EXCHANGE

___ DIRECT PUSH

___ INJECTION

___ VAPOR EXTRACTION

___ SPARGING

___ REMEDIATION

___ OTHER (SPECIFY)

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 35 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 4 (Ft.) & DATE MEASURED 6-19-00

ESTIMATED YIELD * 38 (GPM) & TEST TYPE air lift

TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN N/A (Ft.)

* *May not be representative of a well's long-term yield.*

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (inches)	CASING (S) TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (inches)
0	25	10								
25	260	8								
0	38		X				PVC F480	5	SDR-21	
38	158			X			PVC F480	5	SDR-21	.032

DEPTH FROM SURFACE Ft.	to Ft.	ANNULAR MATERIAL TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	20	X			concrete
20	24		X		chips
24	260			X	pea gravel

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME HUCKFELDT WELL DRILLING (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2110 Penny Lane CITY Napa STATE CA ZIP 94559

Signed [signature] (WELL DRILLER/AUTHORIZED REPRESENTATIVE) DATE SIGNED 7-11-00

C-57 LICENSE NUMBER 439-746

DWR 188 REV. 11-97 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Well 9

File with DWR

Page ___ of ___

Owner's Well No. ___

Date Work Began 11/20/07, Ended 11/27/07

Local Permit Agency Napa

Permit No. E07-00852 Permit Date 11/16/07

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 0948382

DWR USE ONLY — DO NOT FILL IN

05N05W02

STATE WELL NO./STATION NO.

3818837 12212233

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD air FLUID versafoam

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	20	brown clay
20	30	brown clay gray shale
30	50	gray shale
50	70	hard fract gray shale little white
70	110	soft gray shale
110	130	hard gray shale
130	360	hard & soft gray shale

TOTAL DEPTH OF BORING 360 (Feet)

TOTAL DEPTH OF COMPLETED WELL 360 (Feet)

CITY STATE ZIP

WELL LOCATION

Address 1727 Partrick Road

City Napa

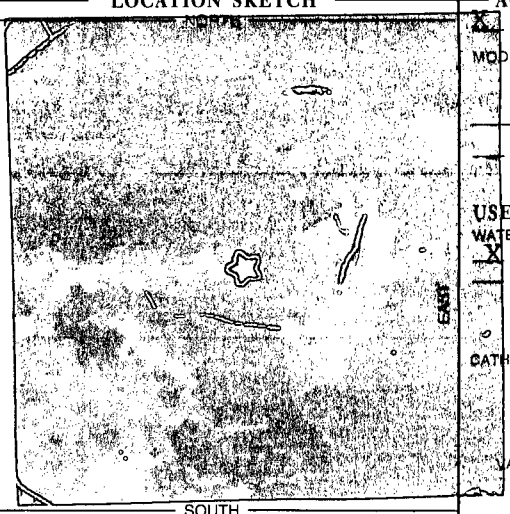
County Napa

APN Book 050 Page 010 Parcel 013

Township ___ Range ___ Section ___

Lat ___ N DEG. MIN. SEC. Long ___ W DEG. MIN. SEC.

LOCATION SKETCH



*Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR

___ Deepen

___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

USES (✓)

WATER SUPPLY

X Domestic ___ Public

___ Irrigation ___ Industrial

___ MONITORING

___ TEST WELL

___ CATHODIC PROTECTION

___ HEAT EXCHANGE

___ DIRECT PUSH

___ INJECTION

___ VAPOR EXTRACTION

___ SPARGING

___ REMEDIATION

___ OTHER (SPECIFY)

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___

ESTIMATED YIELD * 1-2. (GPM) & TEST TYPE test pump

TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)

** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	53	123/4	X				F480	6	200	
53	60	97/8	X				F480	6	200	
60	80	9 7/8		X			F480	6	200	factory
80	100	9 7/8	X				F480	6	200	
100	120	97/8		X			F480	6	200	factory
120	140	97/8	X				F480	6	200	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	53	X			
53	360				peagravel

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME McLean & Williams, Inc.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 878 El Centro Ave., Napa, CA 94558
CITY STATE ZIP

Signed [signature] 12/19/07
C-57 LICENSED WATER WELL CONTRACTOR DATE SIGNED

396352
C-57 LICENSE NUMBER

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

OSP 03 78836

Well 9, Cont.

State of California Well Completion Report No. 0948382

continue casing list:

140 - 160	9 7/8	Perf	F480	6"	200	factory
160 - 180	9 7/8	Blank	F480	6"	200	
180 - 200	9 7/8	Perf	F480	6"	200	factory
200 - 220	9 7/8	Blank	F480	6"	200	
220 - 240	9 7/8	Perf	F480	6"	200	factory
240 - 260	9 7/8	Blank	F480	6"	200	
260 - 280	9 7/8	Perf	F480	6"	200	factory
280 - 300	9 7/8	Blank	F480	6"	200	
300 - 320	9 7/8	Perf	F480	6"	200	factory
320 - 340	9 7/8	Blank	F480	6"	200	
340 - 360	9 7/8	Perf	F480	6"	200	factory

A.P.#050-010-013
1727 Partrick Road, Napa, CA 94558
Oscar Renteria

Well 10 Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form. E 9/23/15

File Original with DWR

Page _____ of _____

Owner's Well Number _____

Date Work Began 05/12/2015 Date Work Ended 5/15/2015

Local Permit Agency Napa County Environmental Services

Permit Number E15-00260 Permit Date 4/29/15

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0230396

DWR Use Only – Do Not Fill In

State Well Number/Site Number: 05N05W02

Latitude: 38 13 36 N Longitude: 122 12 33 W

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify _____

Drilling Method Air Drilling Drilling Fluid Foam

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	20	Top soil brown clay.
20	80	Shale.
80	100	Shale 70%, grey clay 30%.
100	120	Shale 80%, multicolor rock 20%.
120	140	Shale 70%, multicolor rock 30%.
140	180	Shale 80%, gray clay 20%.
180	240	Shale 70%, multicolor rock 30%.
240	260	Shale 55%, multicolor rock30%, gray clay 15%.
260	300	Shale 60%, gray clay 40%.
		******CONTINUED CASING LIST******
250	270	9 Blank F480 PVC .316 6.625 Milled slot 0.032
270	290	9 Screen F480 PVC .316 6.625

Total Depth of Boring 300 Feet

Total Depth of Completed Well 290 Feet

Well Location

Address 1727 Partrick Road

City Napa County Napa

Latitude ___ ___ ___ N Longitude ___ ___ ___ W (Deg. Min. Sec.)

Datum _____ Dec. Lat. _____ Dec. Long. _____

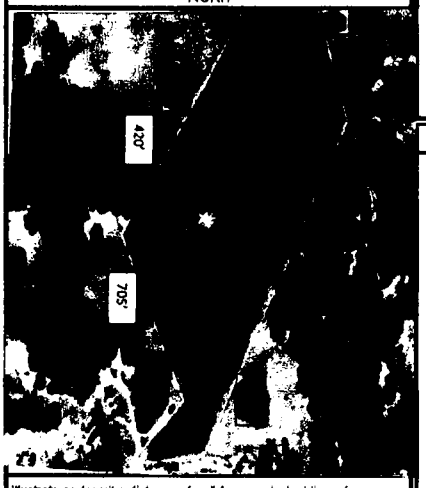
APN Book 050- Page 010- Parcel 013-000

Township _____ Range _____ Section _____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North



Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other _____
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

◉ Water Supply
☑ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
○ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other _____

Water Level and Yield of Completed Well

Depth to first water 58 (Feet below surface)

Depth to Static Water Level 58 (Feet) Date Measured 05/15/2015

Estimated Yield * 40 (GPM) Test Type Air Lift

Test Length 4.0 (Hours) Total Drawdown _____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	70	12	Blank	F480 PVC	.316	6.625		
70	90	9	Screen	F480 PVC	.316	6.625	Milled Slots	0.032
90	110	9	Blank	F480 PVC	.316	6.625		
110	170	9	Screen	F480 PVC	.316	6.625	Milled Slots	0.032
170	190	9	Blank	F480 PVC	.316	6.625		
190	250	9	Screen	F480 PVC	.316	6.625	Milled Slots	0.032

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	55	Cement	
55	290	Filter Pack	Pea gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other _____

Attach additional information, if it exists

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name McLean & Williams, Inc. (Person, Firm or Corporation)

878 El Centro Ave. (Address) Napa (City) CA (State) 94558 (Zip)

Signed _____ (C-57 Licensed Water Well Contractor) 08-20-2015 (Date Signed) 396352 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Well 11

#3

File with DWR

Page 1 of 1

Owner's Well No. _____

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. 777411

Date Work Began 9-30-99, Ended 10-4-99

Local Permit Agency Napa County Environmental Mgmt.

Permit No. 96-10856 Permit Date 10-8-99

DWR USE ONLY — DO NOT FILL IN
05N05W01
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD rotary air FLUID _____

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	40	brown clay with embedded rock
40	45	gray clay
45	80	90% shale/ 10% clay
80	210	shale
210	215	sandstone
215	290	shale
290	320	60% shale/ 40% sandstone
320	385	shale
385	400	gray clay
187	287	screen PVC 5" .032 slot
287	307	blank PVC 5"
307	367	screen PVC 5" .032 slot

TOTAL DEPTH OF BORING 400 (Feet)

TOTAL DEPTH OF COMPLETED WELL 367 (Feet)

WELL LOCATION

CITY _____ STATE _____ ZIP _____

Address same

City Napa

County Napa

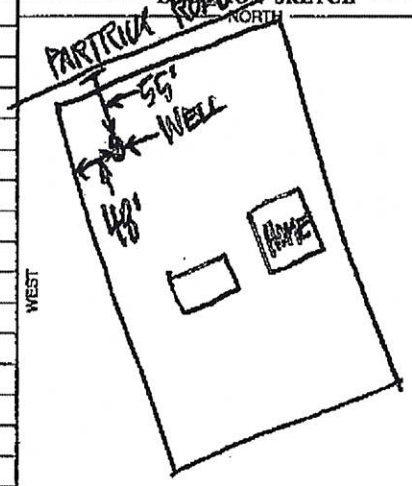
APN Book 50 Page 010 Parcel 17

Township _____ Range _____ Section _____

Latitude _____ DEG. _____ MIN. _____ SEC. NORTH

Longitude _____ DEG. _____ MIN. _____ SEC. WEST

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

PLANNED USES (✓)

WATER SUPPLY
X Domestic ___ Public
X Irrigation ___ Industrial

___ MONITORING
___ TEST WELL
___ CATHODIC PROTECTION
___ HEAT EXCHANGE
___ DIRECT PUSH
___ INJECTION
___ VAPOR EXTRACTION
___ SPARGING
___ REMEDIATION
___ OTHER (SPECIFY)

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 45 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 34 (Ft.) & DATE MEASURED 10-4-99

ESTIMATED YIELD * 75 (GPM) & TEST TYPE air lift

TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN N/A (Ft.)

** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	25	10								
25	400	8								
0	27		X				PVC	5	SDR-21	
27	87			X			PVC	5	SDR-21	.032
87	187		X				PVC	5	SDR-21	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	23	X			concrete
23	367			X	pea gravel

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other _____

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME HUCKFELDT WELL DRILLING
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2110 Penny Lane ADDRESS Napa CITY CA STATE 94559 ZIP

Signed _____ WELL DRILLER/AUTHORIZED REPRESENTATIVE

10-13-99 DATE SIGNED

439-746 C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Well 12

File with DWR

Page ___ of ___

Owner's Well No. ___

Date Work Began 3-16-04 Ended 3-22-04

Local Permit Agency Napa County

Permit No. 96-12567 Permit Date 11-19-03

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 0901106

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO. 05N05W

LATITUDE ___ LONGITUDE ___

APN/TRS/OTHER ___

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD rotary FLUID Mud

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0 45	brown clay
45 65	broken up black sandstone
65 90	blue clay
90 200	blue shale, streaks of gray sandstone
200 350	blue shale
350 355	gray sandstone
355 400	blue shale

TOTAL DEPTH OF BORING 400 (Feet)

TOTAL DEPTH OF COMPLETED WELL 400 (Feet)

WELL LOCATION

Address Same

City Napa

County Napa

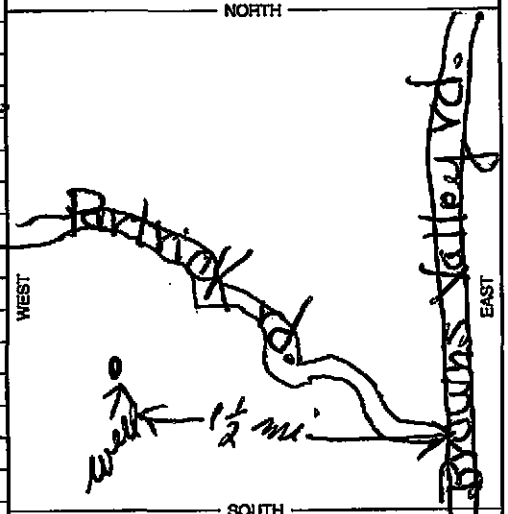
APN Book ___ Page ___ Parcel 50-010-11

Township ___ Range ___ Section ___

Lat ___ DEG. ___ MIN. ___ SEC. N

Long ___ DEG. ___ MIN. ___ SEC. W

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR ___ Deepen ___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

USES (✓)

WATER SUPPLY ___ Domestic ___ Public ✓ Irrigation ___ Industrial

MONITORING ___

TEST WELL ___

CATHODIC PROTECTION ___

HEAT EXCHANGE ___

DIRECT PUSH ___

INJECTION ___

VAPOR EXTRACTION ___

SPARGING ___

REMEDIATION ___

OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 45 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 40 (Ft.) & DATE MEASURED 3-22-04

ESTIMATED YIELD * 15 (GPM) & TEST TYPE Air Lift

TEST LENGTH 4 (Hrs.) TOTAL DRAWDOWN 380 (Ft.)

* *May not be representative of a well's long-term yield.*

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	CASING (S) TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0 25	11"	X				PLASTIC	5"	200	
25 50	9"	X				"	"	"	
50 400	9"		ACT			PERF	"	"	5/32

DEPTH FROM SURFACE Ft. to Ft.	ANNULAR MATERIAL TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0 25	X			
25 400				PEA GRAVEL

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Tullian Well Drilling (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2877 Piedmont Av. CITY Napa STATE Ca. ZIP 94558

Signed Bill Tullian C-57 LICENSED WATER WELL CONTRACTOR

DATE SIGNED 3-28-04

C-57 LICENSE NUMBER 248677

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

OSP 03 78838

Well 13

~~PW~~ IW

ORIGINAL
File with DWR

Page ___ of ___
Owner's Well No.
Date Work Began 8-30-12, Ended 9-10-12
Local Permit Agency Napa County
Permit No. E12-00489 Permit Date 8-21-12

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. 0947977

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.: 03N05W02
LATITUDE: 38 18 46
LONGITUDE: 122 22 24
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD Rotary FLUID mud

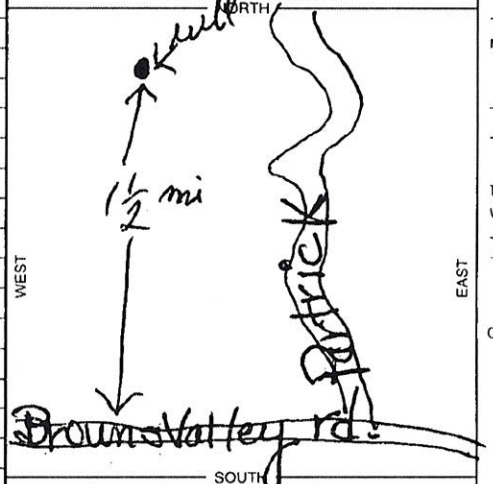
DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	30	brown clay & Shale
30	200	blue Shale, streaks of broken up Sandstone
200	217	blue Shale

TOTAL DEPTH OF BORING 220 (Feet)
TOTAL DEPTH OF COMPLETED WELL 217 (Feet)

WELL LOCATION

Address Same
City Same
County Napa
APN Book ___ Page ___ Parcel 050-010-018
Township ___ Range ___ Section ___
Lat ___ DEG. ___ MIN. ___ SEC. N
Long ___ DEG. ___ MIN. ___ SEC. W

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)
✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

USES (✓)
WATER SUPPLY
___ Domestic ___ Public
✓ Irrigation ___ Industrial
___ MONITORING
___ TEST WELL
___ CATHODIC PROTECTION
___ HEAT EXCHANGE
___ DIRECT PUSH
___ INJECTION
___ VAPOR EXTRACTION
___ SPARGING
___ REMEDIATION
___ OTHER (SPECIFY)

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 30 (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 20 (Ft.) & DATE MEASURED ___
ESTIMATED YIELD * 20 (GPM) & TEST TYPE AIR LIFT
TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN 2/0 (Ft.)
* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	23	11"	X				PLASTIC	5"	200	
23	37	8"	X				"	"	"	
37	217	8"		FACT			PERF "	"	"	3/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	23	X			
23	217				WELL PACK #6

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Pulliam Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
ADDRESS 2877 Piedmont Av. CITY Napa STATE Ca. ZIP 94558
Signed Bill Pulliam
C-57 LICENSED WATER WELL CONTRACTOR
DATE SIGNED 9-26-12
C-57 LICENSE NUMBER 248677

DWR 188 REV. 05-03 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM OSP 03 78836

Well 14

File with DWR

Page ___ of ___

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 0947977

DWR USE ONLY — DO NOT FILL IN

05N05W02

STATE WELL NO./STATION NO.

LATITUDE 38 18 46 LONGITUDE 122 22 24

APN/TRS/OTHER

Owner's Well No.

Date Work Began 8-30-12 Ended 9-10-12

Local Permit Agency Napa County

Permit No. E12-00489 Permit Date 8-21-12

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD Rotary FLUID mud

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0 30	brown clay & Shale
30 200	blue Shale, streaks of broken up Sandstone
200 217	blue Shale

TOTAL DEPTH OF BORING 220 (Feet)

TOTAL DEPTH OF COMPLETED WELL 217 (Feet)

WELL LOCATION

Address Same

City Same

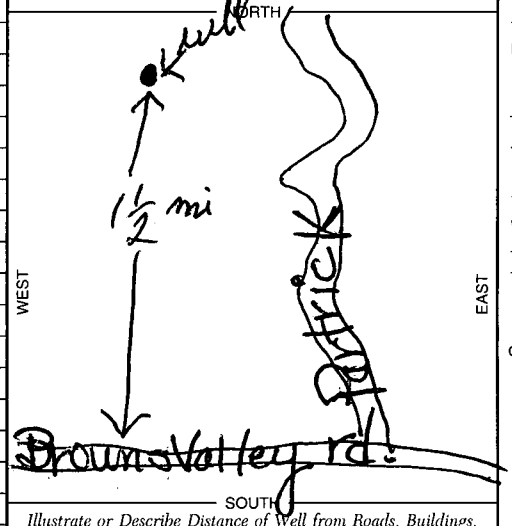
County Napa

APN Book ___ Page ___ Parcel 050-010-018

Township ___ Range ___ Section ___

Lat ___ N DEG. MIN. SEC. Long ___ W DEG. MIN. SEC.

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR

___ Deepen

___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

USES (✓)

WATER SUPPLY

___ Domestic ___ Public

X Irrigation ___ Industrial

___ MONITORING

___ TEST WELL

___ CATHODIC PROTECTION

___ HEAT EXCHANGE

___ DIRECT PUSH

___ INJECTION

___ VAPOR EXTRACTION

___ SPARGING

___ REMEDIATION

___ OTHER (SPECIFY)

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 30 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 20 (Ft.) & DATE MEASURED ___

ESTIMATED YIELD * 20 (GPM) & TEST TYPE AIR LIFT

TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN 210 (Ft.)

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0 23	11"	X				PLASTIC	5"	200	
23 37	8"	X				"	"	"	
37 217	8"		FACT			PERF "	"	"	3/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0 23	X			
23 217				WELL PACK #6

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Pulliam Well Drilling (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2877 Piedmont Av. CITY Napa, STATE Ca. ZIP 94558

Signed [signature] C-57 LICENSED WATER WELL CONTRACTOR

DATE SIGNED 9-26-12 C-57 LICENSE NUMBER 748677

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

OSP 03 78836

Well 15

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in
No. 364944

Notice of Intent No. _____
Local Permit No. or Date 2-12-1991

State Well No. _____
Other Well No. 05N05W01B

(2) LOCATION OF WELL (See instructions):
County Napa Owner's Well Number _____
Well address if different from above same
Township 5 N. Range 5 W. Section Rancho
Distance from cities, roads, railroads, fences, etc. Napa

A.P.# 50-040-03

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☒
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other ☐
(Describe)

(5) EQUIPMENT:
Rotary ☒ Reverse ☐
Cable ☐ Air ☒
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☐ No ☑ Size: _____
Diameter of bore 9"
Packed from _____ to _____ ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☐ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Slot size

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☐ No ☐ If yes, to depth _____ ft.
Were strata sealed against pollution? Yes ☐ No ☐ Interval _____ ft.
Method of sealing _____

(10) WATER LEVELS:
Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:
Was well test made? Yes ☐ No ☐ If yes, by whom? _____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes ☐ No ☐ If yes, by whom? _____
Was electric log made Yes ☐ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 300 ft. Completed depth _____ ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
		TEST HOLE LOG
0	60	light brown clay
60	160	br. clay with embedded rock
160	220	soft lt. br. & gray shale (sm. grvl
220	300	soft gray shale

*Filled in test hole with clay & shale cuttings from drilling process.

Work started 2-12-91 19__ Completed 2-14 19 91

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief

Signed Lloyd Huckfeldt (Well Driller)

NAME HUCKEELDT WELL DRILLING (Person, firm, or corporation) (Typed or printed)

Address 2110 Penny Lane

City Napa ZIP 94559

License No. 439-746 Date of this report 2-20-1991

DWR 188 (REV. 12-86) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM 86 96355

Well 16

File with DWR

Page ___ of ___

Owner's Well No. ___

Date Work Began 5-2-1991, Ended 5-3-1991

Local Permit Agency Napa County Environmental Mgmt.

Permit No. ___ Permit Date ___

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 482426

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO. 05N05W01E

LATITUDE ___ LONGITUDE ___

APN/TRS/OTHER ___

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	20	brown clay
20	30	dark brown clay
30	31	gravel
31	85	shale
85	90	sandstone
90	130	50% shale/ 50% sandstone
130	180	shale
180	200	gravel
200	220	shale
		*Filled in test hole with cuttings from drilling process.

TOTAL DEPTH OF BORING 220 (Feet)

TOTAL DEPTH OF COMPLETED WELL ___ (Feet)

WELL OWNER

CITY ___ STATE ___ ZIP ___

WELL LOCATION

Address same

City ___

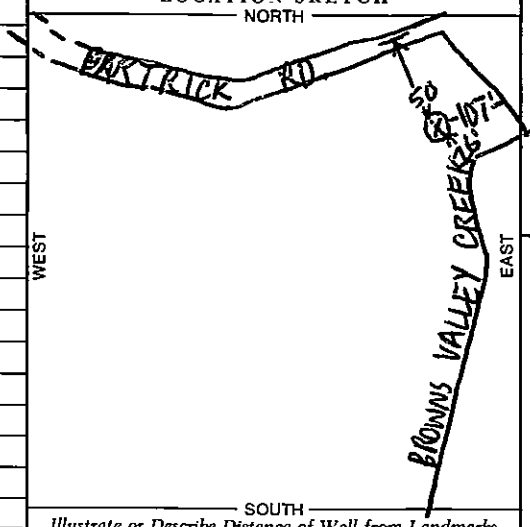
County Napa

APN Book 50 Page 040 Parcel 03

or Township 5 N. Range 5 W. Section Rancho Napa

or Latitude ___ DEG. MIN. SEC. NORTH Longitude ___ DEG. MIN. SEC. WEST

LOCATION SKETCH



Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR

___ Deepen

___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

PLANNED USE(S) (✓)

___ MONITORING

WATER SUPPLY

___ Domestic

___ Public

___ Irrigation

___ Industrial

X "TEST WELL"

___ CATHODIC PROTECTION

___ OTHER (Specify)

DRILLING METHOD Rotary (air) FLUID ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___

ESTIMATED YIELD* ___ (GPM) & TEST TYPE ___

TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)

* *May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	220	8								

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	220			x	shale

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME HUCKFELDT WELL DRILLING (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2110 Penny Lane CITY Napa STATE CA ZIP 94559

Signed Lloyd Huckfeldt WELL DRILLER/AUTHORIZED REPRESENTATIVE

DATE SIGNED 5-6-1991

C-57 LICENSE NUMBER 439-746

DWR 188 REV. 7-90

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

APPENDIX B

NAPA COUNTY GROUNDWATER RECHARGE ANALYSIS

Napa County Groundwater Recharge Analysis

Introduction

Developing accurate estimates of the spatial and temporal distribution of groundwater recharge is a key component of sustainable groundwater management. Efforts to quantify recharge are inherently difficult owing to the wide variability of factors controlling hydrologic processes, the wide range of available tools/methods for estimating recharge, and the difficulty in assessing the accuracy of estimates because direct measurement of recharge rates is, for the most part, infeasible (Healy 2010, Seiler and Gat 2007).

Numerical modeling is a common approach for developing recharge estimates. Soil-water-balance modeling is one category of numerical models particularly well-suited for estimating recharge across large areas with modest data requirements. This study describes an application of the U.S. Geological Survey's (USGS) Soil Water Balance Model (SWB) (Westenbroek et al. 2010) to develop spatial and temporal distributions of groundwater recharge across Napa County. This model operates on a daily timestep and calculates surface runoff based on the Natural Resources Conservation Service (NRCS) curve number method and potential evapotranspiration based on the Hargreaves-Samani methods (Hargreaves and Samani 1985). Actual evapotranspiration (AET) and recharge are calculated using a modified Thornthwaite-Mather soil-water-balance approach (Westenbroek et al. 2010).

It is important to note that the SWB model focuses on surface and soil-zone processes and does not simulate the groundwater system or track groundwater storage over time. The model also does not simulate surface water/groundwater interaction or baseflow; thus, the runoff estimates represent only the surface runoff component of streamflow resulting from rainstorms and the recharge estimates represent only the infiltration recharge component (also referred to as diffuse recharge) of total recharge (stream-channel recharge is not simulated).

This modeling work and summary report has been prepared by O'Connor Environmental, Inc., for it's private use in relation to Water Availability Analyses (WAA) prepared on behalf of private clients for projects using groundwater in "hillside" areas of Napa County as required by Napa Planning, Building & Environmental Services. The modeling to-date is complete in its current form but remains subject to revision; it is considered a working draft with information suitable for use to support WAA projects. Parties interested in obtaining more information regarding the modeling or who may wish to offer comments should contact O'Connor Environmental, Inc.

Model Development

The model was developed using a 30-meter (98.4 ft) resolution rectangular grid. Water budget calculations were made on a daily time step. Key spatial inputs included a flow direction map developed from the USGS 1 arc-second resolution Digital Elevation Model (DEM), a land cover map derived from the U.S. Forest Service (USFS) CALVEG dataset that was supplemented by a database of agricultural areas maintained by the County of Napa (Figure 1), a distribution of Hydrologic Soil Groups (A through D classification from lowest to highest runoff potential; Figure 2), and a distribution of Available Water Capacity (AWC) developed from the NRCS Soil Survey Geographic Database (SSURGO) (Figure 3).

A series of model parameters were assigned for each land cover type/soil group combination including an infiltration rate, a curve number, dormant and growing season interception storage values, and a rooting depth (Table 1).

Infiltration rates for hydrologic soil groups A through D were applied based on Cronshey et al. (1986) (Table 2) along with default soil-moisture-retention relationships based on Thornthwaite and Mather (1957) (Figure 4). Curve numbers were assigned based on standard NRCS methods. Interception storage values and rooting depths were assigned based on literature values and from previous modeling experience including a SWB model covering Sonoma County and calibrated using runoff volumes from several stream gages (OEI 2017).

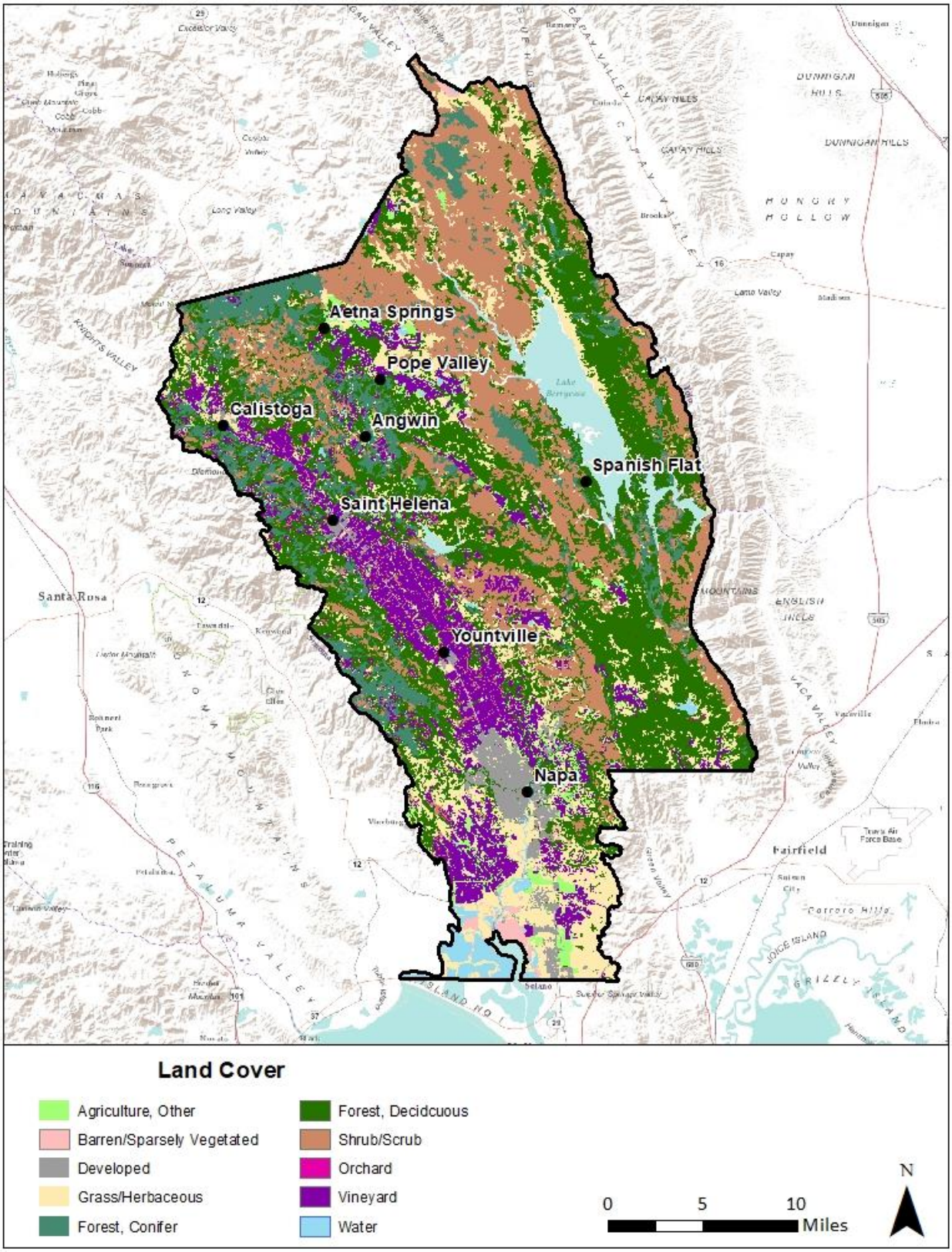


Figure 1: Land cover distribution used in the Napa County SWB model.

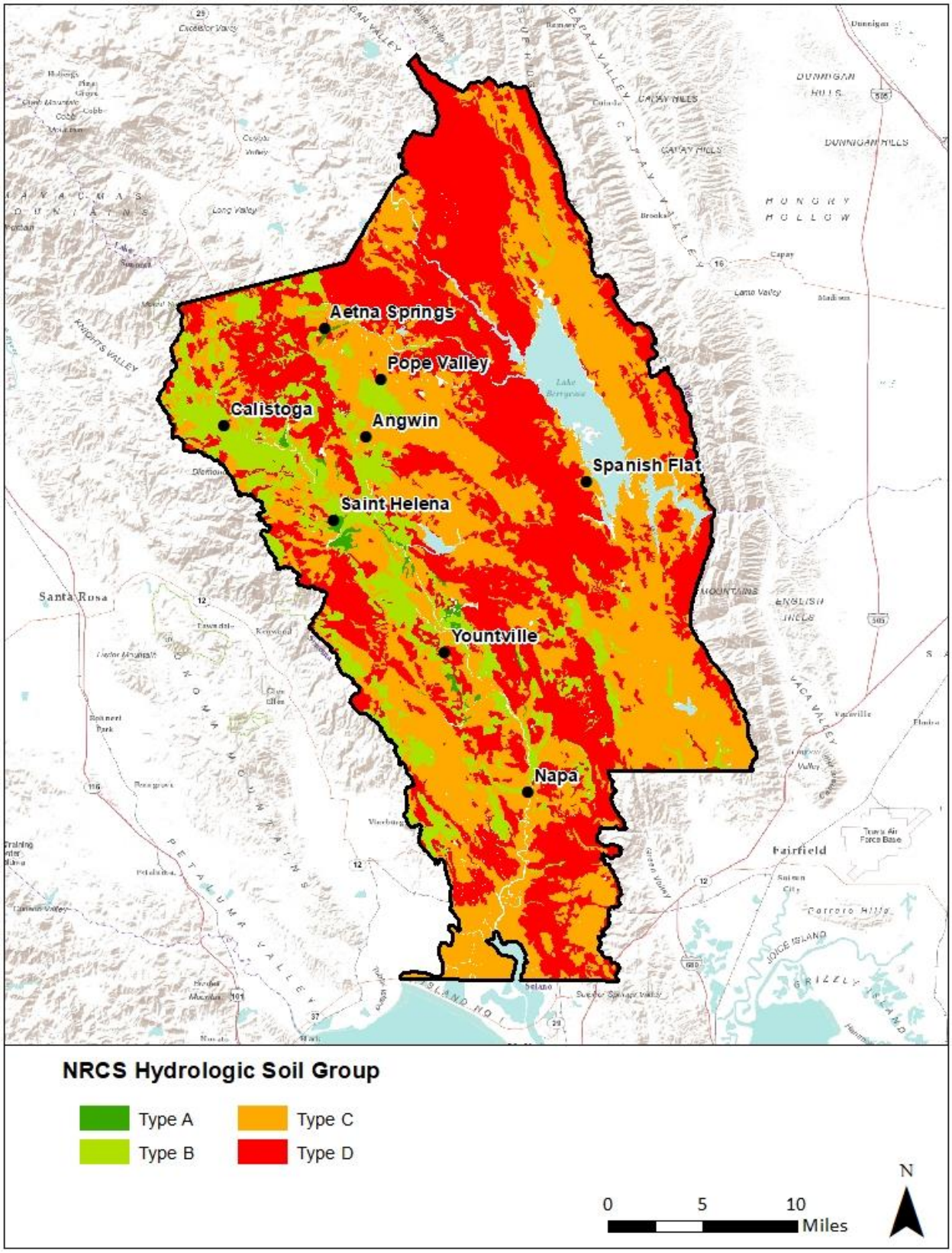


Figure 2: Hydrologic soil group distribution used in the Napa County SWB model.

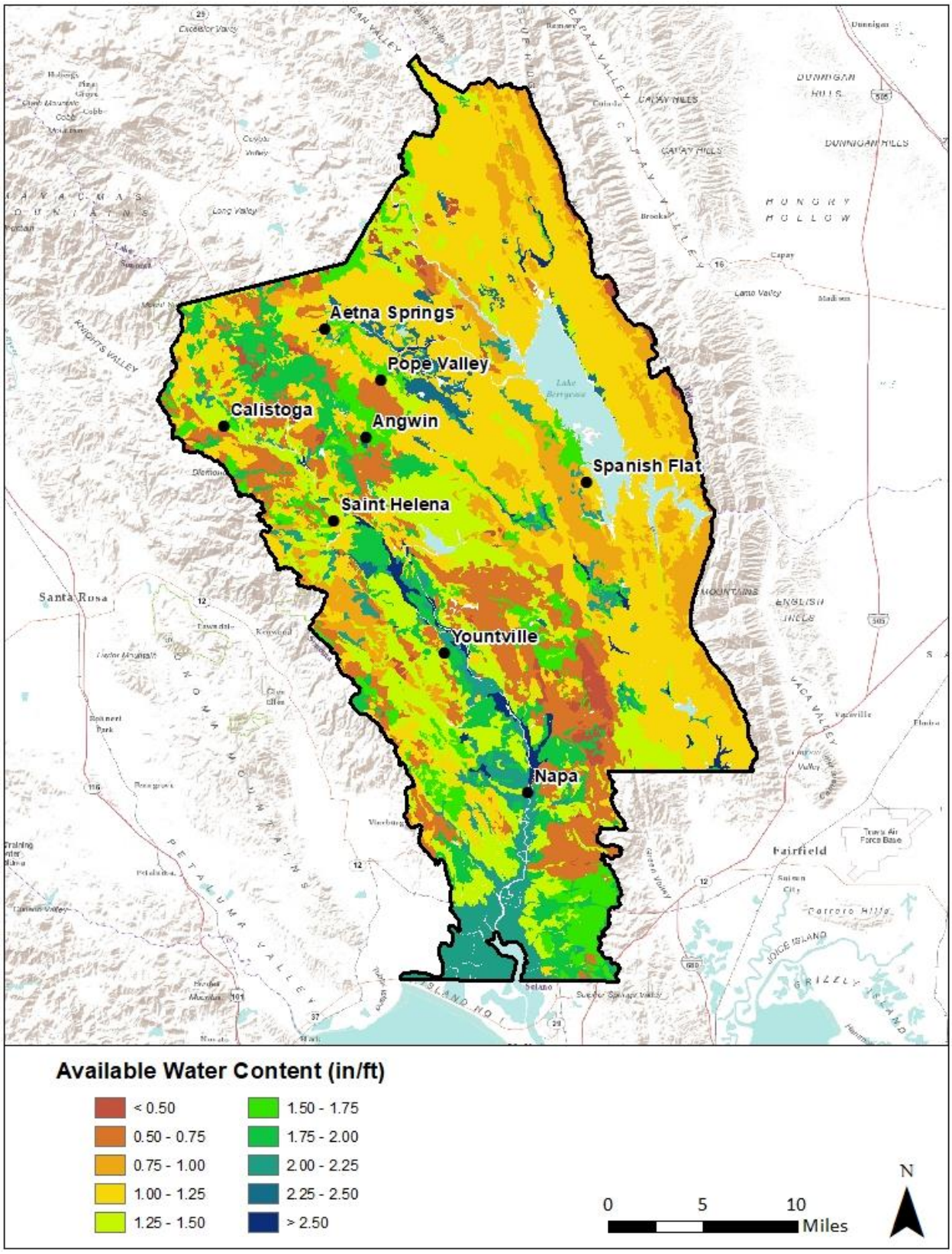


Figure 3: Available water capacity distribution used in the Napa County SWB model.

Table 1: Soil and land cover properties used in the Napa County SWB model.

Land Cover	Interception Storage Values ()		Curve Number by NRCS Soil Type ()				Rooting Depth by NRCS Soil Type (ft)			
	Growing Season	Dormant Season	Type A	Type B	Type C	Type D	Type A	Type B	Type C	Type D
Agriculture, Other	0.080	0.040	38	61	75	81	2.0	1.9	1.8	1.7
Barren	0.000	0.000	77	86	91	94	0.0	0.0	0.0	0.0
Developed	0.005	0.002	61	75	83	87	2.3	2.1	2.0	1.8
Grassland/Herbaceous	0.005	0.004	30	58	71	78	1.3	1.1	1.0	1.0
Forest, Coniferous	0.050	0.050	30	55	70	77	5.9	5.1	4.9	4.7
Forest, Deciduous	0.050	0.020	30	55	70	77	5.9	5.1	4.9	4.7
Shrub/Scrub	0.080	0.015	30	48	65	73	3.2	2.8	2.7	2.6
Orchard	0.050	0.015	38	61	75	81	3.2	2.8	2.7	2.6
Vineyard	0.080	0.015	38	61	75	81	2.2	2.1	2.0	1.9
Water	0.000	0.000	100	100	100	100	0.0	0.0	0.0	0.0

Table 2: Infiltration rates for NRCS hydrologic soil groups (Cronshey et al. 1986).

Soil Group	Infiltration Rate (in/hr)
A	> 0.3
B	0.15 - 0.3
C	0.05 - 0.15
D	<0.05

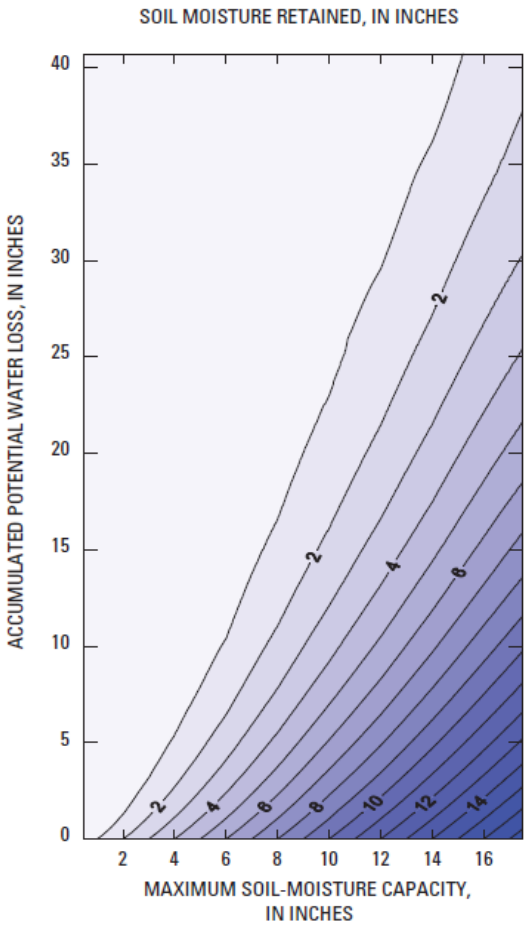


Figure 4: Soil-moisture-retention table (Thornthwaite and Mather 1957).

The SWB model utilizes daily precipitation and mean daily temperature data derived from climate stations. To account for the spatial variability of these parameters, daily precipitation and mean daily temperature were input as gridded (spatially-distributed) time-series. The gridded precipitation time-series was created using data from 15 weather stations in Napa County, and the gridded mean temperature time-series was created using data from 8 stations (Table 3). These stations were selected based on completeness of the records and to provide station data representative of the range of climates experienced in the county. Data was obtained from the California Data Exchange Center (CDEC), the National Climatic Data Center (NCDC), and from Napa One Rain.

To create the gridded time-series, the model domain was divided into discrete areas represented by individual weather stations (Figures 5 and 6). This delineation was based on climate variations described by existing gridded mean annual (1981-2010) precipitation and temperature data (PRISM 2010) and local knowledge of climatic variations across the county.

For the precipitation time-series, each area representing a weather station was subdivided into four to twenty-three zones based on 1-inch average annual precipitation contours. Within each zone the raw station data was multiplied by a unique scaling factor. This scaling factor was calculated as the ratio of average annual precipitation within a zone to average annual precipitation at the representative rain gage. In certain locations, typically near the boundary of areas represented by gages located on the valley bottom and at higher elevations, this scaling was unable to smoothly resolve differences in annual and event precipitation totals. To more accurately estimate precipitation near these boundaries, precipitation records from the two gages in question were averaged using weights calculated proportionally to the difference between PRISM mean annual precipitation at a rain gage and within a selected zone. The resulting gridded time-series is comprised of 220 individual time-series based on the scaled station data from 15 stations.

The assignment of temperature stations was based on the understanding that the spatial variability of temperatures across Napa County is relatively homogenous, with elevation being the primary variable. Temperature records were classified either as Mountain, Valley Bottom, or East County and applied within areas the PRISM datasets described as being similar. To smooth the transition from Mountain zones to Valley Bottom and East County zones, Hillside zones were created where the temperature records of the two nearest gages were averaged.

Missing and suspect data was encountered in the raw precipitation and temperature data from the weather stations used by the model. Values that were significantly outside the typical range, and where similar observations were not found at nearby stations, were removed from the datasets. These and missing values were filled using scaled data from other nearby stations. Precipitation data used for gap filling was scaled using the ratio of the 1981 to 2010 mean annual precipitation (PRISM 2010) between the two stations. Temperature data was scaled using the ratio of the 1981 to 2010 mean monthly minimum and maximum temperatures (PRISM 2010) between the two stations.

The current analysis focuses on Water Year 2010 (October 1, 2009 – September 30, 2010) and Water Year 2014 (October 1, 2013 – September 30, 2014). These years were selected because they represent periods with data available from most weather stations in the county and where most stations reported annual precipitation totals close to the long-term average (WY 2010) and significantly below the long term average (WY 2014). Based on a comparison between station data and PRISM average precipitation depths during Water Year 2010, rainfall averaged 101% of long-term average conditions and ranged from 78% at Lake Hennessey to 111% at the Napa County Airport. In Water Year 2014, rainfall averaged 55% of long-term average conditions and ranged from 41% at Lake Hennessey to 73% at the Napa State Hospital (Table 3).

Table 3: Weather stations used in the Napa County SWB model. See Figures 7- 9 for associated timeseries.

Station	Data Used	1981 - 2010 Mean Annual Precip (in)	WY 2010		WY 2014	
			Precip (in)	% Avg	Precip (in)	% Avg
Angwin[1]	Precip & Temp	42.54	44.64	105%	25.04	59%
Atlas Peak[1]	Precip & Temp	41.76	39.04	93%	20.08	48%
Berryessa[1]	Precip & Temp	28.97	28.16	97%	13.97	48%
Calistoga[2]	Precip	39.41	41.75	106%	18.18	46%
Knoxville Creek[1]	Temp Only	-	-	-	-	-
Lake Hennessey[3]	Precip Only	34.09	26.52	78%	13.92	41%
Mt. George[3]	Precip Only	31.15	29.64	95%	18.24	59%
Mt. Veeder[3]	Precip Only	44.81	46.44	104%	28.6	64%
Napa County Airport[2]	Precip & Temp	21.14	23.56	111%	9.87	47%
Napa River at Yountville Cross Rd[3]	Precip Only	31.86	32.72	103%	14.93	47%
Napa State Hospital[2]	Precip & Temp	26.81	28.85	108%	19.66	73%
Petrified Forest[3]	Precip Only	42.39	46.6	110%	22.84	54%
Redwood Creek At Mt. Veeder Road[3]	Precip Only	34.71	37.36	108%	23.48	68%
Saint Helena[2]	Precip & Temp	37.43	39.11	104%	19.11	51%
Saint Helena 4WSW[1]	Precip & Temp	45.44	47.88	105%	28.88	64%
Sugarloaf Peak[3]	Precip Only	32.20	26.16	81%	17.12	53%

1 – Data accessed from California Data Exchange Center (CDEC)
2 – Data accessed from National Climate Data Center (NCDC)
3 – Data access from Napa One Rain

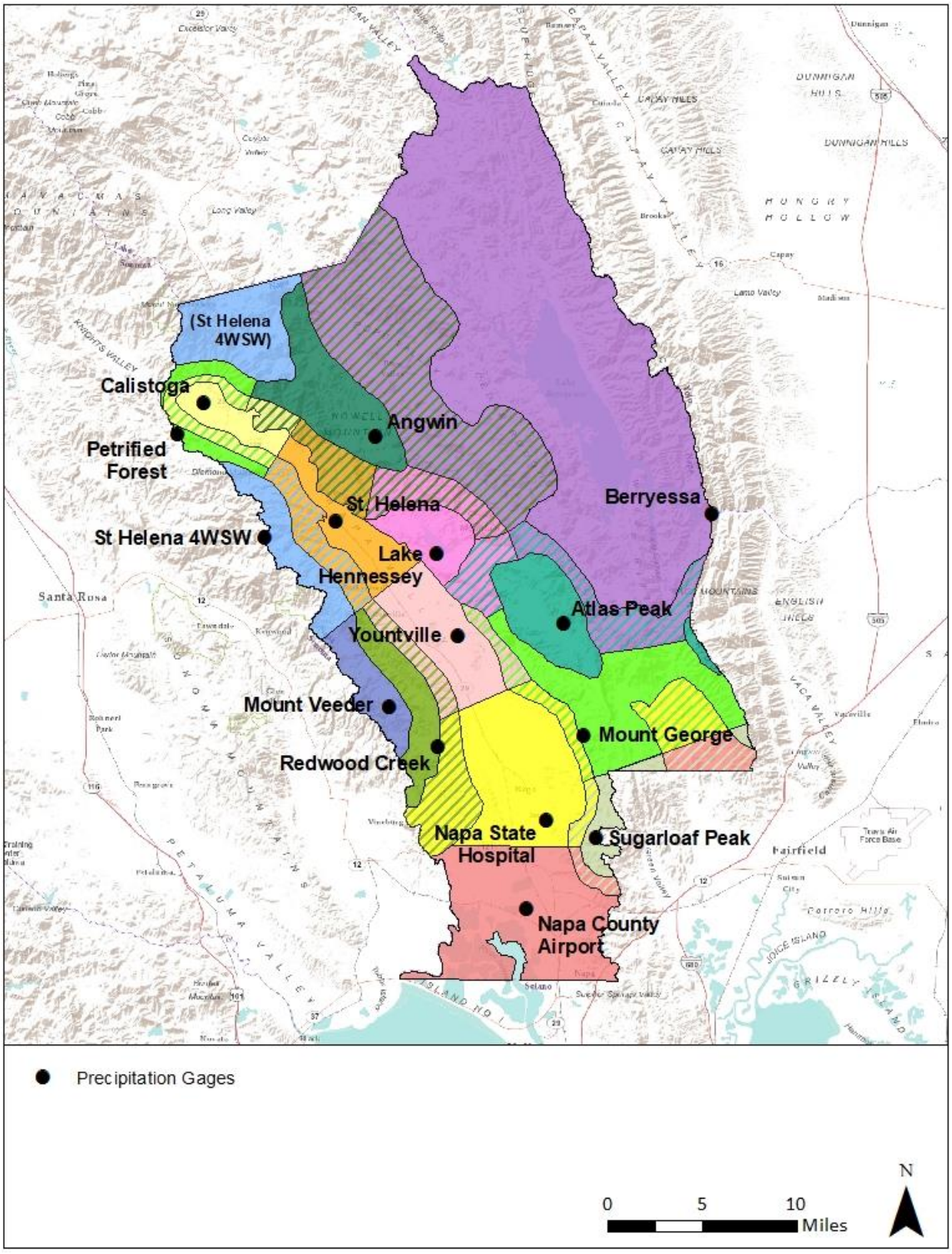


Figure 5: Precipitation zones used in the Napa County SWB model. Hatching indicates areas where two precipitation records were averaged across a zone.

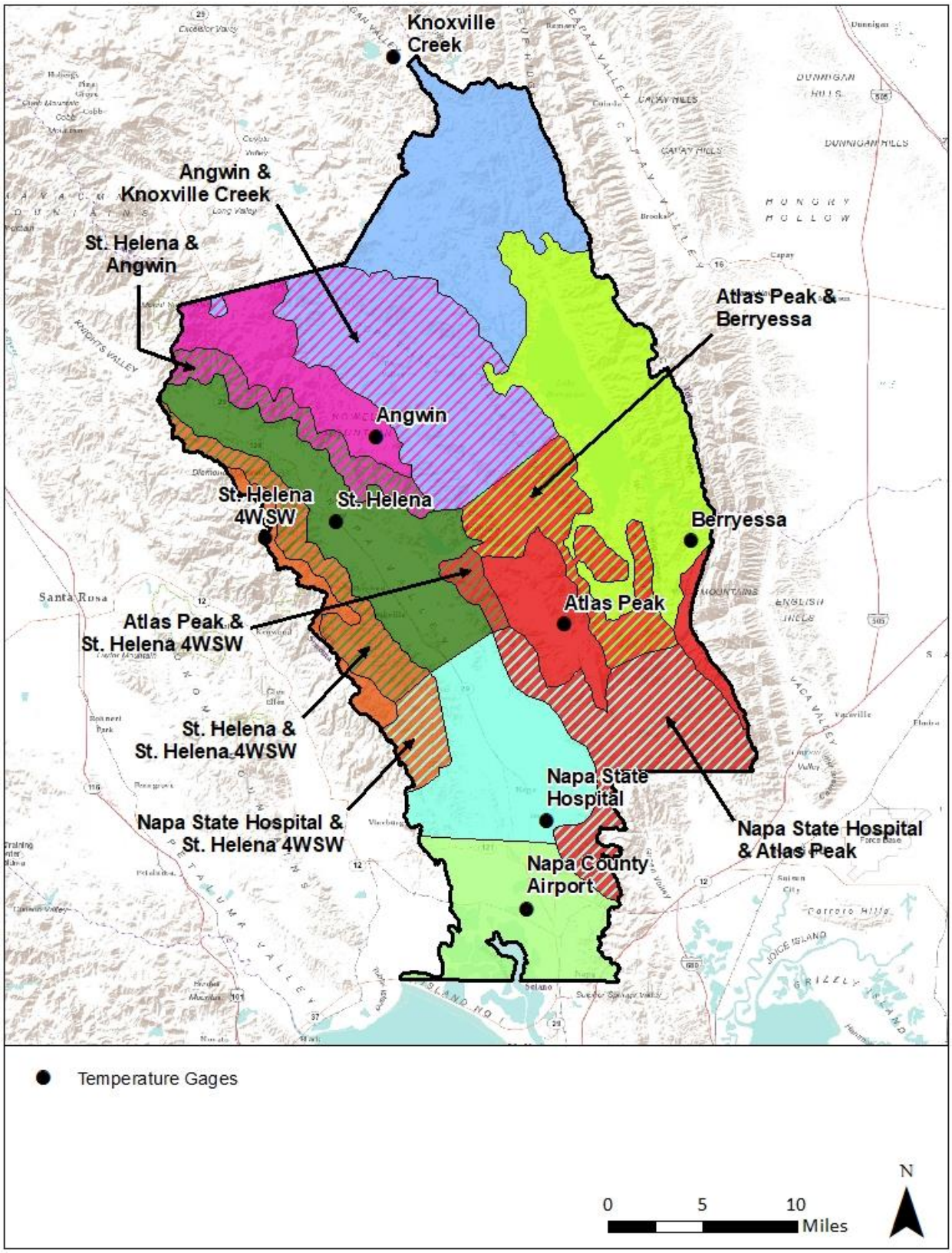


Figure 6: Temperature zones used in the Napa County SWB model. Hatching indicates areas where two temperature records were averaged across a zone.

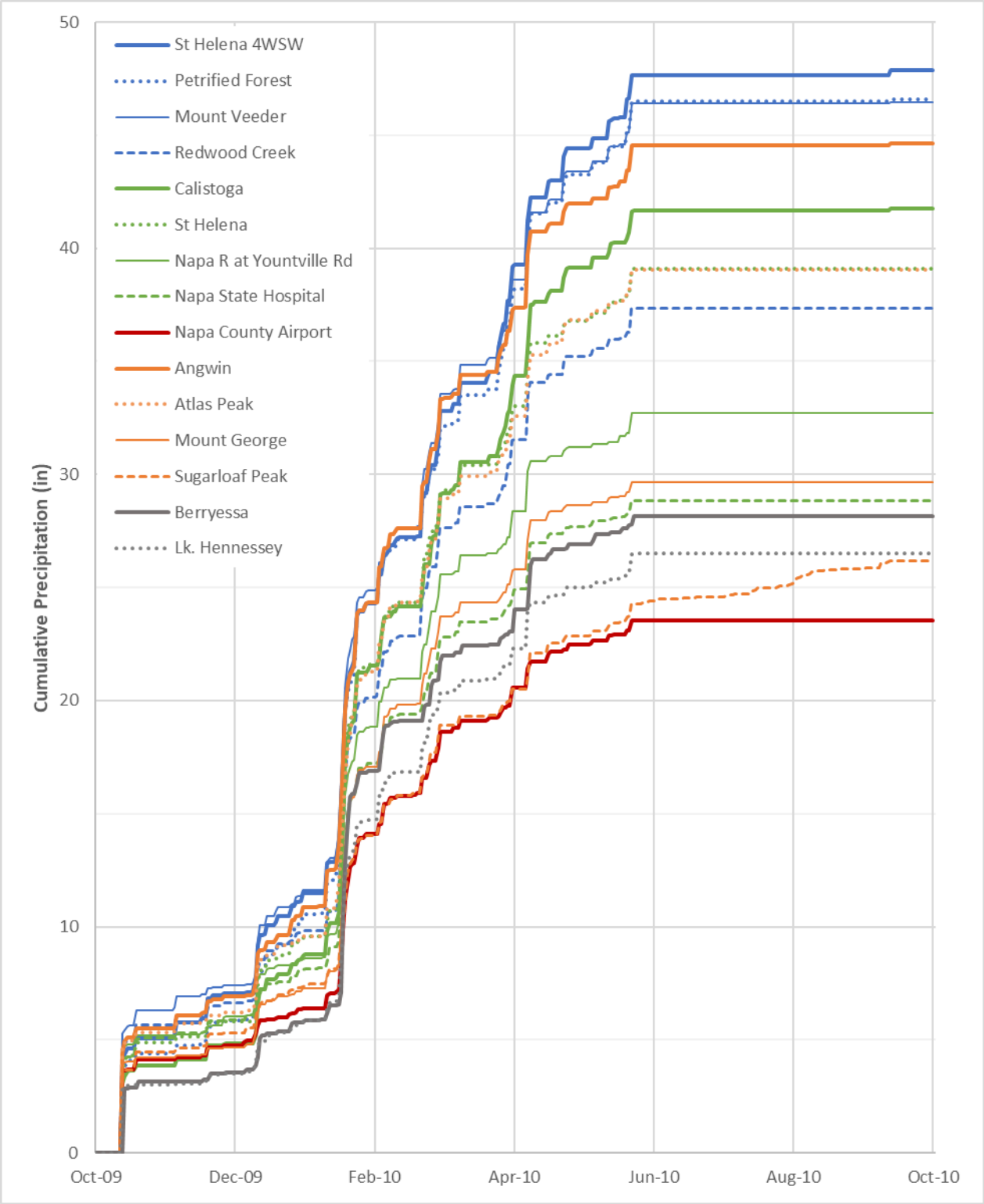


Figure 7a: Daily precipitation data used in the Napa County SWB model for WY 2010.

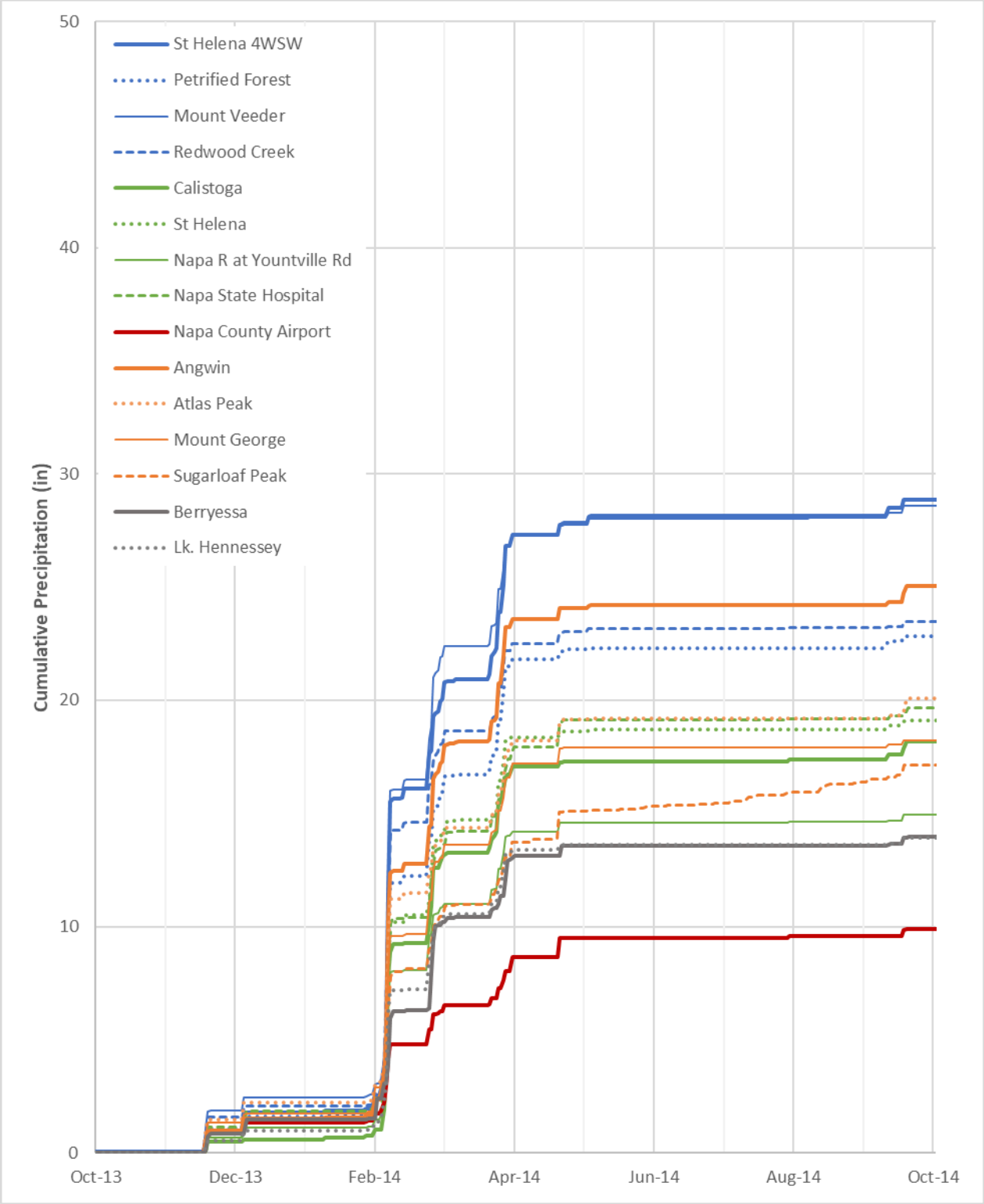


Figure 7b: Daily precipitation data used in the Napa County SWB model for WY 2014.

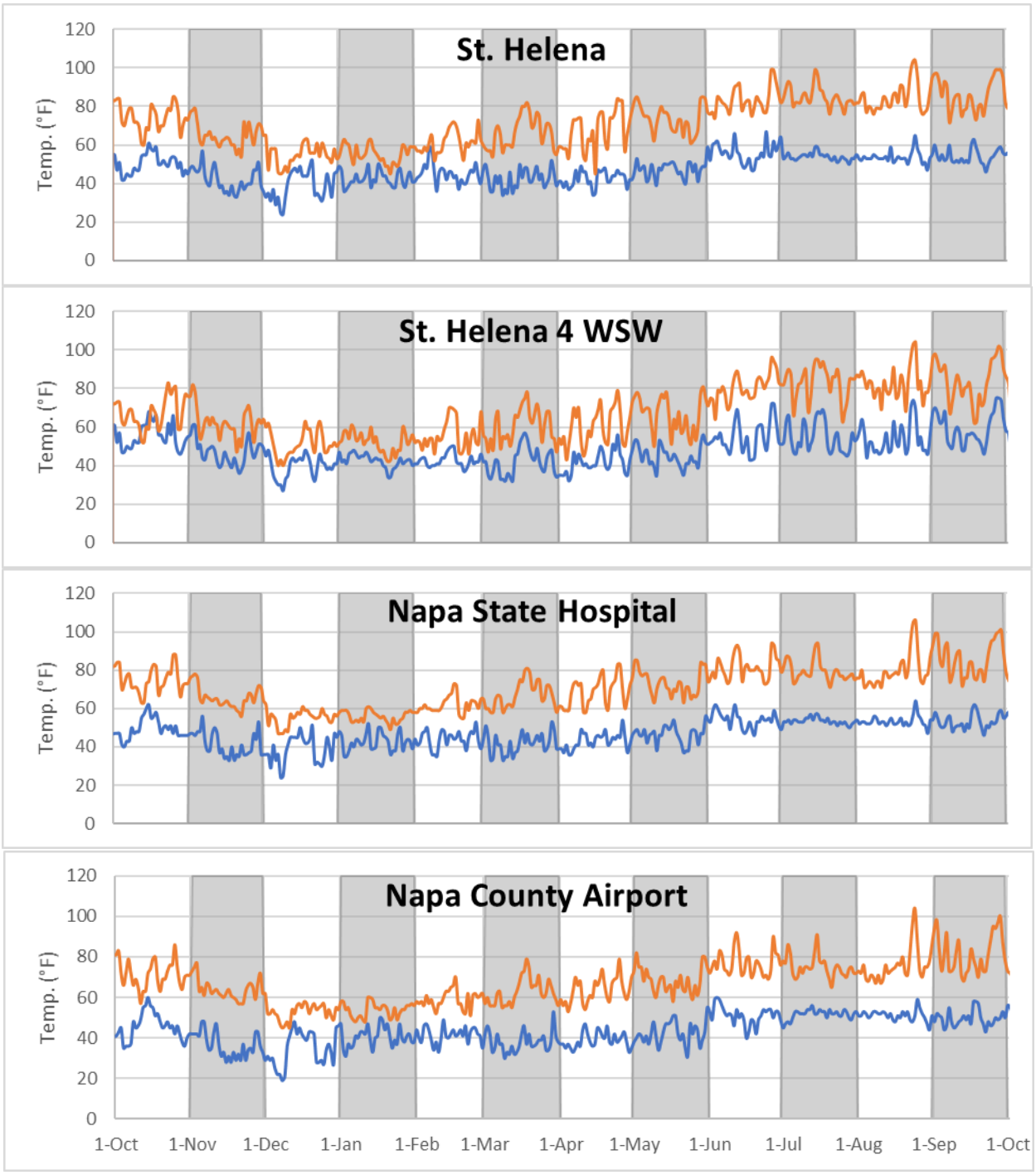


Figure 8: Daily minimum and maximum temperature data used in the Sonoma County SWB model for WY 2010.

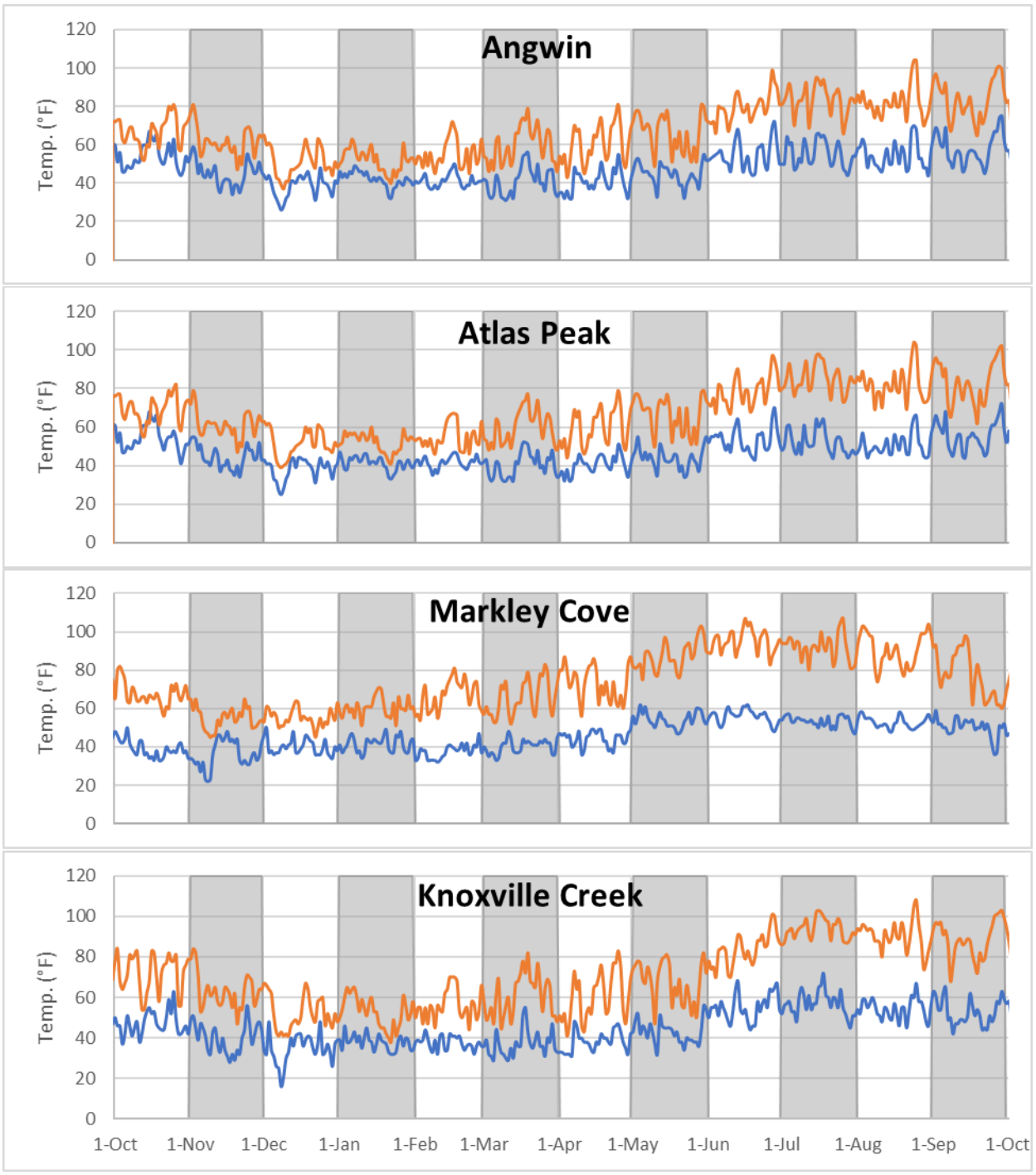


Figure 8 – cont.

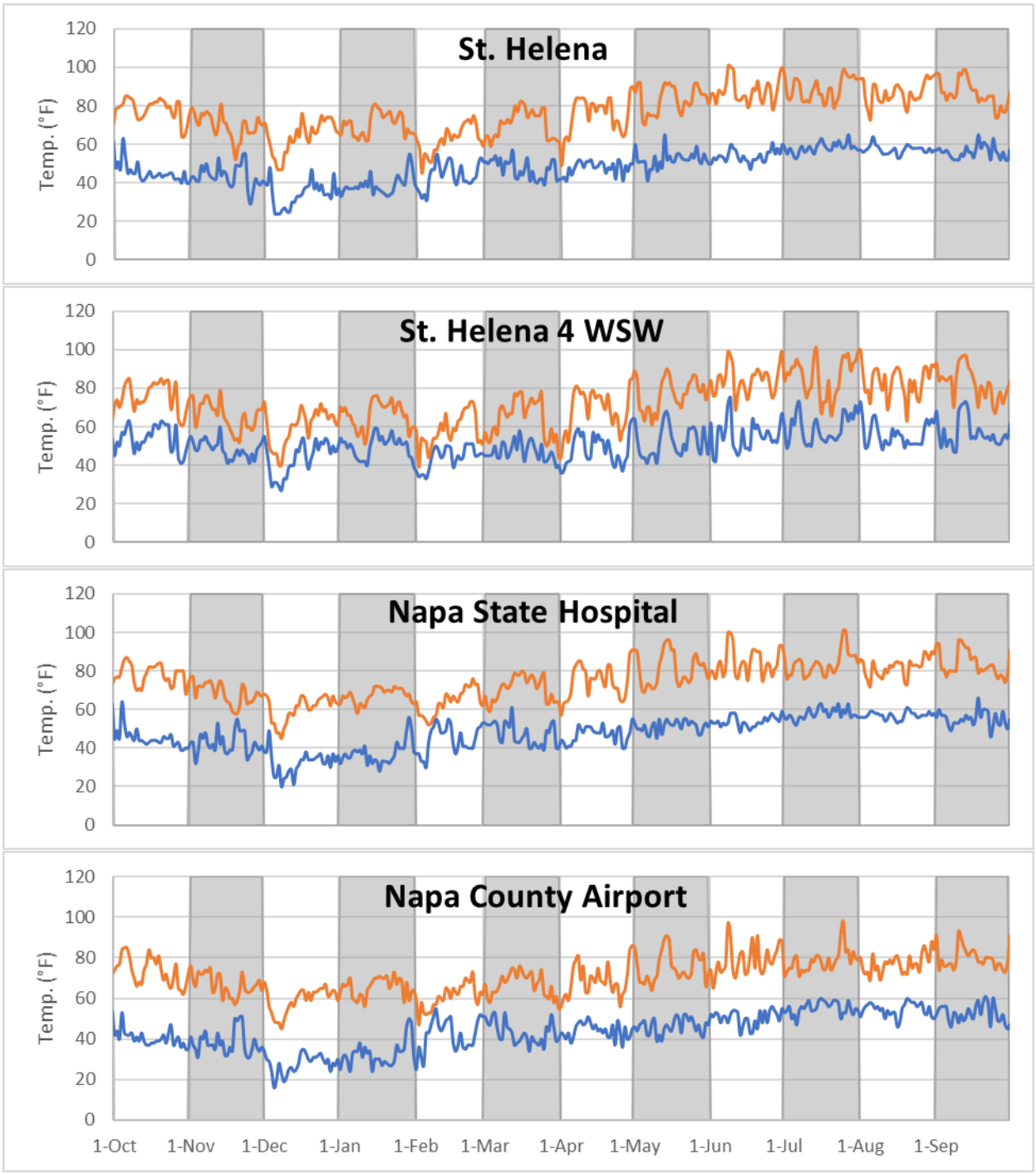


Figure 9: Daily minimum and maximum temperature data used in the Sonoma County SWB model for WY 2010.

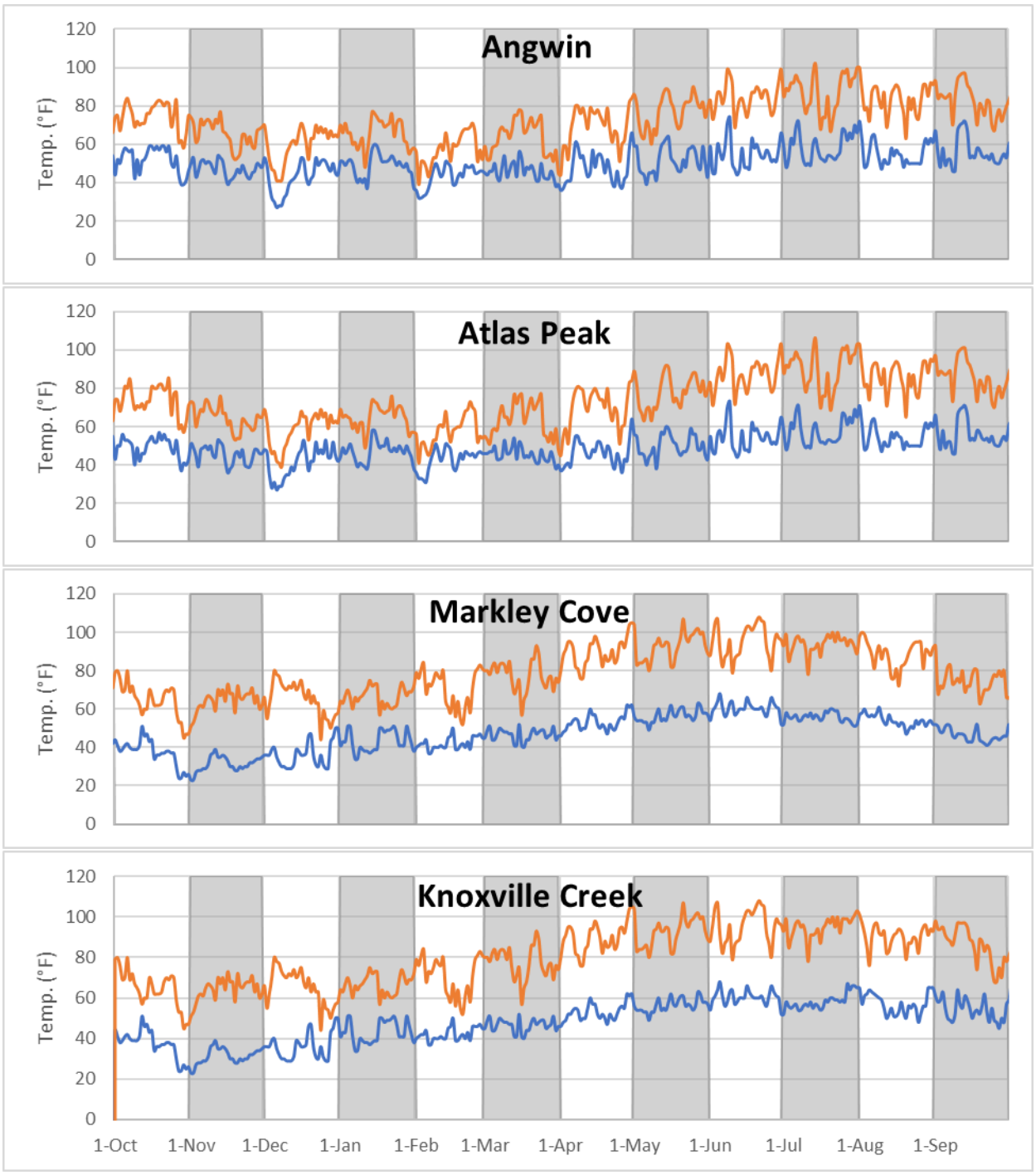


Figure 9 – cont.

Model Calibration

Available data are insufficient to calibrate the Water Year 2010 and 2014 SWB simulations; however, the land cover and soil properties used in the model were obtained from a previously prepared and calibrated SWB model of Sonoma County (OEI 2017). The Sonoma County model was calibrated against total monthly runoff volumes derived using baseflow separation of streamflow data for five watersheds within Sonoma County. Gages were selected because they represented relatively small watersheds (1.2 – 14.3 mi^2) without significant urbanization, diversions, groundwater abstraction, reservoir impoundments, or large alluvial bodies where significant exchanges between surface water and groundwater may be expected. These attributes are desirable because the hydrographs can more readily be separated into surface runoff and baseflow components and the surface runoff pattern is more directly comparable to the SWB simulated surface runoff which does not account for water use, reservoir operations, or surface water/groundwater exchange.

SWB utilizes a simplified routing scheme whereby surface runoff is routed to downslope cells or out of the model domain on the same day in which it originates as rainfall, thus it is not capable of accurately estimating streamflow over short time periods. The use of the total monthly surface runoff volumes provided a means of calibrating the Sonoma County SWB model to measured surface runoff data within the limitations of the model's approach to simulating surface runoff.

The SWB model of Sonoma County reproduced seasonal variations in surface runoff in all five calibration watersheds. Monthly Mean Errors (ME) ranged from -0.2 to 0.4 inches with a mean value of 0.1 inches. Annual surface runoff totals ranged from an under-prediction of approximately 10% at Franchini Creek to an over-prediction of approximately 19% at Buckeye Creek, with a mean over-prediction of approximately 6% across the five watersheds. These results indicate that the SWB model was able to reproduce monthly surface runoff volumes with a reasonable degree of accuracy and that the model tends to over-predict surface runoff somewhat, suggesting that the model may generate a low-range estimate of recharge.

Although the climate in Napa County is slightly drier than in Sonoma County, the vegetation, soils, and geology are similar and parameters calibrated using data from Sonoma County should be applicable to Napa County. Calibration of the Napa County SWB model was not performed due to a lack of publicly-available contemporary discharge records in suitable watersheds. Contemporary discharge records exist for USGS gaging stations located along the Napa River near St. Helena and Napa, but the watersheds above these gages are large and contain significant groundwater abstraction, reservoir impoundments, and alluvial bodies. USGS gages on smaller watersheds in Napa County have been inactive since 1983 or earlier. Discharge records exist through Napa One Rain for several streams gaged by the Napa County Resource Conservation District (RCD) but the RCD has cautioned against use of these discharge records for calibration purposes due to incomplete rating curve development.

Estimates of groundwater recharge are also available from an earlier model prepared by Luhdorff and Scalmanini Engineers and MBK Engineers (LSCE 2013). This report provided estimates of average annual recharge as a percentage of average annual precipitation for nine watersheds in Napa County. Averaged across the same nine watersheds, the SWB model predicts significantly higher rates of recharge than the model prepared by LSCE, which predicts slightly lower AET but significantly more runoff (Table 4). Differences in methodology between these two models complicate direct comparisons. The LSCE model calculated infiltration into the soil as the difference between monthly precipitation and discharge volumes within each watershed. Discharge volumes were calculated from USGS stream gages and included both direct runoff and baseflow from groundwater. Inclusion of baseflow with direct runoff in these calculations may inappropriately reduce the estimated volume of water infiltrated into the soil and available for recharge.

Table 4: Comparison of results from SWB model and Luhdorff and Scalmanini model.

USGS Gage	HUC	Mean Precip, 2010 (in)	Mean AET, 2010 (% Precip)		Mean Runoff, 2010 (% Precip)		Mean Recharge, 2010 (% Precip)	
			SWB	LSCE	SWB	LSCE	SWB	LSCE
Conn Ck nr Oakville	11456500	34.8	59%	53%	21%	25%	21%	21%
Dry Ck nr Napa	11457000	41.5	56%	50%	18%	43%	25%	6%
Milliken Ck nr Napa	11458100	32.3	52%	41%	20%	51%	28%	8%
Napa Ck at Napa	11458300	36.6	61%	43%	16%	46%	23%	11%
Napa R nr Napa	11458000	39.5	56%	48%	20%	35%	24%	17%
Napa R nr St Helena	11456000	47.9	46%	45%	23%	42%	30%	14%
Redwood Ck nr Napa	11458200	39.6	53%	49%	26%	40%	22%	10%
Tulucay Ck nr Napa	11458300	27.0	64%	49%	16%	47%	20%	5%

Model Results

The principal elements of the annual water budget simulated with the Napa County SWB model for Water Years 2010 and 2014 are presented in map form in Figures 10 - 19 and in tabular form for 27 major watershed areas in Napa County (Tables 5 - 8). The watersheds are based on USGS HUC-12 watersheds and are named for the stream which comprises the largest proportion of the area; in many cases the areas consist of multiple tributary streams (Figure 20).

In Water Year 2010 (representing "average" hydrologic conditions) precipitation varied from 21.8 inches in the Ledgewood Creek watershed to 53.3 inches in the Saint Helena Creek watershed (Figure 10, Table 5). Actual evapotranspiration (AET) ranged from 13.4 inches in the Jackson Creek watershed to 25.2 inches in the Saint Helena Creek watershed (Figure 11). Surface runoff ranged from 3.4 inches in the Ledgewood Creek watershed to 13.5 inches in the Saint Helena Creek watershed (Figure 12). Recharge ranged from 3.3 inches in the Ledgewood Creek watershed to 14.4 inches in the Saint Helena watershed. (Figure 13). Small decreases in soil moisture storage (up to 1.8 inches) occurred in most watersheds, with changes in most

watersheds being less than an inch (Figure 14). Note that the San Pablo Bay estuaries have been excluded from these comparisons.

Expressed as a percentage of the annual precipitation, AET ranged from 77% in the Ledgewood Creek watershed to 45% in the Jackson Creek watershed (Table 6). Surface runoff ranged from 15% of precipitation in the Ledgewood Creek watershed to 42% in the Jackson Creek watershed. Recharge ranged from 10% of the precipitation in the Jackson Creek watershed to 27% in the Saint Helena watershed.

In Water Year 2014 (representing "dry" hydrologic conditions during the second year of an extreme three-year drought) precipitation varied from 10.1 inches in the American Canyon Creek watershed to 32.2 inches in the Saint Helena Creek watershed (Figure 15, Table 7). Actual evapotranspiration (AET) ranged from 10.3 inches in the Jackson Creek watershed to 17.8 inches in the Saint Helena Creek watershed (Figure 16). Surface runoff ranged from 0.7 inches in the American Canyon Creek watershed to 13.2 inches in the Saint Helena Creek watershed (Figure 17). Recharge ranged from 0.6 inches in the Wragg Canyon watershed to 4.1 inches in the Saint Helena watershed. (Figure 18). Large decreases in soil moisture storage of between 2.3 and 4.3 inches were also simulated (Figure 19).

Expressed as a percentage of the annual precipitation, AET ranged from 55% in the Saint Helena Creek watershed to 121% in the Jackson Creek watershed (Table 8). These very large AET rates caused significant decreases in soil moisture. Decreases in soil moisture ranged from 9% of precipitation in the Saint Helena watershed to 36% in the American Canyon Creek watershed. Surface runoff ranged from 7% of precipitation in the American Canyon Creek watershed to 41% in the Saint Helena Watershed. Recharge ranged from 18% in the Milliken Creek Watershed to 5% in the Jackson Creek and Wragg Canyon watersheds.

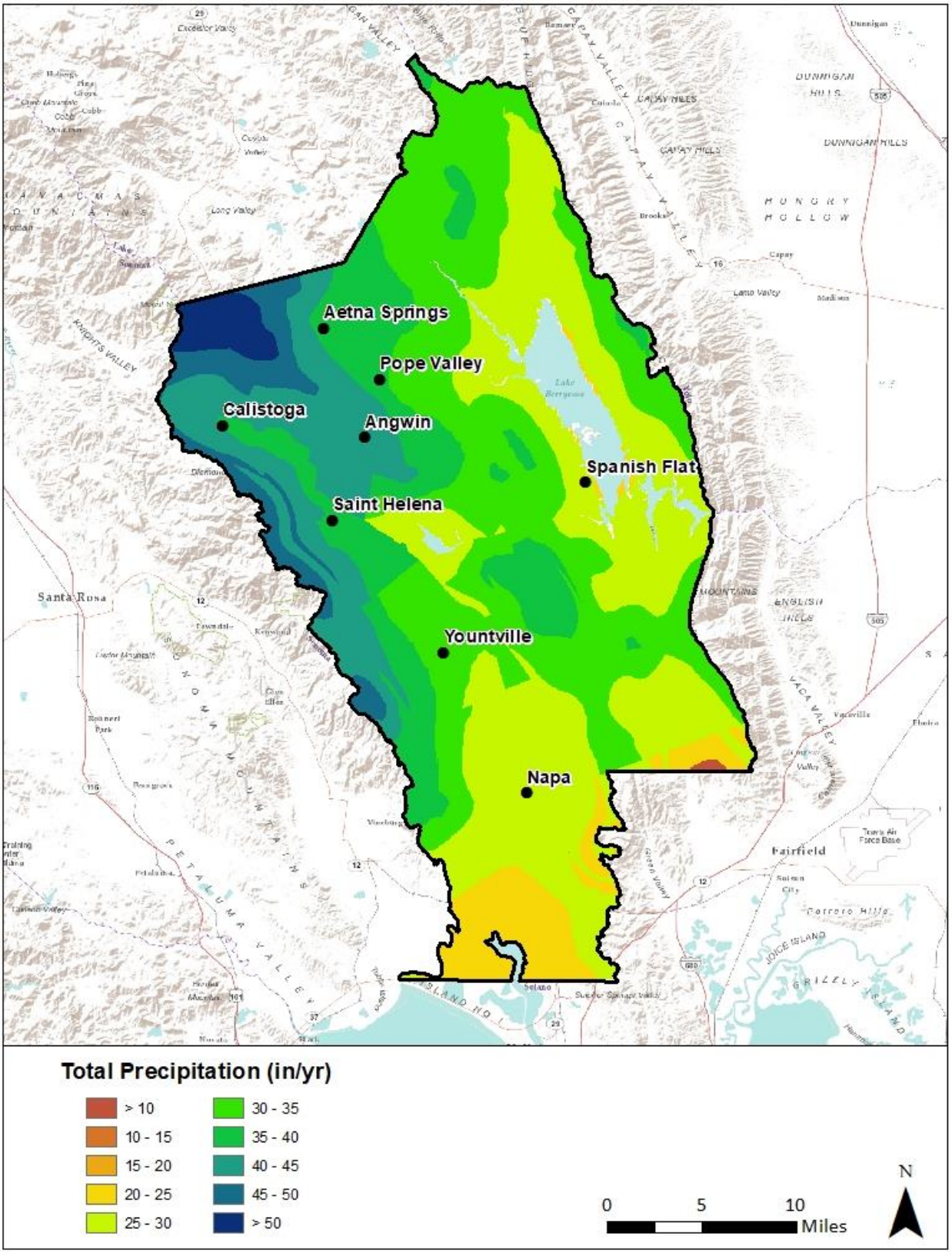


Figure 10: Water Year 2010 precipitation simulated with the Napa County SWB model.

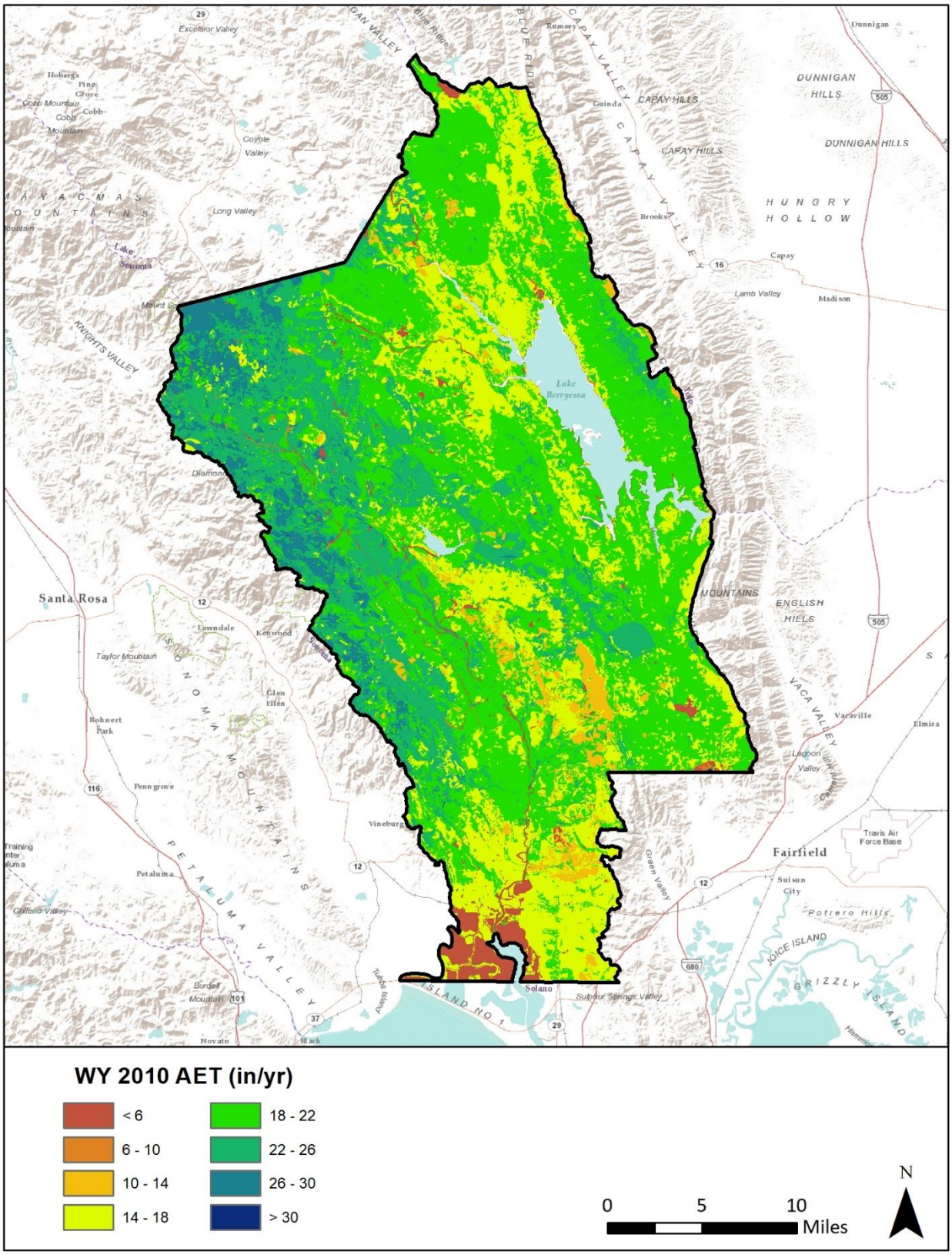


Figure 11: Water Year 2010 AET simulated with the Napa County SWB model.

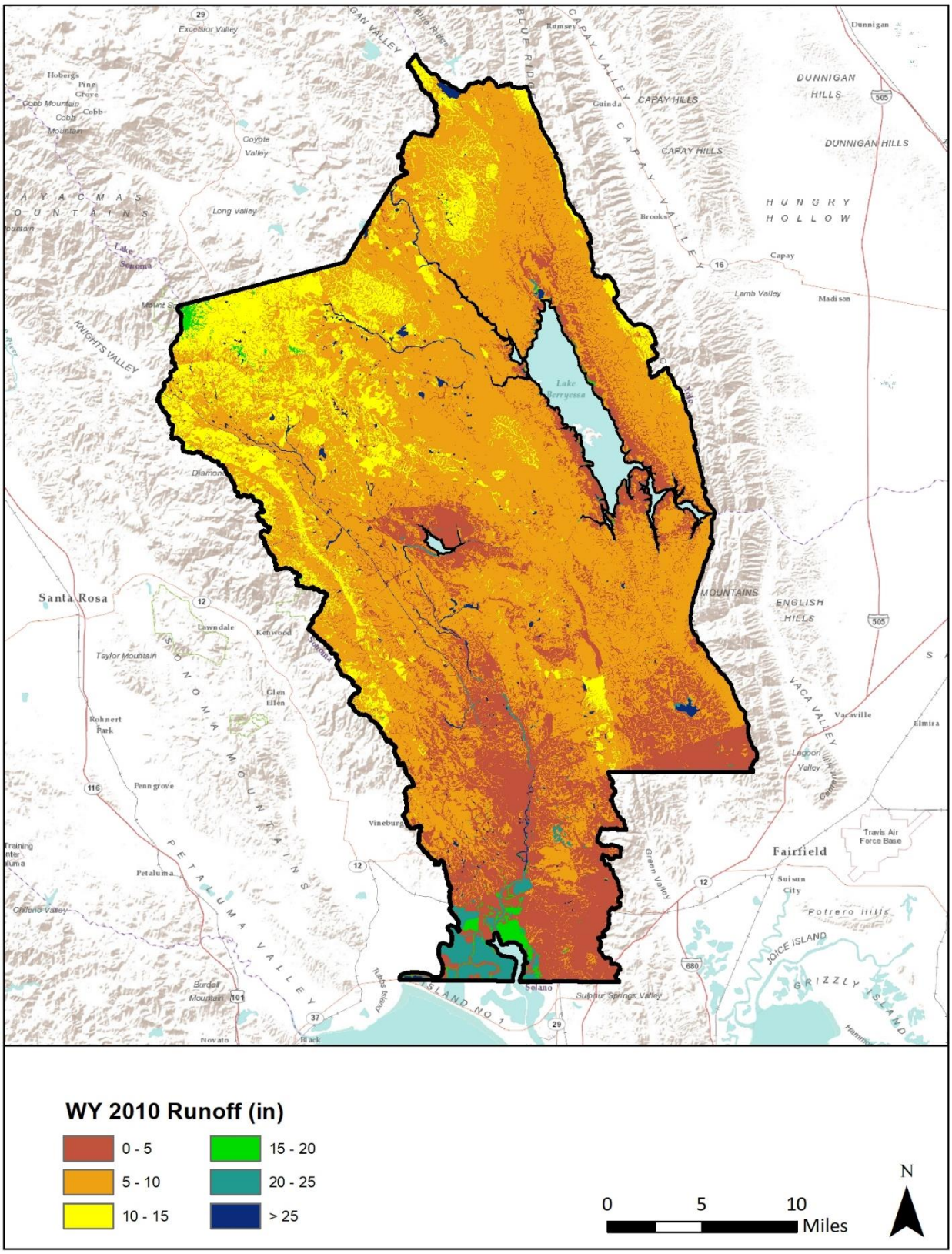


Figure 12: Water Year 2010 runoff simulated with the Napa County SWB model.

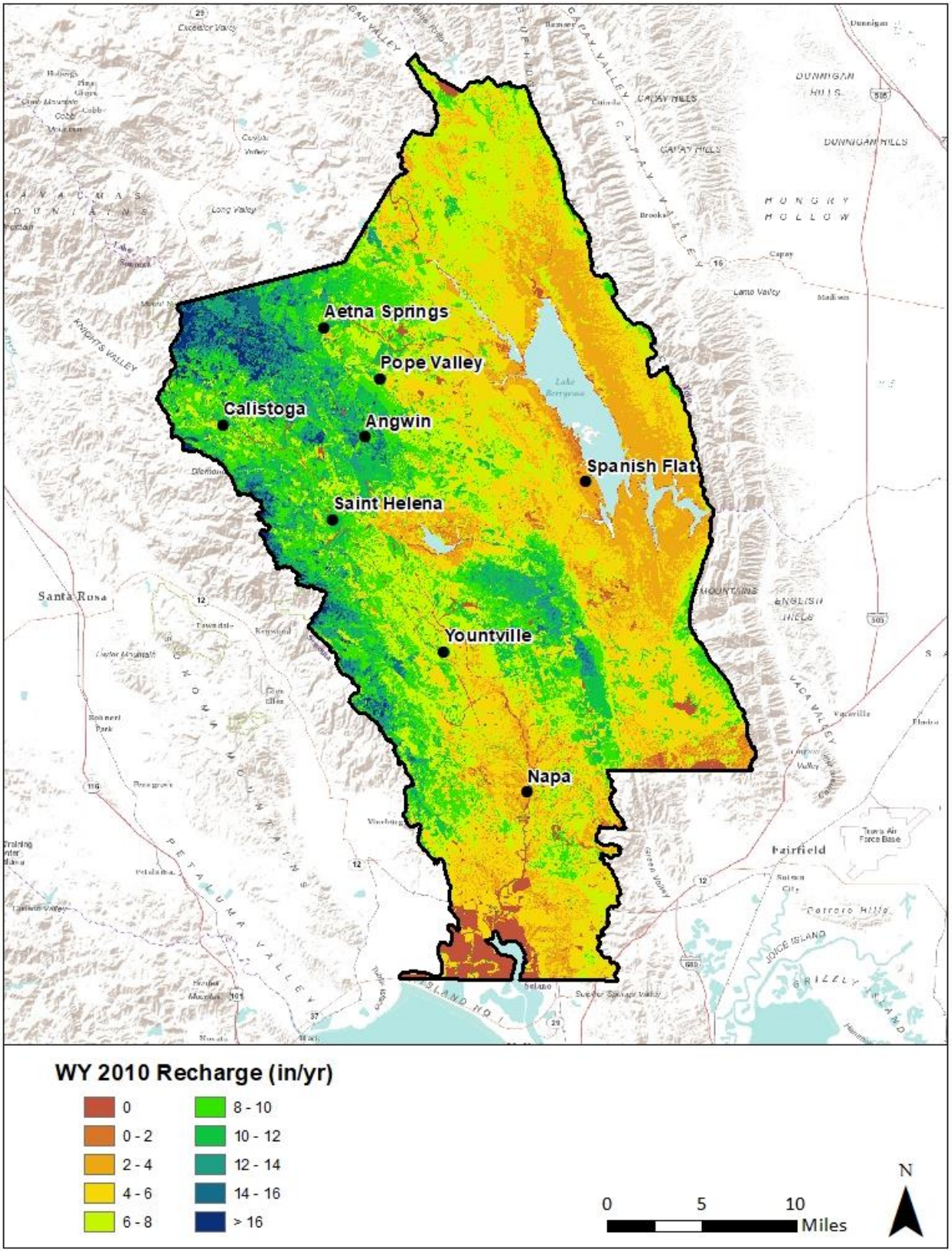


Figure 13: Water Year 2010 recharge simulated with the Napa County SWB model.

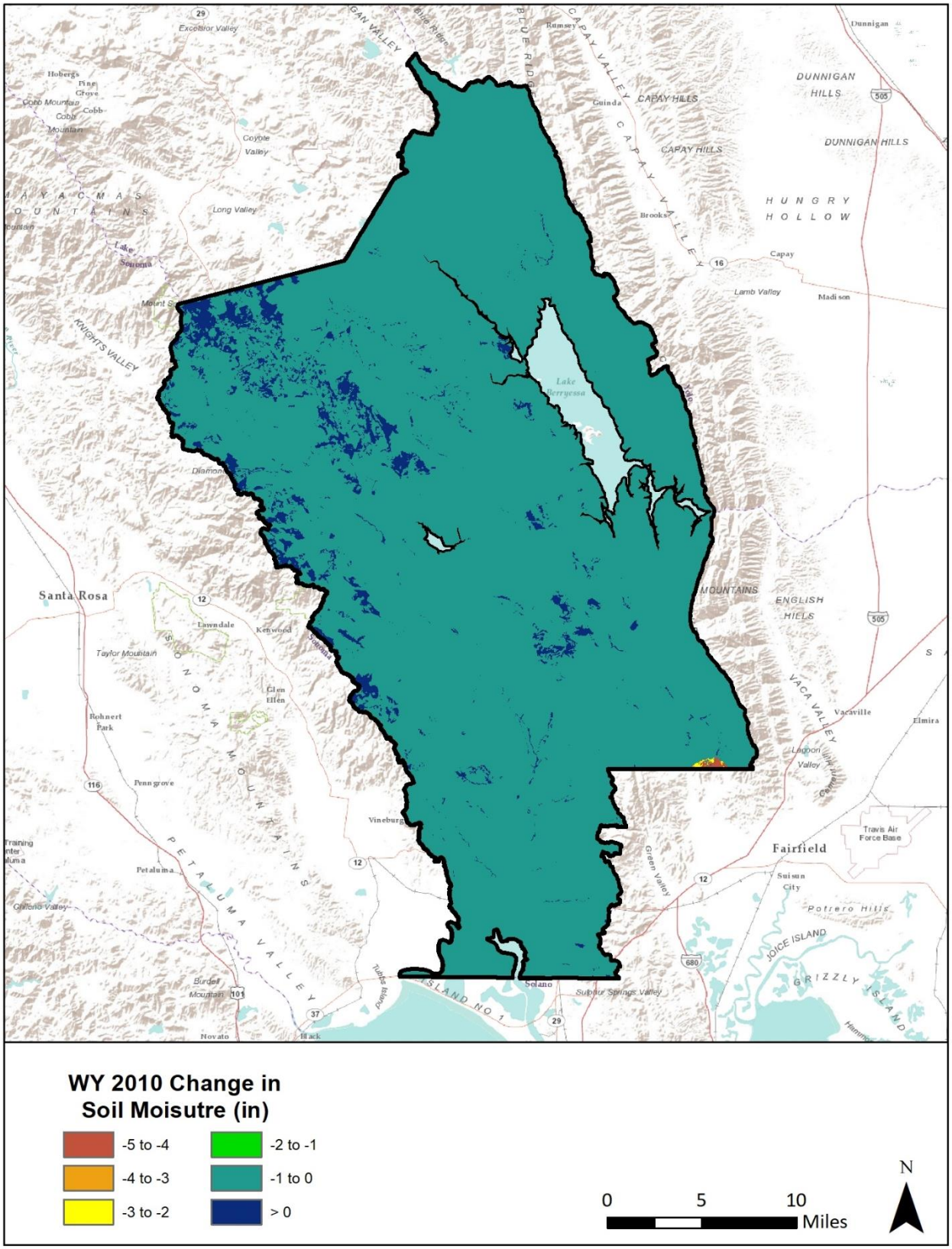


Figure 14: Water Year 2010 change in soil moisture content simulated with the Napa County SWB model.

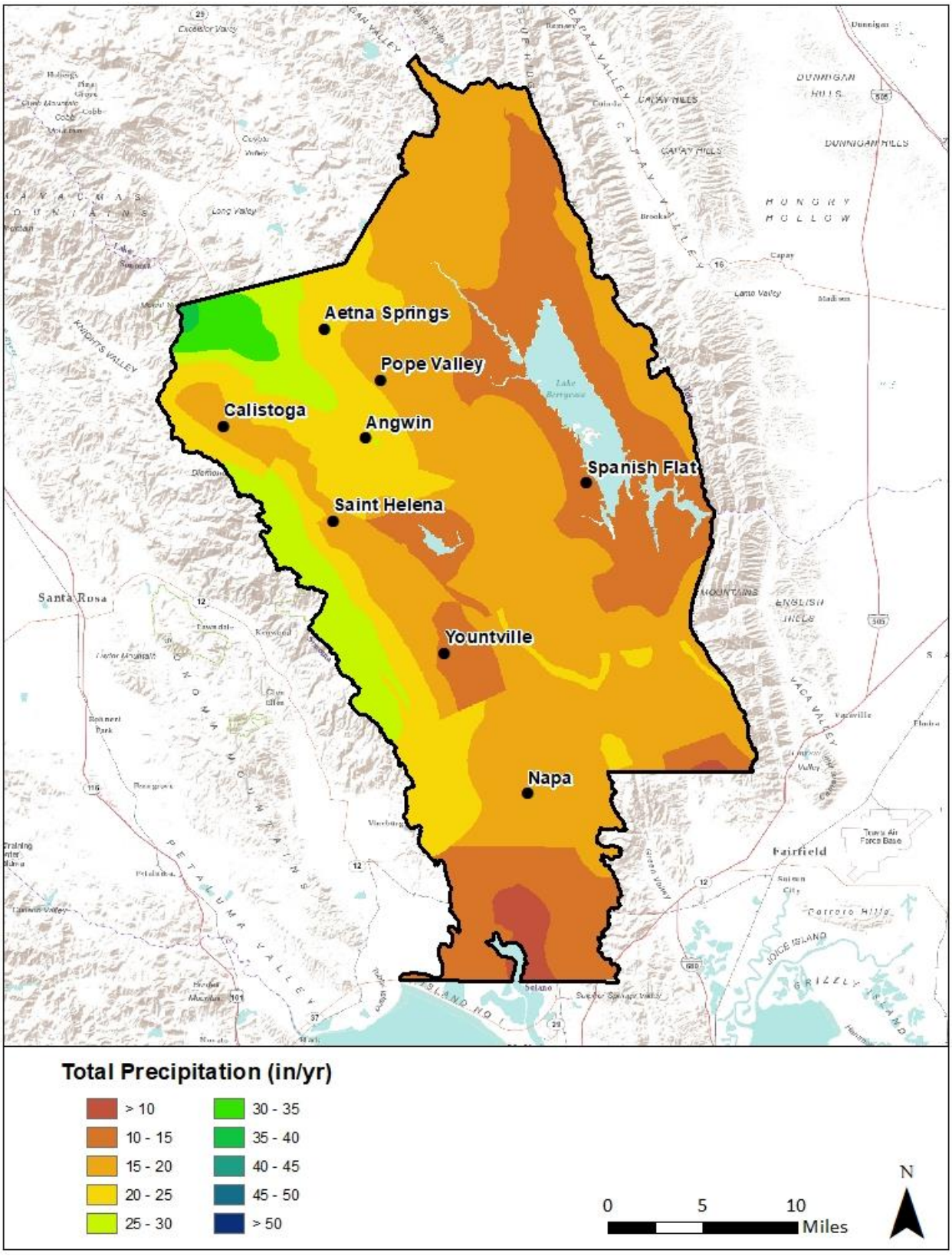


Figure 15: Water Year 2014 precipitation simulated with the Napa County SWB model.

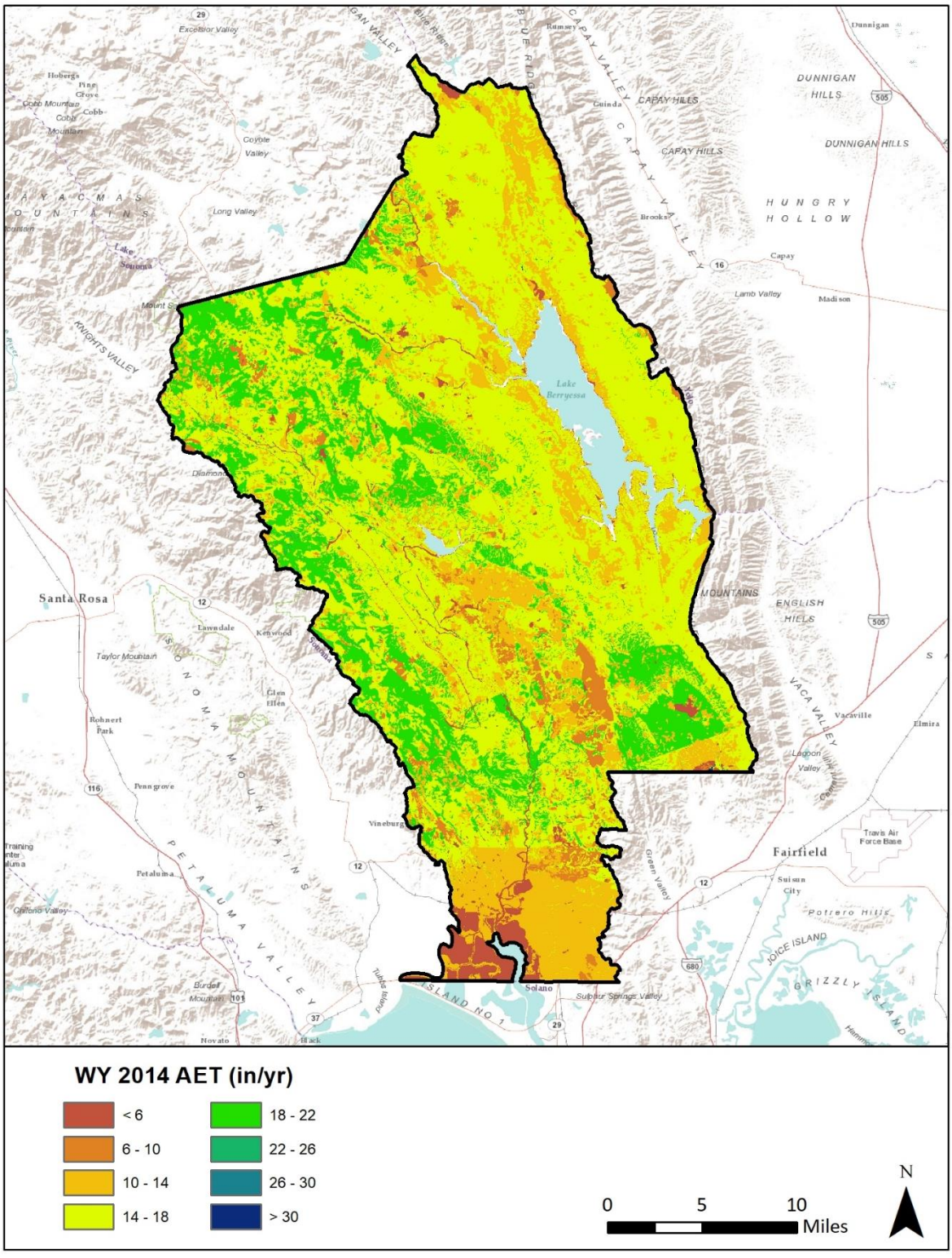


Figure 16: Water Year 2014 AET simulated with the Napa County SWB model.

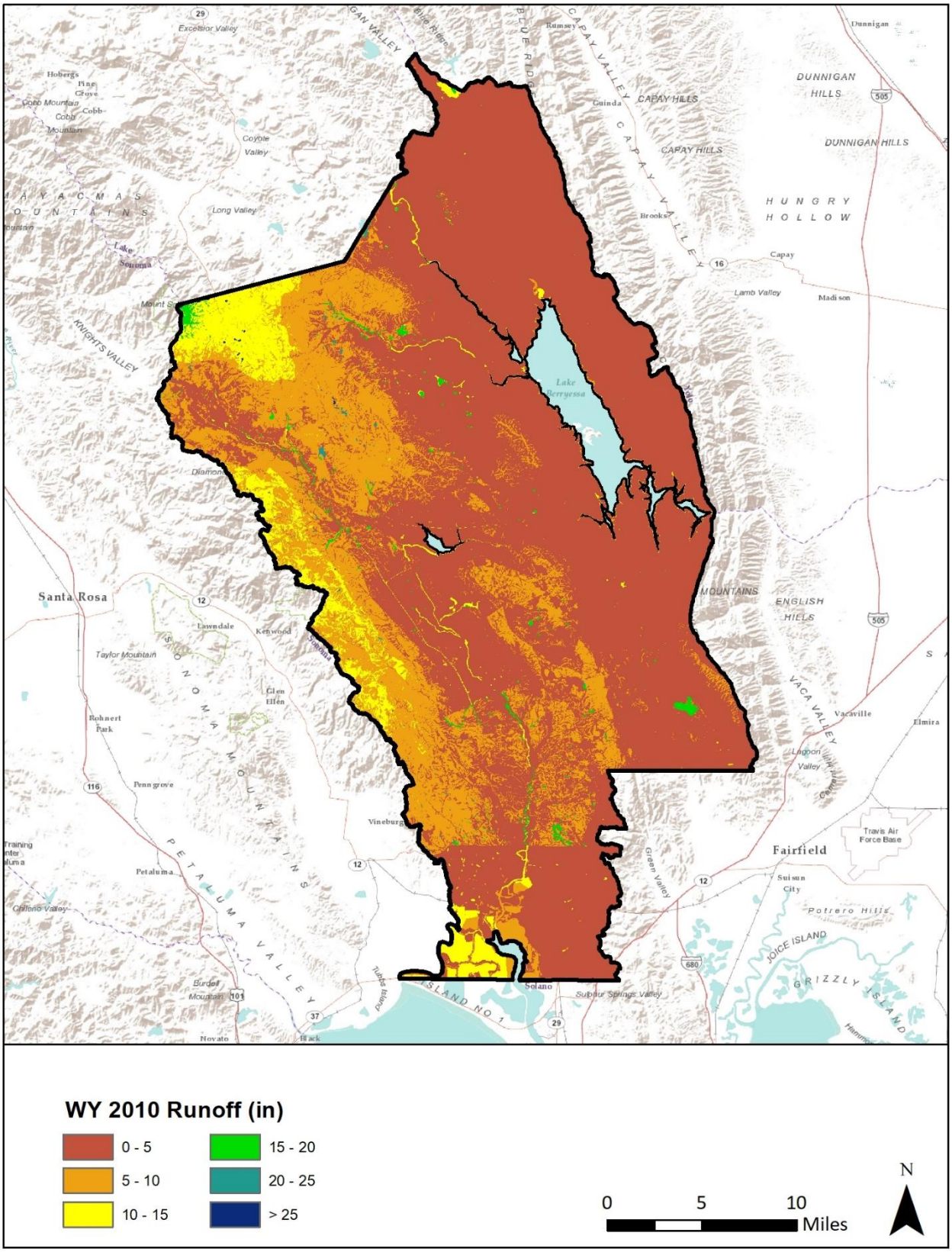


Figure 17: Water Year 2014 recharge simulated with the Napa County SWB model.

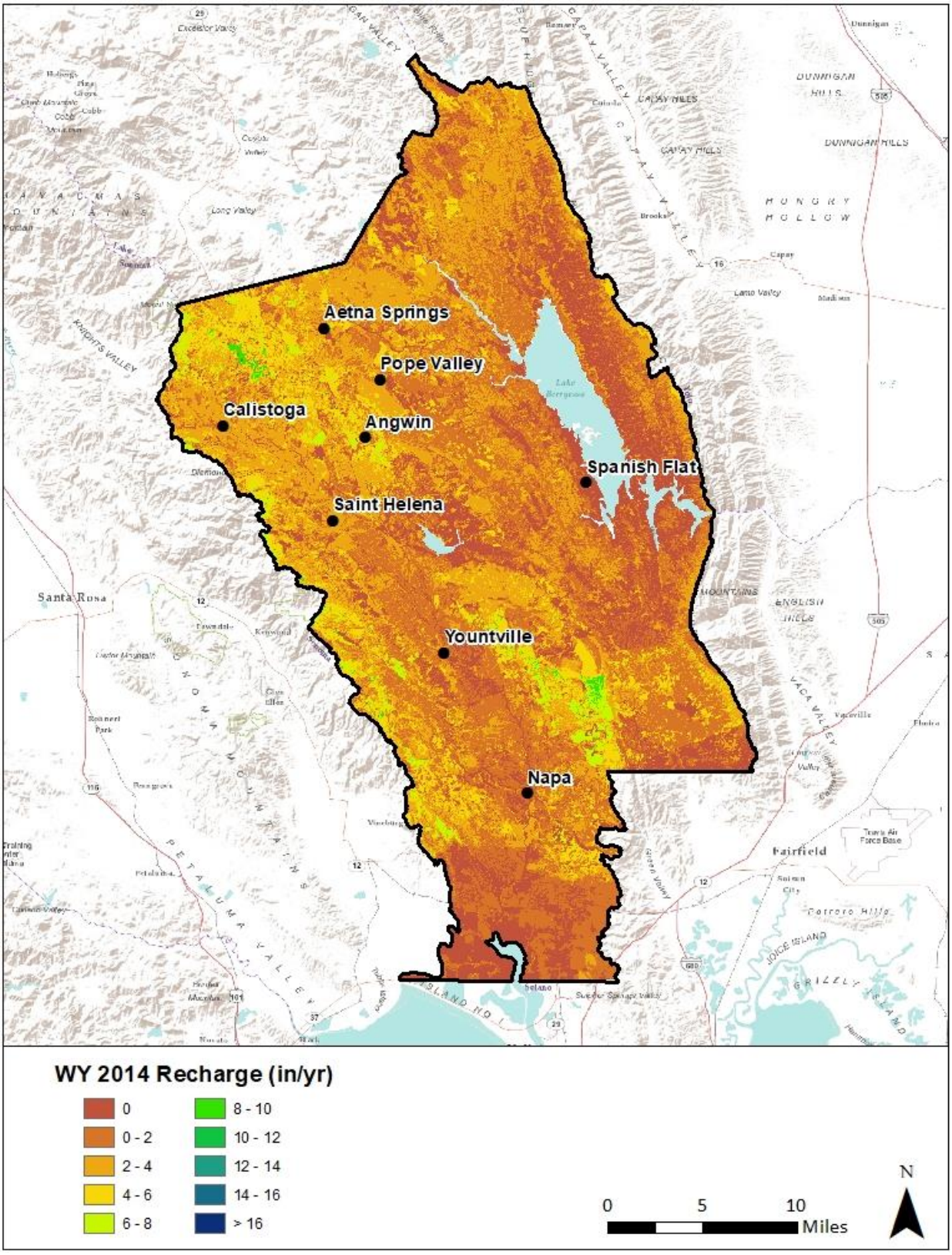


Figure 18: Water Year 2014 recharge simulated with the Napa County SWB model.

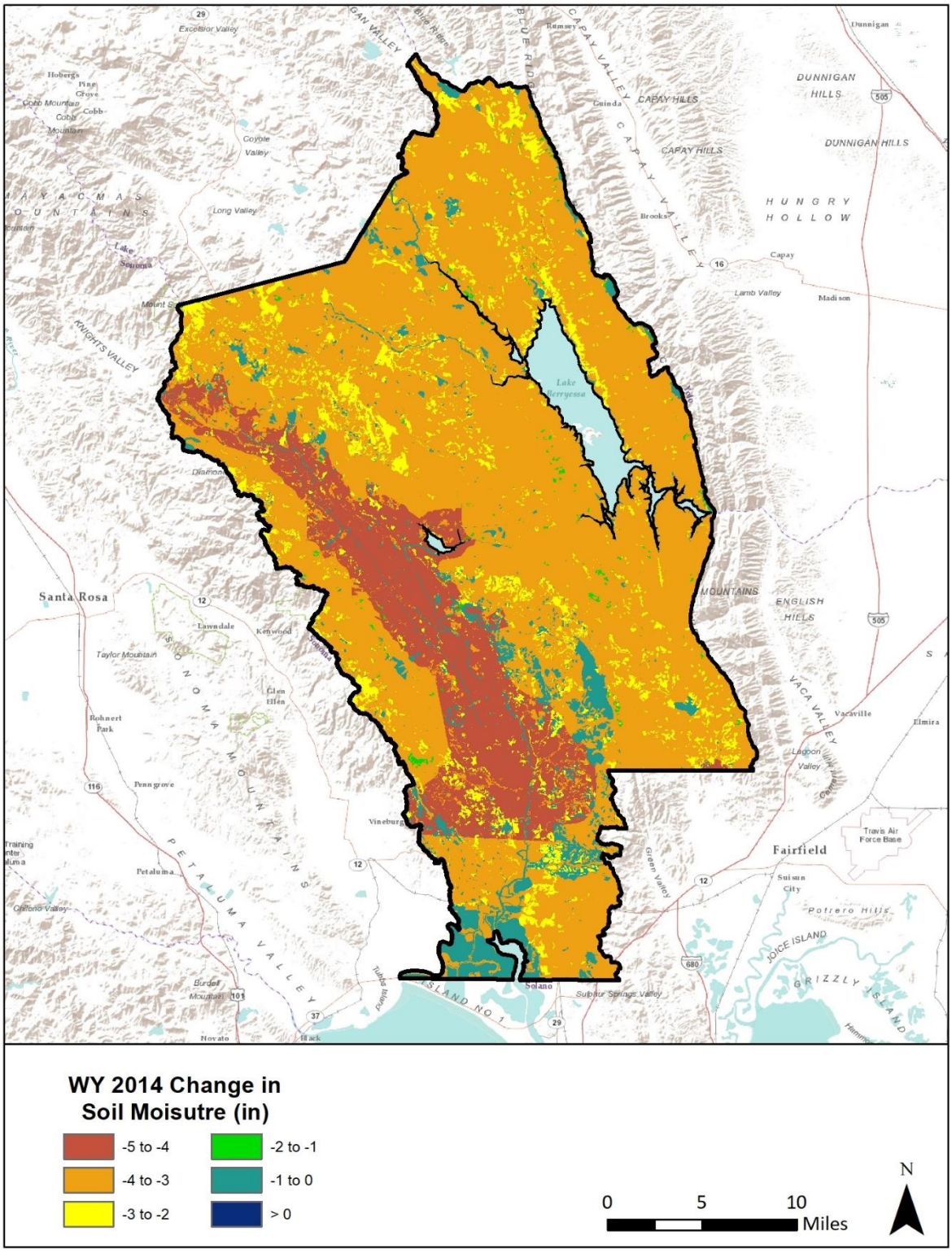


Figure 19: Water Year 2014 change in soil moisture content simulated with the Napa County SWB model.

Table 5: Simulated precipitation and recharge values averaged across HUC-12 watersheds in Napa County for Water Year 2010 expressed as depths. See Figure 20 for watershed locations.

Name	Drainage Area (mi^2)	Precipitation (in)	AET (in)	Surface Runoff (in)	Recharge (in)	Soil Moisture Change (in)
American Canyon Creek	10.8	24.1	16.3	3.7	4.7	-0.6
Bucksnort Creek	1.9	47.9	24.5	12.1	11.1	0.1
Butts Creek-Putah Creek	49.9	33.0	17.4	9.7	6.2	-0.7
Capell Creek	43.0	31.1	19.1	7.4	5.0	-0.6
Carneros Creek	29.7	28.0	18.6	5.2	5.5	-0.6
Chiles Creek	32.0	34.6	21.1	7.1	6.8	-0.5
Dry Creek	28.8	37.0	22.2	7.2	8.4	-0.5
Hunting Creek	12.0	33.7	19.0	9.7	5.7	-0.8
Jackson Creek-Putah Creek	54.5	29.9	13.4	12.6	3.0	-0.5
Lake Curry-Suisun Creek	16.4	30.7	18.9	6.5	5.9	-0.6
Lake Hennessey-Conn Creek	20.0	35.1	19.6	8.5	7.3	-0.4
Ledgewood Creek	6.4	21.8	16.9	3.4	3.3	-1.8
Lower Eticuera Creek	44.0	30.0	17.7	8.1	4.7	-0.7
Lower Napa River	45.0	31.7	19.9	5.6	6.7	-0.6
Lower Pope Creek	31.8	33.9	18.0	9.7	6.5	-0.6
Maxwell Creek	35.1	34.7	19.6	8.7	6.9	-0.6
Middle Napa River	60.3	39.9	22.8	8.5	9.2	-0.5
Milliken Creek	29.7	30.9	16.9	6.6	7.9	-0.6
Rector Creek-Conn Creek	22.3	32.8	18.0	7.1	8.2	-0.7
Saint Helena Creek	7.7	53.3	25.2	13.5	14.4	0.1
San Pablo Bay Estuaries	19.5	23.9	8.1	13.8	2.3	-0.3
Tulucay Creek	34.2	26.1	16.7	4.6	5.4	-0.7
Upper Eticuera Creek	25.6	31.2	17.2	8.6	6.1	-0.8
Upper Napa River	44.6	44.7	23.6	10.6	10.8	-0.4
Upper Pope Creek	21.7	44.5	22.7	10.5	11.5	-0.3
Wooden Valley & Suisun Creeks	23.3	29.0	19.0	5.1	5.5	-0.6
Wragg Canyon-Putah Creek	34.2	28.3	16.3	8.6	3.3	-0.6

Table 6: Simulated precipitation and recharge values averaged across HUC-12 watersheds in Napa County for Water Year 2010 expressed as a percentage of precipitation. See Figure 20 for watershed locations.

Name	Drainage Area (mi^2)	Precipitation (in)	AET (%)	Surface Runoff (%)	Recharge (%)	Soil Moisture Change (%)
American Canyon Creek	10.8	24.1	67%	15%	19%	-3%
Bucksnort Creek	1.9	47.9	51%	25%	23%	0%
Butts Creek-Putah Creek	49.9	33.0	53%	29%	19%	-2%
Capell Creek	43.0	31.2	61%	24%	16%	-2%
Carneros Creek	29.7	29.7	66%	19%	20%	-2%
Chiles Creek	32.0	34.6	61%	21%	20%	-1%
Dry Creek	28.8	37.8	60%	20%	23%	-1%
Hunting Creek	12.0	33.7	56%	29%	17%	-2%
Jackson Creek-Putah Creek	54.5	29.7	45%	42%	10%	-2%
Lake Curry-Suisun Creek	16.4	30.7	61%	21%	19%	-2%
Lake Hennessey-Conn Creek	20.0	36.0	56%	24%	21%	-1%
Ledgewood Creek	6.4	21.8	77%	15%	15%	-8%
Lower Eticuera Creek	44.0	30.0	59%	27%	16%	-2%
Lower Napa River	45.0	31.7	63%	18%	21%	-2%
Lower Pope Creek	31.8	33.9	53%	29%	19%	-2%
Maxwell Creek	35.1	34.7	56%	25%	20%	-2%
Middle Napa River	60.3	40.4	57%	21%	23%	-1%
Milliken Creek	29.7	30.9	55%	21%	26%	-2%
Rector Creek-Conn Creek	22.3	32.8	55%	22%	25%	-2%
Saint Helena Creek	7.7	53.3	47%	25%	27%	0%
San Pablo Bay Estuaries	19.5	23.9	34%	58%	10%	-1%
Tulucay Creek	34.2	26.1	64%	18%	21%	-3%
Upper Eticuera Creek	25.6	31.2	55%	28%	19%	-3%
Upper Napa River	44.6	44.7	53%	24%	24%	-1%
Upper Pope Creek	21.7	44.5	51%	23%	26%	-1%
Wooden Valley & Suisun Creeks	23.3	29.0	65%	18%	19%	-2%
Wragg Canyon-Putah Creek	34.2	28.3	58%	31%	12%	-2%

Table 7: Simulated precipitation and recharge values averaged across HUC-12 watersheds in Napa County for Water Year 2014 expressed as depths. See Figure 20 for watershed locations.

Name	Drainage Area (mi^2)	Precipitation (in)	AET (in)	Surface Runoff (in)	Recharge (in)	Soil Moisture Change (in)
American Canyon Creek	10.8	10.1	12.3	0.7	0.7	-3.6
Bucksnort Creek	1.9	28.8	17.6	11.5	2.6	-3.0
Butts Creek-Putah Creek	49.9	16.9	14.2	3.9	1.9	-3.2
Capell Creek	43.0	15.8	14.8	3.1	1.1	-3.1
Carneros Creek	29.7	15.0	14.7	4.6	2.0	-3.7
Chiles Creek	32.0	18.3	16.5	3.7	1.5	-3.3
Dry Creek	28.8	21.5	16.5	6.8	2.5	-3.7
Hunting Creek	12.0	16.7	15.4	3.1	1.6	-3.4
Jackson Creek-Putah Creek	54.5	14.9	10.3	6.1	0.7	-2.3
Lake Curry-Suisun Creek	16.4	18.4	16.1	3.7	1.9	-3.4
Lake Hennessey-Conn Creek	20.0	19.1	14.8	5.7	2.2	-3.2
Ledgewood Creek	6.4	12.2	13.9	1.7	0.8	-4.3
Lower Eticuera Creek	44.0	14.9	14.0	2.6	1.3	-3.1
Lower Napa River	45.0	19.4	15.9	5.0	2.2	-3.6
Lower Pope Creek	31.8	17.8	14.5	4.5	2.0	-3.2
Maxwell Creek	35.1	18.3	15.9	3.8	2.0	-3.3
Middle Napa River	60.3	21.3	16.5	6.6	2.5	-3.7
Milliken Creek	29.7	18.7	13.7	4.5	3.4	-2.9
Rector Creek-Conn Creek	22.3	16.5	13.6	4.0	2.3	-3.4
Saint Helena Creek	7.7	32.2	17.8	13.2	4.1	-3.0
San Pablo Bay Estuaries	19.5	10.4	6.0	5.6	0.5	-1.6
Tulucay Creek	34.2	14.6	13.5	2.6	1.7	-3.3
Upper Eticuera Creek	25.6	15.5	14.1	2.5	2.1	-3.2
Upper Napa River	44.6	22.9	16.2	6.9	3.3	-3.5
Upper Pope Creek	21.7	25.6	16.8	8.5	3.5	-3.2
Wooden Valley & Suisun Creeks	23.3	17.9	16.4	3.1	2.0	-3.5
Wragg Canyon-Putah Creek	34.2	14.1	12.6	3.6	0.6	-2.8

Table 8: Simulated precipitation and recharge values averaged across HUC-12 watersheds in Napa County for Water Year 2014 expressed as a percentage of precipitation. See Figure 20 for watershed locations.

Name	Drainage Area (mi^2)	Precipitation (in)	AET (%)	Surface Runoff (%)	Recharge (%)	Soil Moisture Change (%)
American Canyon Creek	10.8	10.1	121%	7%	7%	-36%
Bucksnort Creek	1.9	28.8	61%	40%	9%	-10%
Butts Creek-Putah Creek	49.9	16.8	84%	23%	11%	-19%
Capell Creek	43.0	15.8	94%	20%	7%	-20%
Carneros Creek	29.7	17.6	98%	30%	13%	-25%
Chiles Creek	32.0	18.4	90%	20%	8%	-18%
Dry Creek	28.8	22.1	77%	32%	12%	-17%
Hunting Creek	12.0	16.7	92%	18%	10%	-20%
Jackson Creek-Putah Creek	54.5	14.7	69%	41%	5%	-16%
Lake Curry-Suisun Creek	16.4	18.4	88%	20%	10%	-19%
Lake Hennessey-Conn Creek	20.0	19.6	78%	30%	12%	-17%
Ledgewood Creek	6.4	12.2	114%	14%	7%	-35%
Lower Eticuera Creek	44.0	14.9	94%	18%	9%	-21%
Lower Napa River	45.0	19.4	82%	26%	11%	-19%
Lower Pope Creek	31.8	17.8	81%	25%	11%	-18%
Maxwell Creek	35.1	18.3	87%	21%	11%	-18%
Middle Napa River	60.3	21.8	77%	31%	12%	-18%
Milliken Creek	29.7	18.7	74%	24%	18%	-16%
Rector Creek-Conn Creek	22.3	16.5	83%	24%	14%	-21%
Saint Helena Creek	7.7	32.2	55%	41%	13%	-9%
San Pablo Bay Estuaries	19.5	10.4	58%	53%	4%	-16%
Tulucay Creek	34.2	14.6	93%	18%	12%	-23%
Upper Eticuera Creek	25.6	15.5	91%	16%	14%	-21%
Upper Napa River	44.6	22.9	71%	30%	14%	-15%
Upper Pope Creek	21.7	25.6	66%	33%	14%	-12%
Wooden Valley & Suisun Creeks	23.3	17.9	91%	17%	11%	-20%
Wragg Canyon-Putah Creek	34.2	14.1	90%	26%	5%	-20%

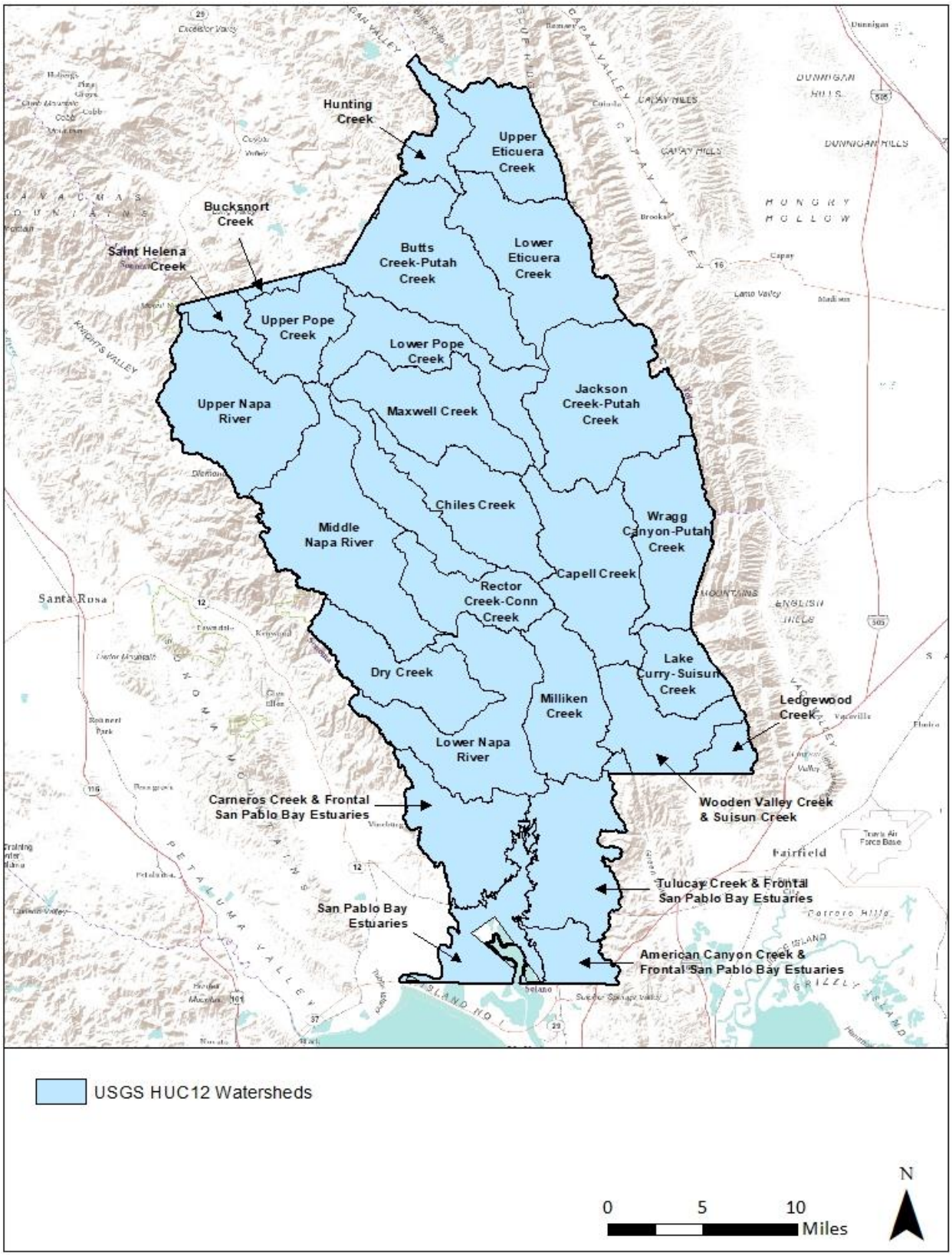


Figure 20: Major watersheds areas used to summarize water budget information in Tables 5 - 8.

Discussion and Conclusion

Numerous previous modeling studies have estimated water budget components in several larger watershed areas in Sonoma and Napa Counties including the Santa Rosa Plain, the Green Valley and Dutch Bill Creek watersheds, and the Sonoma Valley (Farrar et. al., 2006; Kobor and O'Connor, 2016; Woolfenden and Hevesi, 2014). Comparisons to these water budgets are useful for evaluating the SWB results, but one would not expect precise agreement owing to significant variations in climate, land cover, soil types, underlying hydrogeologic conditions, and different spatial scales of modeling studies. These regional analyses estimate that average annual recharge varies from 7% to 19% of the annual precipitation. The equivalent county-wide value from this study is slightly higher at 20%.

Water budgets for the Napa River and selected sub-basins were also estimated in a previous study by Luhdorff and Scalmanini Engineers and MBK Engineers (LSCE 2013). The LSCE study estimated that, as a percentage of annual precipitation, AET comprised slightly less, runoff significantly more, and recharge substantially less of the typical annual water budget. LSCE (2013) calculated infiltration of precipitation based on the difference between total monthly streamflow at selected gaging stations and total monthly precipitation for the gages' drainage area. Streamflow volumes include both direct runoff (overland flow and interflow) and baseflow from groundwater. Inclusion of baseflow with direct runoff in these calculations may inappropriately reduce the estimated volume of water infiltrated into the soil and available for recharge; the LSCE approach therefore tends to underestimate groundwater recharge. Additionally, many of the gauging stations used for the analysis are located in reaches that may be significantly influenced by upstream reservoir releases, surface water diversions, groundwater abstraction, and/or surface water groundwater exchanges, further complicating the interpretation of the LSCE (2013) runoff rates and the interrelated calculations of AET and recharge rates. In contrast, the SWB model presented here is based on calibrated parameter values developed for a similar model in Sonoma County which was calibrated to gauges specifically selected to minimize the effects of reservoir releases, water use, or significant surface water/groundwater interaction, and after separating and removing the baseflow component of streamflow.

The recharge estimates presented here arguably represent the best available county-wide estimates produced at a fine spatial resolution using a consistent and objective data-driven approach. This analysis focused on two Water Years, 2010 and 2014, which represent average and drought conditions respectively. Input parameters were determined based on literature values and values calibrated through prior modeling experience in Sonoma County.

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