PROJECT EVALUATION AND PRE-DESIGN ENGINEERING REPORT

FOR A PROPOSED PUBLIC WATER SYSTEM IN BOONVILLE, CA

ANDERSON VALLEY COMMUNITY SERVICES DISTRICT

JUNE 2017

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List of Abbreviations

AVCSD	-	Anderson Valley Community Services District
AV	-	Anderson Valley
DFA	-	State Water Resources Control Board, Division of Financial Assistance
DDW	-	State Water Resources Control Board, Division of Drinking Water
gpm	-	gallons per minute
MDD	-	Maximum Day Demand
MCL	-	Maximum Contaminant Level
NCRWQCB	-	North Coast Regional Water Quality Control Board
PHD	-	Peak Hour Demand
PWS	-	Public Water System
SR	-	State Route
SWRCB	-	State Water Resources Control Board
ug/L	-	micrograms per liter, also known as parts per billion

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1 Proposed Service Area and Existing Facilities

The Anderson Valley Community Services District (AVCSD) provides various municipal services for the Anderson Valley/Boonville area (primarily fire), but does not currently provide water or sewer service. Currently, all properties use domestic wells and septic systems for water supply and wastewater disposal, respectively. Contamination of the domestic wells due to aging or proximity to septic systems has spurred AVCSD to investigate potential installation of a community public water system.

The AVCSD Board authorized the creation of a citizen committee (The Boonville Planners) to encourage public input and participation in the planning process and assist in the dissemination of project related information throughout the community. Based on public input, AVCSD has proposed several water service areas that include the business district, fairgrounds, and densely populated areas in Boonville along Highway 128. The design and construction of a supply source, treatment facilities, and distribution system for Boonville will be referred to herein as the "Project".

The project area is the rural community of Boonville in Mendocino County. Boonville is a census-designated place located[1] within the community area of Anderson Valley and is located approximately 115 miles north of San Francisco and 40 miles southeast of Fort Bragg. Boonville is located along State Route 128 with the highway dividing the valley lengthwise in a northwest-southeast direction. State Route 128 is a main route from Highway 101 to State Route 1 and the Mendocino Coast. Boonville experiences warm, dry summers and cool wet winters, with an average annual rainfall of approximately 38 inches. Local variation in weather can occur in the valley due to the region's proximity to the Pacific Ocean.

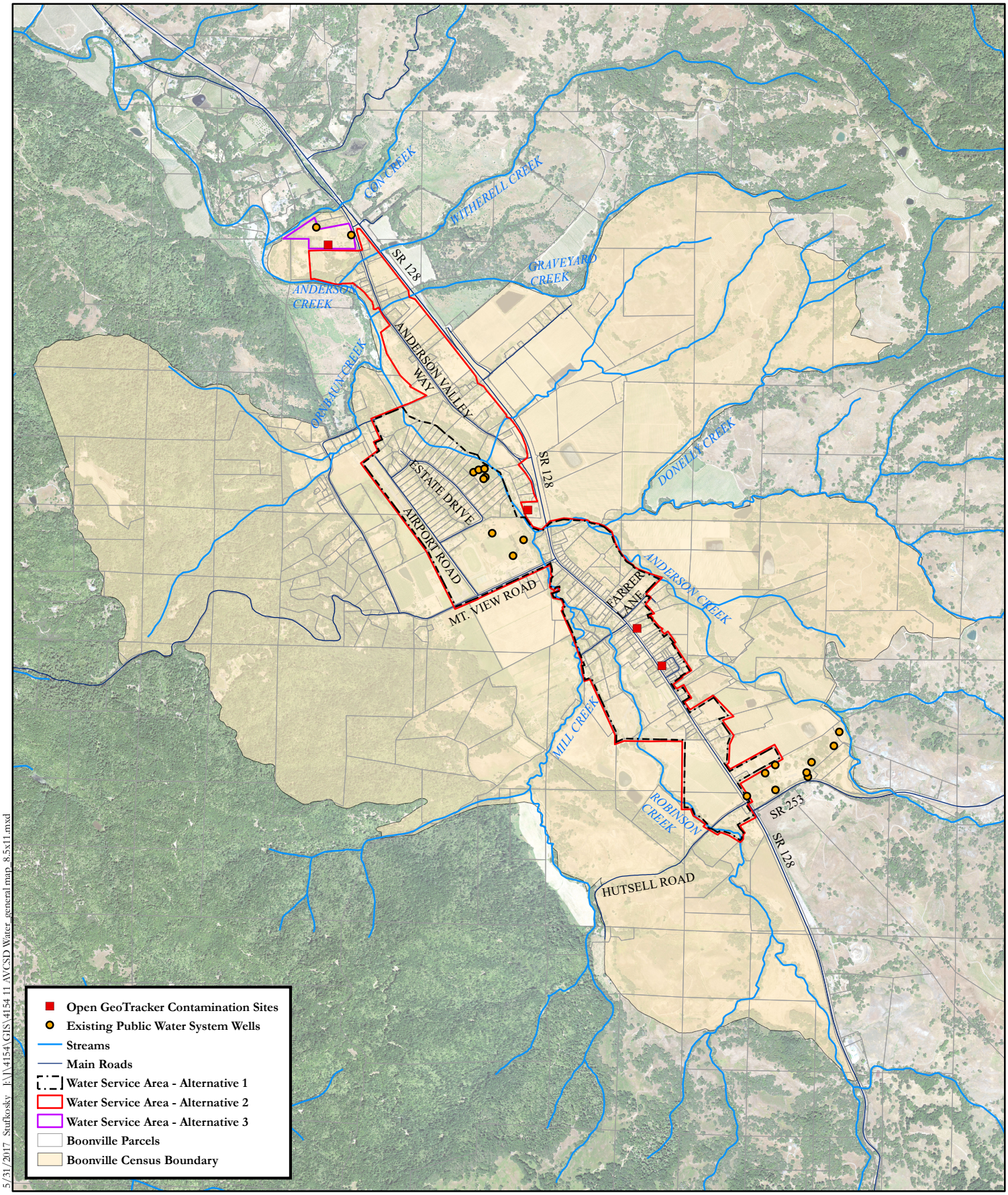
The local economic industries in the area are tourism and agriculture, with local agriculture mainly comprised of wine grape cultivation. From the 2015 American Community Survey (issued by the United States Census Bureau), the median household income was $37,865 (+/- $8,055) and the mean household income was $54,329 (+/-$18,185). Boonville has an assortment of land uses including residential, commercial, offices, lodging, and other community services.

1.1 Proposed Service Area

In coordination with the AVCSD, four service area alternatives have been identified. The first proposed alternative (Figure 1) includes the general downtown business core, the Meadow Estates subdivision, Pennyroyal Farm (tasting room and homes), and the mobile homes at the southern end of the valley on Hutsell Road. The second proposed alternative (Figure 1) encompasses Alternative 1 and includes the residences along Anderson Valley Way. Alternative 3 adds the Anderson Valley Elementary School at the north end of the valley to Alternative 2. The fourth alternative is simply Alternative 1 plus the Anderson Valley Elementary School (this alternative is not shown on Figure 1).

The owners of four parcels at the end of Farrer Lane submitted a written request to AVCSD to not be included in any proposed water service areas. They indicated that their wells and septic systems are relatively new and should have many more years of useful life. Anderson Valley Brewing Company was not included in any service areas as the company has its own public water system with treatment.

[1] Mendocino County General Plan (2009)



5/31/2017 Stufkosky E:\4154\GIS\4154 11 AVCSD Water_general map_8.5x11.mxd

Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Units: Foot US

Parcels, zoning, and road data source: County of Mendocino, Information Services Division
Census Boundary source: US Census Bureau
Stream data source: CA Department of Fish and Wildlife
Aerial Imagery: US Dept. of Agriculture, NAIP series

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NORTH

0 625 1,250 2,500 Feet

1 inch = 2,500 feet

FIGURE 1
BOONVILLE VICINITY

ANDERSON VALLEY COMMUNITY SERVICES DISTRICT
MAY 2017

1.1.1 Population Estimation

To determine the required water demands of a drinking water system, an estimation of the population and connections within the proposed service areas is required.

Population Estimation

California state regulations[2] present several methods for determining the number of persons served by a water system including: a) using most recent census data, b) multiplying the number of service connections by 3.3, or c) determining the number of dwelling units, commercial units, industrial units, etc. and multiplying this total by 2.8.

According to the 2010 United States Census, Boonville's population was 1,035 people and 372 of the 413 household units were occupied. Since Boonville is a census-designated place, the population estimate aligns with the census boundary. Unfortunately, the census boundary and proposed water system boundary alternatives do not align (Figure 1), requiring the proposed water system population to be estimated using the other two methods.

The population estimate using the other two methods is 650-870 people with the population varying between methods and service area alternatives. Using the "connection estimate times 3.3" method, the population was estimated as approximately 700 people with 211 connections in the smallest proposed service area (Alternative 1). For the largest proposed service area (Alternative 3), the population was estimated as 870 people with 262 connections. Using the "building estimate times 2.8" method, the population was determined as approximately 650 people within the smallest proposed service area (Alternative 1). The number of buildings in the area was estimated as the number of connections plus the number of buildings at connections that have more than one building (i.e. the schools or the fairgrounds) for a total of 233 buildings. For the largest proposed service area (Alternative 3), the population was estimated for 280 buildings as 780 people using the "building estimate times 2.8" method.

Connection Estimation

A build-out analysis of the Boonville area was performed by the County of Mendocino, Department of Planning and Building Services in 2015. The area analyzed included a total of 210 parcels distributed as 152 residential lots with 174 dwelling units and 58 commercial lots.

As the exact boundary of the analysis could not be reconstructed, a new analysis of lot and dwelling unit count was performed by Brelje and Race to align with the proposed service area alternatives. There are 214 parcels in service area Alternative 1, 269 parcels in Alternative 2, 270 parcels in Alternative 3, and 215 parcels in Alternative 4. The parcels were sorted according to each parcel's zoning (Table 1) and used in the following connection analysis.

[2] California Code of Regulations, Title 22, Chapter 15, Section 64412

Table 1. Parcel Count and Zoning within each Service Area Alternative

Residential Parcels					
Parcel Zoning	**Minimum Parcel Size**	**Parcel Quantity**			
		Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**
Single Family Residence (SFR)		**95**	**130**	**130**	**95**
SFR	Less than 1 acre	58	68	68	58
SFR	1 acre	37	37	37	37
SFR	5 acres	0	25	25	0
Total Multi Unit		**32**	**37**	**37**	**32**
Multi-Unit	Less than 1 acre	20	20	20	20
Multi-Unit	1 acre	10	10	10	10
Multi-Unit	5 acres	0	5	5	0
Multi-Unit (rangeland)	160 acres	2	2	2	2
Total Vacant Residential		**19**	**22**	**22**	**19**
Vacant	Less than 1 acre	10	10	10	10
Vacant	1 acre	8	8	8	8
Vacant	5 acres	0	3	3	0
Vacant	40 acres	1	1	1	1
Total Residential Parcels		**146**	**189**	**189**	**146**
Non-residential Parcels					
Parcel Zoning	**Minimum Parcel Size**	**Parcel Quantity**			
		Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**
Commercial (C2)	No min. lot size for commercial zoning	50	50	50	50
Ag (AG)	40 acres	4	13	13	4
Rangeland	160 acres	2	2	2	2
Schools	Less than 1 acre	1	1	2	2
Utilities	1 acre	1	1	1	1
Public Facilities (PF)	No min. lot size for zoning	10	13	13	10
Total Non-residential Parcels		**68**	**80**	**81**	**69**
Total Parcels		**214**	**268**	**269**	**215**

The potential number of residential connections in each proposed service area was estimated by multiplying each parcel by a factor based on zoning type (i.e. single-family vs. multi-family residences). A parcel zoned "single-family residence" was assumed to have one potential connection per parcel. Reviewing aerial imagery, the number of dwelling units on the multi-family residence parcels varied from 2 to 6 units per parcel (i.e. duplexes, apartment building, mobile homes). For the parcels zoned multi-family residential, the parcels were multiplied by a factor of 2.5 to obtain the number of dwelling units; a factor of 2.5 was used in an attempt to reflect that the multi-family parcels are not exclusively

duplexes. Aerial imagery was not used for estimation of residential connections because garages, airplane hangars, and homes were not easily distinguishable from aerial imagery.

In the service area Alternatives 1 and 4, there is a total estimated 175 residential connections or dwelling units distributed as 95 single-family residences and 80 units on multi-family parcels (counting each individual apartment or duplex unit). In the service area Alternatives 2 and 3, there is an estimated 225 residential connections distributed as 130 single-family residences and 93 units on multi-family parcels.

The non-residential connections were estimated from a list of businesses and an aerial imagery count. Parcel zoning was not used to estimate the number of non-residential buildings as there was sometimes more than one building per non-residential parcel. Each business or building was counted as one potential connection to obtain 36 non-residential connections as follows in Alternative 1:

- 26 Commercial Facilities (restaurants, markets, wine tasting rooms, gas station, hotel, offices)
- 2 Public Facilities (AV High School, Mendocino County Fairgrounds)
- 7 Institutions (churches, airport, post office, fire station, senior center)
- 1 Health Facility

In Alternative 2, there is an additional church and the AVCSD Historical Society museum. Alternative 3 adds the Anderson Valley Elementary School as a potential connection. The number of residential connections in Alternative 1 and 4 are the same.

The total residential and non-residential connection count was projected as follows:

- Alternative 1: 211 connections (175 residential, 36 non-residential)
- Alternative 2: 261 connections (223 residential, 38 non-residential)
- Alternative 3: 262 connections (223 residential, 39 non-residential)
- Alternative 4: 212 connections (175 residential, 37 non-residential)

While the total number of connections appears to be similar to the total number of parcels, these estimates represent different values. The parcel total is the sum of the parcel types sorted by zoning. The total connections is the sum of the residential and non-residential connections based on building counts, parcel factors, and aerial imagery.

1.1.2 Growth Potential

Maximum Growth Potential

In the 2015 Build-out Analysis completed by Mendocino County, a maximum build-out of parcels was estimated if public utility services (water and/or sewer) were available. The minimum residential lot size requirements would reduce from the current lot size of 40,000 sq. ft to 12,000 sq. ft if water or sewer were available or to 6,000 sq. ft if both services were available. With all lots subdivided to the smallest possible lot size, the number of dwelling units could increase from 174 units to approximately 813 or 1,441 units, based on one or both services being present. This estimate is the theoretical maximum build-out potential of Boonville residential parcels and would never be fully achieved.

Design Growth Allowance

One of the potential funding options for this project, the State Revolving Fund, typically permits up to a 10% allowance to be added to preliminary design criteria for facility capacities to account for uncertainties associated with the planning process and incidental growth. With a 10% allowance, the estimated population that could be served would be approximately 715-770 people for the smallest proposed service area (Alternative 1) and 850-950 people for the largest service area (Alternative 3).

1.2 Existing Facilities

The proposed service areas include several existing public water systems and many private wells.

1.2.1 Public Water Systems

The proposed service areas currently include four public water systems (PWS) regulated by the State Water Resources Control Board, Division of Drinking Water (DDW). Service area Alternative 1 includes two recognized public water systems, Meadow Estates Mutual Water Company and Anderson Valley High School. Service area Alternatives 3 and 4 incorporate a third system, Anderson Valley Elementary School. A fourth public water system, Anderson Valley Brewing Company, resides to the southeast of the service area alternatives.

A public water system is "a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year".[3]

The existing, active public water systems with DDW public water system identification numbers are:

- Meadow Estates Mutual Water Company (PWS No. 2300506)
- Anderson Valley High School (PWS No. 2300764)
- Anderson Valley Elementary School (PWS No. 2300770)
- Anderson Valley Brewing Company (PWS No. 2300901)

Details of each water system, including treatment and capacity, are discussed in the following sections. Water quality details of each system are discussed in Section 1.3.

Meadow Estates Mutual Water Company

The Meadow Estates Mutual Water Company system serves a small residential subdivision called Meadow Estates adjoining the Boonville Airport, northwest of downtown Boonville. The system is classified as a community water system and serves an estimated population of 85 people through 35 connections. The water system has three active wells with a total source capacity of 60 gpm.

Water treatment consists of filtration through a sand filter followed by a granular activated carbon filter and disinfection with liquid sodium hypochlorite solution. The total available water storage capacity is 60,000 gallons. The maximum day demand during the last ten years was 30,500 gallons,

[3] CA Health and Safety Code, Section 116275(h)

equating to approximately 870 gallons per connection. The average day demand for the system is approximately 9,100 gallons or 260 gallons per connection.

Anderson Valley High School

The Anderson Valley High School Water System serves the junior high and high school in Boonville and is classified as a nontransient, noncommunity system. The school is located next to the Boonville Airport and serves an estimated population of 300 people through eight connections. The water system has three active wells with a total source capacity of 30 gpm.

Water treatment consists solely of disinfection using a sodium hypochlorite solution. The total available water storage capacity is 11,050 gallons. The maximum day demand during the last ten years was 10,000 gallons. The average day demand for the system is approximately 2,300 gallons or 8 gallons per person.

Anderson Valley Elementary School

The Anderson Valley Elementary School Water System serves the elementary school in Boonville and is classified as a nontransient, noncommunity system. The school is located at the northern end of the proposed service areas, approximately 1.5 miles outside of the downtown commercial core. The system serves a population of 350 people through 11 active connections. The system has one active well with a total source capacity of 13 gpm.

Water treatment consists of disinfection and oxidation with liquid sodium hypochlorite solution followed by filtration through two greensand media filters operated in series. The total available water storage capacity is 10,350 gallons. The maximum day demand during the last ten years was 7,000 gallons. The average day demand for the system is approximately 1,300 gallons or 4 gallons per person.

Anderson Valley Brewing Company

The Anderson Valley Brewing Company Water System serves the Anderson Valley Brewing Company and is classified as a nontransient, noncommunity system. The water system is located on the southern end of Boonville at the junction of State Route 128 and SR 253. The system has nine active wells and serves a maximum population of 175 people through four connections.

Water treatment consists of two bag filters operated in series (100 and 25 micrometer pore size), disinfection with a sodium hypochlorite solution, two chlorine contact tanks operated in parallel, two cartridge filters operated in series (30 and 1 micrometer), and a polishing carbon filter. Finished water is stored in a 100,000 gallon bolted steel tank. There are no records available regarding the system's maximum day demand since the system recently began being regulated by DDW in 2016.

Pending Public Water Systems

There are also eight pending public water systems in the proposed service areas that do not have a Domestic Water Supply Permit from DDW to date. If a centralized, community public water system is not installed as a result of this project, DDW will finalize permitting of these pending systems. The pending public water systems include:

- Pennyroyal Farm
- Anderson Valley Health Center
- Boonville General Store
- Boonville Hotel (also serves Mosswood Market, Paysanne)
- Redwood Drive-In
- Boont Berry Farm Store
- Lauren's Café
- Mendocino County Fairgrounds

California Senate Bill 1263 discourages the formation of new, unsustainable public water systems. If a centralized system were not created, the pending systems listed would need to become permitted public water systems. However, each of these eight facilities becoming a new, separate public water system would be contrary to the intent of SB 1263.

1.2.2 Private Wells

Any business or residences not included in the existing or pending public water systems discussed above are served by private wells. The majority of the parcels (approximately 80%) in Boonville are served by private wells and not an existing public water system.

Generally, the supplies derived from private wells in the area are not subject to any treatment, leaving users at risk from groundwater contamination. Known contamination or water quality issues in the area are discussed in the next section.

1.3 Water Quality Issues

The private wells and public water systems in the proposed service areas have several documented water quality problems, the most prominent being iron, manganese, nitrate, and bacteria. Contaminated areas in the vicinity are also discussed in this section.

1.3.1 Private Well Testing by Anderson Valley Community Services District

To determine the magnitude of water quality problems in Boonville, the AVCSD conducted water sampling from 23 private wells within the proposed water service areas in winter of 2016. The wells were tested for the following acute contaminants: total coliform bacteria, E. coli bacteria, and nitrate. Of the 23 samples, 70% (16 wells) contained E. coli, 30% (7 wells) had nitrate levels over 10 mg/L nitrate as N, and 61% (14 wells) had concentrations greater than 8 mg/L nitrate as N. As a reference, the California Code of Regulations specifies the maximum contaminant level[4] for nitrate as 10 mg/L nitrate as N and detections of fecal coliform (E. coli) in a public drinking water systems are not permitted, as they indicate the presence of fecal matter from a warm-blooded animal in the water supply.

1.3.2 Existing Public Water System Data

The existing public water systems are required to monitor for certain chemicals based on the water system classification. Community water systems are required to monitor for more chemicals and on a more frequent basis than nontransient, noncommunity systems such as the schools. The results for each water system are displayed on the California Drinking Water Watch website. As the Anderson Valley Brewing Company is a newly regulated system, no monitoring data is available for this system at this time. The historical results for the schools and the Meadow Estates MWC were reviewed to determine water quality issues in the area. Table 2 and Table 3 summarize chemical detections over the MCL for the systems' active and standby wells.

Primary Drinking Water Standards are legally enforceable water quality levels for contaminants in drinking water. In California, Secondary Standards are enforceable for community water systems, but not for transient or nontransient, noncommunity water systems. The Primary Standards address acute and chronic health concerns related to contaminants while the Secondary Standards address aesthetic issues of drinking water such as taste, odor, and visual appeal.

The constituents detected over the respective maximum contaminant levels were iron, manganese, aluminum, turbidity, color, and odor (Table 2). These constituents are all considered Secondary Drinking Water Standards under state and federal governments, with the exception of aluminum. Aluminum is listed under both the Primary and Secondary Drinking Water Standards, but the allowable MCL is higher for this constituent under the California Primary Standards at 1 mg/L (1,000 ug/L) versus 0.2 mg/L (200 mg/L) under the National Secondary Standards. A national primary standard has not been set for aluminum, only a state primary standard.

The constituents of primary concern in the local groundwater are iron, manganese, and aluminum. The occurrence of these constituents are further discussed in the following paragraphs. The other

[4] MCL: the maximum concentration of a contaminant permitted in public water system water

constituents (turbidity, color, and odor) have not exceeded the respective MCLs consistently and are not considered a potential concern.

Manganese levels in the active wells range from 0.6 to 11 times the MCL in the active wells (Table 2), with the average and median being 122 ug/L and 98 ug/L, respectively. The manganese MCL has been exceeded for all samples taken at the Meadow Estates Wells 3 and 5; the AV High School 1st Base Line Well and Jr. High Well; and in the AV Elementary School Well 2. The manganese MCL has only been exceeded once in the Meadow Estates Well 2.

Iron levels in the active wells range from 0.2 to 6.6 times the iron MCL of 300 ug/L (Table 2), with the average and median being 478 ug/L and 195 ug/L, respectively. Iron is less pervasive compared to manganese; the iron MCL has not been consistently exceeded in all active wells. The Meadow Estates Well 3 has exceed the iron MCL three out of six samples. The Meadow Estates Well 5 well has only exceeded the iron MCL once out of six samples. The AV High School Jr. High Well and the AV Elementary School Well 2 have exceed in all samples, but the sample size is reduced due to the classification of the systems (only two samples for AV High and one sample for AV Elementary taken). Because they are classified as nontransient, noncommunity systems, the AV High School and the AV Elementary School have reduced chemical monitoring schedules and thus less historic test results.

Iron levels in the standby well (Well 4) at Meadow Estates have consistently exceeded the iron MCL with test result concentrations ranging from 4,500 to 39,000 ug/L (Table 3). While these results grossly exceed the iron MCL, they do not appear to be indicative of iron concentrations in the region due to the shallowness of the well compared to other wells. In addition, Well 4 is substandard in terms of annular seal depth and well head protection and the system intends to abandon it.

Aluminum levels in the active wells range from 1.1 to 1.7 times the MCL of 1,000 ug/L, with the average and median being 252 ug/L and 0 ug/L, respectively. There have only been three exceedances of the aluminum primary standard MCL in the active wells. The exceedances have not been consistent in year of occurrence or more than one occurrence per well.

Manganese and iron are the chemicals most likely to be detected in any potential municipal wells based on the occurrence of these constituents in the existing public water system wells. As aluminum has been detected inconsistently over the MCL, this constituent may not be of concern.

Table 2. Chemical detections over respective MCLs in *active* wells at public water systems in Anderson Valley

Public Water System	Well Name	Sample Date	Constituent	Result	MCL	Units	Notes
Anderson Valley Elementary School	Well 2	10/10/2000	Iron	440	300	ug/L	Only sample taken
		10/10/2000	Manganese	550	50	ug/L	Only sample taken
		1/26/2005	1,2,3 TCP	0.006	No MCL yet	ug/L	Not detected in later samples
Anderson Valley High School	Jr. High Well	1/27/2009	Iron	1,300	300	ug/L	
		4/01/2009		600	300	ug/L	Last sample taken
		1/27/2009	Manganese	59	50	ug/L	
		4/01/2009		55	50	ug/L	Last sample taken
		1/27/2009	Aluminum	1,100	1,000	ug/L	Not detected in later samples
		1/27/2009	Turbidity	39	5	NTU	
		4/1/2009		5.3	5	NTU	Last sample taken
	1st Base Line	1/27/2009	Manganese	110	50	ug/L	
		4/1/2009		93	50	ug/L	Last sample taken
Meadow Estates MWC	Well 2	12/11/2007	Manganese	68	50	ug/L	
	Well 3	12/11/2007	Iron	520	50	ug/L	
		7/22/2013		2,000	300	ug/L	
		8/29/2016		570	300	ug/L	Last sample taken
		3/13/2001	Manganese	96	50	ug/L	
		12/21/2004		110	50	ug/L	
		12/11/2007		110	50	ug/L	
		5/06/2010		92	50	ug/L	
		7/22/2013		110	50	ug/L	
		8/29/2016		130	50	ug/L	Last sample taken
		7/22/2013	Odor	10	3	Ton	Not detected in later samples
		7/22/2013	Fluoride	3.1	2	mg/L	2016 sample below MCL
		7/22/2013	Aluminum	1,700	1,000	ug/L	2016 sample below MCL
		7/22/2013	Turbidity	16	5	NTU	2016 sample below MCL
	Well 5	8/29/2016	Fluoride	3.7	2	mg/L	Last sample taken
		8/29/2016	Iron	1,100	300	ug/L	Last sample taken
		3/13/2001	Manganese	99	50	ug/L	
		12/21/2004		120	50	ug/L	
		12/11/2007		150	50	ug/L	
		5/06/2010		140	50	ug/L	
		7/22/2013		92	50	ug/L	
		8/29/2016		94	50	ug/L	Last sample taken
		8/29/2016	Aluminum	1,400	1,000	ug/L	Last sample taken
		8/29/2016	Turbidity	12	5	NTU	Last sample taken

Table 3. Chemical detections over respective MCLs in *standby* wells at public water systems in Anderson Valley

Public Water System	Well Name	Sample Date	Constituent	Result	MCL	Units	Notes
Meadow Estates MWC	Well 4 - Standby	12/21/2004	Color	70	15	Units	
		12/11/2007		90	15	Units	Last sample taken
		12/21/2004	Iron	9,400	300	ug/L	
		12/11/2007		39,000	300	ug/L	
		03/22/2014		4,500	300	ug/L	Last sample taken
		03/22/2001	Manganese	130	50	ug/L	
		12/21/2004		160	50	ug/L	
		12/11/2007		420	50	ug/L	Last sample taken
		03/22/2001	Turbidity	19	5	NTU	
		12/21/2004		170	5	NTU	
		12/11/2007		540	5	NTU	Last sample taken
		03/22/2001	Odor	5	3	Ton	
		12/21/2004		6	3	Ton	Not detected in 2007 sample

1.3.3 Contaminated Sites in Proposed Service Areas

The California State Water Resources Control Board GeoTracker database was reviewed for open contaminated sites in the proposed service areas. Four open contaminated sites were identified in Boonville; details of each site follow and are named as in the GeoTracker database. The main constituents of concern from contaminated sites in Boonville are diesel and gasoline derivatives.

From the reports of the contaminated sites, the general flow of groundwater varied throughout the valley, but appeared to flow towards Anderson Creek, which meanders through Boonville. In the downtown core of Boonville, the Jeff's Chevron clean-up site was noted as having a groundwater direction of north to northwest with a hydraulic gradient ranging from 0.01 to 0.1 feet/foot. Groundwater at the CalTrans Maintenance station was noted as flowing west/northwest. The clean-up site at the Anderson Valley Elementary School was noted as having a groundwater direction of southwest and a hydraulic gradient ranging from approximately 0.05 to 0.08 feet/foot.

CalTrans Boonville Maintenance Station

The clean-up site is located at the CalTrans Boonville Maintenance Station at 13550 Anderson Valley Way. The contaminated site was previously used for washing CalTrans vehicles.

The wash pad and surrounding soil were contaminated with diesel, gasoline, and lead. Contaminated soil (198 tons) was excavated from the site and landfilled in 2011. Groundwater was noted as flowing west/northwest towards Anderson Creek.[5]

A land use restriction (covenant) has been drafted for the property such that no groundwater extraction at any depth is allowed in the contaminated "Restricted Area" without prior approval from the North Coast Regional Water Quality Control Board (NCRWQCB). The covenant also restricts any excavation work greater than two feet in depth in the Restricted Area and any contaminated soils brought to the surface by grading, excavation, trenching, drilling, or backfilling must be managed properly by the property owner or site occupant. The restriction is still in draft format between CalTrans and the NCRWQCB, but will most likely be finalized by the end of 2017.

Geocon Consulting (CalTrans' site assessment consultant) had requested a closure of the site and submitted a "No Further Action Required" request to the NCRWQCB in 2011. With completion of the land use restriction, the site will most likely be closed as a contaminated site.

Chevron #9-6221

The clean-up site is located at 14125 Highway 128, between the current Mosswood Market café and the Pic & Pay Market/Laundromat. The site was previously used as a Chevron gas station and is currently occupied by Philo Ridge Winery Tasting Room.

Three underground storage tanks suspected of leaking were removed in 1978 and replaced with new tanks. The new tanks were removed in 1991 when the gas station was demolished. Potential contaminants of concern were benzene, diesel, and gasoline. No remediation has occurred at the site to date. The site will undergo a physical site assessment in summer of 2017 to determine what type of remediation should be installed, if any.

[5] Geocon Consultants, Inc., 2007

Jeff's Chevron

The site is located at 14289 Highway 128 near Haehl Street, across from the AVCSD Fire Department and the Mendocino County Fairgrounds. It was previously used as a Chevron gas station succeeded by an automobile tire sales/repair shop and convenience grocery store.

Diesel was detected in several wells in the vicinity in 1988 and a subsequent Cleanup and Abatement Order was issued by the NCRWQCB to the Chevron station owners in 1989. Two tanks were excavated in 1992 and another three tanks excavated in 1999. Contaminants of concern were diesel, gasoline, MTBE, and other fuel oxygenates. Groundwater monitoring was performed between 1999 and 2004. No remediation efforts or sampling efforts occurred between 2004 and 2010 according to NCRWQCB documents in the GeoTracker database.

There were four domestic wells in the vicinity of the clean-up site that were contaminated with MTBE due to the leaking underground tanks. One well serves the Mi Esperanza Market (convenience grocery store), one well serves the Anderson Valley Fire Department (AVFD), and the other two serve private residences. Well head treatment systems were installed on two wells: the AVFD well in 2011 and the Mi Esperanza Market/tire shop well in 2013.

Limited excavation of the site occurred in 2014 by EBA Engineering. Excavation included removal of impacted soils in the former gas station's dispenser islands, product piping, and vent lines. Excavated soils were landfilled appropriately. Soil samples were taken during the excavation and showed MTBE detections in the vicinity of several old piping appurtenances, suggesting prior leaks.

A 2015 feasibility study performed by EBA Engineering showed the majority of soil and groundwater contamination in the capillary/transition zone (12-22.5 ft below ground surface) between the saturated and unsaturated zones. EBA Engineering estimated contaminant masses of approximately 3,900 pounds in the soil and 115 pounds groundwater.[6] In the study, EBA Engineering recommended dual phase extraction as the best method for remediation at the site. To date, dual phase extraction remediation has not been installed.

Groundwater flow was noted in case reports as north to northeast and at a rate of 0.01 to 0.1 feet/foot. SCS Engineering noted that "the groundwater flow direction may be locally influenced by pumping domestic wells, seasonal recharge, and discharge of aquifer beneath the site and vicinity."[7]

Anderson Valley Unified School District Bus Barn

The clean-up site is located at the Anderson Valley Elementary School, which also has a public water system of the same name. Two underground gasoline storage tanks, a 660 gallon (in 1990) and a 1,000 gallon (in 1993), were removed at the school property. Both tanks had leaked and impacted the soil and water onsite. Contaminants of concern were diesel and gasoline in the soil and groundwater.

In 1995, 12,000 cubic yards of impacted soil were excavated and stockpiled on site. From 1996-1997, monitoring wells were installed. Domestic wells at the school and adjacent properties and monitoring wells were sampled during this time period and found to be impacted by petroleum hydrocarbons. In

[6] EBA Engineering, 2015
[7] SCS Engineering, 2011

March 1999, a Cleanup and Abatement Order was issued requiring potable water to be supplied to all impacted domestic wells; new wells were subsequently installed at the school and on neighboring properties. In 1999, a free phase skimming system was installed in monitoring well MW-3. In 2000, the soil stockpile was land applied, treated with Biosolve, and seeded. Any runoff water from the stockpile was collected and treated before disposal. The land-applied soils were retested in 2011 and found to have low concentrations of diesel range organics. The school has since reclaimed the soil site for solar panel use.

In 2004, a dual phase extraction (DPE) system was installed, which extracts water and air from four wells and discharges the treated water to land. Groundwater was remediated through the DPE system and then discharged to land as allowed by the NCRWQCB. The dual phase system was operated since installation in 2004 until 2011. The DPE system was not operated in 2011 due to not being able to meet the land discharge requirements for treated groundwater. A new remediation company obtained the remediation operation in 2011 and installed a granular activated carbon (GAC) system in series with the DPE system. The GAC and DPE have been operated since 2011. The vapor phase of the DPE system was not operated in 2015. Continued remediation is required as several monitoring wells still have high levels of benzene, xylenes, diesel range organics, and gasoline range organics.

Groundwater flow was noted as to the southwest towards Anderson Creek with a hydraulic gradient ranging from approximately 0.05 to 0.08 feet/foot.[8]

[8] EBA Engineering, 2016

2 Water Demands and Supply/Storage Requirements

The potential water demands of the system include domestic and fire flow demands. Several similar-sized existing public water systems in Mendocino and Lake Counties were reviewed to aid in estimating water demands for residences in Boonville. Domestic demands were determined based on connection type. The California Fire Code was reviewed to establish minimum fire flow requirements. From the estimated demands, the water supply and storage requirements were established.

2.1 Similar System Demands

Since no water usage data is available for Boonville as a whole, the California Code of Regulations[9] suggests using production records from a system of similar size, elevation, climate, residential property size, and metering to determine the average water usage per service connection, maximum day demand, and peak hourly demand.

To estimate demands for Boonville, several existing public water systems in Mendocino and Lake Counties were reviewed for number of connections, population, demographics, annual water production, and climate. The Division of Drinking Water (DDW) requires public water systems to submit an Annual Report on each system's status and annual water production, among other items. Each system's past three Annual Reports and the system's most recent DDW inspection report were reviewed and are discussed in the following sections. The average and maximum day demands are discussed for each system and populated in Table 5. The maximum day demand (MDD) estimation for each system was based on the most recent ten years of water production records in accordance with state regulations; all systems with less than 1,000 connections are required to have enough water storage to meet their MDD.

2.1.1 Hopland

Hopland Public Utilities District serves a population of 1,038 people and 326 connections (34 commercial and 292 residential connections) in the census-designated place of Hopland in Mendocino County. The system is served by two wells; one of the wells is designated as standby. Hopland is located approximately 13 miles to the east of Boonville and has similar population demographics and climate, but with a substantially more robust visitor serving center than Boonville. Hopland also serves the Hopland Band of Pomo Indians through an intertie; the tribe's water use is included in the system's overall demand as it could not be separated.

Water production data from the last 25 years was provided by DDW. The system's maximum day demand from the last ten years was 430,000 gallons or 1,320 gallons per connection (in 2007), but had been as high as high as 940,000 gallons in 2000. As the system has two storage tanks with a total capacity of 844,000 gallons, the system can meet the MDD of the last ten years. Calculated from the total annual production, the average daily demand of the system was 203,000 gallons or 620 gallons per connection.

From the system's 2015 Annual Report, the Hopland rate structure includes a base rate of $15 and an additional usage rate of $1.90 per 1,000 gallons. The average monthly residential water rates in 2015 were: $26.40 for 600 cubic feet (~4,500 gallons), $37.80 for 1,200 cubic feet (~9,000 gallons), and

[9] California Code of Regulations, Title 22, Chapter 16, Section 64554

$60.60 for 2,400 cubic feet (~18,000 gallons). The values of 600, 1,200, and 2,400 cubic feet are arbitrary values used by DDW in the 2015 Annual Reports for comparison purposes of rates across systems.

2.1.2 Laytonville

The Laytonville County Water District (CWD) serves a population of 1,301 people through 394 connections (61 commercial, 328 residential, 5 agricultural connections) in the census-designated place of Laytonville in Mendocino County. The system is served by two wells. Laytonville is located approximately 47 miles north of Boonville and has a similar climate and demographic with a small downtown surrounded by residential connections.

Water production data from the last 10 years was provided by DDW. The system's maximum day demand was 552,000 gallons or 1,470 gallons per connection in 2009. As the system has three storage tanks with a total capacity of 1 million gallons, the system can meet the total MDD of the last ten years. Calculated from the total annual production, the average daily demand of the system was 157,500 gallons or 430 gallons per connection.

From the system's 2015 Annual Report, the Laytonville CWD rate structure includes a base rate of $25 for 600 cubic feet and an additional usage rate of $4.15 per 100 cubic feet (~750 gallons). The average monthly residential water rates in 2015 were: $24.90 for 600 cubic feet (~4,500 gallons), $49.80 for 1,200 cubic feet (~9,000 gallons), and $99.60 for 2,400 cubic feet (~18,000 gallons).

2.1.3 Upper Lake

The Upper Lake County Water District serves a population of 989 people through 375 connections (54 commercial, 1 agricultural, and 320 residential connections) in the census-designated place of Upper Lake near Clear Lake in Lake County. The system is served by two wells. Upper Lake is located approximately 27 miles east-northeast of Boonville and has a similar climate and demographic of a small downtown surrounded by residential connections.

Water production data was reviewed from the past four years of Annual Reports and the most recent DDW inspection report. The system had a maximum day demand of 300,000 gallons or 800 gallons per connection in 2013. Calculated from the total annual production, the average daily demand of the system 127,000 gallons or 340 gallons per connection.

From the system's 2015 Annual Report, the Upper Lake rate structure includes a base rate of $26 for single family residences, $32 for multi-family residences, and $34 for commercial units. The residential units have an additional variable usage rate per 100 cubic feet of $0.94 up to $3.74. The commercial units have an additional variable usage rate of $2.06 up to $4.11. The average monthly residential water rates in 2015 were: $31.61 for 600 cubic feet (~4,500 gallons), $37.22 for 1,200 cubic feet (~9,000 gallons), and $60.37 for 2,400 cubic feet (~18,000 gallons).

2.1.4 Middletown

The Callayomi County Water District serves a population of 845 people through 289 connections in the census-designated place of Middletown near Clear Lake in Lake County. The system is served by three wells. Middletown is located approximately 45 miles east-southeast of Boonville and has a similar climate and demographic of a small downtown surrounded by residential connections.

Middletown was severely affected by the Valley Fire in 2015 and lost a significant number of connections (almost 100 connections). The Annual Reports reviewed were from before the fire when the system had 381 connections.

Water production data was provided for the last 15 years. The system had a maximum day demand of 365,000 gallons or 1,090 gallons per connection in 2014. Calculated from the total annual production, the average daily demand of the system was 110,000 gallons or 320 gallons per connection.

From the system's 2015 Annual Report, the Callayomi CWD rate structure includes a base rate of $42.20 and an additional usage rate of $1.98 per 100 cubic feet (~750 gallons). The system did not list average monthly residential water rates in their Annual Report.

2.1.5 Spring Valley

The Lake County – County Service Area #2 Spring Valley water system serves a population of 1,386 people through 495 connections in the census-designated place of Spring Valley in Lake County. The system is served by one surface water intake. Spring Valley is located approximately 42 miles east of Boonville. Spring Valley is similar in climate to Boonville, but has a different demographic (only residential).

Water production data was provided for the last 10 years. The system had a maximum day demand of 650,000 gallons or 700 gallons per connection in 2010. Calculated from the total annual production, the average daily demand of the system was 122,000 gallons or 270 gallons per connection.

From the system's 2015 Annual Report, the Spring Valley rate structure includes a base rate of $25 and an additional variable usage rate per 100 cubic feet of $2.75 up to $8.00. The average monthly residential water rates in 2015 were: $32.20 for 600 cubic feet (~4,500 gallons), $54.20 for 1,200 cubic feet (~9,000 gallons), and $496.20 for 2,400 cubic feet (~18,000 gallons). In 2015, the system had in effect an "Emergency Conservation Ordinance" surcharge of $350 if a customer used over 2,000 cubic feet per month.

2.1.6 Meadow Estates Mutual Water Company

As previously discussed, Meadow Estates Mutual Water Company serves a small residential subdivision called Meadow Estates in Boonville with an estimated population of 85 people through 35 connections.

The maximum day demand during the last ten years was 30,500 gallons, equating to approximately 870 gallons per connection. The average day demand for the system is approximately 9,100 gallons or 260 gallons per connection.

The Meadow Estates rate structure includes a base rate of $45 and an additional variable usage fee beyond 1,000 gallons as follows. The system did not list average monthly residential water rates in their Annual Report.

- $1.50 per 1,000 gallons in the 1,000-16,000 gallon range
- $2.00 per 1,000 gallons in the 16,000-20,000 gallon range
- $2.50 per 1,000 gallons in the 20,000-26,000 gallon range
- $4.00 per 1,000 gallons in the 26,000-31,000 gallon range
- $5.00 per 1,000 gallons in the 31,000 gallon and above range

2.1.7 Summary of Similar Systems Demand

From review of the similar systems, an average single-family residential demand was estimated for Boonville as 250 gallons per day per connection based on the following rational. The average demands of Hopland, Laytonville, and Middletown were considered too high as a basis because these systems serve busier commercial districts than Boonville. Since the commercial use could not be separated from the residential demand in the average day, these three systems' average day demand were not considered reflective of a residential demand. The average day demand of Upper Lake was considered higher than expected for a reasonable residential demand due to the system's water rates being relatively low. Spring Valley and Meadow Estates are solely residential systems with reasonable water rates. These two waters systems were used in estimating the single-family residential demand for Boonville.

Table 4. Comparative System Average Day Demands and Rates

System	Average Day Demand (gal per connection)	Water Rate per 1,200 cubic feet
Hopland	620	$37.80
Laytonville	430	$49.80
Upper Lake	340	$37.22
Middletown	320	$67.54
Spring Valley	270	$54.20
Meadow Estates	260	$58.50

Table 5. Comparative Water System Production Data

System	Pop.[10]	No. of Connections[10]	Maximum or Average	Water Production (MG)			Per Connection Daily Use (gal)			Total Average Daily Use (gal)
				Annual	Max. Month	Max. Day	Annual	Max. Month	Max. Day	
Hopland	1038	326	Average	67.4	9.62	0.363	620	1011	1125	203,000
			Maximum	98.6	16.78	0.430	860	1902	1365	270,000
Laytonville	1301	394	Average	57.5	8.47	0.393	430	744	1077	158,000
			Maximum	69.1	10.48	0.552	510	914	1468	189,000
Upper Lake	989	375	Average	46.3	6.28	0.290	340	560	776	127,000
			Maximum	54.5	8.00	0.300	400	713	802	149,000
Middletown	1223	381	Average	40.3	5.19	0.270	320	505	792	110,000
			Maximum	46.5	6.00	0.365	380	635	1090	127,000
Spring Valley	1386	495	Average	44.4	5.60	0.316	270	418	701	122,000
			Maximum	63.4	9.62	0.650	410	760	1555	174,000
Meadow Estates MWC[11]	85	35	Average	3.32	0.48	0.019	260	459	554	9,091
			Maximum	4.53	0.62	0.031	350	593	871	12,411
AV Elementary School[11]	350	11	Average	0.48	0.05	0.004	4	5	12	1,314
			Maximum	0.52	0.06	0.007	4	5	20	1,418
AV High School[11]	300	8	Average	0.86	0.08	0.007	8	9	24	2,343
			Maximum	0.91	0.13	0.010	8	14	33	2,506

[10] Listed population and number of connections are the system's current values.
[11] Existing public water systems in the Boonville area.

2.2 Domestic Demands

Boonville is comprised of a small, downtown commercial core surrounded by residential parcels for a total estimate of 211 potential connections in Alternative 1, 268 connections in Alternative 2, 269 connections in Alternative 3, and 212 connections in Alternative 4.

The largest potential connection is the Mendocino County Fairgrounds and its associated campground. The fairgrounds has three major events during the year: one 1-day event with ~3,000 people camping and ~6,000 people total attending (Anderson Valley Beer Festival); one 4-day event with ~4,000 people camping and ~8,000 people total attending each day (Sierra Nevada Music Festival); and one 3-day event with ~1,000-1,500 people camping and ~15,000 people total attending over three days (Mendocino County Fair). The four day event is reported as the event with the highest water demand. The Fairgrounds also has smaller events on most weekends involving a maximum of 200 people. The campground use is also significantly lower on an average day with approximately only 15 people per day using the facility in the summer.

2.2.1 Demand Estimation Methodology and Values

The demand for each connection type was determined from existing public water system data or from typical demands listed in literature. The single-family residential demand was estimated as discussed in the previous section based on existing, comparative public water system data. The multi-family residential and commercial demands were estimated from typical demands outlined in Table 7 from Metcalf and Eddy.[12]

The following methodology was used in establishing an average day demand for the community. As not all connections are used seven days per week (i.e. school or church), the typical demands for each connection type were averaged across a seven day week to approximate the average daily use. All demands per connection type were then summed to obtain an average day demand for the system. As the Fairgrounds and associated campground demands are not high every day, only the routine weekend events and average campground use were used in establishing an average day demand for the service areas.

To establish a maximum day demand, the average day demand was multiplied by a factor of 2.25 as required by state regulations. The peak hour demand was estimated as the MDD divided by 24 hours and multiplied by a factor of 1.5.

The fairgrounds' highest use event was not included in the community MDD as the fairgrounds' events would greatly skew the MDD. To understand how much water the fairgrounds uses for its largest event, the highest fairgrounds' day demand was estimated for the Sierra Nevada Music Festival as this event has the highest population. From communications with the fairgrounds' staff, 30 portable toilets are brought to the site during this event. The use of portable toilets allowed for a reduction in the estimated number of people using the permanent toilet facilities from 8,000 to 6,000 people for a total demand of 60,000 gallons per day for the fairgrounds' facilities. The campground also experiences high use during this event; the associated primary demand was assumed to be the showers at the

[12] Metcalf and Eddy, Wastewater Engineering, 1991.

campground. The following assumptions were made regarding shower usage: each shower stall used 3 times per hour, 8 hours per day resulting in a typical demand per shower of ~30 gallons. With 12 shower stalls, the maximum total shower demand was estimated to be 9,000 gallons per day.

The average day demand, maximum day demand, and peak hour demand established for each service alternative are presented in Table 6. Addition of the Anderson Valley Elementary School in Alternatives 3 and 4 only increases the average day demand of the system by only 1,000 gallons compared to Alternatives 2 and 1, respectively.

Table 6. Maximum Day and Peak Hour Demands

Estimate	Average Day Demand (gal)	Max Day Demand (gal)	Peak Hour Demand (gal)
Service Area Alternative 1	55,000	123,000	7,700
Service Area Alternative 2	66,500	150,000	9,300
Service Area Alternative 3	67,500	152,000	9,500
Service Area Alternative 4	56,000	125,000	7,800
Highest Fairgrounds' estimate	--	69,000	4,300

The fairgrounds' highest use was not included in the MDD estimates presented above because it would be impractical to design the water system to meet the fairgrounds' intermittent events. Instead, it is proposed that the fairgrounds offset its high use events with its existing onsite water facilities.

Table 7. Demand Estimation for Boonville per Connection Type

Connection Type	Unit	# of Units per Conn.	Typical Demand per Unit (gal)	Total Daily Demand (gal)	Days Used per Week	Average Day Demand (gal)
School with Cafeteria	Person	350	4	1400	5	1000
School with Cafeteria and Gym	Person	300	8	2400	5	1710
Church	Person	15	3	135	1	20
Restaurant	Person	50	10	4000	7	4000
Market with Deli	Customer	50	3	300	7	300
Convenience Market	Bathroom	2	30	120	7	120
Mercantile Stores	Bathroom	2	15	120	7	120
Wine Tasting Room (7 d/wk)	Person	50	3	300	7	300
Wine Tasting Room (4 d/wk)	Person	50	3	300	4	170
County Fairgrounds (small weekend events)	Person	150	10	1500	2	430
County Fairgrounds (office/maintenance staff)	Person	4	6	24	5	20
Campground/RV Park at Fairgrounds	Person	15	30	450	7	450
Health Center	Person	100	15	1500	5	1070
Airport	Person	2	3	6	7	10
Cheese Factory/Wine Tasting	Person	100	10	1000	7	1000
Post office	Employee	5	6	30	5	20
Fire station	Person	5	10	50	7	50
Fire station (car wash weekly)	Truck	2	30	60	1	10
Senior Center	Person	15	7	105	3	45
Historical Society Museum	Person	5	3	15	2	5
Real Estate Office	Person	3	12	72	5	50
Hotel w/Laundry	Person	35	70	2500	7	2500
Restaurant at Hotel	Person	30	10	400	5	290
Gas station	Bathroom	1	300	300	7	300
Laundromat	Machine	6	500	3000	7	3000
Residential - Single Family	House	1	250	23750	7	23750
Residential - Multi	House	1	200	18000	7	18000

2.3 Fire Demands

The 2016 California Fire Code sets the required fire flows[13] for residential and non-residential buildings based on building construction materials, building footprint in square feet, and if a building contains an automatic sprinkler system. The fire code was reviewed for fire flows with respect to the buildings in the Boonville community.

Boonville is comprised of residential and non-residential buildings, all currently without sprinkler systems. The residential buildings in the proposed service areas were assumed to have footprints less than 3,600 sq. ft. The non-residential buildings vary in footprint area. The largest buildings' footprints were estimated using aerial imagery and are compiled in Table 8.

Table 8. Largest non-residential building footprint estimates in Boonville.

Building	Area Estimate (sq. ft)	Number of stories
Fairgrounds - front building	19,900	1
High School - largest building	18,900	1
High School - gym	14,600	1
Elementary School - largest building	16,900	1
Pic & Pay/Laundry Mat	7,700	1
Boonville Hotel	8,000	2
The Buckhorn Boonville	4,800	2

For residential buildings in the 0-3,600 sq. ft range, the minimum fire flow is 1,000 gpm for a duration of 1 hour, a total volume of 60,000 gallons. If the residential buildings had automatic sprinkler systems, the minimum fire flow could be reduced to 500 gpm for a duration of 30 minutes, a total volume of 15,000 gallons for the duration of the fire.

For non-residential buildings, the minimum fire flow varies based on footprint and construction type. From communications with the Anderson Valley Fire Department Fire Chief, Andres Avila, [14] most building construction in Boonville falls in the category of wood frame with no fire retardant materials (Type V-B in CA Fire Code). The Fire Chief noted that several of the newer buildings may have fire retardant materials (Type V-A), but there is probably only three of these buildings (AV Brewing Company, Harmonique Wines/Art Gallery, and the AV Health Center).

The largest non-residential buildings fall in the 18,000-20,600 sq. ft range and are required to have a minimum fire flow of 3,750 gpm for a duration of 3 hours. This fire flow comes to a total volume of 675,000 gallons or 225,000 gallons per hour. This fire flow and volume is impractical for this size of proposed public water system. The fire code[15] authorizes the fire chief to reduce the fire-flow

[13] 2016 California Fire Code: Title 24, Part 9, Appendix B
[14] Anderson Valley Fire Department, 2017
[15] 2016 California Fire Code, Appendix B, Section B103.1

requirements for "a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical."

While the buildings in Boonville do not currently have automatic sprinklers, any new buildings or any extensive building remodels would include installation of a sprinkler system. If sprinklers were to be installed in the largest buildings, the fire flow requirements could be reduced to 25% of the non-sprinklered flow, but not less than 1,000 gpm. The flow duration with sprinklers remains the same as non-sprinklered durations. The addition of sprinklers would greatly reduce the fire flow of the non-residential units, correlating to a total required fire volume of 180,000 gallons or 60,000 gallons per hour.

Table 9. Fire Flow Requirements for Applicable Building Footprints[16]

Connection Type	Construction Area (sq. ft)	Fire Flow Required (gpm)	Flow Duration (hr)	Total Fire Volume (gal)	Fire flow per hour (gph)	Construction Material
Residential	0-3,600	1,000	1	60,000	60,000	NA
Residential w/NFPA 13R sprinklers	0-3,600	500	0.5	15,000	30,000	NA
Non-residential	0-3,600	1,500	2	180,000	90,000	Type V-B
Non-residential	3,601-4,800	1,750	2	210,000	105,000	Type V-B
Non-residential	4,801-6,200	2,000	2	240,000	120,000	Type V-B
Non-residential	6,201-7,700	2,500	2	300,000	150,000	Type V-B
Non-residential	7,701-9,400	2,500	2	300,000	150,000	Type V-B
Non-residential	9,401-11,300	2,750	2	330,000	165,000	Type V-B
Non-residential	11,301-13,400	3,000	3	540,000	180,000	Type V-B
Non-residential	13,401-15,600	3,250	3	585,000	195,000	Type V-B
Non-residential	15,601-18,000	3,500	3	630,000	210,000	Type V-B
Non-residential	18,001-20,600	3,750	3	675,000	22,5000	Type V-B
Non-residential w/NFPA 13 sprinklers	less than 23,600	1,000	3	180,000	60,000	Type V-B
Non-residential	8,201-10,900	1,750	2	210,000	105,000	Type V-A

As automatic sprinkler systems are installed with new buildings or as part of retrofit projects, backflow prevention will need to be installed on the water service that supplies the sprinkler system in order to protect the potable water system.[17] Backflow protection is required for each sprinkler system as the sprinklers are pressurized at all times and water in the pipes will become stagnant. Stagnant water could pose a water quality risk to the public water system.

[16] 2016 California Fire Code: Title 24, Part 9, Appendix B
[17] 2016 California Fire Code, Part 9, Section 912.6

Boonville resides in a Wildland-Urban Fire Interface. This categorization does not require additional fire flow demands, but specifies construction and vegetation management best practices in wildland fire prone areas.

2.4 Estimated Supply/Storage Requirements

Based on the potential demands presented in the preceding sections, a secure source supply of approximately 100 gpm (includes a 10% design allowance) would be required to satisfy the estimated maximum day demand of 123,000 gallons of Alternative 1. Since all systems with less than 1,000 connections are required to have sufficient water storage to meet their MDD, the system would need at least 140,000 gallons of storage for domestic purposes (includes a 10% design allowance). Should the system be intended to provide fire protection, storage for fire flows would also needed. The required fire protection volume was established as 180,000 gallons. As the MDD and a fire would likely not occur on the same day, adding the fire storage requirement to the MDD volume would generate an overly conservative requirement. A more reasonable storage requirement would be a domestic volume equal to the average day during the month of maximum demand (1.5 times the average day plus a 10% design allowance) plus the fire protection volume. This method yields a total storage requirement of 270,000 gallons.

As addition of the elementary school only increases the average day demand of Alternatives 1 and 2 by 1,000 gallons, only Alternative 3 is discussed herein for comparison purposes to Alternative 1. A secure source supply of approximately 120 gpm (includes a 10% design allowance) would be required to satisfy the estimated maximum day demand of 152,000 gallons of Alternative 3. The system would need at least 170,000 gallons of storage for domestic purposes (includes a 10% design allowance). With the inclusion of the fire storage volume as discussed above, the total storage volume required would be 290,000 gallons.

3 Water Supply Availability and Anticipated Treatment

3.1 Water Supply

Groundwater is the most practical water supply available to the community of Boonville (Anderson Valley groundwater sub-basin). Surface water in the region, small springs in the foothills, and seasonal creeks that run through the valley are not sufficient or in close enough proximity to be considered a viable source for the community without the establishment of a raw water storage facility(s).

Community public water systems using only groundwater are required to have at least two approved sources. The system must also be able to meet its maximum day demand with the highest-capacity source offline.[18] As the project would be considered a community public water system, it would need to meet these requirements.

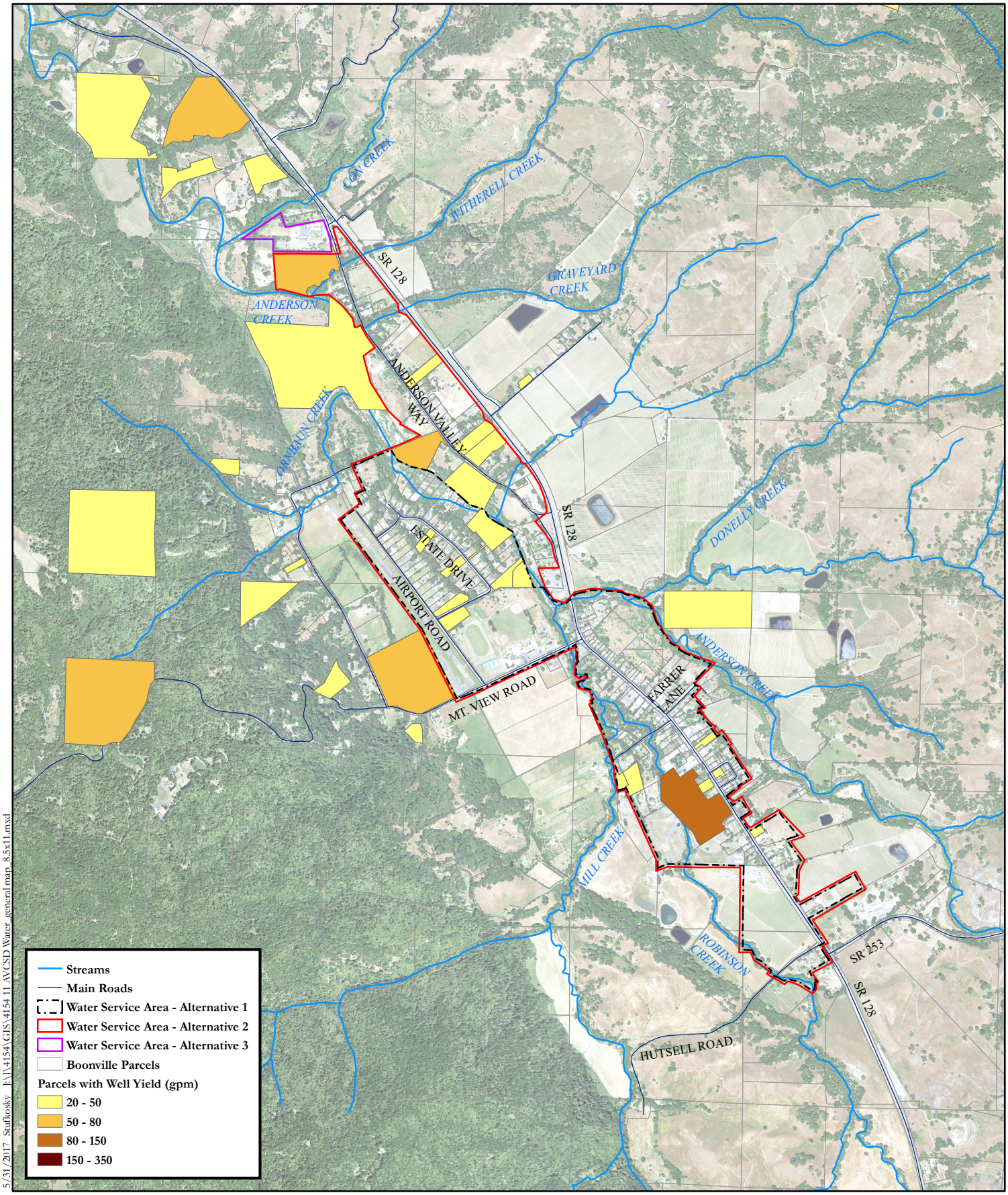
To gain a better understanding of the groundwater availability in the area, well completion reports were obtained for the Boonville region. The reports were reviewed for various attributes including well test yield, well depth, screened intervals/perforations, and annular seal depths. The well logs were narrowed to wells with test yields above 20 gallons per minute (gpm). These wells were attached to their associated parcel and the parcels mapped to better understand the spatial layout of potential water supply in the valley (Figure 2). From this figure, several wells have been selected based on location, well yield, and well depth; the selected well owners will be contacted for permission to test their wells to gain additional information regarding groundwater availability and quality. Following the well tests, AVCSD anticipates having further discussions with the well owners and/or owners of nearby parcels regarding their willingness to enter into an agreement for future acquisitions for development of municipal water supply wells and if needed, treatment facilities.

As determined in the demand section, the maximum day demand will require a minimum supply of approximately 100 gpm for Alternative 1 or 120 gpm for Alternative 3. It is anticipated that at least two well fields, each having a minimum of two wells, will be required to meet this demand based on well completion reports reviewed.

3.2 Anticipated Treatment

Based on a review of water quality data from the existing public water systems, an iron and manganese removal system will likely need to be installed for any potential groundwater source located in Anderson Valley. An iron and manganese removal system would probably consist of chemical pre-oxidation with either chlorine or potassium permanganate followed by filtration. A post-filtration disinfection system would also be provided if chlorine was not used in the pre-oxidation process to ensure a disinfectant residual is present in the distribution system (mains, tanks, etc.) to prevent bacteriological water contamination. Discussion of treatment options/requirements will be discussed further after the test wells are sampled for water quality.

[18] California Code of Regulations, Title 22, Chapter 16, Section 64554.c



5/31/2017 Stufkosky E:\V4154\GIS\4154 11 AVCSD Water_general map_8.5x11.mxd

Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Units: Foot US

Parcels, zoning, and road data source: County of Mendocino, Information Services Division
Census Boundary source: US Census Bureau
Stream data source: CA Department of Fish and Wildlife
Aerial Imagery: US Dept. of Agriculture, NAIP series

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NORTH

0 500 1,000 2,000 Feet

1 inch = 2,000 feet

FIGURE 2

PARCELS WITH WELL YIELDS GREATER THAN 20 GPM

ANDERSON VALLEY COMMUNITY SERVICES DISTRICT

MAY 2017

4 Distribution System Alternatives

4.1 Distribution System Essentials

The proposed water service area is a long, narrow band that runs along both sides of State Route 128. As the majority of the connections are located on the main roads, the distribution system would be a tree-like system configuration with a transmission main feeding a number of smaller diameter dead-end distribution mains and service connections. The transmission main would consist of a larger diameter pipe (12-inch) running from the potential tank site on Hutsell Road to SR 128 and continuing north along the highway. Smaller diameter piping (6 and 8-inch) would be used for side streets (Airport Road, Estate Drive, Lambert Lane, Farrer Lane, Mrs. Harris Lane, Mountain View Road, and Haehl Street). The smaller diameter mains would be looped where possible, but this could only be accomplished at three locations. Hydrants should be spaced at an average 500 feet apart with a maximum of 250 feet from any point on the street to a hydrant. This spacing assumes that buildings will ultimately either be retrofitted or replaced with ones having automatic sprinklers. Customer services would be a minimum of 1-inch diameter in order to accommodate future installation of automatic sprinklers.

Creek crossings should be valved on each side of the creek. There are eight potential creek crossings in the distribution system:

- Two on Hutsell Road
- One on Lambert Lane
- One on Mountain View Road
- One on State Route 128
- Three along Anderson Valley Way

Alternatives 2 through 4 include several additional considerations. Service area Alternative 2 would require that an 8-inch main be extended approximately 1.5 miles from the Mountain View Rd and SR 128 junction up towards the elementary school. For fire protection flows to be adequate for the school in Alternatives 3 and 4, the main must be upsized to 12-inch diameter. Fire hydrants at a spacing of 500 ft along Anderson Valley Way have been included in service area Alternatives 2 and 3. For Alternative 4, fire hydrants at a spacing of 1,000 ft along Anderson Valley Way have been included. Figures 3 through 6 present the potential distribution layouts for each service area alternative.

4.2 Distribution Alternatives

AVCSD has directed that two distribution system alternatives be studied: a complete system capable of delivering domestic and fire flows and a system with deferred fire storage and hydrants.

4.2.1 Complete System

The complete system alternative would include storage for both domestic and fire demands. As previously discussed, the recommended fire flow volume would be 180,000 gallons, the volume necessary to fight a three-hour fire with fire flows of 1,000 gpm. For service area Alternatives 1 and 4, total storage volume would be roughly 270,000 gallons (180,000 gallons to meet fire flows plus

approximately 90,000 gallons to meet the system's average day in the maximum month). For service area Alternatives 2 and 3, total storage volume would be 290,000 gallons (180,000 gallons to meet fire flows plus approximately 110,000 gallons to meet the system's average day in the maximum month).

The preferred storage tank arrangement would be to install two tanks, each being capable of storing half the required volume. This arrangement would mitigate the impact associated with removing a tank from service for maintenance or repairs and, if conducted during a low demand period, would ensure reasonable fire protection capabilities are maintained.

4.2.2 Deferred Fire Protection

Under the deferred fire storage and hydrants alternative, only storage necessary for domestic demands would initially be installed with the second tank installation occurring at a future time. This alternative would allow the community to defer the expenditure if desired. Since the community would not have sufficient storage to meet fire demands under most conditions without the second tank, hydrant installation could also be deferred to reduce the initial project costs. In our view, the fire hydrants should only be deferred if it appears absolutely necessary to ensure that the project moved forward. Deferral of fire facilities for an extended time period may likely lead to them never being installed.

SR 128

ANDERSON VALLEY WAY

WITHERELL CREEK

GRAVEYARD CREEK

DONELL CREEK

ANDERSON CREEK

ANDERSON CREEK

ORNBAUN CREEK

MT. VIEW ROAD

SR 128

ROBINSON CREEK

MILL CREEK

PROPOSED TANK SITE

HUTSELL ROAD

6"W

6"W

6"W

8"W

8"W

12"W

6"W

8"W

6"W

12"W

12"W

LEGEND

- PROPOSED SERVICE AREA
- 12"W — WATER MAIN
- CREEK
- FIRE HYDRANT
- VALVE

1000 0 1000

SCALE IN FEET

1" = 1000Ft.

FIGURE 3

SERVICE AREA ALTERNATIVE 1 DISTRIBUTION SYSTEM OVERVIEW

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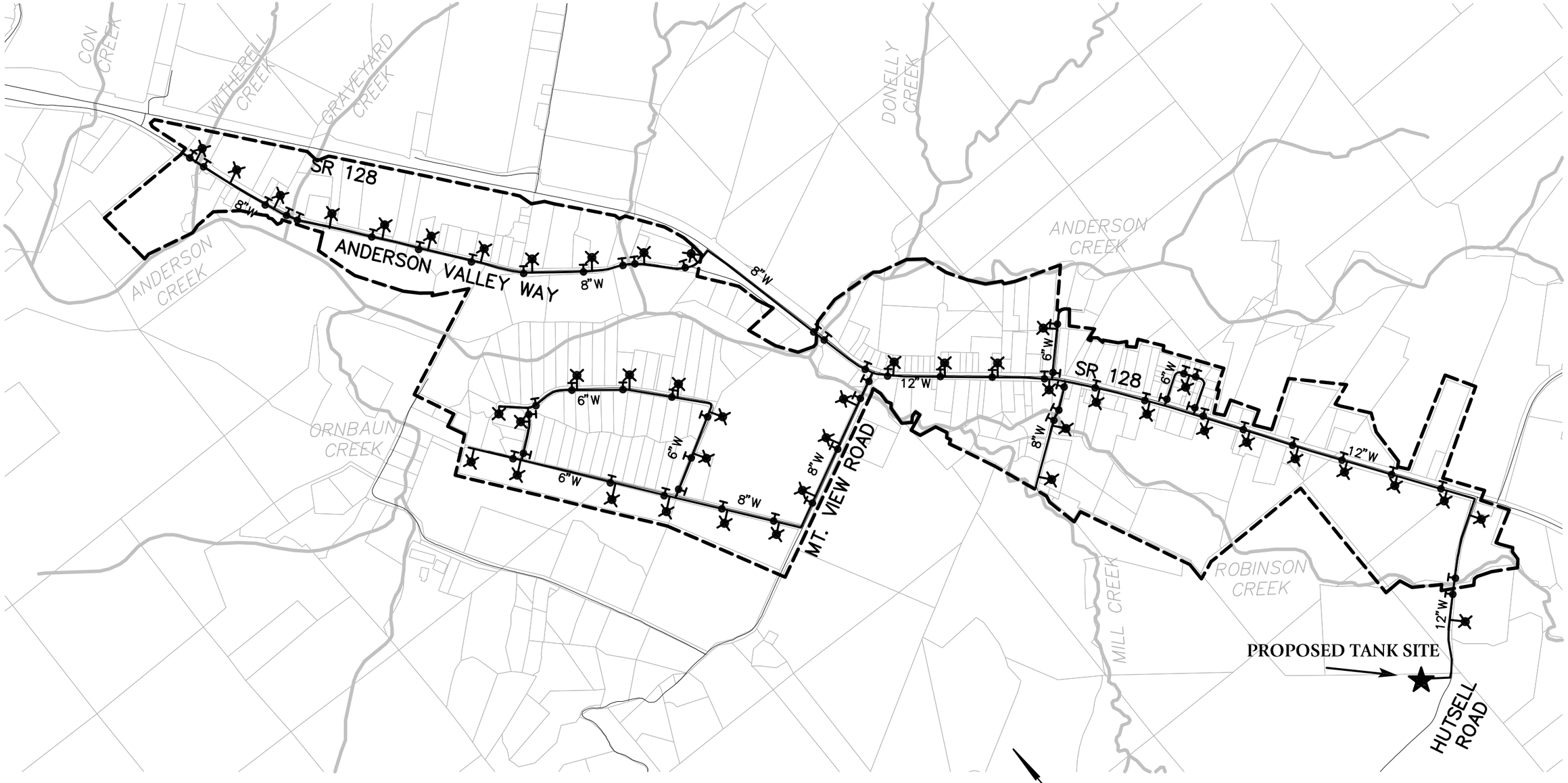
06-01-17 stufcoaky \4154\dwg\4154 11\4151.11 DISTRIBUTION SYSTEM.dwg TAB: Fig 3– Alt 1 11x17



LEGEND

- PROPOSED SERVICE AREA
- 12"W — WATER MAIN
- CREEK
- FIRE HYDRANT
- VALVE

1000 0 1000

SCALE IN FEET

1" = 1000Ft.

FIGURE 4

SERVICE AREA ALTERNATIVE 2 DISTRIBUTION SYSTEM OVERVIEW

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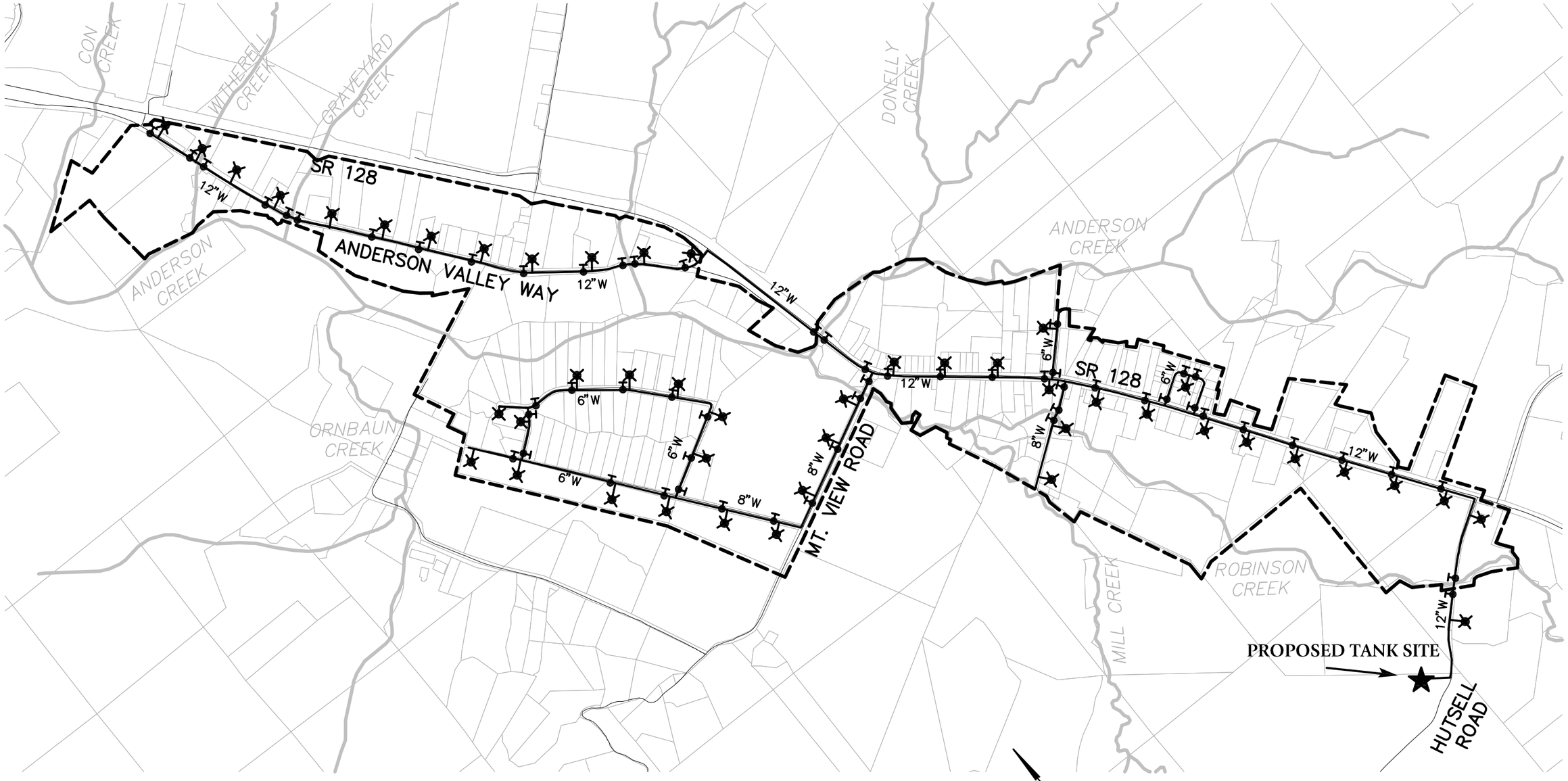

LEGEND

- PROPOSED SERVICE AREA
- 12"W — WATER MAIN
- CREEK
- FIRE HYDRANT
- VALVE

1000 0 1000

SCALE IN FEET

1" = 1000Ft.

FIGURE 5

SERVICE AREA ALTERNATIVE 3 DISTRIBUTION SYSTEM OVERVIEW

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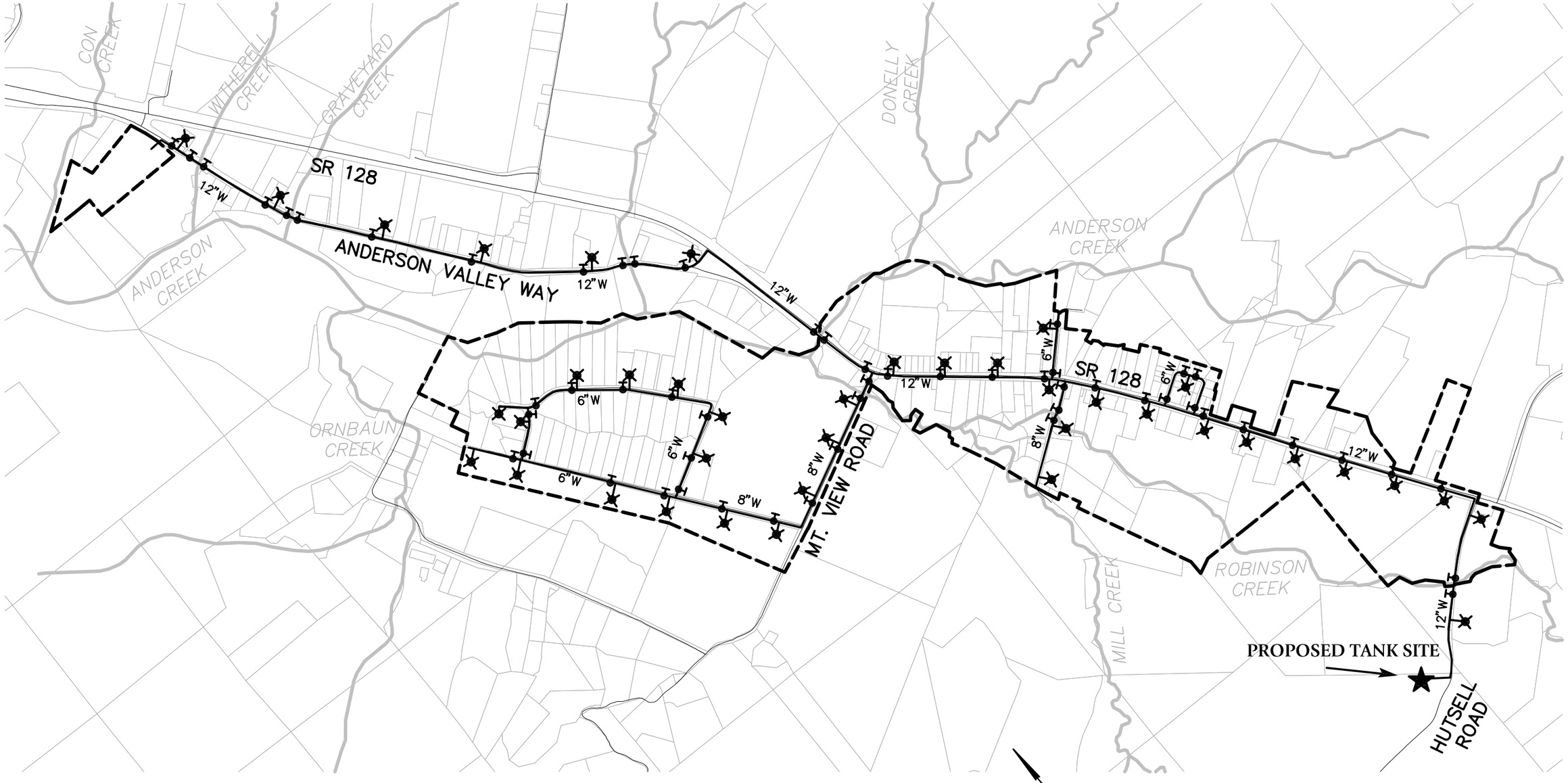
08-01-17 stufkosky \4154\dwg\4154 11\4151.11 DISTRIBUTION SYSTEM.dwg TAB: Fig 5-Alt 3 - 11x17



LEGEND

- PROPOSED SERVICE AREA
- 12"W — WATER MAIN
- CREEK
- FIRE HYDRANT
- VALVE

1000 0 1000

SCALE IN FEET

1" = 1000Ft.

FIGURE 6

SERVICE AREA ALTERNATIVE 4 DISTRIBUTION SYSTEM OVERVIEW

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5 Storage

The storage requirement is approximately 270,000 gallons for service area Alternatives 1 and 4 and 290,000 gallons for Alternatives 2 and 3. For Alternatives 1 and 4, this volume would be provided in two tanks having approximate dimensions of 33 ft diameter with a 28 ft shell height assuming a maximum operating water level of 22 ft. For Alternatives 2 and 3, this volume would be provided in two tanks having approximate dimensions of 33 ft diameter with a 30 ft shell height assuming a maximum operating water level of 24 ft. Two tanks of similar volume are preferred rather than a single, larger tank to facilitate future maintenance that would involve a tank being removed from service. The most cost effective tanks in this size range are bolted steel tanks.

Review of the terrain within the proposed water system boundary confirms that the distribution system could consist of a single pressure zone (elevation change from southeast to northwest is not too excessive) and that an appropriate elevation range for gravity storage tanks would be 550 to 570 feet above mean sea level. Given that the valley floor slopes downward to the northeast, it would be preferable to site storage at the southern (higher) end of the distribution system so that the pressure drop during fire flow deliveries (due to pipe friction) to the northerly portion of the service areas will be somewhat mitigated by the drop in elevation of the valley floor. While storage could be located elsewhere, this layout would be the most efficient in this particular circumstance.

Two potential gravity tank sites were identified on private property (APN 029-170-18) outside the proposed service areas on Hutsell Road during a review of the terrain surrounding the southerly end of the proposed distribution system. The locations are indicated on Figure 7. Further study of the sites will be necessary including a review by a geotechnical engineer, before it can be determined if they are suitable for the proposed purpose.

A field visit in April 2017 suggested that Tank Site #1 (Figure 7) is preferable due to general site stability, topography, and accessibility. The underlying parcel is protected under the Williamson Act (also known as California Land Conservation Act of 1965), but the designation is not expected to be a major issue as the impact to the ongoing agricultural use would be minimal.

In addition to right-of-way for the tanks, which could consist of an easement or fee title, the District will need to acquire easement rights for an access roadway and the water pipeline. While the pipeline could be located under the access roadway, a more direct route from the public roadway to the site is more efficient and preferable in many circumstances. The tank sites would be secured with fencing to prevent entry by unauthorized persons and large animals. The access roadway would be equipped with a lockable gate, if necessary, to prevent unauthorized use.

Figure 7. Potential Tank Sites – APN 029-170-18

6 Conclusions

6.1 Findings

This concludes the project evaluation and pre-design findings of a potential public water system for a portion of the community of Boonville. There are four proposed water service area alternatives with the largest service area encompassing a potential 262 connections and up to 880 people.

Demands were established for the community based on connection type and historical water use data. For service area Alternative 1, the average day demand was established as 55,000 gallons and the maximum day demand as 123,000 gallons. For service area Alternative 2, the average day demand was established as 66,500 gallons and the maximum day demand as 150,000 gallons. For service area Alternative 3, the average day demand was established as 67,500 gallons and the maximum day demand as 152,000 gallons. For service area Alternative 4, the average day demand was established as 56,000 gallons and the maximum day demand as 125,000 gallons.

With a 10% design allowance included, the system would need a supply of approximately 100 gpm and storage of 270,000 gallons for service area Alternatives 1 and 4. If fire facilities were deferred, the storage requirement would be reduced to approximately 140,000 gallons to meet maximum day domestic demands. For Alternatives 2 and 3, the system would need a supply of roughly 120 gpm and storage of 290,000 gallons. If fire facilities were deferred in these alternatives, the storage requirement would be reduced to approximately 170,000 gallons to meet maximum day domestic demands.

Based on historic water quality data from the three existing public water systems in the proposed service areas, the anticipated water treatment is disinfection and likely iron and manganese removal.

The Mendocino County Fairgrounds average use was included in demands. However, the intermittent high-use events were not included in the community's maximum day demand. The fairgrounds' intermittent events would need to be satisfied with the fairgrounds' current water supply facilities.

6.2 Next Steps

Moving forward, a hydrogeological investigation to establish suitable sources to develop for the system will be completed and pump tests performed on a maximum of two existing wells in the vicinity of the proposed service areas. The pump tests will include water quality testing to determine water chemistry in the region.

After completion of these tasks, an Engineering Report will be prepared. The Report will be an in-depth design report with a summary of alternatives evaluated, basis of design, selection of preferred alternative, conceptual design, and opinion of probable construction costs.

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