Tecopa Safe Drinking Water and Fire Water Supply Feasibility Study

Tecopa and Tecopa Hot Springs California

JWI.1345

Prepared For:

Amargosa Conservancy
Post Office Box 63
Shoshone, California 92384

Prepared By:

JOHNSON WRIGHT, INC.

3730 Mt. Diablo Boulevard, Suite 230
Lafayette, California 94549

R|O Anderson

1603 Esmeralda Avenue
Minden, Nevada 89423

November 12, 2013

Jon Philipp, California Professional Geologist and Certified Hydrogeologist, as an employee of Johnson Wright, Inc., has prepared the following "Tecopa Safe Drinking Water and Fire Water Supply Feasibility Study" dated November 12, 2013. His signature and stamp appear below:

Jon Philipp
Professional Geologist #7945
Certified Hydrogeologist #864
November 12, 2013

PROFESSIONAL GEOLOGIST
JON PHILIPP
NO. HG 864
CERTIFIED HYDRO GEOLOGIST
STATE OF CALIFORNIA

Kent Neddenriep, California Professional Civil Engineer, as an employee of R.O.Anderson, Inc., has prepared the following "Tecopa Safe Drinking Water and Fire Water Supply Feasibility Study" dated November 12, 2013. His signature and stamp appear below:

Kent Neddenriep
Professional Civil Engineer #48475
November 12, 2013

REGISTERED PROFESSIONAL ENGINEER
KENT R. NEDDENRIEP
NO. C048475
Exp. 06-30-14
CIVIL
STATE OF CALIFORNIA

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

EXECUTIVE SUMMARY

The communities of Tecopa and Tecopa Hot Springs, located in remote southeastern Inyo County, have no safe sources of potable drinking water and lack auxiliary storage for fire water supply. While nearly all households have private wells, the local geology and hydrogeology suggests that it is doubtful any of the domestic wells in the region meet the State of California safe drinking water standards for dissolved constituents such as fluoride, arsenic and other minerals.

Johnson Wright, Inc. (JWI) and their partner, R.O Anderson Engineering, Inc. (JWI Team), performed a Feasibility Study on behalf of the Amargosa Conservancy (AC) to address the range of water quality and supply issues in Tecopa and Tecopa Hot Springs. Preliminary conclusions from this feasibility study were developed based on reviewing available hydrogeological information for the Tecopa area, assessing the groundwater resources available and the water supply requirements, and holding community meetings to provide feedback on the study.

Fire water storage is considered to be the most urgent need of the residents of Tecopa as drinking water is currently available in Pahrump. Therefore, it is recommended to provide fire water storage immediately. If funds are not available for two fire water storage tanks, one tank would provide significant benefit over the current conditions.

If only one fire water storage facility can be funded, input from the Fire District is critical to determine the preferred location because they will be using the tank and best know the advantages and disadvantages of each location as it relates to their needs. Further, investigation of the existing welded steel storage tank is warranted before proceeding with its use. If the tank is found to be in reasonably good condition then it should be used for fire water storage to reduce the cost of equipment, otherwise, a new polyethylene storage tank is recommended.

The supply of a source of safe drinking water in the area is also a high priority. Fill stations at both proposed locations would be beneficial to the area. However, if both fill stations are constructed it is expected that the use of each fill station would be approximately one half of the use if only one were to be constructed and the revenues would not be sufficient to cover the operation and maintenance costs. For economic reasons the fill station at in Tecopa Heights is recommended.

1.0 INTRODUCTION

The communities of Tecopa and Tecopa Hot Springs, located in remote southeastern Inyo County, California (Figure 1), have no safe sources of potable drinking water. While nearly all households have private wells, the local geology and hydrogeology suggests that it is doubtful any of the domestic wells in the region meet the State of California safe drinking water standards for dissolved constituents such as fluoride, arsenic and other minerals. Currently, residents either drive 45 miles to Pahrump, Nevada to purchase purified water or they drink unregulated well water. The long-term health effects associated with highly mineralized water is a concern for this community. In addition to the economic impact of residents purchasing purified water and health impact for residents who drink private well water, there is also an urgent need to establish water storage capacity for the local volunteer emergency services district. Recent fires have brought to light the difficulty of controlling fires in the area without the ability to quickly refill the various fire-fighting vehicles. The storage of water could also be vital for providing water during emergencies that involve power outages, which are a frequent result of the desert high winds and heat.

Johnson Wright, Inc. (JWI) assembled a team (JWI Team) with extensive technical experience and local understanding to execute a Feasibility Study on behalf of the Amargosa Conservancy to address the range of water quality and supply issues in Tecopa and Tecopa Hot Springs. The Feasibility Study provides an analysis of the current situation, a range of possible solutions, and estimates of the costs of these solutions. The JWI Team consists of:

- Johnson Wright, Inc., Lead Consultant, Hydrogeology
- R.O. Anderson Engineering, Inc., Engineering and GIS

The Feasibility Study involved reviewing available hydrogeological information for the Tecopa area, assessing the groundwater resources available and the water supply requirements, and holding community meetings to provide feedback on the study. This information was used to develop potential project alternatives and requirements, which were then further refined to develop the recommended alternatives and estimated costs.

2.0 DATA COLLECTION AND ASSESSMENT ACTIVITIES

The JWI Team reviewed available hydrogeological information for the Tecopa area, including technical reports, available data, maps and other information. Relevant data were used to perform a hydrogeological assessment that evaluated the groundwater resources (water quality and quantity) available for use for the proposed project. This included three water samples collected from Tecopa area wells as part of this Feasibility Study, water quality and quantity data collected as part of the Amargosa Conservancy's Amargosa River Hydrologic Survey, and other publically available data including a variety of data provided by local residents and businesses. The available water quality data were scrutinized for pertinent water quality parameters, including exceedances of the primary and secondary drinking water standards as defined by Title 22 of the California Code of Regulations. The primary contaminants in the area are arsenic and fluoride, which have maximum contaminant levels (MCLs) of 10 micrograms per liter (μg/L) and 2.0 milligrams per liter (mg/L), respectively.

2.1 Feasibility Study Sample Collection Activities

Three groundwater samples were collected and analyzed as part of this Feasibility Study. The sample collection locations included the domestic water-supply well at the 590 Sunset Road residence, the water-supply well located at the Tecopa-Francis School on Old Spanish Trail Highway, and the out of service hand-dug well at Cynthia's Hostel located at 2001 Old Spanish Trail Highway. The samples were all collected on April 24, 2013. Each sample was properly packaged and transported on ice to Advanced Technology Laboratories, Inc. (ATL, a California-certified analytical laboratory) in Las Vegas, Nevada for analysis. Each sample was analyzed for metals, cations, anions, alkalinity, hardness, total dissolved solids, specific conductivity, total organic carbon, arsenic speciation and sulfide. The locations of the three wells where data were collected are shown on Figure 2. The details of the analytical results from the three samples collected are discussed and presented in Section 4.1.1 of this report. Appendix A contains the laboratory report from ATL.

2.2 Other Groundwater Analytical Data

Additional groundwater analytical data were compiled from a number of different sources as part of this Feasibility Study. The data includes springs and groundwater samples collected as part of the Amargosa Conservancy's ongoing hydrologic survey and groundwater data from Tecopa Hot Springs. The locations of the data collection points are shown on Figure 3.

2.3 Information Canvassing Efforts

An essential facet of the water resource evaluation for this Feasibility Study was the identification of private wells, and the businesses and residences that rely upon them, for their domestic drinking water supply. To that end, the JWI team conducted a well canvassing effort for the Tecopa and Tecopa Hot Springs area which included visual tours of the area, conversations with local officials, business owners and residents, and the distribution/collection of domestic water source and use questionnaires. The questionnaire was distributed to the Tecopa and Tecopa Hot Spings community and 30 responses were obtained. The purpose of the questionnaire was to collect information to better assess who would use the water, where the infrastructure should be built, the amount of water necessary to meet community needs, and the cost of the drinking water and fire water supply systems. The community was asked to provide input on the number of year round and seasonal residents, the source of household and drinking water, and whether they would use potable water if it were made available in Tecopa. A summary of the conversations and information collected are found in Appendix B. Please note that private information shared with the JWI team are not included in this report, and that questionnaires submitted as part of this Feasibility Study have been destroyed.

2.4 Mapping and Number of Residents

Updated copies of Inyo County's GIS database were obtained as well as the best available aerial photography of the region. This information was used to create base maps showing the area including roads, significant features, and parcel lines. These maps are contained in Appendix C and are also submitted electronically in ArcGIS format.

The 2010 U.S. Census listed 150 full time residents in the Tecopa area, which includes Tecopa Heights, Tecopa Hot Springs, and downtown Tecopa. Based upon survey results from hand delivered questionnaires and site visits made during this feasibility study, it was estimated that an additional 220 people may be present as a transient population during winter seasonal tourism periods, for an estimated total combined population of roughly 375 people. The transient population is based upon an estimate of the Recreational Vehicle (RV) spaces and an assumption of 2 people per RV space.

2.5 Maxey-Eakin Water Supply Availability Estimate

As availability of surface water supplies are not anticipated for either fire-fighting or potable water, a groundwater assessment to evaluate potential sources of potable and/or fire-fighting water supplies in the Tecopa area was conducted. Based on our previous work in the Amargosa Basin, we believe that a portion of the recharge to the Tecopa area south of Tecopa Hot Springs is derived from recharge that occurs in the Kingston Range (Figure 4), which moves downward toward the Amargosa River. As part of the Feasibility Study, an estimate of groundwater recharge in the Kingston Range area was conducted using a Maxey-Eakin analysis. The Maxey-Eakin method uses precipitation at various elevations to estimate groundwater recharge from a mountainous drainage area, such as the western slopes of the Kingston Range.

The first step of the Maxey-Eakin analysis is to establish a correlation between average yearly precipitation and elevation using weather station data. Currently, there is only one local precipitation station at an elevation substantially above the Amargosa River, so the analysis will represent a screening-level recharge estimate for the purposes of this Feasibility Study. However, looking beyond to areas such as Death Valley and the Spring Mountains, over thirty annual precipitation values were obtained at elevations ranging from below sea level to over 8,000 feet above sea level. The annual precipitation values were plotted against elevation and a polynomial trend line was fit to the data, the equation for which defines the general relationship used in the Maxey-Eakin analysis. This plot is shown in Figure 5 and the equation from the polynomial fit to the data is:

$$P = 0.00000018L^2 + 0.00094946L + 1.79781040 \qquad (1)$$

where P is precipitation and L is the elevation. The precipitation corresponding to the range of elevations for the Kingston Range was calculated using Equation 1. To perform the Maxey-Eakin analysis, three areas were measured that corresponded to the elevations that bracketed three different precipitation zones: 8-12 inches, 12-15 inches, and 15-20 inches. The measured areas (A) along with the average precipitation for each of these zones and the Maxey-Eakin coefficient (α_i) were entered into the Maxey-Eakin (ME) equation defined below to obtain water availability:

$$\mathrm{ME}_{\mathrm{recharge}} = \sum_{i=1}^{3} A_i \propto_i P_i \qquad (2)$$

A summary of the values used to estimate the recharge for the Kingston Range is presented in Table 1. The total estimated recharge using the Maxey-Eakin analysis is 728 acre-feet per year. Based on this estimated recharge rate and the anticipated average water usage of 355 gallons per day (0.4 acre-feet per year) for the communities of Tecopa and Tecopa Hot Springs, ample groundwater is available in the region to support this usage. In addition, potential impacts to well owners, springs, and the federally-designated Wild and Scenic River from the possible water usage are not anticipated.

Table 1. Values used in the Maxey-Eakin Analysis

Elevation Range (feet)	Precipitation Zone (inches)	Average Precipitation (inches)	Average Precipitation (feet)	M-E coefficient	Area (square feet)	Recharge (acre-ft/year)
6300 - 7700	15 - 20	17.5	1.46	15%	19,621,015	99
5300 - 6300	12 - 15	13.5	1.13	7%	141,341,242	256
3800 - 5300	8 - 12	10	0.83	3%	650,988,265	374
					Total Recharge	**728**

M-E coefficients obtained from Maxey and Eakin (1949)

3.0 COMMUNITY CONSULTATION

Several community meetings were held at the Tecopa Community Center in order to obtain feedback from the community regarding the Feasibility Study. The first community meeting was held on April 10, 2013 with the purpose of introducing the project and getting some initial verbal feedback from the community about the various aspects of the project. This meeting initiated several weeks of data collection efforts, including canvassing the community for domestic supply wells, encouraging business owners and residents to fill out questionnaires regarding community water supplies and uses, and consulting with local officials including the Southern Inyo Fire Protection District (SIFPD) Fire Chief Lawrence Levy.

The information collected immediately following the first community meeting was compiled and forwarded to R.O. Anderson for use in performing a preliminary analysis regarding potential options for establishing a drinking water supply and fire suppression water supply for Tecopa. These initial options were presented to the Tecopa community at a meeting conducted on July 10, 2013. At this meeting, the various options were presented followed by an open discussion.

4.0 RECOMMENDED PROJECT ALTERNATIVES AND ESTIMATED COSTS

The recommended project alternatives and estimated costs are presented in this section in two parts. The safe drinking water supply alternatives are first discussed followed by the discussion on the alternatives for the fire water supply. Each part discusses two alternatives, the potential locations of the water supply, environmental permitting, and a cost analysis.

Below is a summary of the alternatives that were selected for this study. The first two are for the safe drinking water supply and the last two are for the fire water supply:

- A dispensing station for potable water located at the fire district property in Tecopa Heights using the new fire Department well including dispensing for RV use. Treatment will be by adsorption with no waste stream.
- A dispensing station for potable water located at the Community Center in Tecopa Hot Springs using the existing water supply including dispensing for RV use. Treatment will possibly include chlorination water softening prior to the Reverse Osmosis charcoal filtration. This treatment will have a waste stream that most likely will be disposed of in the wastewater treatment ponds.
- A static water supply at the fire district property in Tecopa Heights filled by their new well and using the site tank.
- A static fire water supply at the fire property in Tecopa Hot Springs with a new polyethylene tank to be filled by the fire tender during non-emergencies.

4.1 Safe Drinking Water Supply

4.1.1 Water Quality

Presently there is no known local source of drinking water that meets either Federal or California safe drinking water standards available to the community of Tecopa. Of primary concern is the presence of elevated levels of arsenic and fluoride in the local water. While the concentrations of arsenic do vary between sources in the Tecopa area, all of the sources sampled in this study presented concentrations in excess of the primary Maximum Contaminant Level (MCL)[1] for the State of California – i.e. > 10 µg/L. Fluoride is also present at levels in excess of the State of

[1] The United States Environmental Protection Agency (USEPA) sets primary MCLs which are legally enforceable standards to protect the health of drinking water consumers. Secondary MCLs are non-enforceable standards for contaminants that may either cause cosmetic effects (skin discoloration) or have aesthetic effects on the water such as taste and odor (USEPA, 2013). States may choose to enforce Federal secondary MCLs at their discretion.

California primary MCL of 2.0 mg/L. Subsequently, residents and visitors must either consume untreated water pumped from domestic wells, provide their own treatment, or purchase treated water from another location. Even though most residences are served by domestic wells, many residents indicated that they prefer to purchase their water from a treated source in Pahrump, Nevada, about 45 miles away from the Tecopa area, citing health concerns and aesthetic issues (taste) for not consuming well water.

Arsenic is a toxic substance for humans, and ingestion of arsenic may result in a myriad of adverse health conditions for the consumer, including increased risk of cancer (USEPA, 2013). Fluoride at low levels (below the MCL) can have positive health effects – especially dental health. Ingestion of fluoride at high levels however, can have adverse health effects including increased risk of bone fractures and pain, as well as adverse cosmetic effects on teeth, especially in children (USEPA, 2013). The primary MCL for the State of California is 2 mg/L and the Federal primary MCL is 4 mg/L (2 mg/L is the Federal secondary MCL).

In addition to arsenic and fluoride, the water quality results indicate that the groundwater in the Tecopa Hot Springs area exceeds secondary standards for Total Dissolved Solids (TDS) and sulfate. Secondary standards are in place for aesthetics including odor and taste and exceeding these standards do not have definitive adverse health effects. Further, high turbidity (cloudiness resulting from suspended particles), pH, hardness, silica, sulfates and alkalinity (characteristic of mineralized ground water) are present at high levels, which can adversely impact available water treatment options even though they do not have adverse health or aesthetic affects.

4.1.1.1 Tecopa Heights

Many of the full time residents in the Tecopa area reside in Tecopa Heights, which lies to the east of the downtown Tecopa near the intersection of Old Spanish Trail and Furnace Creek Road. Three existing wells were sampled in Tecopa Heights as a part of this study – the School Well, Cynthia's Well, and the well located at 590 Sunset Road. The locations of these wells are shown on the Area Map included in Figure 2. The water quality results for each of these wells are included in Table 2 below. As can be seen from the water quality analysis, all three wells exceed the Federal and State of California primary MCL for arsenic (10 µg/L, which is the equivalent of 0.010 mg/L) and the Federal secondary and State primary MCL for fluoride (both 2 mg/L). In addition to arsenic and fluoride, the ground water sampled in the area of Tecopa Heights contains relatively high levels of sulfate, hardness, alkalinity, and pH. The results of the water quality analysis performed for three wells in the Tecopa Heights area are shown in Table 2, which also lists both the Federal and State of California primary and secondary MCLs for reference. One well (Cynthia's Well) showed high turbidity which is not commonly found in groundwater, likely a result of the hand dug nature of the well itself.

4.1.1.2 Tecopa Hot Springs

Tecopa Hot Springs lies to the north of downtown Tecopa and is a popular location for tourists to visit, especially in the winter. All of the local businesses, including Recreational Vehicle (RV) parks and the County-owned campground, are located in Tecopa Hot Springs which makes this area ideal for locating a potable water source. The ground water in the vicinity of Tecopa Hot Springs is of a lesser quality than that of the wells sampled in Tecopa Heights. While no samples were taken during the course of this feasibility study, historic water quality analysis reports of the Hot Springs (from February of 2012) are available and are included as Table 3 below. All of the constituents of concern for the Tecopa Heights area discussed previously are present at higher concentrations in the ground water near Tecopa Hot Springs, with arsenic levels up to 42 times the MCL. The relatively high concentration of total dissolved solids (TDS) at over 2,000 mg/L classifies the water as “brackish water.” Brackish water is water that has a saline content greater than freshwater and less than seawater. Additionally, fluoride is present at a concentration of 3.6 mg/L which exceeds the California MCL and approaches the Federal MCL for safe drinking water (4.0 mg/L). Silica, alkalinity, and sulfates are also present at high concentrations, with sulfate levels over twice the Federal and California secondary MCLs.

Table 2: Tecopa Heights Water Quality Analysis

Parameter	Federal		California		Units	Cynthia's Well	School Well	590 Sunset Well
	Primary MCL	Secondary	Primary MCL	Secondary				
Arsenic	0.01	-	0.01	-	mg/L	**0.011**	**0.032**	**0.014**
Arsenic III (Arsenite)	0.01	-	0.01	-	mg/L	0.000197	0.000370	0.000288
Fluoride	4	2	2	-	mg/L	**2.8**	**2.3**	**2.5**
Turbidity	-	1 - 5	-	5	NTU	**2.0**	0.51	0.35
Barium	1	-	1	-	mg/L	0.023	0.025	0.025
Copper	1.3	1	1.3	1	mg/L	ND	0.0073	ND
Iron	-	0.3	-	0.3	mg/L	ND	ND	0.12
Zinc	-	5	-	5	mg/L	ND	0.15	0.012
Chloride	-	250	-	250	mg/L	43	86	51
Nitrogen, Nitrate (As N)	10	-	45	-	mg/L	ND	0.16	0.22
Sulfate	-	250	-	250	mg/L	210	210	190
pH	-	6.5 - 8.5	-	-	ph Units	7.9	7.9	8
Boron	-	-	-	-	mg/L	0.88	2.8	0.81
Calcium	-	-	-	-	mg/L	16	23	38
Magnesium	-	-	-	-	mg/L	19	21	23
Molybdenum	-	-	-	-	mg/L	0.013	0.010	0.007
Silica (SiO2)	-	-	-	-	mg/L	52	46	35
Strontium	-	-	-	-	mg/L	0.69	0.78	1.4
Vanadium	-	-	-	-	mg/L	0.0056	0.0069	0.0058
Hardness, Calcium (As CaCO3)	-	-	-	-	mg/L	39	56	95
Hardness, Magnesium (As CaCO3)	-	-	-	-	mg/L	80	88	95
Total Hardness (As CaCO3)	-	-	-	-	mg/L	120	140	190
Alkalinity, Bicarbonate (As CaCO3)	-	-	-	-	mg/L	300	310	200
Alkalinity, Carbonate (As CaCO3)	-	-	-	-	mg/L	11	ND	ND
Alkalinity, Total (As CaCO3)	-	-	-	-	mg/L	320	310	210
Suspended Solids (Residue, Non-Filterable)	-	-	-	-	mg/L	54	ND	ND
Temp. at time of pH Analysis	-	-	-	-	ph Units	25	25	25
Aluminum	-	0.2	-	0.2	mg/L	ND	ND	ND
Antimony	0.006	-	0.006		mg/L	ND	ND	ND
Beryllium	0.004	-	0.004	-	mg/L	ND	ND	ND
Cadmium	0.005	-	0.005	-	mg/L	ND	ND	ND
Chromium	0.1	-	0.05	-	mg/L	ND	ND	ND
Cobalt	-	-	-	-	mg/L	ND	ND	ND
Lead	0.015	-	0.015	-	mg/L	ND	ND	ND
Manganese	-	0.05	-	0.05	mg/L	ND	ND	ND
Nickel	-	-	0.1	-	mg/L	ND	ND	ND
Selenium	0.05	-	0.05	-	mg/L	ND	ND	ND
Silver	-	0.1	-	0.1	mg/L	ND	ND	ND
Thallium	0.002	-	-	-	mg/L	ND	ND	ND
Mercury	0.002	-	0.002	-	mg/L	ND	ND	ND
Nitrogen, Nitrite	1	-	1	-	mg/L	ND	ND	ND
Phosphorus, Dissolved Orthophosphate (As P)	-	-	-	-	mg/L	ND	ND	ND
Alkalinity, Hydroxide (As CaCO3)	-	-	-	-	mg/L	ND	ND	ND
Organic Carbon, Total	-	-	-	-	mg/L	ND	ND	ND
Sulfide	-	-	-	-	mg/L	ND	ND	ND

ND : Non-detect

Table 3: Tecopa Hot Springs Water Quality Analysis

Parameter	Federal		California		Units	Hot Springs
	Primary MCL	Secondary	Primary MCL	Secondary		
Arsenic	0.01	-	0.01	-	mg/L	**0.42**
Fluoride	4	2	2	-	mg/L	**3.6**
Total Dissolved Solids	-	500	-	500	mg/L	**2200**
Sodium	-	-	-	-	mg/L	19
Potassium	-	-	-	-	mg/L	19
Sulfate	-	250	-	250	mg/L	510
pH	-	6.5 - 8.5	-	-	ph Units	8.2
Calcium	-	-	-	-	mg/L	4.4
Magnesium	-	-	-	-	mg/L	1.8
Silica (SiO2)	-	-	-	-	mg/L	100
Total Hardness (As CaCO3)	-	-	-	-	mg/L	18
Alkalinity, Bicarbonate (As CaCO3)	-	-	-	-	mg/L	730
Alkalinity, Total (As CaCO3)	-	-	-	-	mg/L	600
Total Phosphorus	-	-	-	-	mg/L	0.14
Iron	-	0.3	-	0.3	mg/L	ND
Nitrogen, Nitrate (As N)	10	-	45	-	mg/L	ND
Alkalinity, Carbonate (As CaCO3)	-	-	-	-	mg/L	ND
Manganese	-	0.05	-	0.05	mg/L	ND
Nitrogen, Nitrite	1	-	1	-	mg/L	ND
Phosphorus (As P04)	-	-	-	-	mg/L	ND
Alkalinity, Hydroxide (As CaCO3)	-	-	-	-	mg/L	ND
Sulfide	-	-	-	-	mg/L	ND

ND : Non-detect

4.1.2 Water Treatment

The 2010 U.S. Census listed 150 full time residents in the Tecopa area, which includes Tecopa Heights, Tecopa Hot Springs, and downtown Tecopa. Based upon survey results from hand delivered questionnaires and site visits made during this feasibility study, it was estimated that an additional 220 people may be present as a transient population during peak winter seasonal tourism periods, for an estimated total combined maximum population of roughly 375 people. The transient population is based upon an estimate of the RV spaces and an assumption of 2 people per RV space. For the purpose of estimating the daily quantity of treated drinking water required to serve the Tecopa area a rate of 1.1 gallon per capita-day was assumed. Since it is anticipated that tourists will likely use the treated water source to fill their RV water tanks, a factor of safety of 1.5 was included in the maximum daily treated water demand estimate for a total maximum daily demand of about 600 gallons per day (GPD).

During the hot summer months there is very little use of the RV parks. Additionally, more of the permanent homes are vacant. It is assumed that during the summer the population will be approximately 100 people and there will be very few RV fill-up's, resulting in an estimated summer water use of 110 GPD.

For this report it is assumed that the peak winter daily water consumption for drinking will be 600 GPD, the summer water consumption for drinking will be 110 GPD, and the annual water consumption for drinking will be 355 GPD or 0.40 acre feet per year in the Tecopa Area. Additionally, the water supply for consumption should be capable of supplying water at a reasonable rate of approximately 10 gallons per minute. This is so that water bottles or RVs could be filled in a reasonable amount of time.

Since arsenic and fluoride are the primary constituents of concern in the Tecopa area, any water treatment system considered must be effective at reducing both arsenic and fluoride concentrations. There are a number of options for treating this water and each option varies in cost, time, and effectiveness, as well as sensitivity to the feed water quality. Based upon the relatively small quantity of water to be treated daily, the feed water quality, and past experience, treatment options were narrowed down to two types of systems, viz. Adsorption and Reverse Osmosis.

4.1.3 Adsorption

Adsorption (as contemplated in this study) is the process by which a contaminant such as arsenic is physically removed from water and attached to a porous media. Adsorption can be an effective treatment process for removing both arsenic and fluoride, however, the adsorption media is non-selective and therefore competing ions in the feed water will tend to 'compete' for adsorption sites on the media. Significant competing ions include silica and phosphorous (as orthophosphate), and recommended feed water levels for these ions are less than 30 mg/L and less than 1 mg/L, respectively (Amargosa Conservancy, 2012). This process is considered the most feasible option for treating water in the Tecopa Heights area, even though the silica level is slightly higher than the recommended concentration of less than 30 mg/L. This results in the adsorption media having to be changed slightly more often than if silica were not present.

A typical adsorption system would consist of a small building to house the system, piping, and appurtenances. Feed water would be delivered from a nearby well to a pre-filter which would remove large particles, sediment, and debris. From the pre-filter, water would then enter the adsorption media canisters where arsenic and other contaminants would largely be removed. Treated water leaving the adsorption media could then be supplied to consumers. Initial conversations with Isolux, a potential adsorption system manufacturer, indicate that up to 140,000 gallons could be treated per set of adsorption media canisters given the water chemistry.

We have assumed 94,000 gallons per canister and that they would last up to 5 months at peak winter usage of 600 GPD before the canisters would need to be replaced. The life of the pre filter is more difficult to predict and depends upon the turbidity and suspended solids in the water. It is assumed that these would have a useful life of approximately one half of that of the adsorptive media or 45,000 gallons. There would not be a back flush requirement and no waste stream would be associated with an adsorption system. When the pre filters and adsorptive media filters are replaced the used components will be disposed of either through testing to verify that they do not meet the criterion of a hazardous waste and disposal at a landfill or sent back to the supplier who will either recycle the components or properly dispose of them.

4.1.4 Reverse Osmosis

Reverse Osmosis (RO) is the process by which water is permeated across a selective filter membrane via a pressure differential which is typically supplied by a pump. The treated water which permeates through the filter membrane could then be supplied to consumers. RO typically requires soft water (hardness less than 17 mg/L), low iron and silica concentrations, and low turbidity. For these reasons, RO is not generally recommended for the Tecopa area. Hardness can scale (clog) the RO membranes and silica will tend to abrade and damage the RO membranes. However, brackish water RO systems may potentially be suitable for the Tecopa Hot Springs area, since the feed water quality in this area would not be viable for either adsorption or standard RO systems.

A typical brackish water RO system would include multimedia and activated carbon pre-filters, followed by an anti-scalant injection, and depending on the nature of the arsenic present, possibly chlorine injection prior to the pre-filters. After the pre-filtration and chemical injection, the water would be sent to the RO membranes where arsenic and other contaminants would be removed. Cooling of the water is also recommended. The water would then be distributed for consumption. As with all RO systems there would be a waste stream of "brine" which would need to be disposed of, most likely into the existing sewage ponds west of the Community Center as discussed later in this Report.

4.1.5 Distribution

Distribution for consumption could be provided in a number of different ways, however, given the low daily demand and relatively close geographic proximity of the residents in the Tecopa area, a central point of entry treatment and distribution system (fill station) is recommended. This could be accommodated by a water vending machine that would provide people the option of filling water bottles (5 gallon bottles for instance) or RV tanks, similar to those located at grocery stores. Water would be supplied to the vending machine from the treatment system at the same building that houses the treatment works. Arizona Water Vending, a potential distributor of water vending machines, has a distribution machine that could be mounted inset to one of the treatment building walls, which would provide consumers with access to the vending machine while keeping the water treatment system and connection protected inside the building. This type of system is essentially the same as that which is being currently used by those Tecopa residents who purchase their water in Pahrump, Nevada.

4.1.6 Location

The locations for fill stations should be convenient and near the area where water will be used. Additionally, if the cost of operation and maintenance of these fill stations is to be recovered by charging for the water (as discussed later in this report) they should have good visibility in order to promote sales and increase revenue. Further, the locations should have the proper general plan designations so that the use will be compatible with other uses in the area. Finally, the locations must have access to a suitable water supply or the ability to drill a well, power and have the ability to secure a long term agreement with the owner of the property for the use.

At the second Community Meeting these criterion were discussed and through consensus two potential locations for fill stations have been determined to best meet this criterion – the 2.5 acre Fire District leased parcel near the intersection of Bob White Way and Furnace Creek Road in Tecopa Heights (a portion of APN 046-310-02, a separate parcel number has not yet been assigned) and near the community center adjacent to Tecopa Hot Springs Road in Tecopa Hot Springs (APN 046-220-22).

4.1.6.1 Tecopa Heights

The proposed location for a fill station in Tecopa Heights is the 2.5 acre parcel leased by the Southern Inyo Fire District from the Bureau of Land Management (BLM). This is leased for public purposes under BLM Lease Number CACA 45857 01 and is a portion of APN 046-310-02 as shown on the Area Map in Figure 2 This location is very convenient to the Tecopa Heights residents being on the edge of the residential area. It is visible from Old Spanish Trail that has significant tourist and RV use. The current general plan designation is Open Space Recreation however, the Fire department is in the process of developing a fire station at this location and the general plan designation and zoning is expected to be changed to public facilities. With that change a fill station would be a compatible use. A new well was recently drilled at this site and is constructed to modern standards with an appropriate sanitary seal. The well log is included in Figure 6. The location of the well is approximately between Cynthia's Well and the 590 Sunset Well and is expected to have similar water quality to these two wells. Further, there are no known sources of groundwater contamination in the area. Eventually a septic system will be constructed to serve the fire station and there is adequate area at this site to properly separate the new septic from the existing well. Electrical power has recently been brought to this site and is expected to be available. In conversations with Fire Chief Lawrence Levy the Fire District is preliminarily agreeable to the use of a portion of their parcel and partial use of their well for a filling station. The existing Lease with the BLM must be amended to allow this use and the improvements of the fill station approved by the BLM. The conceptual plans for the Tecopa Heights fill station are included as Figure 7. The design is based upon a flow rate of 10 gallons per minute and an annual average flow of 355 gallons per day.

4.1.6.2 Tecopa Hot Springs

The proposed location for a fill station in Tecopa Hot Springs is the Community Center parcel leased from the BLM, APN 046-220-22. This parcel is listed as a BLM Recreation Site, and the County Park is located on this parcel west of Tecopa Hot Springs Road. This location would conveniently serve the transient tourist population as it is very near the existing RV parks and campgrounds.

The Community Center may find this fill station convenient. This location already has a public facilities general plan designation and the fill station will be a compatible use. Electric power is available nearby and there is domestic water available that is permitted as a Transient Noncommunity small water system through Inyo County, #1400096. This type of water system permit does not regulate or require treatment for arsenic or fluoride and throughout the facility there are notifications to not drink the water. Additionally this water is warm. In conversations with Kathy Barton, the Inyo County Small Water Systems Coordinator the water supply which is from a spring box at the hot springs east of Tecopa Hot Springs Road has been determined to not be under the influence of surface water. However, the spring box needs some improvement and better operation and management is recommended. The water quality at this site is not ideal but there are no potential sites in this area with significantly better water quality. The existing Lease with the BLM (CACA-45831) must be amended to allow this use and the improvements of the fill station approved. The conceptual plans for the Tecopa Hot Springs fill station are included as Figure 8. The design is based upon a flow rate of 10 gallons per minute and an annual average flow of 355 gallons per day.

4.1.7 Permitting

It is anticipated that any water treatment system in the Tecopa area would need to be licensed as a private water source through the California Department of Public Health Food and Drug Branch (CDPH FDB). Licensure as a private water source requires multiple water quality testing regimens – including general chemical, physical, and radiological tests to be performed annually and bacteriological tests performed weekly. The water vending station must also be sanitized once every 30 days and have the most recent sanitation date listed in a visible location. The design of the water treatment system must be performed by a licensed professional registered in the State of California, and the design of the system must include information about the hydrogeology of the source aquifer and supply well. Additional licensure for vending the treated water will also be required through the CDPH FDB. CDPH FDB will also require that the source well be approved by the local health agency, which in this case is Inyo County Environmental Health.

The waste stream from RO treatment is considered an industrial discharge and not domestic sewage and therefore is not currently permitted to be discharged to the existing sewer treatment ponds that are operated by Inyo County and permitted by the Lahontan Regional Water Quality Control Board (LRWQCB) under Board Order 6-94-102.

The waste stream from the RO treatment is expected to have very high concentrations of Total Dissolved Solids (TDS) and other contaminants. The existing sewage treatment works discharges to the groundwater through partially lined evaporation / percolation ponds. LRWQCB policy requires that the groundwater cannot be degraded unless findings are made that the degradation is in the best interest of the people. Therefore, because the waste stream from the RO is expected to be higher in TDS than the groundwater, discharging this higher concentration of TDS to the groundwater will degrade the groundwater. The existing permit through the LRWQCB will have to be modified to allow the discharge and findings made with the permit application that this degradation of the groundwater is in the best interests of the people. This is a very rigorous process requiring significant study and effort estimated to cost $25,000 as reflected in the cost estimates. Alternatively, the treatment and disposal system at the sewage lagoons would have to be modified so that the concentrations of pollutants are equal to or less than the groundwater. This is expected to require more costly physical modifications to the treatment works and therefore is not preferred.

Other potential concerns with a discharge to the existing sewage treatment system include conveying the flow to the collection system and the available capacity of the system. The location of the fill station is upgradient of the collection system so gravity flow should not be a problem. Also the flow will be minimal, up to approximately 400 GPD so capacity in the pipes and lagoon should not be a concern.

Both of the proposed locations for a water treatment facility will require building permits and plan reviews through Inyo County Planning Department (ICPD). If the fill station located in Tecopa Heights is developed prior to the general plan designation being modified to Public Facilities by Inyo County, it will likely require a special use permit be obtained to construct a dispensing station.

4.1.8 Environmental Permitting

As discussed previously the fill stations are not expected to be contrary to existing land use. Therefore, it is anticipated that fill stations will be Categorically Exempt under the California Environmental Quality Act (CEQA) for several reasons: 1) they are new construction of small structures; 2) they may be considered adjustments to existing facilities; and 3) they may be considered the installation of health or safety protection devices. Further, the estimated annual use of 0.40 acre feet per year is expected to have a less than significant effect on groundwater and the flows in the down gradient Amargosa River. A document of Categorical Exemption should be filed prior to development of a fill station.

Both parcels are owned by the United States Bureau of Land Management (BLM) and it is anticipated that a water treatment project located on either parcel would be considered as a categorical exclusion from the National Environmental Policy Act (NEPA) in that they are for the public health and safety. Therefore an Environmental Impact Study (EIS) should not be required. However the BLM must process the categorical exclusion and in processing this it is expected that they will find that the withdrawal of the estimated annual use of 0.40 acre feet per year will not affect the Amargosa River, which is designated as a Wild and Scenic River. It is noted that prior to the lease of the 2.5 acre parcel to the SIFPD the BLM completed environmental assessment EA# CA-680-05-24 in 2008. This document found no environmental effects on critical elements including no effect on the Amargosa River. The EA consider the future use of the parcel as a district office with a well, septic system, water storage tank and other appurtenances.

4.1.9 Cost Analysis

Tables 4 and 5 below provide an estimated cost analysis for both of the potential water treatment systems described above. It is estimated that an adsorption system located in Tecopa Heights will be the least expensive option both on an initial cost (design, permitting, and construction) and annual cost (administration, operation and maintenance) basis.

Table 4. Cost Analysis for Adsorption System in Tecopa Heights

Costs Associated with Administration and O&M of Adsorption at an Estimated Annual Flow of 355 Gallons Per Day

ITEM	DESCRIPTION	QUANTITY		UNIT COST		TOTAL
1	Electricity	1	Annually	$600.00	/YR	$600
2	Adsorption Cartridge Changes (1 per 94,000 gallons)	1.4	Annually	$253.00	/EA	$354
3	Pre-Filter Cartridges (1 per 45,000 gallons ~ 2.5 Months Ea.)	3	Annually	$120.00	/EA	$348
3	Operation, Maintenance and Repairs	1	Annually	$6,200.00	/YR	$6,200
4	Water Sampling (General)	1	Annually	$3,000.00	/YR	$3,000
5	Water Sampling (Bacteriological - Weekly)	52	Annually	$40.00	/YR	$2,080
6	Private Water Source License	1	Annually	$473.00	/YR	$473
SUB TOTAL						**$13,055**
ADMINISTRATION AT 10%						**$1,306**
CONTINGENCY AT 15%						**$1,958**
Engineer's Preliminary Estimate of Annual Administration and O&M Costs						**$16,319**

ITEM	DESCRIPTION	QUANTITY		UNIT COST		TOTAL
1	Capital Recovery (Savings for Eventual Replacement)	5%	Annually	$1,447.25	/YR	$1,447 [1]
Engineer's Preliminary Estimate of Annual O&M Costs with Capital Recovery						**$17,766**

Design, Permitting, and Construction

ITEM	DESCRIPTION	QUANTITY		UNIT COST		TOTAL
1	Mobilization, Demobilization, Bonds & Insurance	1	Lump Sum	$3,000.00	/LS	$3,000
2	Isolux 10 GPM POE Arsenic Treatment System	1	Lump Sum	$1,950.00	/LS	$1,950
3	Piping, BFP, Valves, and Appurtenances	1	Lump Sum	$4,500.00	/LS	$4,500
4	Arizona Water Vendors AWV-300SS Vending Machine	1	Lump Sum	$3,995.00	/LS	$3,995
5	CMU Treatment/Vending Building	1	Lump Sum	$10,000.00	/LS	$10,000
6	Inyo County Building Permit	1	Lump Sum	$1,000.00	/EA	$1,000
7	CDPH FDB Licensing	1	Lump Sum	$2,500.00	/LS	$2,500
10	Electrical Components (Pressure Switch, Lights, Heat, Outlets)	1	Lump Sum	$2,000.00	/LS	$2,000
CONSTRUCTION SUB TOTAL						**$28,945**
DESIGN AND CONSTRUCTION ADMINISTRATION AT 20%						**$5,789**
CONTINGENCY AT 15%						**$4,342**
Engineer's Preliminary Estimate of Design, Permitting, and Construction Costs						**$39,076**

[1] 5 % of construction costs; assumes inflation equals interest and 20 year life of system.

Table 5. Cost Analysis for Brackish Water RO in Tecopa Hot Springs

Costs Associated with Administration and O&M of Reverse Osmosis at an Annual Flow of 355 Gallons Per Day

ITEM	DESCRIPTION	QUANTITY		UNIT COST		TOTAL
1	Electricity	1	Annually	$1,000.00	/YR	$1,000
2	Antiscalant	1	Annually	$200.00	/EA	$200
3	Chlorine	1	Annually	$200.00	/EA	$200
4	5 Micron Filter Cartridge	1	Annually	$600.00	/YR	$600
5	Activated Carbon Media	1	Annually	$600.00	/YR	$600
6	Operation, Maintenance and Repairs	1	Annually	$8,000.00	/YR	$8,000
7	Water Sampling (General)	1	Annually	$3,000.00	/YR	$3,000
8	Water Sampling (Bacteriological - Weekly)	52	Annually	$40.00	/YR	$2,080
9	Private Water Source License	1	Annually	$473.00	/YR	$473
10	Sewer Use Fees	1	Annually	$2,000.00	/YR	$2,000
SUB TOTAL						**$18,153**
ADMINISTRATION AT 10%						**$1,815**
CONTINGENCY AT 15%						**$2,723**
Engineer's Preliminary Estimate of Annual Administration and O&M Costs						**$22,691**

ITEM	DESCRIPTION	QUANTITY		UNIT COST		TOTAL
1	Capital Recovery	5%	Annually	$3,999.75	/YR	$4,000 [1]
Engineer's Preliminary Estimate of Annual O&M Costs with Capital Recovery						**$26,691**

Design, Permitting, and Construction

ITEM	DESCRIPTION	QUANTITY		UNIT COST		TOTAL
1	Mobilization, Demobilization, Bonds & Insurance	1	Lump Sum	$3,000.00	/LS	$3,000
2	Pure Aqua MF-400 Skid Mounted Reverse Osmosis Treatment System	1	Lump Sum	$12,500.00	/LS	$12,500
3	Piping, BFP, Valves, Metering Pumps, Cooler, and Appurtenances	1	Lump Sum	$15,000.00	/LS	$15,000
4	Arizona Water Vendors AWV-300SS Vending Machine	1	Lump Sum	$3,995.00	/LS	$3,995
5	CMU Treatment/Vending Building	1	Lump Sum	$10,000.00	/LS	$10,000
6	Inyo County Building Permit	1	Lump Sum	$2,000.00	/EA	$2,000
7	CDPH FDB Licensing	1	Lump Sum	$2,500.00	/LS	$2,500
10	Electrical Components (Pressure Switch, Vent, Heat, Lights, Outlets)	1	Lump Sum	$3,000.00	/LS	$3,000
11	Concentrate Drain to Sewer System	1	Lump Sum	$3,000.00	/LS	$3,000
12	Modification of LRWQCB Waste Discharge Requirements	1	Lump Sum	$25,000.00	/LS	$25,000
CONSTRUCTION SUB TOTAL						**$79,995**
DESIGN AND CONSTRUCTION ADMINISTRATION AT 20%						**$15,999**
CONTINGENCY AT 15%						**$11,999**
Engineer's Preliminary Estimate of Design, Permitting, and Construction Costs						**$107,993**

1 5 % of construction costs; assumes inflation equals interest and 20 year life of system.

As can be seen in both Tables 4 and 5, one of the most significant annual costs associated with either system is the water sampling cost. Since water sampling is required by the State of California, these samples must also be sent to a certified laboratory for processing. Because there are no labs in the immediate area these samples will have to be shipped by overnight delivery service.

Vended water is presently available in Pahrump, Nevada, at a cost of $0.20 per gallon. The proposed water treatment systems discussed in this feasibility study would need to provide water at a cost competitive with the water available in Pahrump. Assuming that the capital improvement costs associated with the installation of a water treatment system could be reasonably covered through grant funds, the cost per gallon of water required to cover the annual administration, operation and maintenance at an annual demand of 355 GPD would be $0.13 for the adsorption system and $0.18 for the brackish water RO system. If capital recovery costs are also considered, the cost per gallon increases to $0.14 and $0.21 for the adsorption and RO systems, respectively.

Since there is uncertainty that the estimated annual demand of 355 GPD would be realized, a better approach would be to determine how many gallons need to be sold at the same price as the water available in Pahrump needed to cover the annual O&M costs. This approach indicates that at $0.20 per gallon, approximately 82,000 gallons (223 GPD) would need to be vended for the adsorption system and 133,000 gallons (311 GPD) for the brackish water RO system. If the costs of capital recovery are also considered, the required volume to be vended becomes approximately 89,000 gallons (243 GPD) for the adsorption system and the RO system cannot be operated at a price per gallon of $0.20 or less. The water demands for the adsorption system in Tecopa Heights are less than the estimated annual water use for the Tecopa area, and therefore it is reasonable to assume that the O&M costs for this treatment system could be covered at a water vending rate that is competitive with the water available elsewhere. In order for the RO system in Tecopa Hot springs to be financially viable the rate charged would have to be approximately $0.21 per gallon and average annual use would have to be 355 gallons per day or more.

Prior to proceeding with a fill station it is critical that a responsible agency be found that is willing to operate the fill station. It has been suggested that the SIFPD might operate the fill station at Tecopa Heights and either Inyo County or the RV Park Concessionaire operate the fill station at Tecopa Hot Springs.

4.2 Fire Water Supply

4.2.1 Fire Water Demand

The major necessity of an accessible and adequate supply of water for firefighting in the Tecopa area has been affirmed by the Southern Inyo Fire Protection District (SIFPD). The lack of such a supply is presently a major hindrance to firefighting efforts. The Amagosa Conservancy has echoed this need, stating that "Recent fires have brought to light the difficulty of controlling fires in the area…" without a sufficient supply of firefighting water (Amargosa Conservancy, 2012). The firefighting equipment currently available to the Tecopa area is comprised of fire engines with little water storage capacity; a 2,000 gallon water tender that can deliver water to fire engines or a 2,000 gallon portable tank. In a larger fire the water tender will fill the portable tank then travel to the nearest water source to refill. A local private pond is available, though due to the pond's algal content and sediment which can clog the firefighting equipment thus impairing firefighting efforts, this is not a preferred fire water supply source. Water is also available at the CalTrans yard in Shoshone, which is approximately 10 miles away from downtown Tecopa. The time required to resupply from the CalTrans yard makes this location ineffective for firefighting supply water. Therefore, given these considerations, it is in the best interest of public safety for the residents and visitors of the Tecopa area to have an adequate fire water supply in Tecopa.

4.2.2 Fire Water Storage

Presently water must be hauled to the site of a fire using the existing water tender, which has a capacity of 2,000 gallons. Conversations with SIFPD have indicated that an auxiliary storage capacity of 10,000 to 15,000 gallons in the Tecopa area would greatly enhance the effectiveness of firefighting efforts. Additionally, a method of recirculating water through a large capacity reservoir in order to test fire-fighting equipment is desirable.

The environmental conditions in Tecopa range from quite warm (in excess of 100º F) to occasionally below freezing. Therefore, any storage tank will need to be equipped with flexible connections and all exposed pipes and valves should be insulated as well. Since this region of California is prone to seismic activity given the presence of several active faults, any water storage tank should be equipped with seismic restraints designed by a California registered Structural Engineer and fastened to an appropriately designed concrete pad. To help protect the tanks from vandalism a chain link fence to surround tank and pad is recommended. Ease of access and appropriate fire department fittings must be provided for firefighting personnel and an auxiliary port on the tank can easily accommodate testing of equipment.

4.2.2.1 Existing Storage Tank

SIFPD currently owns a used, welded steel tank with an estimated storage capacity of 10,000 gallons. The tank is not presently in use and is stored on site at the Fire District leased parcel in Tecopa Heights. The tank appears to be in reasonably good condition and of sufficient volume to adequately serve for fire water storage. An estimate of remaining tank life of 15 years is assumed for this feasibility study. However, a detailed investigation is required to better estimate the remaining useful life of this tank.

4.2.2.2 New Storage Tank

For the purposes of this study, polyethylene storage tanks were considered. Polyethylene is a popular material for water storage as it offers several advantages over metal and concrete tanks such as cost, weight, and corrosion resistance. There are several suppliers of polyethylene water storage tanks that can provide tanks in capacities of 10,000 gallons (or more). Typically lead times are anywhere from three (3) to five (5) weeks, though this varies from one supplier to the next. A polyethylene tank would need to be supplied in a dark color to retard the growth of algae within the tank, as well as provide for UV resistance. As the weather in Tecopa can often exceed 100º F, it is recommended that any potential tank supplier include ambient temperatures of this magnitude within the tank warranty. Since polyethylene tanks are not designed to be pressurized, the appropriate vents must be included to prevent the tanks from becoming pressurized during filling or the formation of a vacuum during Fire District use.

4.2.3 Location and Permitting

The same locations proposed for water treatment facilities have also been considered for fire water storage. SIFPD has recommended that access to fire water storage be provided in both locations as the majority of residences in the Tecopa area are located near one of these two parcels. Similar to the water treatment project described above, it is anticipated that the construction and implementation of fire water storage at either parcel would be considered Categorically Exempt under the CEQA.

4.2.3.1 Tecopa Heights – A Portion of APN 046-310-02

The two and one-half acre parcel presently leased by the Fire District in Tecopa Heights is served by a domestic well and has convenient access from both Furnace Creek Road and Bob White Way. A mobile structure owned by the Fire District is also located on this parcel. This parcel has a general use designation of open space according to the ICPD. While a change to the general plan designation would not be required to utilize this parcel for fire water storage, a special use permit would be required through ICPD, in addition to building permit and plan review through the same entity. ICPD does not anticipate any aesthetic requirements for the fire water storage supply. The conceptual plans for the Tecopa Heights fire water tank are included as Figure 9.

The existing lease from the BLM was granted in anticipation of the SIFPD developing the site with a 5,000 gallon water storage tank and the environmental assessment completed prior to the lease included this tank. It is expected that the change from a 5,000 gallon to a 10,000 gallon tank is insignificant and no NEPA actions would be required.

4.2.3.2 Tecopa Hot Springs – APN 046-220-22

This parcel is presently has a general use designation of public facilities, and there are existing structures including a community center already located on the parcel. The parcel is served by a spring with a spring box[2]. Access to the parcel is provided primarily by Tecopa Hot Springs Road. Since this parcel is already used for public facilities and is developed, ICPD does not anticipate that a special use permit will be required and subsequently the only permitting necessary will be a building permit and plan review.

[2] It is worth mentioning here that this particular spring (and its associated appurtenances) is considered by Inyo County Environmental Health to be a groundwater source not under the influence of surface water.

It is also anticipated that a fire water storage project located on this parcel would be considered as a Categorical Exclusion from NEPA in it is for the public health and safety. Therefore an Environmental Impact Study (EIS) should not be required. However the BLM must process the categorical exclusion and in processing this it is expected that they will find that infrequent water use for firefighting will not affect the Amargosa River that is designated as a Wild and Scenic River. The conceptual plans for the Tecopa Hot Springs site water tank are included as Figure 10.

4.2.4 Cost Analysis

The following cost analyses include providing one new polyethylene storage tank at one of the two potential locations. Assuming the existing welded steel tank is salvageable there will be a significant savings in material and freight over the purchase of a new tank. However, the useful life of the existing tank is assumed to be less than a new tank. Additionally, annual maintenance on the welded steel tank, which may include corrosion and leak repairs, will need to be considered. Table 6 below consists of a cost estimate for installing the existing welded steel tank at the Tecopa Heights location, while Table 7 includes a cost estimate for providing a new tank in the Tecopa Hot Springs location.

If found to be desirable and with available funding, a new tank could be provided at both the Tecopa Heights and Tecopa Hot Springs locations. A new tank at Tecopa heights would have the same cost as the new tank at Tecopa Hot Springs.

Table 6. Cost Analysis for Fire Water Storage Tank in Tecopa Heights

Costs Associated with Fire Water Storage Operation and Maintenance at Tecopa Heights

ITEM	DESCRIPTION	QUANTITY		UNIT COST		TOTAL
1	Capital Recovery	6.6%	Annually	$808.50	/YR	$809
2	Tank Filling Electricity Demand	1	Annually	$50.00	/YR	$50
3	Repairs and Maintenance	1	Annually	$600.00	/YR	$600
SUB TOTAL						**$1,459**
CONTINGENCY AT 15%						**$219**
Engineer's Preliminary Estimate of Annual O&M Costs with Capital Recovery						**$1,677**

Design, Permitting, and Construction

ITEM	DESCRIPTION	QUANTITY		UNIT COST		TOTAL
1	Mobilization and Demobilization	1	Lump Sum	$2,000.00	/LS	$2,000
2	Concrete Pad	1	Lump Sum	$2,000.00	/LS	$2,000
3	PE Structural Calcs	1	Lump Sum	$2,000.00	/LS	$2,000
4	Fencing	1	Lump Sum	$2,000.00	/LS	$2,000
5	Inspect, Clean, Modify, and Paint Existing Tank	1	Lump Sum	$2,000.00	/LS	$2,000
6	Fire Department Fittings, Valves, Vents, Appurtenances	1	Lump Sum	$3,000.00	/LS	$3,000
7	Restraint System	1	Lump Sum	$1,000.00	/LS	$1,000
8	Permitting	1	Lump Sum	$250.00	/LS	$250
CONSTRUCTION SUB TOTAL						**$14,250**
DESIGN AND CONSTRUCTION ADMINISTRATION AT 20%						**$2,850**
CONTINGENCY AT 15%						**$2,138**
Engineer's Preliminary Estimate of Design, Permitting, and Construction Costs						**$19,238**

1 6.6% of construction costs; assumes inflation equals interest and 15 year life of system.

Table 7. Cost Analysis for New Fire Water Storage Tank in Tecopa Hot Springs

Costs Associated with Fire Water Storage Operation and Maintenance at Tecopa Hot Springs

ITEM	DESCRIPTION	QUANTITY		UNIT COST		TOTAL
1	Capital Recovery	3.3%	Annually	$618.75	/LS	$619
2	Tank Filling Electricity Demand	1	Annually	$50.00	/YR	$50
3	Repairs and Maintenance	1	Annually	$300.00	/YR	$300
SUB TOTAL						**$969**
CONTINGENCY AT 15%						**$145**
Engineer's Preliminary Estimate of Annual O&M Costs with Capital Recovery						**$1,114**

Design, Permitting, and Construction

ITEM	DESCRIPTION	QUANTITY		UNIT COST		TOTAL
1	Mobilization and Demobilization	1	Lump Sum	$2,000.00	/LS	$2,000
2	Concrete Pad	1	Lump Sum	$2,000.00	/LS	$2,000
3	PE Structural Calcs	1	Lump Sum	$500.00	/LS	$500
4	Fencing	1	Lump Sum	$2,000.00	/LS	$2,000
5	10,000 Gallon Polyethylene Water Storage Tank W/ Freight	1	Lump Sum	$10,000.00	/LS	$10,000
6	Fire Department Fittings, Valves, Vents, Appurtenances	1	Lump Sum	$3,000.00	/LS	$3,000
7	Restraint System	1	Lump Sum	$1,000.00	/LS	$1,000
8	Permitting	1	Lump Sum	$250.00	/LS	$250
CONSTRUCTION SUB TOTAL						**$20,750**
DESIGN AND CONSTRUCTION ADMINISTRATION AT 20%						**$4,150**
CONTINGENCY AT 15%						**$3,113**
Engineer's Preliminary Estimate of Design, Permitting, and Construction Costs						**$28,013**

1 3.3% of construction costs; assumes inflation equals interest and 30 year life of system.

The operational cost of these tanks is limited to refilling with water as it is used for fighting fires. Repairs and maintenance of the polyethylene tanks will be minimal and limited to periodic inspection, exercising valves, and repair of any vandalism such as bullet holes. It is estimated that the annual repairs and maintenance are $300 per year. Repairs and maintenance of the welded steel tank will require occasional repainting and changing of the corrosion protection anode in addition to the inspection, exercising valves and repair of vandalism. For the welded steel tank this is estimated to be $600 per year.

A new polyethylene tank is estimated to have a 30 year life with a capital recovery (savings for replacement after 30 years) of $619. The welded steel tank is estimated to have a remaining useful life of 15 years with a capital recovery of $809 per year.

It is assumed that the Fire Department will be responsible for operation, repairs and maintenance of the fire storage tanks and will include these amounts in their budget. They may as appropriate also include capital recovery.

4.3 Conclusions

Fire water storage is considered to be the most urgent need of the residents of Tecopa as drinking water is currently available in Pahrump, even though this is not a convenient option given the travel time required. Therefore, it is recommended to provide fire water storage immediately. If funds are not available for two fire water storage tanks one tank would provide significant benefit over the current conditions.

If only one fire water storage facility can be funded the input of the Fire District is critical to determine the preferred location because they will be using the tank and best know the advantages and disadvantages of each location as it relates to their needs. Further, investigation of the existing welded steel storage tank is warranted before proceeding with its use. If the tank is found to be in reasonably good condition then it should be used for fire water storage to reduce the cost of equipment, otherwise, a new polyethylene storage tank is recommended.

The supply of a source of safe drinking water in the area is also a high priority. Fill stations at both proposed locations would be beneficial to the area. However, if both fill stations are constructed it is expected that the use of each fill station would be approximately one half of the use if only one were to be constructed and the revenues would not be sufficient to cover the operation and maintenance costs. For economic reasons the fill station at in Tecopa Heights is recommended. The water quality in Tecopa Heights is generally better than that found in the Tecopa Hot Springs area and subsequently safe drinking water may be achieved more efficiently and economically at this location utilizing adsorptive technologies. Signage at the Community center in Tecopa Hot Springs could direct people to the fill station in Tecopa Heights.

Prior to proceeding with a fill station it is critical that a responsible entity be found that is willing to operate the fill station. This feasibility study should be presented to possible operators to help them make an informed decision.

5.0 REFERENCES

Armagosa Conservancy. Request for Proposals: Safe Drinking Water and Fire Water Supply Feasibility Study for Tecopa, California. Shoshone, CA : s.n., 2012.

Bedinger, M.S., and J.R. Harrill, 2004. *Regional Potential for Interbasin Flow of Ground Water.* Appendix 1 of (Belcher, 2004).

Belcher, Wayne, ed., 2004. *Death Valley Regional Ground-Water Flow System, Nevada and California – Hydrogeologic Framework and Transient Ground-Water Flow Model.* U.S. Geological Survey Scientific Investigations Report 2004-5205.

Brogan, George E., Karl S. Kellog, D. Burton Slemmons, and Christina L. Terhune, 1991. *Late Quaternary Faulting Along the Death Valley – Furnace Creek Fault System, California and Nevada.* U.S. Geological Survey Bulletin 1991.

Maxey, G.B. and T.E. Eakin, 1949. Ground Water in White River Valley, White Pine, Nye, and Lincoln Counties, Nevada. Nevada Department of Conservation and Natural Resources Water REsources Bulletin No 8, 59 pp.

United States Environmental Protection Agency. Arsenic Treatment Technology Evaluation Handbook for Small Systems. 2003.

United States Environmental Protection Agency (US EPA). water.epa.gov. [Online] May 21, 2012. [Cited: July 31, 2013.] http://water.epa.gov/.

FIGURES

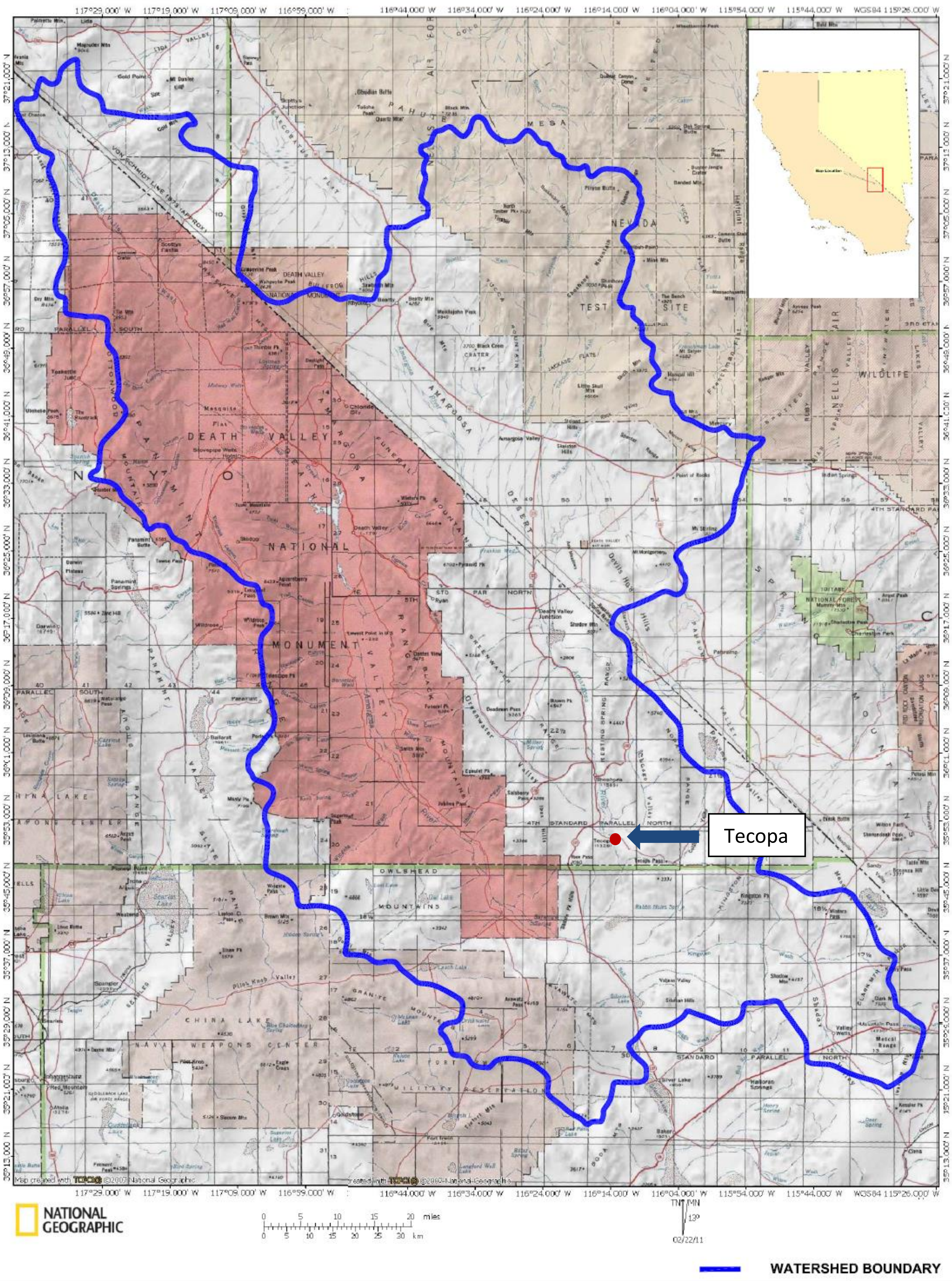


Figure 1. Location of Tecopa, California, Inyo County

JOHNSON WRIGHT, INC.
Environmental Engineering and Regulatory Expertise

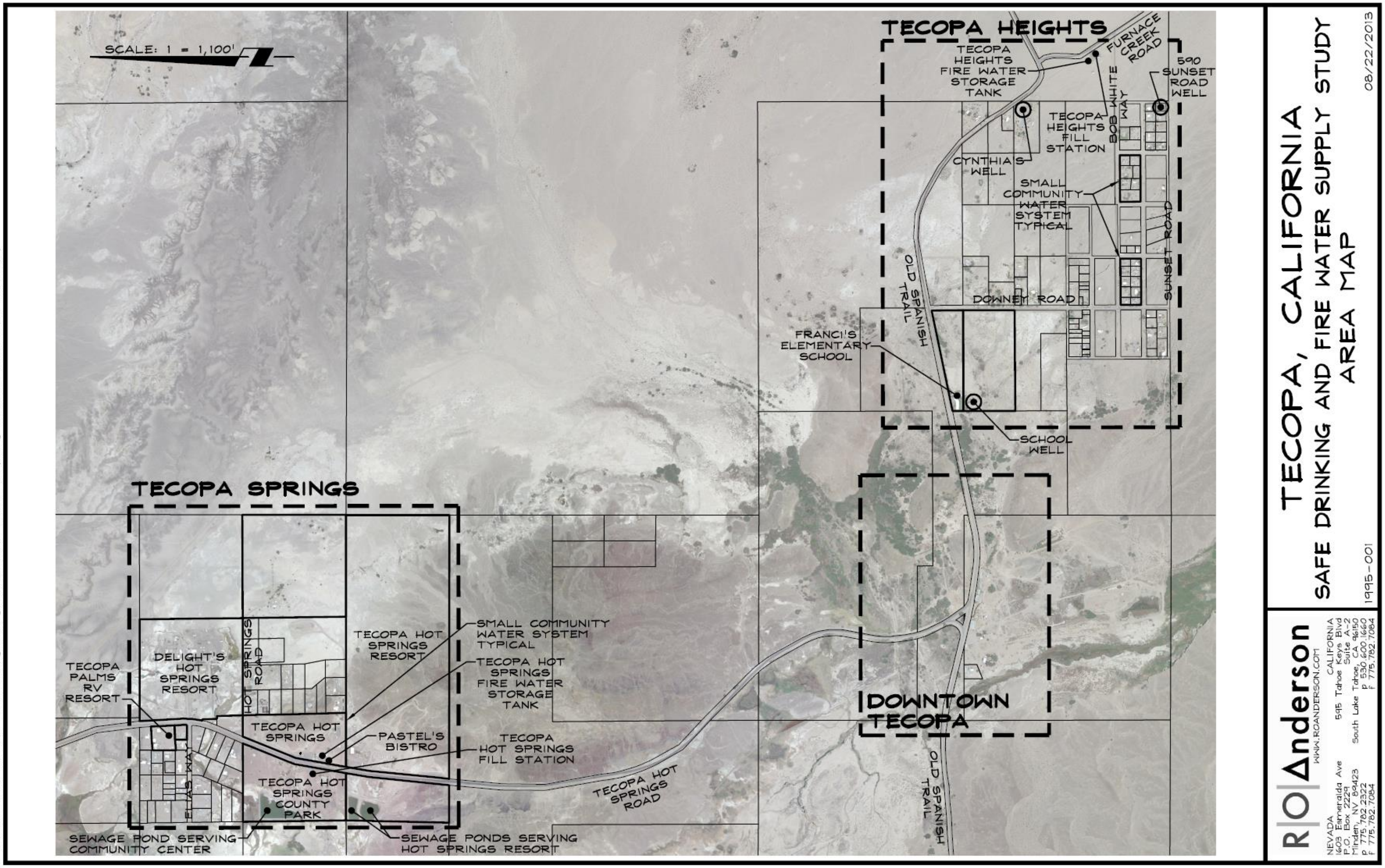


Figure 2. Safe Drinking and Fire Water Supply Study Area Map, Tecopa, California

JOHNSON WRIGHT, INC.
Environmental Engineering and Regulatory Expertise

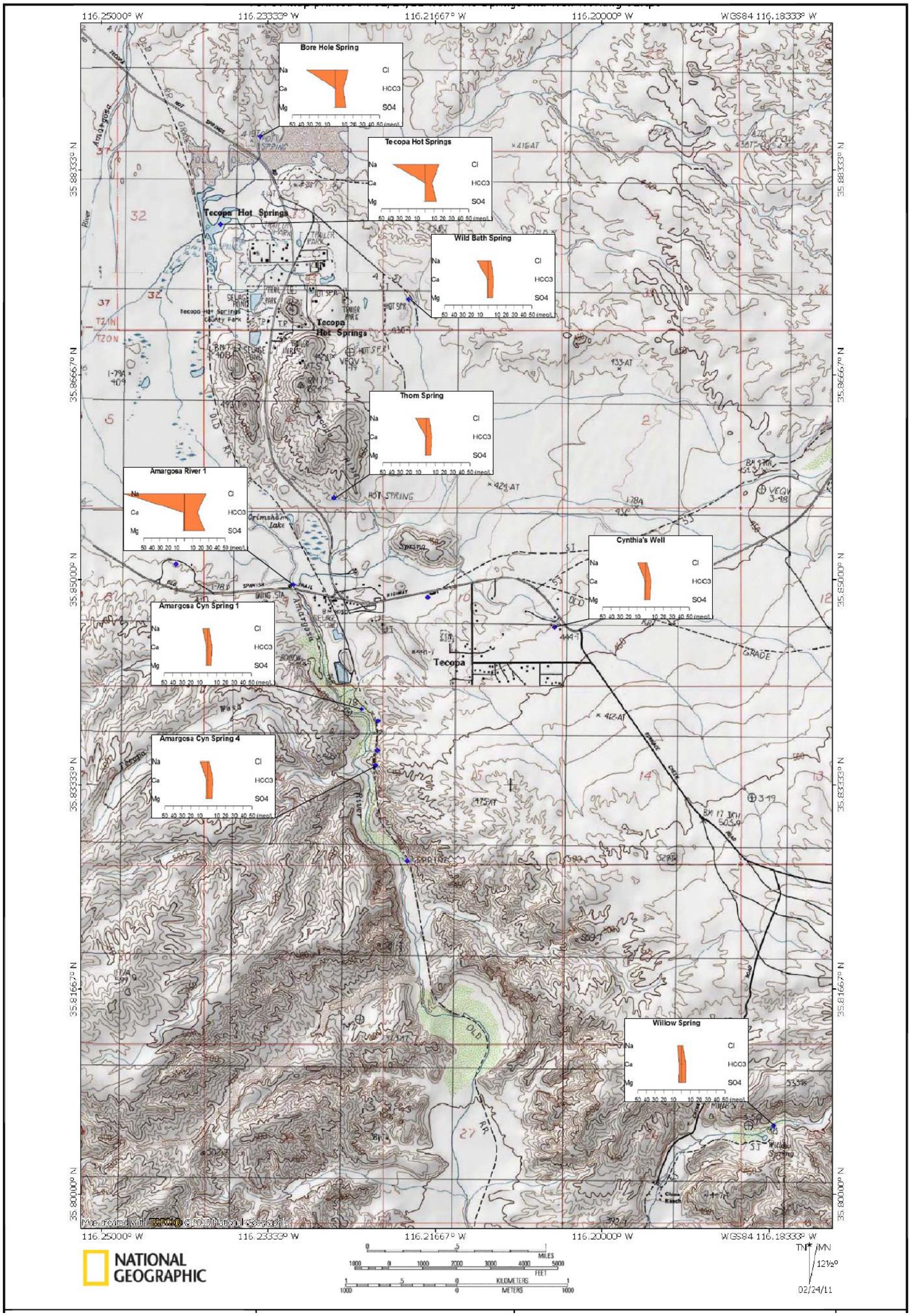


Figure 3. Tecopa Area Data Collection Locations

JOHNSON WRIGHT, INC.
Environmental Engineering and Regulatory Expertise

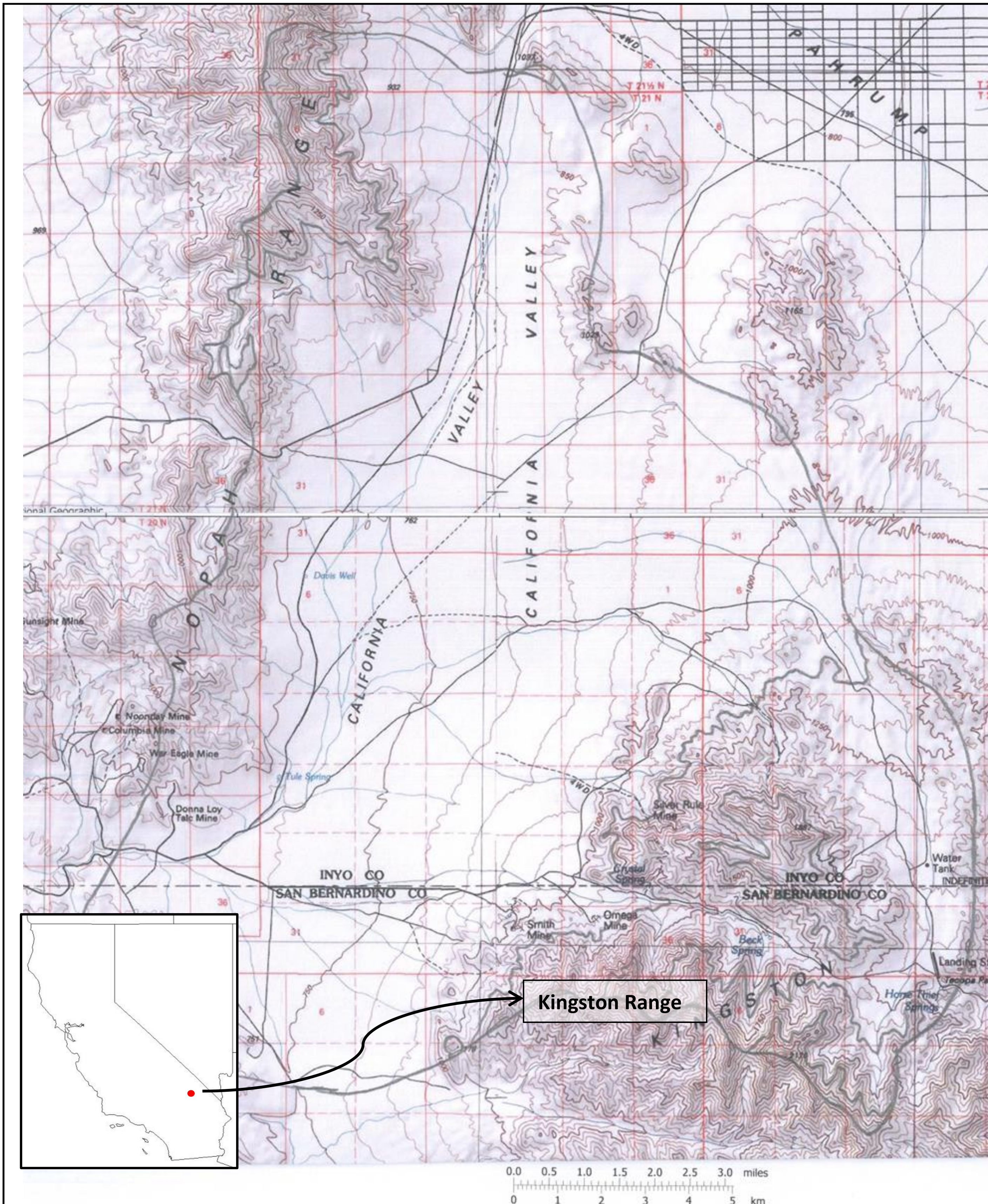


Figure 4. Location of the Kingston Range

JOHNSON WRIGHT, INC.
Environmental Engineering and Regulatory Expertise

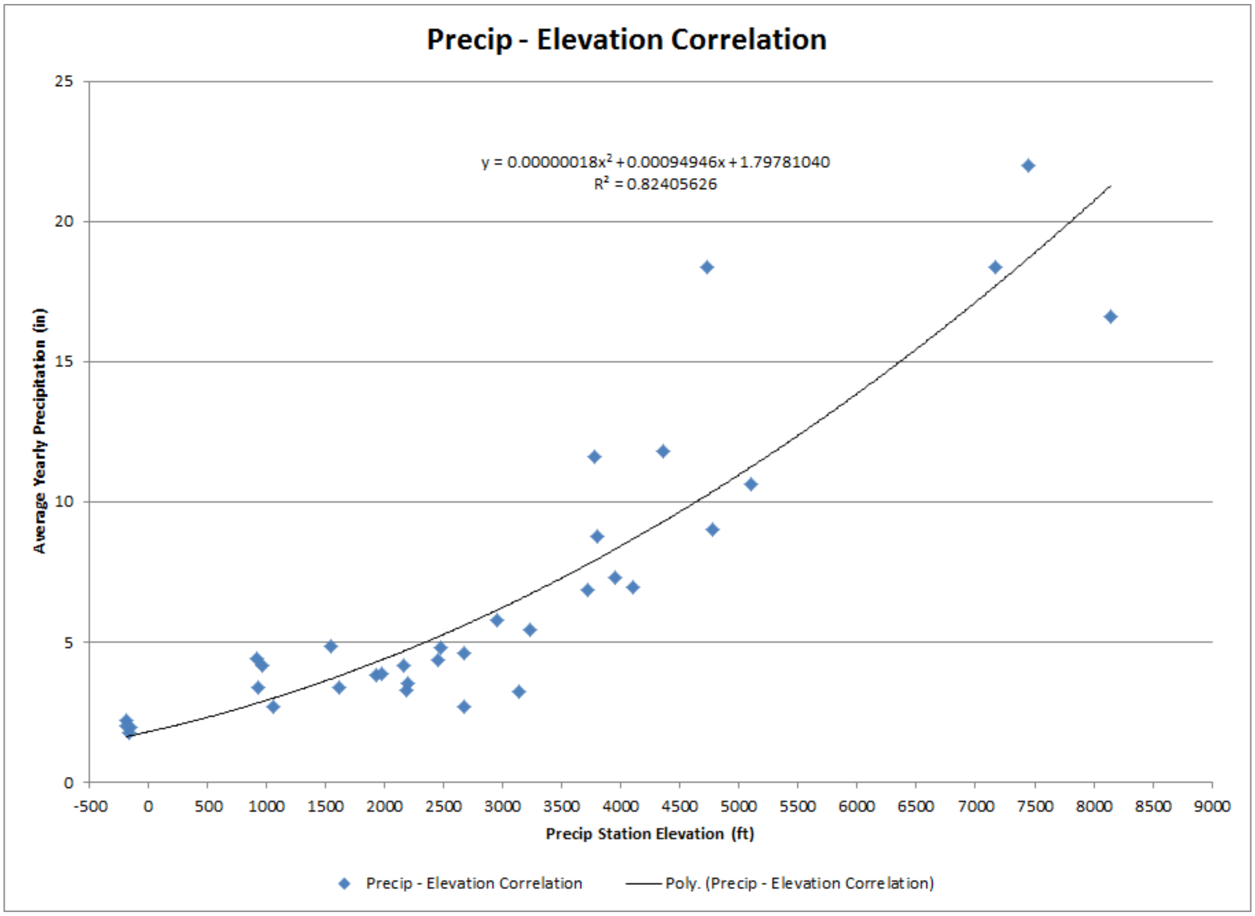


Figure 5. Precipitation-Elevation Correlation used in the Maxey-Eakin Analysis

JOHNSON WRIGHT, INC.
Environmental Engineering and Regulatory Expertise

DUPLICATE
Driller's Copy

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

Page ___ of ___
Owner's Well No. ___
No. 728957
Date Work Began 12/28/09, Ended 12/30/09
Local Permit Agency Inyo
Permit No. 509-100 W Permit Date 12/18/09

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

GEOLOGIC LOG

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

DEPTH FROM SURFACE Ft. to Ft.		DESCRIPTION Describe material, grain size, color, etc.
0	30	Sand
30	140	Sandy Clay
140	200	Fractured Rock

TOTAL DEPTH OF BORING 200 (Feet)
TOTAL DEPTH OF COMPLETED WELL 200 (Feet)

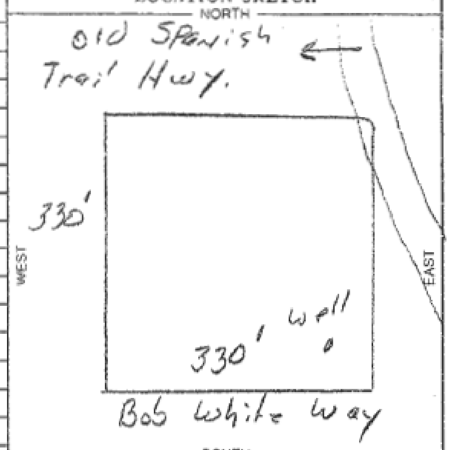
WELL OWNER

Name Southern Inyo Fire Station
Mailing Address P.O. Box 51
Tecopa CITY CA STATE 92389 ZIP

WELL LOCATION

Address Southern Inyo Fire Station
City Tecopa
County Inyo
APN Book 46 Page 31 Parcel 002
Township 20 N Range 7E Section 2,3 & 11
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
___ 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 42 (Ft.) & DATE MEASURED 12-30-09
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)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	140	10.75	✓				PVC	6	.280	N/A
140	200	10.75		✓			PVC	6	.280	1/8 x 3

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.		CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	50	✓			
50	200				3/8 Gravel

ATTACHMENTS (✓)

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

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS

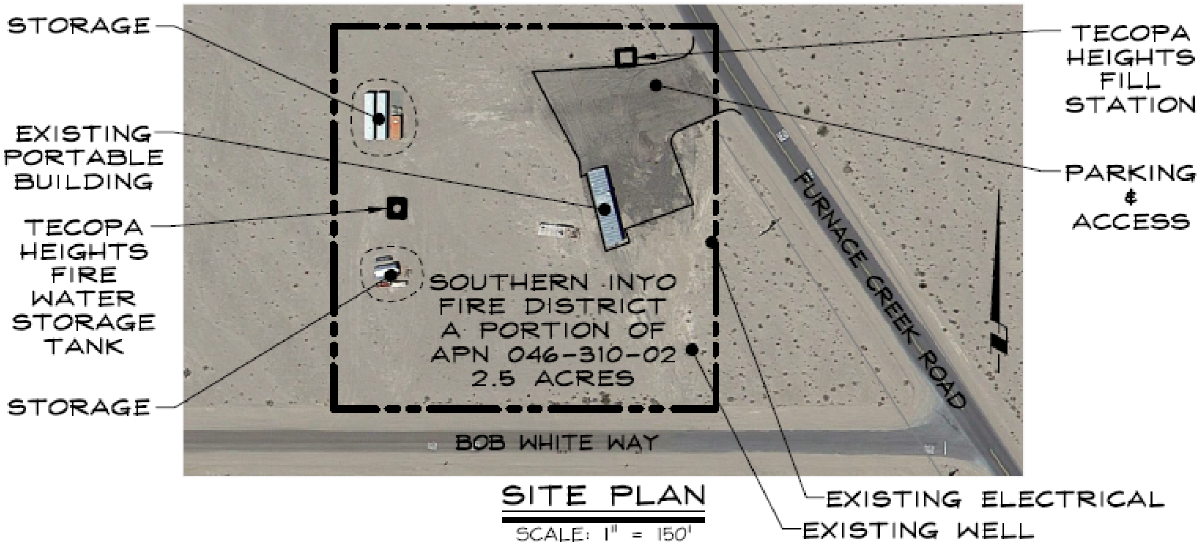
CERTIFICATION STATEMENT

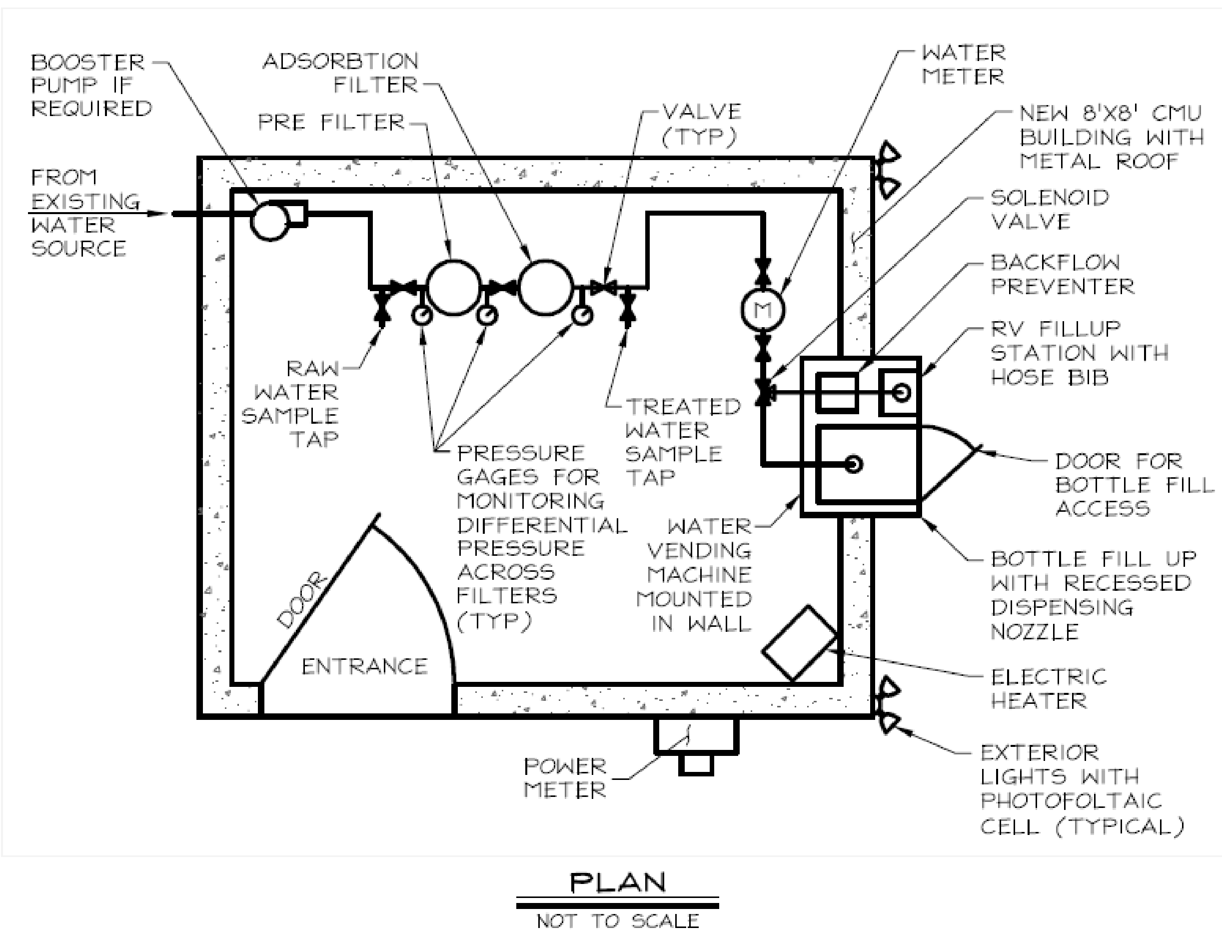
I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Great Basin Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
1220 E. Manse Rd Pahrump NV 89048
ADDRESS CITY STATE ZIP
Signed [signature] 1-20-10 643943
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

Figure 6. Southern Inyo Fire District Well Log, Tecopa, California

JOHNSON WRIGHT, INC.
Environmental Engineering and Regulatory Expertise





R|O|Anderson
WWW.ROANDERSON.COM

NEVADA
1603 Esmeralda Ave
P.O. Box 2229
Minden, NV 89423
p 775.782.2322
f 775.782.7084

CALIFORNIA
595 Tahoe Keys Blvd
Suite A-2
South Lake Tahoe, CA 96150
p 530.600.1660
f 775.782.7084

TECOPA HEIGHTS
CONCEPTUAL FILL STATION
TECOPA, CALIFORNIA

1995-001 08/22/2013

Y:\Client Files\1995\1995-001\CAD\Engineering\Exhibits\1995-001_Heights.dwg 8/22/2013 4:57:29 PM Eric T. Herron

Figure 7. Tecopa Heights Conceptual Fill Station, Tecopa, California

JOHNSON WRIGHT, INC.
Environmental Engineering and Regulatory Expertise

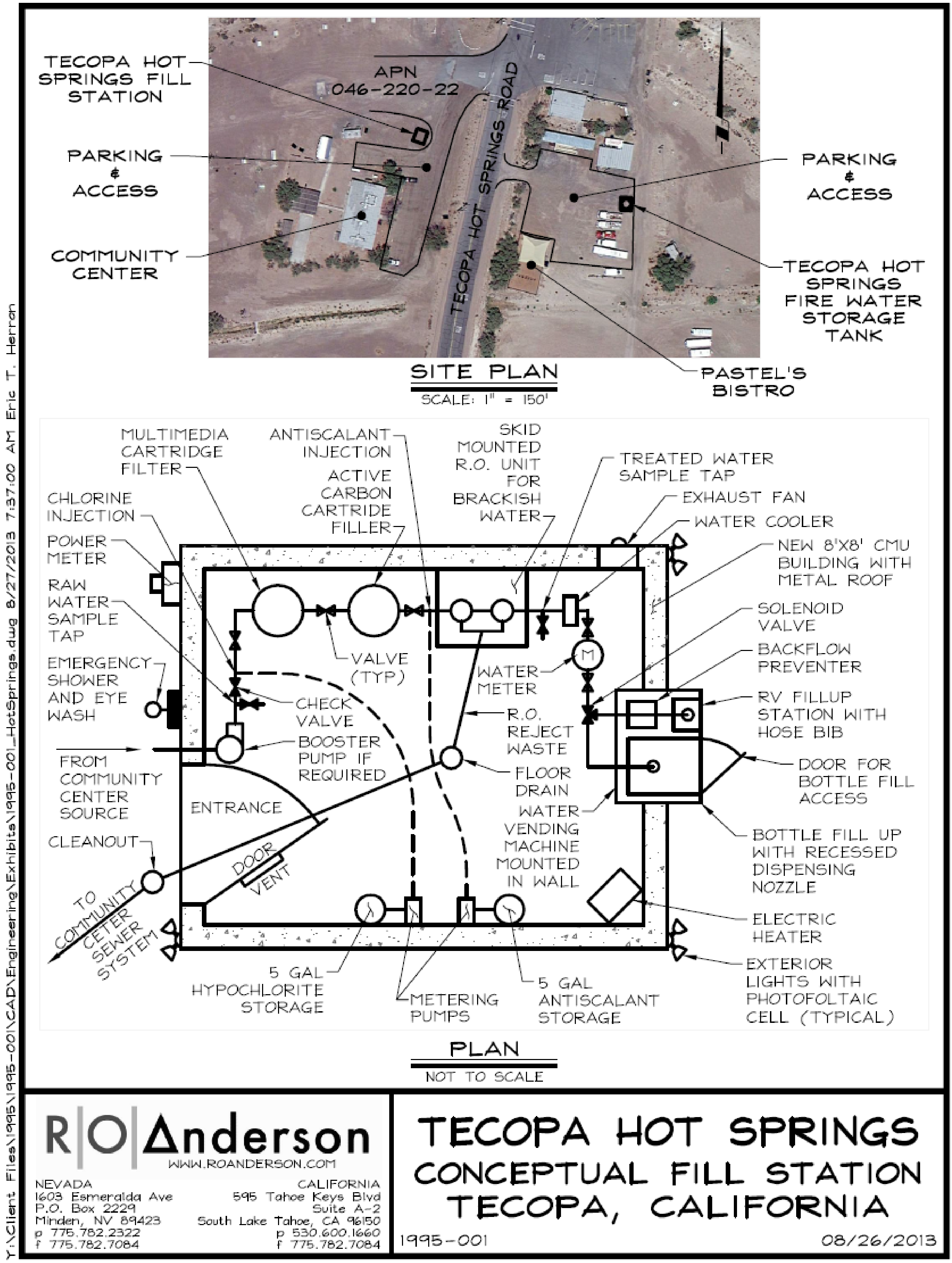
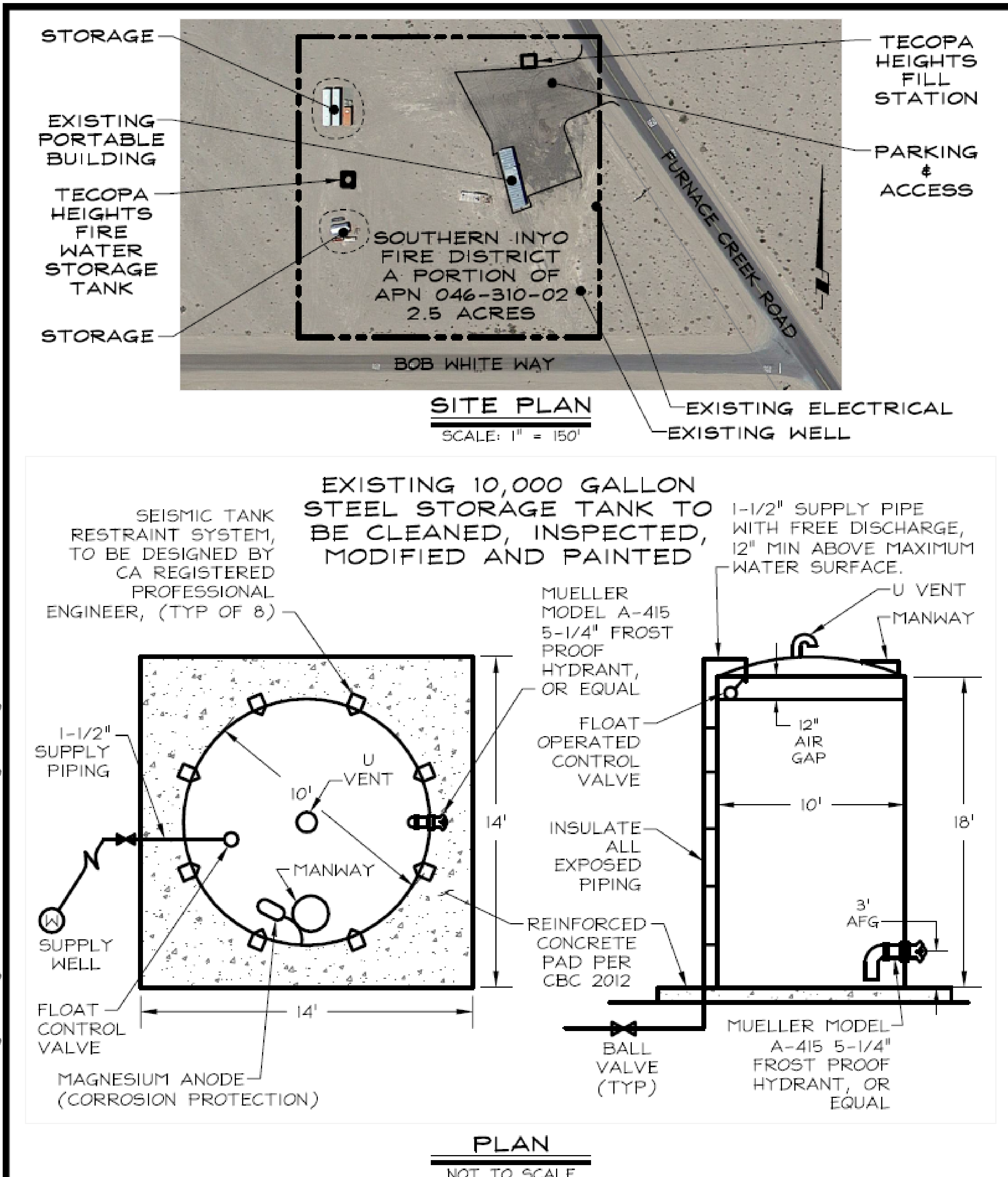


Figure 8. Tecopa Hot Springs Conceptual Fill Station, Tecopa, California

JOHNSON WRIGHT, INC.
Environmental Engineering and Regulatory Expertise

Y:\Client Files\1995\1995-001\CAD\Engineering\Exhibits\1995-001_Heights.dwg 8/22/2013 4:57:04 PM Eric T. Herron



R|O|Anderson
WWW.ROANDERSON.COM

NEVADA
1603 Esmeralda Ave
P.O. Box 2229
Minden, NV 89423
p 775.782.2322
f 775.782.7084

CALIFORNIA
595 Tahoe Keys Blvd
Suite A-2
South Lake Tahoe, CA 96150
p 530.600.1660
f 775.782.7084

TECOPA HEIGHTS
CONCEPTUAL FIRE WATER TANK
TECOPA, CALIFORNIA

1995-001 08/22/2013

Figure 9. Tecopa Heights Conceptual Fire Water Tank, Tecopa, California

JOHNSON WRIGHT, INC.
Environmental Engineering and Regulatory Expertise

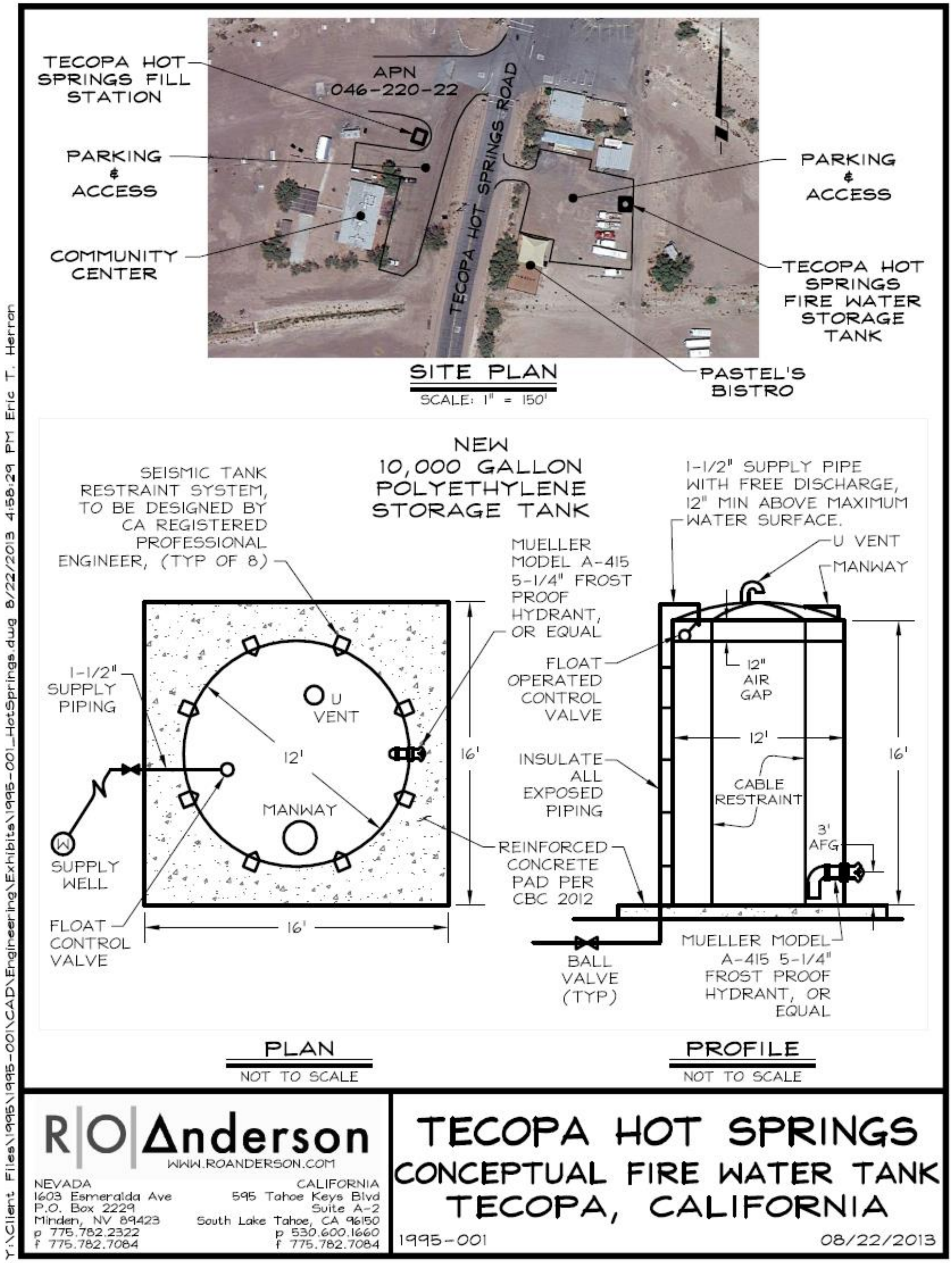


Figure 10. Tecopa Hot Springs Conceptual Fire Water Tank, Tecopa, California

JOHNSON WRIGHT, INC.
Environmental Engineering and Regulatory Expertise