ARCHITECTURAL & ENGINEERING CONTRACTS
TASK ORDER

TASK ORDER NO.: WRIME–2014–002

Contractor: WRIME, Inc.

Request for Services under Standard Agreement No. 4600008949

Dated: April 7, 2014

DESCRIPTION OF TASK:

Contractor (WRIME, Inc.) will prepare for the Department of Water Resources (DWR) a replacement water storage tank design for the Lost Hills Utility District (LHUD).

SCOPE OF WORK:

Task 1 – Develop Preliminary Engineering Design Report

Contractor will develop a preliminary engineering design report for the new water storage tank. This task is covered under Contract Exhibit A, A.1(a), A.1(g), A.3, and A.6. Contractor will do the following:

A. ***Calculate Tank Sizing*** - Contractor will calculate the storage volume to meet present and 2030 projected needs. Tank sizing will consider fire protection and domestic consumption, irrigation, and operational and emergency storage. The criteria used will be clearly stated in the preliminary design report and will include criteria from industry standards such as the American Water Works Association (AWWA).

B. ***Perform Geotechnical Investigation*** – Contractor will provide a geotechnical investigation for the selected replacement tank site. The geotechnical investigation will include drilling two exploratory borings, analyzing soil samples, and preparing a geotechnical report that will provide:

   1) Vicinity Map
   2) Site Plan with boring locations
   3) Subsurface Conditions, Soil Boring Logs, Depth to Groundwater (if encountered)
   4) Summary of Laboratory Tests
   5) Geologic and Seismic Literature Review
   6) Seismic Design Criteria (based on mapped 2013 CBC parameters only)

7) Recommendations for site preparation, earthwork, and foundation subgrade
8) Recommended embedment and allowable bearing pressure for shallow foundations
9) Total and Differential Settlement for recommended foundations
10) Allowable lateral bearing pressure and skin friction
11) Requirements for imported fill materials
12) Cut and fill recommendations
13) Lateral earth pressures and frictional coefficient
14) Corrosion and expansion characteristics of on-site soils
15) Excavation stability
16) Discussion of liquefaction potential and seismic settlement
17) Recommendations for site drainage

The geotechnical report will evaluate existing subsurface conditions and provide parameters necessary for final design.

C. ***Survey*** - Contractor will provide a survey to establish the horizontal and vertical control of the project to be used for project facility design and construction. The survey will be based on the currently used and agreed upon datum.

D. ***Determine Tank Location*** - Contractor will determine the proposed water tank location based on recommendations made in the LHUD Water System Master Plan (dated October 2013), survey results, and geotechnical data collected.

E. ***Determine Environmental Restrictions*** - Contractor will determine the known occurrences of sensitive species based on a query of the California Natural Diversity Database in the vicinity of the proposed water tank location.

F. ***Identify Tank Type*** - Contractor will evaluate different types of water storage tanks (elevated, at-grade, and buried) and their suitability to deliver the required pressures and flows and recommend the preferred tank type.

G. ***Identify Tank Materials*** - Contractor will evaluate the following materials commonly used for tank construction: welded steel, bolted steel, and prestressed concrete. Contractor will also evaluate the constructability, maintenance, estimated life cycle costs, site factors, security, water quality, and construction schedules of each alternative for the replacement tank. Contractor will recommend the preferred tank material.

H. ***Determine Site Infrastructure*** - Contractor will determine appropriate drainage, security, lighting, instrumentation, and connections to existing water distribution system.

I. ***Identify Permit Requirements*** – After LHUD's acceptance of results of subtasks F and G is obtained, Contractor will identify the permits required for construction of the proposed storage tank type and materials.

J. ***Develop Construction Cost Estimate*** – Contractor will prepare a construction cost estimate based on the tank location, geotechnical information, tank material, and tank appurtenances. The cost estimate will be a Class 3 estimate (within a +25% to -15% level of accuracy) as defined by AACE International.

K. ***Provide a List of Drawings and Specifications*** – Contractor will provide a list of the drawings and specifications needed for final design.

L. ***Prepare Preliminary Design Report*** – Contractor will consolidate information developed in subtasks A through K into a single preliminary design report.

Task 2 – Develop Final Design

Contractor will develop final design documents for the new water storage tank on the basis of the preliminary design report. This task is covered under Contract Exhibit A, A.1(a), A.1(g), A.2(c), and A.6. Contractor will do the following:

A. ***Update Hydraulic Analysis*** - Contractor will update the water system analysis conducted using a WaterCAD hydraulic model, as described in the Water System master Plan (dated October 2013), and validate water system distribution operations.

B. ***Verify Utility Impacts*** - Contractor shall contact all utility companies to obtain current information on the type and location of their facilities potentially affected by construction of the new tank. The location (vertical and horizontal location), type, and size of the utility will be summarized. This information will be incorporated into the design drawings.

C. ***Complete Structural Design*** – Contractor will provide structural design for all components not supplied by the tank manufacturer.

D. ***Prepare Plans and Specifications*** – Contractor will layout and design the project elements in the form of drawings and technical specifications at the 100 percent level. Drawings will show construction limits, survey control points, borrow and staging areas, environmental protection requirements, construction access roads/limits of work area, site restoration requirements, site excavation and grading requirements, structural work, civil work, mechanical work, and electrical work. The resulting drawings will be incorporated into the bidding documents. DWR and LHUD will review the design at 60 percent, 90 percent, and 100 percent screen-check versions to ensure project meets desired requirements.

E. ***Update Construction Cost Estimates*** - Contractor will update the preliminary engineer's cost estimate for construction of the project elements. The cost estimate will be a Class 3 estimate (within a +25% to -15% level of accuracy) as defined by AACE International.

This Task includes the following assumptions:

1. The design of the SCADA (supervisory control and data acquisition), instrumentation, and electrical components will be completed as part of the construction phase.
2. Division 0 and division 1 specifications (also known as “front end bid documents”) will not be developed as part of this Task Order.

Task 3 – Project Management and Coordination

Contractor will assist the DWR Task Order Manager with general project management and coordination activities, including cost, budget, and schedule tracking. Contractor will coordinate with LHUD to ensure timely review of deliverables. Contractor will also attend meetings and conference calls with DWR and LHUD. During project initiation, Contractor will hold a meeting (via conference call) with LHUD to ensure project deliverables will meet the needs of LHUD.

This subtask is covered under contract Exhibit A, Activity A.7.

DELIVERABLES:

All deliverables will be provided to LHUD with a copy to DWR. The following deliverables will be submitted under this Task Order:

1. Electronic copy of the Preliminary Engineering Design Report in Microsoft Word format and Adobe PDF format (July 15, 2014)
2. Electronic copy of the 60 percent design plans and specifications (September 1, 2014)
3. Electronic copy of the 90 percent design plans and specifications (November 14, 2014)
4. Electronic copy of the 100 percent design plans and specifications (December 12, 2014)
5. Four (4) complete paper sets (11”x17”), and an electronic copy, of project plans and specifications at the final level (100 percent level) (December 31, 2014)

SCHEDULE*:

This task order shall begin upon full execution of this task order and will expire on February 28, 2015.

Preliminary Engineering Report for Storage Tank

DRAFT

Lost Hills Utility District

Cannon

May 2014

REGISTERED PROFESSIONAL ENGINEER
AMANDO G. GARZA
NO. 54148
Exp. 12/31/15
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STATE OF CALIFORNIA

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Acronyms

AsWTP	Arsenic Removal Water Treatment Plant
BMWD	Berrenda Mesa Water District
CDP	Census Designated Place
District	Lost Hills Utility District
gpm	gallons per minute
I-5	Interstate 5
LF	linear feet
LHUD	Lost Hills Utility District
psi	pounds per square inch
PVC	polyvinyl chloride
Town	Town of Lost Hills
VFD	variable frequency drive

1.0 Introduction

1.1 Purpose

The Lost Hills Utility District (District) has prepared a Preliminary Engineering Report (PER) for the United States Department of Agriculture's (USDA) Emergency Community Water Assistance Grant (ECWAG) to assist the District's construction of a water storage tank replacement to address the severe condition of the existing storage tank. In addition, the tank provides storage (additional supply) on top of the ability for the water system wells. Due to the falling ground water table, the District has lost some supply from the existing wells. Replacing the existing tank will restore the District' ability to provide an adequate and reliable water supply.

1.2 Overview

Lost Hills is located 42 miles west-northwest of Bakersfield. The town is at the intersection of State Route 46 (SR 46) and Lost Hills Road. The Lost Hills Oil Field, which is the sixth largest by remaining reserves in California, lies west and northwest of town, extending about 10 miles along the range of the low Lost Hills Range, after which the town was named. Interstate 5 (I-5) is located near, but not adjacent, to Lost Hills. A rest stop by I-5 including restaurants, gasoline stations, and motels is located about 1 mile east from the town. A vicinity map is shown in Figure 1: Vicinity Map.

Lost Hills Utility District (District) provides water and sewer to the residents of the Town of Lost Hills, CA, (Town). The District provides water service to the I-5 Travel Center (east of the Town, along Hwy 46 on the west side of I-5) and residential, commercial, and industrial customers that were formerly part of the Berrenda Mesa Water District (BMWD). The District took over the BMWD domestic water system in early 2013, and it is now part of the District's water system.

The District was formed in 1980 to provide sewer services to the Town of Lost Hills. In 1989, the District took over a water system built in the 1950s by an oil company that was active in the Lost Hills area. The primary system included two wells, one storage reservoir, one fire water tank with a booster station, and transmission and distribution pipelines. Water underlying the Town is not potable so the wells are located approximately 12 miles east of the Town and within the Semitropic Water District.

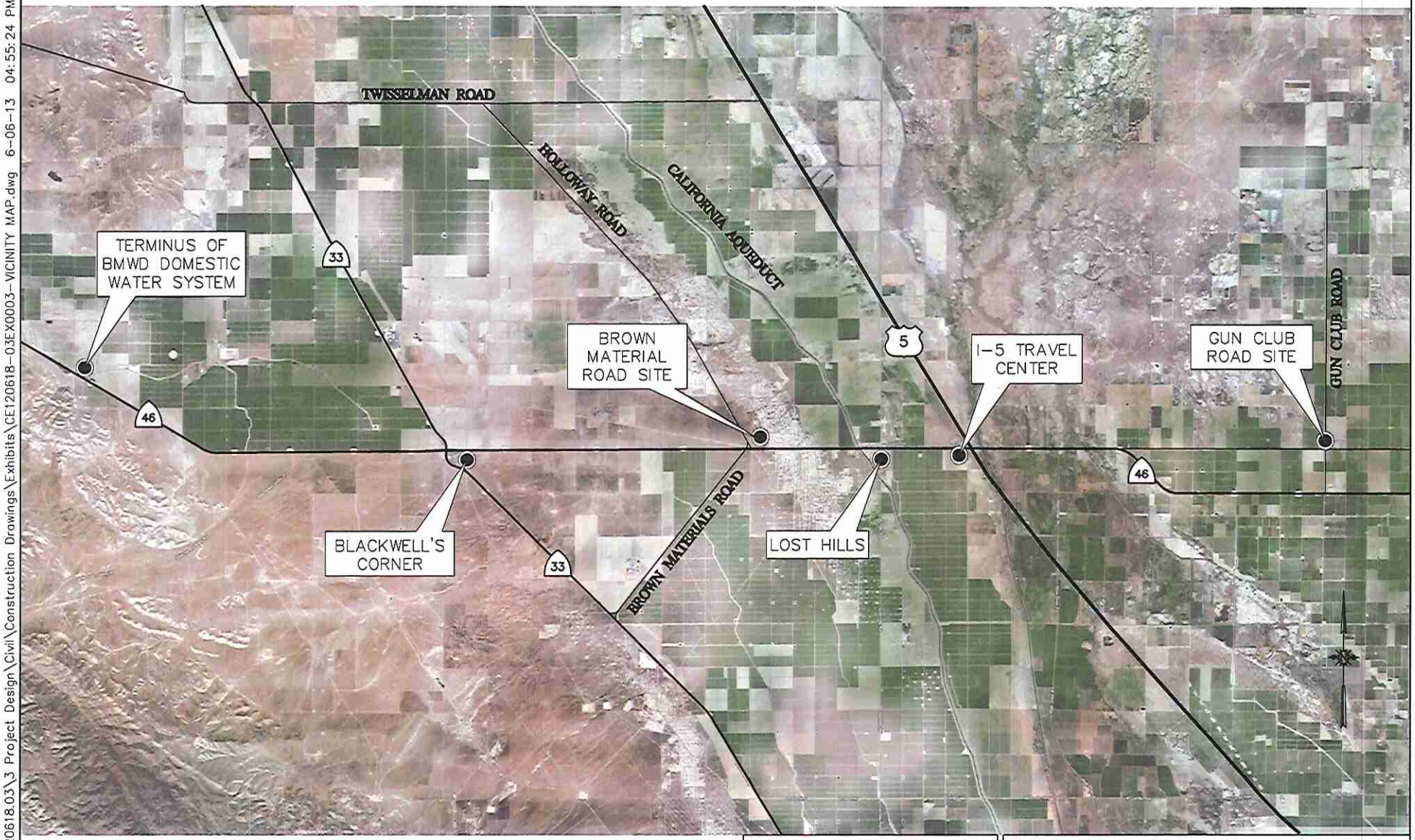
The water transmission main was in a state of disrepair at the time, and the District has made several upgrades since then, including upsize and replacement of the transmission main, upsize and replacement of some distribution pipelines, rehabilitation of both wells, and addition of an arsenic treatment system. The BMWD domestic water system includes a booster pump station near the District's storage reservoir, 18 miles of pipeline, and three distribution tanks, each with booster pump stations.

1.3 Project Location

As shown in Figure 3: Tank Site, the proposed New Tank project site is located approximately 300 feet north of the existing East Well. The project site is located in the south half of the southwest quarter of Section 33 Township 26 south, Range 23 east, Mount Diablo Base Meridian. It is on the east side of the and adjacent to Gun Club Road, north of State Highway 46 and approximately 12 miles east of the community of Lost Hills in Kern County, California. The site is located on the western side of an 80-acre property owned by the District.

1.4 Environmental Resources Present

The District has not prepared a California Environmental Quality Act (CEQA) document for the proposed project yet. However, the District consulted with an ICF International. They determined that because the new tanks are only replacing existing infrastructure and not increasing capacity, the appropriate level of CEQA is to prepare and file an Notice of Exemption (NOE). The existing tank site is adjacent to the Lost Hills Oil fields. The area is highly traveled with oil field construction workers. Completion of the NOE can



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VICINITY MAP
FIGURE 1
LOST HILLS, CALIFORNIA

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be commissioned by the LHUD Board and could be completed within 2 months. This NOE would be completed in Fall/Winter 2014 concurrent with the tank design.

2.0 Existing Facilities

2.1 Existing System Components

The District's existing water system consists of four primary components:

- Gun Club Road Site (Wells and Treatment)
- Town and I-5 Travel Center Distribution System
- Brown Material Road Site (Distribution Reservoir and BMWD Booster Pumps)
- BMWD Domestic Water Distribution System

A schematic of the system is shown on Figure 2: Water System Schematic.

2.1.1 Gun Club Road Site / Alternate Storage Tank Location

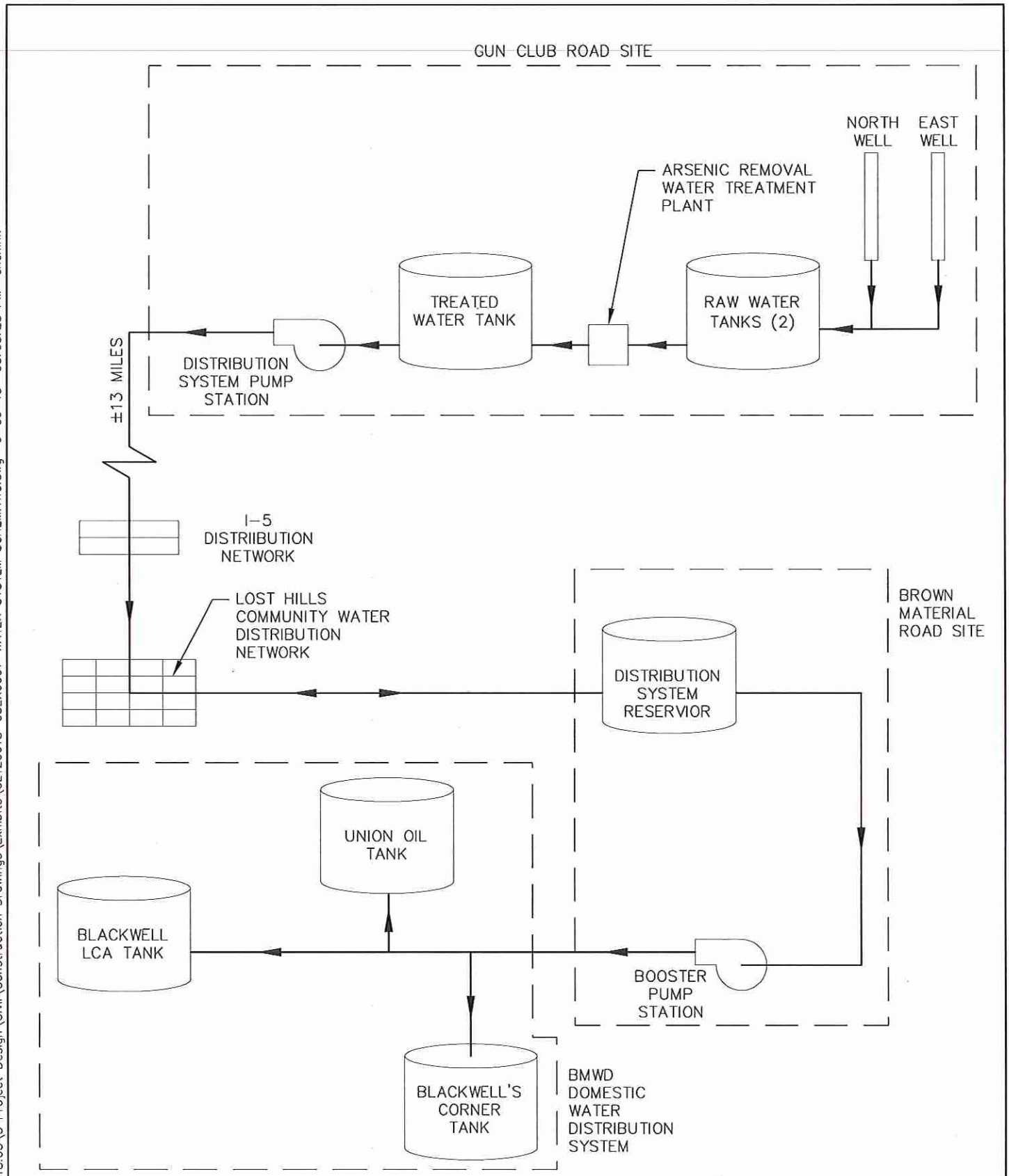
The Gun Club Road Site provides the water supply for the District and is located approximately 12 miles east of the Town. The facilities include two wells, raw water tanks, Arsenic Removal Water Treatment Plant (AsWTP), treated water tank, and distribution system pumps.

Two wells – North Well and East Well – pump groundwater from what is locally known as the lower or confined layer, which is a substantial clay layer at approximately 300 feet. Poor water quality exists above layer, and the water quality beneath the layer is adequate but deteriorates with depth. The wells are sited approximately 10 miles east of the Town due to groundwater with high total dissolved solids concentrations in the west side of San Joaquin Valley. High levels of arsenic occur locally and appear to be associated with lakebed areas that exist along the west side of the Valley. Concentrations vary from just below 10 ppb to 50 ppb and instigated the need for construction of the AsWTP in 2008.

The East Well was constructed in 1954 at a depth of 615 feet, and the North Well was drilled in 1988 to a depth of 623 feet and screened from 450 feet to 600 feet. Static water depth ranges between 200 and 300 below ground surface. Both well pumps are 75 hp and have a rated flow of 500 gpm at total design head of 384 feet. Generally, the East Well produces groundwater with lower arsenic concentrations than the groundwater produced by the North Well. Both wells were rehabilitated in 2008, including a new pump and replacement of worn columns, tubes, and shafts. The well was also pressure wash and motor rehabilitated.

Table 1: Groundwater Supply

	North Well	East Well
Pumping/Flow Rate (gpm)	520	560
Pump Motor Size (HP)	75	75
Current Water Table (ft bgs)	327[a]	317[b]
Pump Depth (ft bgs)	420	420
Well Depth (ft bgs)	625	615
Screened Interval Depth (ft bgs)	450 - 600	450 - 600
Well Yield (gpm)	450[a]	450[a]
Well Casing Material	steel	steel
Well Casing Diameter (in)	14	14
Age (years)	26	62
Regulatory Contaminants	Arsenic	Arsenic



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WATER SYSTEM SCHEMATIC
FIGURE 2
LOST HILLS, CALIFORNIA

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TBD To be determined during design / well development

Notes:

a. Measurement taken in December 2013.
b. Measurement taken in April 2014.
c. Existing well yields have fallen in recent years as the groundwater table has dropped.
d. Arsenic may be present at the new well location but the District intends to conduct zone pumping during well development and screen the well to minimize intake of high arsenic groundwater.

Recently, the District spent approximately $60,000 for minor improvements to the two existing wells. Work at the North Well and East well included:

- Removed pump from well
- Cleaned and tore down pump, tube, and shaft
- Replaced worn pump parts
- Repaired and replaced worn tube and shaft
- Replacement of 140 ft of 6" pump column pipe for the East Well
- Reassembled pump, tube, and shaft

Pumped groundwater is conveyed to two 42,000-gallon raw water tanks. One tank was added with the construction of the AsWTP, and the other tank was constructed in 1988. The tanks provide operational storage upstream of the AsWTP. The second tank was added as part of AsWTP project for redundancy to allow for shutdown of the either tank for repairs or rehabilitation.

The AsWTP is an Oxidation-Filtration Water Treatment System that commenced operation in 2008 to address the high levels of naturally occurring arsenic in the groundwater supply. The treatment component consists of two 625-gpm filter vessels. Two filters provide redundancy for O&M and flexibility of operating one or both wells. The AsWTP is operated to achieve final treated water arsenic concentration of less than 10 ppb and is designed to reduce concentrations to 8 ppb to provide a safety factor.

The AsWTP product water is stored in an 84,000-gallon Treated Water Tank. Water quality compliance testing occurs at the outlet of the tank. Two 375-gpm Distribution System Pumps feed the Town and I-5 Travel Center Distribution System, which is described in the following section.

Emergency Operations Plan

The District is currently implementing an Emergency Operations Plan to ensure the water system can operate temporarily with the Brown Material Road Reservoir offline. The plan includes installation of:

- Third Distribution System Pump with variable frequency drive (VFD); pump design flow of approximately 450 gpm is based on system analysis results in Section 4.3.1.
- VFD for one of two existing Distribution System Pumps
- An automatic transfer switch for connecting a mobile emergency generator at Gun Club Road Site facilities in case of power loss
- Plans for rental of an emergency generator when necessary
- Rental of emergency fire storage tank and fire flow pump

2.1.2 Town and I-5 Travel Center Distribution System

The Town and I-5 Travel Center (Town/I-5) distribution system consists of a 12-inch-diameter polyvinyl chloride (PVC) transmission pipeline that forms the backbone of the system. The line was installed in 1993 to replace the 8-inch transmission pipeline when the District took over the water system in 1989.

The distribution system within the Town consists of 2- to 10-inch pipelines, and the distribution system within the I-5 Travel Center consists of 6- to 8-inch pipelines. In 1999, approximately 17,000 LF of undersized pipelines within the Town were replaced with 8-inch pipelines as part of the Fire Loop Protection System to enable sufficient fire flow. Four-inch pipelines are typically the smallest size constructed under current distribution system standards for fire flow. Therefore, the Town's 2-inch pipelines are slated for replacement in the future. Plans have already been completed and will be implemented as funds are available.

2.1.3 Brown Material Road Site

The Brown Material Road Site is located approximately 3 miles west of the Town and includes the existing 2.2-MG distribution reservoir. This reservoir feeds the Townsite and I-5 distribution system and the BMWD booster pumps. The Distribution System Reservoir is part of the system that the District took over in 1989. The reservoir water surface lies approximately 130 feet higher than the Town site and can provide adequate pressure supply back to the Town (130 feet of pressure is equivalent to approximately 55 psi). In January 2013, the District commissioned a reservoir inspection that determined the reservoir to be in dire need of repair or replacement. Replacement of the reservoir is the primary goal of this PER. As a result of the January 2013 tank inspection (Appendix A), the District is implementing an Emergency Operations Plan to ensure the water system can operate without the reservoir. Therefore, until the tank is replaced with a new tank, the District is moving towards maintaining an adequate Emergency Operations Plan.

2.1.4 BMWD Domestic Water Distribution System

The District took over ownership and operations of the BMWD Domestic Water Distribution System in 2013. The system consists of a booster pump station adjacent to the Brown Material Road Reservoir, approximately 18 miles of distribution pipeline, and three storage tanks, each with booster pump stations for local distribution. Approximately 49,000 LF of 6-inch PVC pipeline and 9,000 LF of 4-inch PVC pipeline were installed in 2011/12 to replace existing deteriorated pipe installed in the 1950s. The remainder of the distribution system pipeline consists of approximately 7 miles of 3- and 4-inch PVC pipe installed in the mid-1980s to replace the 1950s pipe. The LHUD has serviced this system with water since the creation of the water system in Lost Hills and BMWD operated the Domestic Water Distribution system.

The BMWD Domestic Water Pump Station consists of two, 50-gpm pumps and a single 100-gpm pump, all of which were installed in 2012. The three storage tanks with booster pump stations are: 1) Blackwell's Corner Tank; 2) Union Oil Tank; and 3) Blackwell's Tank for servicing residential and commercial customers at the intersection of Hwy 46 and 33. The Blackwell LCA Tank is at the end of the system, and the Union Oil Tank is approximately 3 miles from the Blackwell LCA Tank.

The District used to operate two pipelines from the booster pumps: 1) Belridge pipeline to customers south of Hwy 46; and 2) North pipeline to residential and commercial customers north of Hwy 46. Service to these lines was abandoned in 2010.

The District will continue to deliver water to Chevron north from the booster pump station, but the demand is small (less than 1 AFY).

2.1.5 Operations

The District's system operates based on set points monitored by the SCADA System, which was overhauled in 2008. The system operates based on three primary inputs:

- The well pumps operate based on level set points in Raw Water Tanks.

- The distribution system pumps operate based on levels in the Brown Material Road Reservoir. The Distribution System Reservoir has a maximum operating water level of 21 feet and a low operating water level of 17 feet.
- The BMWD domestic water system pumps operate based on BMWD domestic water system pressure of 191 psi. The pressure decreases as the distribution system storage tanks fill to meet local demands.

2.1.6 Surface Water

The District does not currently use any surface water for potable use. However, two of the largest irrigation areas within the District – Lost Hills Park and Lost Hills Elementary School – use untreated water from the State Water Project. The water supplied is not part of the District's water system.

2.1.7 Water Quality

As discussed above, the Arsenic Water Treatment Plant commenced operation in 2008 to address the high levels of naturally occurring arsenic in the groundwater supply. The AsWTP has been successful in reducing arsenic to below 8 ppb.

The District plans to conduct zone testing during development of the proposed new Well 3 to try to minimize pumping of zone of arsenic. The existing wells were constructed prior to the arsenic issue arising so they are screened continuously for approximately 150 feet. Selective screening could potentially reduce the arsenic concentration in pumped groundwater and the use of the AsWTP.

2.2 Water Demand

2.2.1 Historical Water Demand

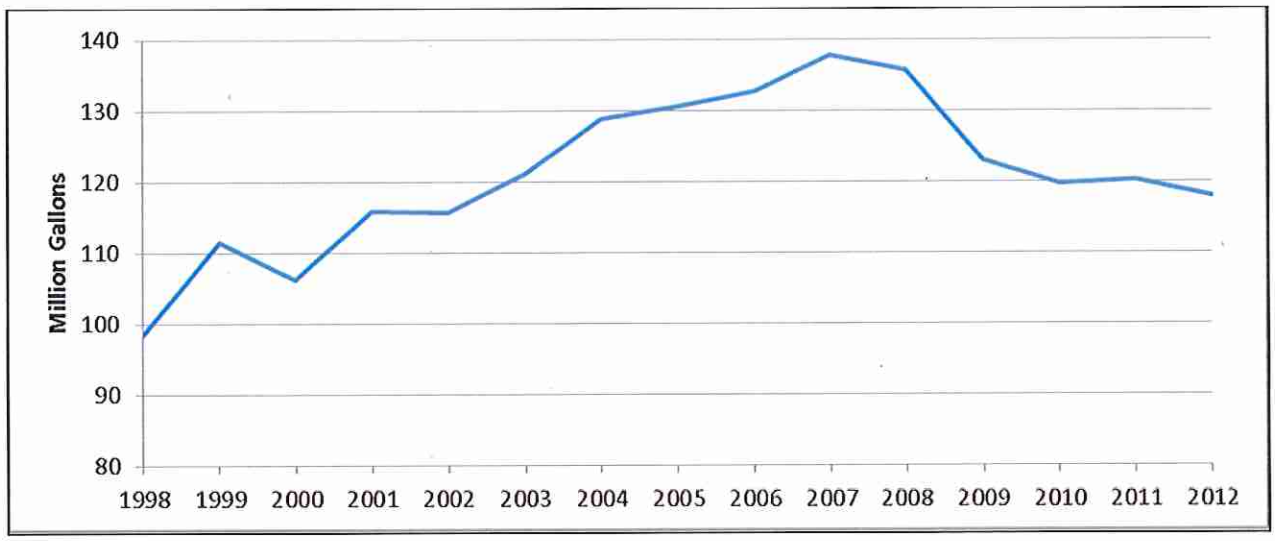
The District's water use comprises three primary demand groups:

- Residential and commercial use in the Town
- Commercial Use at the I-5 Travel Center
- Sales to residential, commercial, agricultural, and industrial customers to the west of the Brown Material Road reservoir, including Berrenda Mesa Water District (BMWD)[1] and Chevron

Historically, the Town accounts for roughly 60% of total District water use, I-5 Travel Center roughly 30%, and BMWD roughly 10%. The District's average annual water use over the past 15 years is 125 MG. Since 2002, the District's total annual water use has fluctuated between a low of 116 million gallons (MG) in 2001 to a peak of 138 MG in 2007, as shown in Figure . Total water use in 2010 and 2011 averaged approximately 120 MG per year and, of that, the Town has averaged approximately 72 MG per year.

[1] As discussed in Section 1, the District recently took over operations of the BMWD domestic water system.

Figure 4: Historical District Annual Water Use (Million Gallons per Year)



The range in historical average annual growth can be attributed to:

- Housing market correction and economic downturn starting in 2007, which eliminated housing growth, increased unemployment, and reduced transportation-related commercial activity
- No growth within the former BMWD service area due to limited water supply
- Elimination of delivery to several connections located west of the service area (Belridge and North lines)
- Reduced purchases by BMWD in 2009 as they switched to untreated SWP water for some of their non-potable water uses
- Decreased BMWD sales in 2012 after the reduction of water losses following replacement of 11 miles of deteriorated pipe

The latter three items are expected to remain in effect into the future; however, going forward, an economic and housing recovery is expected to contribute to future growth in water demand. Additionally, all three major components of the District's demand – Town, I-5 Travel Center, and BMWD Area – are expected to grow in the future through a combination of expansion within existing planning limits and through annexation.

2.2.2 *Projected Water Demand*

Projected water demand was estimated to increase at a rate of 1.8% per year in the Water System Master Plan (Cannon, January 2014) after an analysis of historical water use, historical population growth, historical per-capita water use, and remaining, infill and build-out development. Existing and future (buildout / 2030) demand conditions are summarized below.

Table 2: District Water Use Scenarios

Scenario	Basis	Existing		Future (2030)	
		120 MG/Yr		171 MG/Yr	
		MGD	gpm	MGD	gpm
Average Annual Demand		0.33	229	0.47	326
Max Month Demand (MMD)	Notes 1 & 2	0.54	375	0.77	535

Max Day Demand (MDD)	1.5 x MMD	0.80	558	1.15	797
Peak Hour Demand (PHD)	1.5 x MDD	1.20	837	1.72	1,195
MDD plus Fire Flow - Residential		MDD plus 1,000 gpm for 2 hours in Town			
MDD plus Fire Flow - Commercial		MDD plus 1,500 gpm for 2 hours at I-5 Center			

Notes:
1. Existing MMD based on 16.6 MG in August 2007 (Max Month since 2000)
2. 2030 MMD calculated by applying ratio of Existing MMD:AAD to 2030 AAD.

2.2.3 *Equivalent Dwelling Units / Unit Water Use*

The existing gallons per capita per day (gpcd) water use for the District is approximately 136 gpcd based on District water use of 120 MG in 2010 and Lost Hills CDP population of 2,412 in 2010.The 2020 targeted daily per-capita water use value established for the Tulare Lake hydrologic region is 188 gallons gpcd (Kennedy Jenks, 2011), so the District's water use is well within targeted use for the region.

Water use in an equivalent dwelling unit (EDU) basis is summarized below.

Table 3: Equivalent Dwelling Unit Estimates

	Average Total Use		Number of Connections	Average Use per Connection		Number of EDUs
	Annual	Monthly		Monthly	Daily	
User Type	MG	MG	#	Gallons	Gallons	#
Residential (Single-Family)	42.0	3.5	299	11,706	385	299
Multi-Family Residential	16.2	1.4	3	450,000	14,795	115
Commercial/ Institutional	65.6	5.5	85	64,314	2,114	467
Total	**123.8**		**387**			**881**

Notes: Based on actual use in 2013 as reported to the California Department of Water Resources on DWR Form 38 – Public Water System Statistics.

2.3 System Analysis

The District's primary distribution system reservoir is located at the Brown Road Material Site. The minimum necessary storage under future conditions is 1.65 MG based on methodology described below.

2.3.1 *Storage Requirements*

The principle function of storage is to provide reserve supply of water for:

- Operational equalization
- Fire reserve
- Emergency supply

The sum of the storage needs for each of these items is the minimum required distribution system storage.

Operational Storage

Operational storage is directly related to the amount of water necessary to meet peak demands. The intent of operational storage is to provide the difference in quantity between the customer's peak demands and the system's reliable available supply. This storage is the amount of desirable stored water in a system to regulate fluctuations in demand to avoid the imposition of extreme variations on the source of supply. With operational storage, system pressures are improved and stabilized to better serve customers throughout the service area. Operational storage is commonly estimated between 25% and 50% of the MDD. This study recommends an operational storage equal to 25% of the District's MDD.

Fire Storage

This storage is the amount required when the capacity of the production facilities is insufficient to meet the necessary MDD plus fire flow demands for certain durations of time. The fire flow requirement for commercial development (discussed in the previous section) is 1,500 gpm for a duration of 2 hours. Fire flow requirements for residential development are less than those for commercial development, so this provision will allow the water system to respond to hypothetical fires in residential and commercial areas. The District does not serve any industrial areas, and thus the industrial fire flows were not considered.

Emergency Storage

The volume of water allocated for emergency uses is decided based on the historical record of emergencies experienced and on the amount of time expected to lapse before a hypothetical emergency can be corrected. This storage is the volume recommended to meet demands during emergency situations such as pipeline failures, major trunk main failures, pump failures, electrical power outages, or natural disasters. The amount of emergency storage included within a particular water distribution system is an owner option based on an assessment of risk, the desired degree of system dependability, economic considerations, and water quality concerns. In California, emergency storage is usually estimated at 50 to 100 percent of the MDD.

The District's Water source lies approximately 12 miles east of the Lost Hills town site. The groundwater must be pumped through an Arsenic WTP, stored, boosted, and transported approximately 10 miles before it reaches the bulk of the users. This creates a larger variability for disconnection of water from the source. Therefore, we are recommending the use of an emergency storage volume equal to 100 percent of the District's MDD.

This recommendation is consistent with California Waterworks Standards[2] Section 64554 requirements: *For systems with less than 1,000 service connections, the system shall have storage capacity equal to or greater than MDD, unless the system can demonstrate that it has an additional source of supply or has an emergency source connection that can meet the MDD requirement.*

2.3.1 Supply Capacity Requirements

The following California Waterworks Standards New and Existing Source Capacity (Section 64554) requirements were applied for supply capacity analysis:

- At all times, a public water system's water source(s) shall have the capacity to meet the system's maximum day demand (MDD).

[2] http://www.cdph.ca.gov/services/DPOPP/regs/Pages/R-14-03-RevisionofWaterworksStandards.aspx

Community water systems using only groundwater... shall be capable of meeting MDD with the highest-capacity source offline

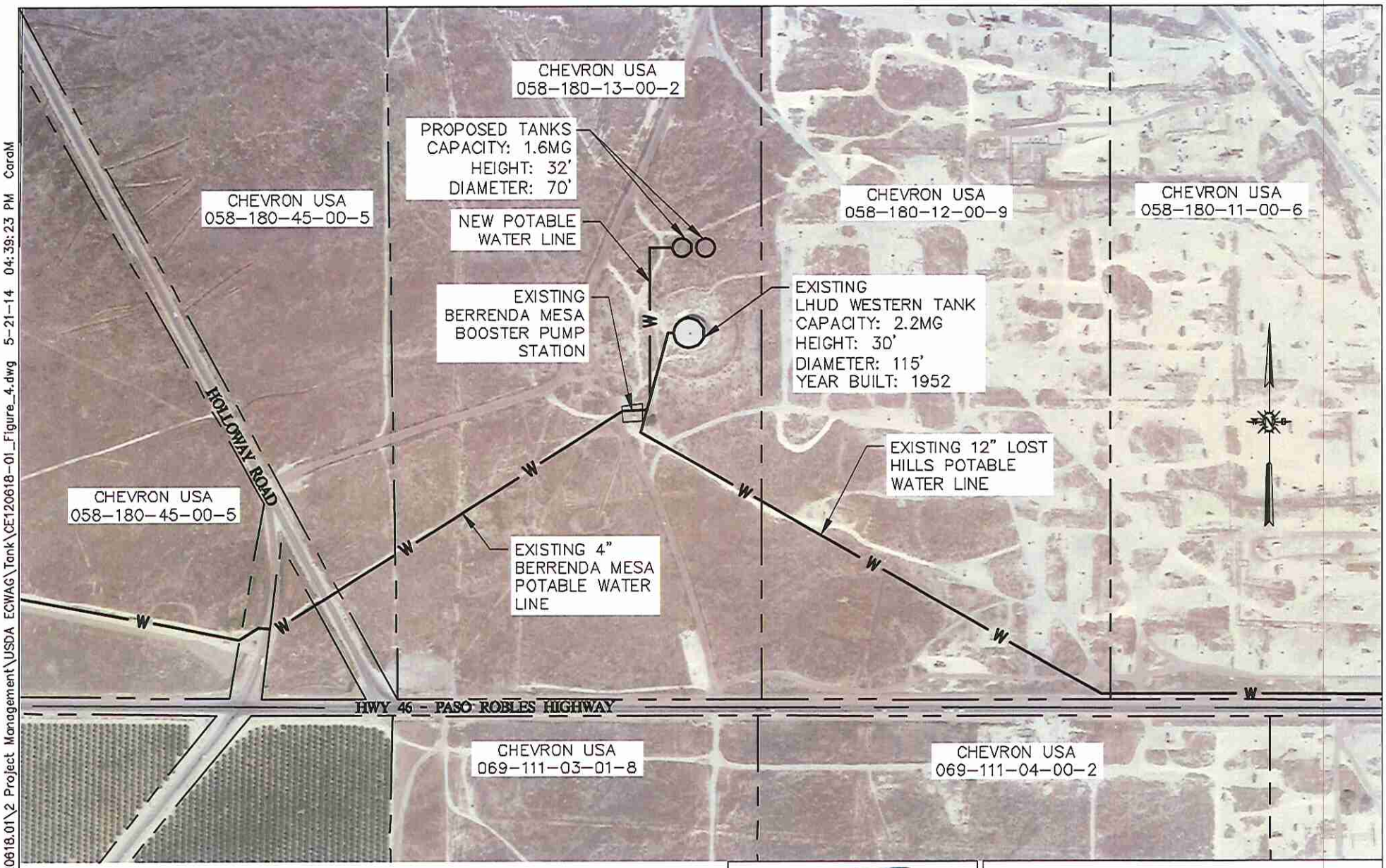
Considering the 3 storage requirements list above, the existing and future storage requirements are calculated and and summarized in **Table 4**. Therefore, the existing reservoir size of 2.2 MG is more than sufficient but was recently determined to be in dire need of repair or replacement. (Refer to Steel Potable Water Reservoir Inspection Report in Appendix B). The reservoir was initially installed to support industrial activities associated with the oil exploration activity and, as a result, is oversized for its current (and future) municipal purposes. Considering that the existing reservoir must be repaired or replaced soon, construction of a new 1.65-MG reservoir is recommended as soon as feasible.

Table 4: Distribution System Reservoir Storage Requirements

Storage Type	Basis	Existing Conditions	Future (2030) Conditions
		MDD = 0.80 MGD	MDD = 1.15 MGD
Operational	25% of MDD	0.2 MG	0.3 MG
Fire Flow	1,500 gpm over 2 hours (for Commercial)	0.2 MG	0.2 MG
Emergency	100% of MDD	0.8 MG	1.15 MG
Total		**1.2 MG**	**1.65 MG**

Note: The total volumes are gross volumes and do not account for tank volume that is not usable at the top and bottom of the tank. The unused volume must be accounted for during design of the new tank.

Although the total recommended storage requirements is calculated for 1.65 MG, the District staff prefers that two storage tanks at 825,000 gallons each be installed. This would provide operational flexibility for removing one tank from service, for a short routine maintenance, while keeping the second tank in service. The tank site plan is shown on FIGURE 4.



Cannon

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NEW WATER TANKS
FIGURE 4
LOST HILLS, CA

DRAWN BY CKM	DATE 05/21/2014	CA JOB NO. 120618.01
CHECKED BY	SCALE NTS	SHEET 1 OF 1

F:\pro\2012\120618\120618.01\2 Project Management\USDA ECWAG\Tank\CE120618-01_Figure_4.dwg 5-21-14 04:39:23 PM CaraM

3.0 Need for Project

The District recently completed a Water System Master Plan that identified the need for a new tank and a new well. The storage tank was diver testing in January 2013 (Appendix A). As a result we determined the tank to be at the end of its useful life and beyond rehabilitation efforts. The new well is needed to meet maximum day demand (MDD) with the highest capacity well offline[3] or in case of significant failure of the East Well. The Water Master Plan listed the tank as the highest priority project.

The master plan did not address near-term impacts from the current drought, which has resulted in static groundwater levels decreasing by over 100 feet in the past 12 years (see graph below). Groundwater levels while pumping at the District's existing wells are within 70 feet of the pump net pressure suction head (NPSH) limit. NPSH is the minimum head above the pump inlet required to keep the pump from cavitating. The District staff measured the water table in December 2013 and April 2014. The depth to water table is 327 ft bgs in the North Well and 317 ft bgs in the east well.

In addition, the drop in water levels has reduced flows from each well as the existing pumps have to increase total head. Reduced flows from the existing wells causes the District to be at risk of meeting MDD with the highest capacity well offline – particularly during the upcoming high demand season during the summer. In summary, to deal with lowering groundwater levels, the District will likely need to lower the pump column and add bowls to the existing pump to be able to pump but flows will be lower than historically and the District risks being unable to meet MDD with the highest capacity well offline.

The Storage Reservoir has been an integral part of supplying water to the District's demands. The two wells, WTP and Transfer pumps generally operate to supply the system demands while filling the 2.0 MG storage tank. Once the tank is full, water demands for the following day are satisfied through further well pumping and from the "operational" storage in the tank. Because the operating band is set at feet (17 and 21 ft) , operational demand is balancing occurs with the water. The four foot band equates to approximately 300,000 gallons and the Tank can supply current MDD of 800,000 gallons "Emergency" supply , the Gun Club Road Site has not needed an emergency engine generator. However, due to the condition of the 2.2 MG storage reservoir tank, improvements are being made to the site so that a rented mobile generator can be easily connected.

3.1 Water Conservation

The District has passed Ordinance May 1, 2014 which restricts the use of water in the following areas.

- Unattended outdoor watering is prohibited.
- Unattended hose must have a nozzle with automatic shutoff.
- Unattended hose nozzle must be in the off-position

The ordinance establishes the right to terminate and/or restrict water to water service connections outside the district boundaries. There are currently several water users outside the water service area (primarily west of lost hills).

The two largest irrigation areas within the District – Lost Hills Park and Lost Hills Middle School (K-8) – use untreated surface water from the State Water Project. The water supplied is not part of the District's water system. The Lost Hills Park implemented the use of the surface water over the last several years while the school has utilized surface water for many years. Additionally, the BMWD domestic water system was upgraded as described in Section 2.1.4. As a result, the system reduced water consumption

[3] California Waterworks Standards, Section 54554

by approximately 50 percent (or 5 MG). This is mainly attributed to the replacement of the 60 year old steel water transmission main that had reoccurring leaks.

As shown in Section 2.2, the peak water use for the LHUD occurred in 2007 and has experienced a steady decline. Although this cannot be attributed to a single effort, the 2013 annual water use is approximately 10% less than the 2007 water use of 137.9 MG.

4.0 Alternatives Considered

The drought conditions have caused groundwater levels to decrease severely in the vicinity of the District's wells. The decreased water levels have raised two primary urgent issues for the District:

- The existing well pumps will be at risk of failure if groundwater levels drop below minimum NPSH.
- Reduced flows from each existing well because the existing pumps have to increase total head, which causes the District to be at risk of meeting MDD with the highest capacity well offline,

In addition, the Master Plan identified the need for replacing the existing storage reservoir due to the age and condition of the existing storage reservoir.

The LHUD is pursuing the drilling of a 3rd well to address immediate issues caused by the falling groundwater levels and to address the long term projected MDD water demand.

In order to address the replacement of the existing reservoir, a few alternatives were considered and evaluated. For example, the District could:

- Optimization of the existing reservoir.
- Acquire SWP rights and construct a WTP
- Import groundwater pumped by the City of Wasco, which is the closest municipal water supplier and located approximately 9 miles to the east

TABLE 5 below summarizes the alternatives considered to address the water supply issues caused by the drought conditions. The table is organized into the five categories identified in the PER guidance document.

Table 5: Alternatives Considered

Categories	Alternatives
(1) optimize the current facilities operation (no construction)	None identified
(2) upgrade the current facilities operation	Alternative 2a – Repair / Rehabilitate Tank Alternative 2b – Replace Tank Alternative 2c – Alternate Tank Locations

4.1 Alternative 2a – Repair / Rehabilitate Existing Tank

The District previously developed a project costs budget of $900,000 for repairing the existing tank. Rehabilitation tank included the follow scope of work:

- Drain & clean bottom surface
- Sandblast and recoat interior & exterior surfaces
- Upgrade existing roof column supports (existing do not meet existing codes)
- Install solar operated mixing system

The tank was diver inspected in January 2013 and it was determined that the tank is beyond repair. Additionally, the tank is estimated to be over 60 years old. As a result of the diver inspection, it was concluded that attempting to sandblast the highly deteriorated metal surface may result in a compromise to the structural integrity of the tank. In addition, rehabilitating the existing tank would require that system operate without a storage tank for up to two months and the system was not set up for this operational scenario. There, the tank rehabilitation is eliminated from further consideration.

4.2 Alternative 2b – Tank Replacement

Replacing the existing tank is considered the most viable alternative for the LHUD. The required tank sizing is discussed in section 2.3. Replacing the existing storage reservoir with new storage reservoirs that provide the operational, emergency and fire flows for the 20-year design period was developed. The technical feasibility of the alternative considers that:

- Current site is available for siting a tank replacement.
- Current site provides storage and hydraulic head for operational and fire flows back to the Lost Hills town site and Highway 46/I-5 users.
- Current site also allows the BMWSD system to pull from the storage reservoir.
- Siting the tank at the current location would not alter the Gun Club Road Transfer Pump station.
- No direct or indirect environmental impacts are anticipated other than temporary construction impacts. The project is likely Categorically Exempt from CEQA since it is considered maintenance of existing facilities.
- No additional land is required.
- Replace the existing reservoir with two reservoirs for maintenance purposes.
-

Based on the information listed above, the alternative is technically feasible.

4.3 Alternative 2c – Alternate locations for new Tank

Locating a new tank at alternate locations were reviewed at two locations (at the I-5/Highway 46 commercial area and at the Gun Club Road Site).

I-5/Highway 46. The District owns a 6,500 square foot lot within the commercial area of the I-6/highway 46. The technical feasibility of the alternative considers that:

- The District owns a 6,500 square foot lot with adjacent land available siting a new tank.
- Land is available to purchase.
- A firewater pump booster and operational pump booster station would be required at this location.
- Design parameters include
  - 1.65 MG tank (approximately 100 ft diameter with 30 ft sidewater depth)
  - 2,050 gpm firewater & operational booster pump station (at 50 psi with 100 hp)
- Site modifications will be needed to the site.
- No direct or indirect environmental impacts are anticipated other than temporary construction impacts. The project is likely a mitigated negative declaration for CEQA since it would be built at a former utility site.

Based on the information listed above, the alternative is technically feasible.

Gun Club Road. The District owns an 80 acre parcel at the Gun Club Road site. Therefore, a 1.65 MG reservoir could easily be sited at this location. However, a firewater booster pump would need also need to be added to the site. Because the site is 12 miles from the Lost Hills town site with a 12-inch transmission main, a firewater system would have a large pressure requirement (+530 psi pressure) to overcome the long pipe run or 12 miles of line would need to be upsized. As a result, this alternative was not considered technical feasibility of the alternative considers that:

4.4 Cost Estimates

Table 6: Cost Estimates

Alternative #	2a	2b	2c
	Repair / Rehabilitate Tank	Replace Tank	Alternate Tank Location
Construction Costs	$ 739,200	$ 1,217,400	$ 1,420,900
Non-Construction Costs	$161,000	$ 258,000	$ 258,000
Total Capital Costs	$ 900,200	$ 1,475,400	$1,678,900
O&M Costs	$ 0	$ 0	$ 1,500/yr

Notes:

1. Detailed cost estimates are included in Appendix A.
2. O&M costs are non-existent for a storage tank.
3. Alternate location tank requires minimal pump station operation costs.

5.0 Selection of Alternative

The District identified two technically feasible alternatives in the previous section. In addition to the costs estimates summarized in TABLE 6, the District considered several non-monetary factor to select a preferred alternative. The factors are:

- *Addresses Immediate Drought Risk:* Does the project reduce the potential impacts of continued decrease in groundwater levels and enable the District to meet minimum water demands for public health and safety (excludes irrigation).
- *Addresses Extended Drought Risk:* Does the project enable the District to meet existing maximum day demand (MDD).
- *Addresses MDD Growth:* Does the project enable the District to meet projected increases in maximum day demand (MDD).
- *Addresses existing Tank condition:* Does the project enable the District to continue serving water if a significant failure of the existing tank occurs? The existing tank is over 50 years old.

Each of the non-monetary factors is discussed further.

Addresses Immediate Drought Risk

The District has little control over management of their groundwater basin since agricultural pumping surrounds the community and agricultural pumping far exceeds the District's groundwater production. The District does not have any alternative water supplies to groundwater so the District must be conservative in anticipating groundwater basin issues affecting their sole water supply, such as significant decreases in groundwater levels.

Lowering of groundwater levels close to the NPSH of the existing pumps would soon cause pump and well failure. Current groundwater levels are within approximately 70 feet of the North Well pump NPSH. The District is concerned that this level could be approached prior to the next wet season (2014/2015) due to the extreme drought conditions. The District would not have an alternate water supply if this occurs. The storage tank currently provides up to 1.6 days of operational storage while maintaining fire flow storage. This is the only source of an alternate "water supply" that the district can maintain.

Addresses Extended Drought Risk

Decreased groundwater levels causing existing equipment to provide more head to meet necessary pressure requirements. Increased head produced from the same pump will decrease flow output. As a result, the District's maximum production capacity has reduced in recent years as groundwater levels dropped. The current production capacity risks dropping below being able to meet MDD with the largest well offline. New bowls can be added to existing pumps to increase the head produced but would not increase flow. A new pump would be necessary to meet increased head needs and restore flows to existing MDD. Also, a new motor would likely be needed due to higher horsepower needs.

If the drought continues and groundwater levels continue to fall, the District will need a new pump to restore the ability to meet existing MDD flows. Providing the storage tank allows for the pumps to rest during lower water demand periods.

Addresses MDD Growth

The Water System Master Plan identified the replacement of the existing distribution system storage tank as the highest priority project. The tank is in urgent need of repair and is currently in the project design phase through a grant from Department of Water Resources. Design is scheduled to be completed in December 2014.

The second priority project is a new well to meet MDD with the highest capacity well offline and in case of significant failure of the East Well. The District currently meets the MDD capacity requirement but expects to require additional pumping capacity in the near future when water demand increases as the general economy improves and housing development restarts.

Replacing the existing tank essentially maintains the districts ability to store upto 1.5 days or MDD and 1.0 days for the 20 year buildout projection.

Addresses Tank Age and conditonRisk

As discussed for the previous factor, the Water System Master Plan identified the need for the tank to be replaced. As a result of the January 2013 diver inspection, it was determined that the tank is beyond repair/rehabilitation efforts.

5.1 Alternatives Comparison

TABLE summarizes the cost and non-monetary factors for the alternative evaluation and FIGURE 6 present capital costs compared with non-monetary scoring.

Table 7: Alternative Comparison Matrix

Alternative #		2a	2b	2c
		Repair / Rehabilitate Tank	Replace Tank	Alternate Tank Location
Cost Comparison				
Capital Cost		$900,200	$1,475,400	$1,678,900
O&M Cost per yr		$ 0	$ 0	$ 1,500
Non-Monetary Factors				
Addresses Immediate Drought Risk		Partially	Yes	Yes
Addresses Extended Drought Risk		No	No	Yes
Addresses MDD Growth		No	Yes	Yes
Addresses Tank Condition/Age Risk		No	No	No
Non-Monetary Scoring				
Addresses Immediate Drought Risk	20	5	5	5
Addresses Extended Drought Risk	15	--	--	--

Addresses MDD Growth	10	--	--	--
Addresses condition/Age Risk	5	5	5	--
Total		**10**	**10**	**5**

Notes:

1. Detailed cost estimates are included in Appendix A.
2. O&M costs included here are the increased above O&M costs for existing Tank. To simplify the comparison, the electricity usage (and associated cost) of the existing tank is assumed to be the same as for each of the alternatives.

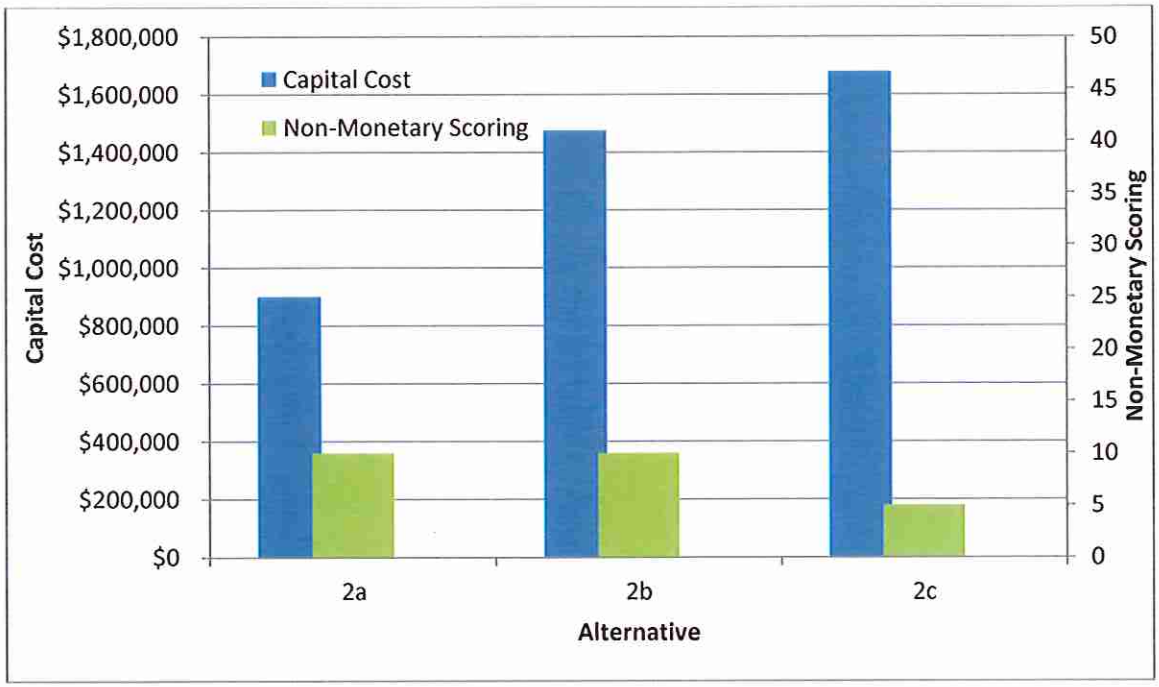


Figure 6: Comparison of Capital Cost and Non-Monetary Scoring

Two trends are evident in FIGURE 6:

- Higher costs are associated with higher non-monetary factor scoring for Alternatives 2a & 2b
- non-monetary factor scoring are very close in comparison

The District's Preferred Alternative is 2b – Tank Replacment with 2 new tank since the project addresses the poor condition of the existing tank and allows for storing a 1.0 to 1.5 day supply of MDD.

6.0 Proposed Project (Recommended Alternative)

6.1 Description

This alternative proposes installation of replacing the existing tank with two equally sized tanks to satify the existing and projected storage requirements of 1.65 MG. The new tanks will be sized at 0.825 MG each and this would provide maintenance abilities for taking storage off-line for periodic inspection and coating repairs. Tank design criteria includes

- Two Tanks
- Each 70ft diameter at 30 feet sidewater
- Solar mixing.
- Pressure Transducer for level control

A layout map of the proposed project showing the location of the planned system components is located in Figure 2.

The Tanks would serve multiple purposes:

- Provide adequate operational, emergency and fire flow for existing MDD and 2036 MDDs.
- Reduce reliance on 50+ year old existing tank
- Increase tank reliability

Water Quantity

Water quantity should not be an issue since the existing and proposed tank volumes are approximately the same. In order to address the potential for water age, a solar powered mixer will be incorporated into the design.

Environmental Impacts

No direct or indirect environmental impacts are anticipated other than temporary construction impacts. A categorical exemption or Initial Study/Negative Declaration is anticipated with similar findings and measures required as for the recent AsWTP dewatering expansion project, which includes:

- No evidence of any listed or special-status species during the field survey and that "it is very unlikely that the project would result in direct impacts to special status species within the identified project footprint."
- Contractor training on local special-status species and habitat requirements
- Pre-construction biological survey

The proposed project is subject to compliance with CEQA. Because the proposed project would receive federal funding, the project is also subject to NEPA and other federal requirements. Federal requirements for reporting environmental information and analysis must be met as well as those for the State of California. The USDS Rural Development Program (RDP) will be responsible for meeting Federal information requirements using the information provided within the categorical exemption or an IS/ND prepared for the proposed project. This will facilitate a concurrent compliance effort with NEPA by the RDP.

Purchase of Land / Easements

The District has a long term agreement with Chevron to use the land for the water storage reservoir.

Agreements

No agreements are needed to implement this alternative.

Potential Construction Problems

No potential construction problems have been identified since the District (and local contractors) have experience constructing tanks in the area. Also, the tanks and pipelines (approximately 500 ft) have a small footprint.

6.2 Project Schedule

The following schedule has been developed for the construction of a new well.

Table 8: Proposed Project Schedule

Task	Start Date	End Date	Notes
Planning	May 1, 2014	June 1 2014	Preliminary Engineering Report
Design	Jul 2014	Dec 2014	By Department of Water Resources
CEQA/NEPA	September 2014	Dec 2014	To be conducted in parallel with Design
Permits	July 2014	Dec 2014	To be conducted in parallel with Design
Land/Easement Acquisition	August. 2014	December 2014	Not applicable
Bid Advertise and Award	Jan 2015	March 2015	
Construction Start	April 2015	Sept. 2015	
Substantial Completion		July 2015	
Final Completion		Sept 2015	
Operational Startup	Sept 2015		

6.3 Permit Requirements

The only permit required for the construction and commissioning of a new tanks are from the Department of Public Health Services. No county permits are anticipated as the LHUD is a special utility district.

6.4 Total Project Cost Estimate

TABLE 9 below provides a construction cost estimate for the proposed project provides a total cost estimate for the proposed project.

Table 9: Construction Cost Estimate

Table 10: Total Project Cost Estimate (PER Guidance Document, Attachment 1)

Total Project Cost Estimate		
Item		
Property Purchase / Lease Agreement		
Easement Acquisition / Right of Way / Water Rights		
Bond Counsel		$ 20,000
Legal Counsel		$ 5,000
Interest / Refinancing Expense		
Other (Identify)		
Environmental Services		
- CEQA Environmental Report (categorical exemption)	$ 4,000	
- NEPA Environmental Report	$ 2,000	
- Environmental Mitigation Contract Services		
Total Environmental Services		**$ 6,000**
Engineering Services		
- Preliminary Engineering Report		$18,000
- Preliminary and Final Design Phase		$ 90,000
- Bidding / Contract Award Phase Services		$ 18,000
- Construction & Post-Construction Phase Services (w/o inspection)		$ 45,000
- Resident Project Representative Services (resident inspector)		$ 50,000
Additional Services		
- Permitting		$ 4,500
- Regulatory Compliance Reports		$ 3,000
- Environmental Mitigation Services (Construction Phase)		$ 4,000
- Easement Acquisition/ROW's Services (Construction Phase)		
- Surveying Services (Construction Services)		$ 3,500
- Operation & Maintenance Manual(s)		$ 2,000
- Geotechnical Services		$ 12,000
- Material Testing Services		
- Other Services - Advertisement		$ 6,000
Total Engineering Services		**$ 258,000**
Equipment / Materials (Direct Purchase using approved methods)		$ 800,000
Construction Cost Estimate		$ 216,400
Contingency		$ 169,600
Total Project Cost Estimate		**$ 1,475,000**

6.5 Operations and Maintenance Costs

Table below summarizes estimated increases in O&M costs for the proposed project.

Table 11: Increased Annual Operations and Maintenance Cost Estimate

Item	Annual O&M Cost	Notes
Salaries	$ 0	
Benefits	$ 0	
Water Purchase	$ 0	
Taxes	$ 0	
Professional Service Fees	$400	For annual inspection cost prorated with other tanks
Interest	$ 0	
Utilities	$ 0	Minor net increase in electricity use since existing well use will be offset. Use may decrease due to more optimal pump operation
Insurance	$ 0	
Annual Repairs & Maintenance	$ 0	Based on cost for existing
Supplies	$ 0	
Total Increased O&M	**$ 400**	

Note: Table does not include short-lived assets, which are discussed in the following section.

6.6 Short-Lived Asset Reserve

Table below presents a schedule of short-lived assets (useful life of less than 15 years) for components of the proposed project and a recommended annual reserve deposit to fund the replacement of the short-lived assets.

Table 12: Increased Annual Operations and Maintenance Cost Estimate

Equipment	Useful Life[1]	Replacement Cost	Annual Reserve[2]
Mixer	10	$5,000	$ 500
Pressure Transducer	10	$5,000	$ 500
		Total	$1,000

Note: Table does not address annual O&M costs, which are discussed in the previous section.

1. Useful Life is listed as 10 years.
2. Annual Reserve = Replacement Cost ÷ Useful Life

7.0 Conclusions and Recommendations

It is my professional opinion that it is imminent that the community may experience a significant decline in the quantity of water if the current drought conditions persist and result in continued decrease in groundwater levels and that such a significant decline is likely to occur within one year.

It is also my opinion that the proposed project is necessary to alleviate this upcoming problem as well as the long term supply requirements. The proposed project addresses both near-term drought impacts and near-term water system upgrades identified in the Water Master Plan. Cheaper projects are available that can respond only to near-term drought impacts – and could be implemented if insufficient capital funds are available – but these actions are temporary solutions. The recommended project provides a long-term solution in a cost effective manner.

8.0 References

- Jones and Stokes, 2004. Initial Study and Negative Declaration, Lost Hills Utility District Water System Modification. November. SCH: 2004121033.
- Lost Hills Utility District Water System Master Plan (Cannon, January 2014)
- McCormick Biological, Inc., 2013. Biological Reconnaissance Survey; Lost Hills Utility District Arsenic Treatment Facility. April 15, 2013.
- Title 22, Division 4, Chapter 16 – California Waterworks Standards (R-14-03; February 7, 2008)[4]

[4] www.cdph.ca.gov/services/DPOPP/regs/Pages/R-14-03-RevisionofWaterworksStandards.aspx

Technical Appendices

Appendix A: Tank Inspection Report

Appendix B: Alternative Cost Estimates

Appendix A

Tank Inspection Report

Tank Inspection Report

Lost Hills Utility District

Western Tank
Liquid Engineering Corporation 44412

Tank Name:	Western Tank	Tank Type:	On-Grade
City:	Lost Hills	Tank Capacity:	2,200,000 Gallon
State:	CA	Type of Construction:	Riveted Steel
Year Built:	Unknown		
Inspected By:	**LEC Maintenance Team 10 – Team Leader C. Fromm**		
Inspection Date:	**January 19, 2013**		

GENERAL

This report is a supplement to the visual and video inspection undertaken for the Lost Hills Utility District, CA, by Liquid Engineering Corporation of Billings, MT. The Western Tank is an on-grade style, riveted steel water storage tank. (See Photo No.1). The tank has a 2,200,000-gallon capacity, with an approximate height of 30' and an overall diameter of approximately 115'.

Photograph No. 1

STANDARDS

The inspection of this tank was performed by a dive maintenance technician using surface supplied air, totally encapsulated in a sealed dry suit mated to a sealed dry divers hard hat and conducted in accordance with all applicable OSHA, EPA, AWWA, NACE, SSPC and ADC requirements and/or recommendations.

The inspection consisted of a visual observation of the tank's interior and exterior components and coating system. The tank was not drained for the inspection and all interior assessment data was recorded using real time video with live voice narration. Exterior assessment data was documented using digital still photographs.

CONDITION OBSERVATIONS

Conditions noted during the field inspection are documented in the following pages and are supplemented with color photographs at the end of the report. Condition ratings used to describe the inspection findings are annotated as follows:

Excellent:	No deficiencies noted.
Good:	Minor deficiencies noted. Item is functioning as designed.
Fair:	Major deficiencies noted. Item is in need of repairs to continue functioning as designed.
Poor:	Repair or replacement required immediately. Item may no longer function as designed.

CONTAMINATION, HEALTH & SAFETY REPORT

Contamination and Health

- **Air Vent(s) and Screen(s)** – There is one center roof vent, and multiple screened cutouts in the upper wall panels for ventilation. The vents contain screening that is in Fair condition. The screens should be cleaned and replaced as needed to allow adequate airflow, and provide contamination protection. There is no Vent Security shroud on the vents. Absence of a Vent Security Shroud can allow the intentional introduction of hazardous chemical or biological contaminates.
- **Hatches** – There are two access hatches on the roof. The hatches are properly sealed.
- **Exterior Overflow** – The overflow is not properly sealed with a flapper valve, gasket, or screen. Installation is recommended to prevent debris/animals from entering or nesting in the plumbing.
- **Cathodic Covers** – *Not applicable*, there are no cathodic covers on this roof.
- **Roof to Wall Joint** – The roof to wall joint is properly sealed.
- **Roof Integrity** – There are no holes or standing water on the roof, but the roof is visibly sagging.
- **Wall Integrity** – There is extensive pitting damage to the interior side of the wall panels. A structural engineer should be hired to identify if the panels can be rehabilitated, or if the tank should be condemned.
- **Manway Integrity** - No visible leaking is present. Proper gasket material is in place.
- **Water Clarity** – Water is clear, there is no unusual odor or floating debris present.
- **Telemetry Penetration(s)** – The visible telemetry penetration appears to be sealed properly.

Facility Safety Compliance

- **External Ladder** – There is no ladder, but a full staircase is in place to access the roof. The staircase appears to be in Good condition. All the attachments, standoffs, and bolt assemblies show no major discrepancy. There is NO locking Vandal Guard on the staircase to help prevent unauthorized access to the tank. Installation is recommended.
- **Safety Climb** – The staircase has a full hand railing for safe access.
- **Manway** – There is one round manway penetration in the lower wall. The manway is approximately 21" in diameter, and appears to be sealed properly.
- **Hatch** – The primary roof access hatch measures 60" x 18". There is deterioration of the wooden structure, and this access point should be considered unsafe. A new steel hatch structure should be installed, with the current minimum dimensions recommended by the American Water Works Association and OSHA.
- **Balcony & Railing** – There is a balcony around the upper ladder, with an adequate railing with 42" high handrails, and a 4" toe rail.
- **Roof** – There are no transmitting antenna, and no approved safety tie off points on the roof of the tank.

Interior Reservoir Roof

- **Vent(s)** – There is one center roof vent, and multiple screened cutouts in the upper wall panels for ventilation. The interior view of the vents shows a heavy amount of uniform surface corrosion.
- **Roof** – The interior roof is rated in Fair to Poor condition. The roof structure is made of wood. There is heavy condensation on the interior roof, allowing the wood to form biologic growth/mold. The hardware for the roof supports is 100% corroded on the surface. There is extensive evidence of advanced cracking, splitting, and deterioration of the wood beams and support structure across the entire area.
- **Protective Coating** – *Not applicable*, there is no paint coating on the interior roof.

Interior Reservoir Walls

- **Wall to Roof Joint** – The joint appears to be fully sealed and there is no leaking or ambient light visible.
- **Ring Panels** – The interior wall panels are made from riveted steel. The walls are rated in Very Poor condition. All of the panels are rated a 0 on the SSPC legend, with 100% of the surface showing corrosion. Corrosion is present in the form of heavy rust noduling with pitting damage underneath, concentration cell corrosion, and uniform surface corrosion. Tested areas identify pitting damage at approximately ¼"+ deep. The middle and upper wall panels show a heavy amount of dealloying. There are layers of dealloyed steel falling off the walls, and much of this material was found lying throughout the floor of the tank.
- **Interior Ladder** – *Not applicable*, there is no ladder inside this tank.
- **Cathodic Protection System** – *Not applicable*, there is no cathodic protection system in this tank.
- **Protective Coating** – The coating on the interior walls is in Extremely Poor condition, and is NOT protecting the steel substrate. The coating has completely failed.

Interior Reservoir Floor

- **Perimeter Seam** – The seam appears sealed and there is no leaking identified at the time of inspection.
- **Floor Panels** – Due to the amount of debris in the tank, the utility could not authorize a complete cleaning as an extensive amount of hand nozzling/debris removal would have to be done. The areas around the inlet and outlet plumbing were cleaned thoroughly, and were enough to get a small localized sample area of the floor to inspect. The subsequent inspection notes the floor in Fair to Poor condition. The floor is concrete, and there were isolated areas of visible cracking present.

Interior Reservoir Plumbing Components

- **Plumbing** – The inlet and outlet plumbing penetration appears to be in Fair to Poor condition. There is corrosion on the visible interior surfaces. Due to the placement of the plumbing, the reservoir water does not appear to be mixing adequately for turnover. This may allow thermal stratification of the water, stagnant water from dead zones, disinfection byproducts to form, and there may be a loss of disinfectant residual in the upper layers of the water. An active mixing system should be installed to prevent stratification, and allow the disinfectant residual to mix thoroughly in the entire water column. Call Liquid Engineering Corp. for options and pricing.
- **Manways** – The manway is in Fair condition. Adequate gasket material is in place and no leaking is identified at the time of inspection. There is corrosion visible in isolated areas.
- **Overflow** – The interior overflow box appears to be in Fair condition. There is corrosion visible, and there is debris partially clogging the opening. The debris consists of failed wooden roof material.

Interior Reservoir Support Columns

- **Column Structure(s)** – The interior columns are made of wood. The columns are rated in Poor/Critical condition. See supplemental video documentation of the interior. Many of the columns have completely failed, and are lying on the floor or suspended in the roof crossbeams. The wood shows many critical discrepancies, including cracking, splitting, separation, as well as biological/mold growth. All of the hardware connecting the supports show varying amounts of corrosion, some have completely failed. Due to the amount of column failure in this tank, the structure is not supporting the roof as designed. **Roof support structure is in critical condition.**

EXTERIOR RESERVOIR INSPECTION REPORT

Exterior Reservoir Roof

- **Vent(s)** – The roof vent is covered in uniform surface corrosion. The screen is very large mesh, and may be allowing contaminants to enter the reservoir. The screen should be cleaned or replaced periodically to maintain an adequate contamination protection and proper ventilation. An ARC³ Omega Security Vent should be installed for the best combination of ventilation and security.
- **Roof** – The exterior roof covering appears to be Good condition. The covering does not show any leaks.
- **Access Hatch** – The primary roof access hatch measures 60" x 18". There is severe advanced deterioration of the wooden structure, and this access point should be considered unsafe. A new steel hatch structure should be installed, with the current minimum dimensions recommended by the American Water Works Association and OSHA.
- **Coating** – *Not applicable*, there is no paint coating on the exterior roof.

Exterior Reservoir Walls

- **Wall to Roof Joint** – The roof to wall joint appears to be in Fair to Good condition and is properly sealed.
- **Ladder** – There is no ladder, but a full staircase is present to access the roof. The staircase appears to be in Good condition. All the attachments, standoffs, and bolt assemblies show no major discrepancy. There is NO locking Vandal Guard on the staircase to help prevent unauthorized access to the tank. Installation is recommended.
- **Ring Panels** – The exterior view of the wall panels show a Fair to Poor condition. There are isolated areas of severe penetrating corrosion damage with areas of complete coating failure.
- **Overflow** – The overflow plumbing appears to be in Good condition. The overflow is not properly sealed with a flapper valve, gasket, or screen. Installation is recommended to prevent debris from entering the plumbing.
- **Coating** – The exterior wall panel coating is in Fair/Good condition. The identified areas of corrosion from the coating discrepancies should be touched up to prevent further corrosion damage.

Footings / Foundation

- **Footings / Foundation** – The exterior foundation is not visible. Any debris, vegetation and overgrowth should be kept clear from the foundation area to prevent unwanted settling of the tank. Any voids should be filled to prevent standing water and water infiltration.
- **Anchor Bolts** – *Not applicable*, there are no visible anchor bolts.

GENERAL TANK SECURITY

Security

- **Fencing** – The tank is surrounded by a security fence.
- **Ladders** – The ladder/staircase is NOT equipped with a locking Vandal Guard.
- **Perimeter** – The area surrounding the tank does NOT appear to be well lit.
- **Vents** – Air Vent(s) do NOT have an installed Vent Security Shroud to prevent the intentional introduction of chemical or biological contaminates. This presents significant water tank security vulnerability and should be addressed as a priority. To the best of LEC's knowledge the only known practical and cost-effective security solution is the Omega Vent Security Shroud, evaluated by the EPA and found on its website. Unless you request otherwise, LEC will have ARC³'s Omega Vent Security Shroud manufacturer contact you in order to provide detailed information to assist you in addressing this security vulnerability.
- **Hatches** – The hatch is NOT equipped with an electronic monitoring device. Installation of such a system is recommended to assist in securing the tank from unauthorized personnel.

SUMMARY

The overall **INTERIOR** condition of the tank appears to be Poor to Critical overall. Recommendations follow:

- There is extensive degradation to the interior of this tank, noted in the above sections and supplemental video and other documentation. **It is the opinion of Liquid Engineering Corporation that this tank is no longer structurally sound, and the tank should be immediately taken out of service - for safety reasons. There is almost certainly too much damage to allow rehabilitation of the tank, and a new tank will likely have to be constructed. It is imperative that a licensed structural engineer assess if this tank can possibly be rehabilitated, or if it should be decommissioned. These decisions should be made immediately. In the event of a seismic event of any significant magnitude, it is our opinion that this tank would likely experience a total structural failure. It is highly recommended that this tank, if absolutely necessary to keep in service, should in the normal course of operation, contain a significantly reduced quantity of water, in order to reduce loads on the failed roof support structure and the severely corroded wall structure.**

  After rehabilitation or replacement tank is completed, the following recommendations should be implemented:
- Installation of a cathodic protection system is recommended, as this technology would prevent corrosion formation under the water line.
- Due to the placement of the plumbing, the reservoir water is not mixing adequately for turnover. This will allow thermal stratification of the water, stagnant water from dead zones, disinfection byproducts to form, and there may be a loss of disinfectant residual in the upper layers of the water. An active mixing system should be installed to prevent stratification, and allow the disinfectant residual to mix thoroughly in the entire water column. Call Liquid Engineering Corp. for options and pricing.
- The utility should clean and inspect the tank every 3 years per AWWA recommendation, which will prevent biological growth in the sediment, and allow opportunity to make touch up repairs to help extend the life of the tank.

The overall **EXTERIOR** condition of the tank appears to be Fair. Recommendations follow:

- The exterior panels appear to be in Fair/Good condition overall. There is severe corrosion in isolated areas of the panels and bolted lap joints, so touch up repair is recommended to prevent further corrosion damage. This inspection should take place again at the recommended 3 year interval per the American Water Works Association.
- The foundation area is impossible to assess. Any debris, vegetation and overgrowth should be kept clear from the foundation area to prevent unwanted settling of the tank. Any voids should be filled to prevent standing water and water infiltration.
- The general tank security condition should be upgraded to include an electronic monitoring device on the hatch, a locking Vandal Guard on the ladder, additional perimeter lighting, and a Vent Security Shroud (see above security section for details).

(As a disinterested third-party inspector, LEC does not engage in the construction or rehabilitation of potable water storage facilities. LEC will, in its commitment to our clients and upon request, identify to the client relevant entities that are professionally reliable and best capable of completing the recommended work, or assist the client in research tips that will enable them to make a decision that best serves the utility.)

DISCLAIMER

Unless otherwise noted, the findings documented in this report were neither prepared by nor reviewed by a Licensed Professional Engineer.

APPENDIX A

Photographs

Example of dealloyed steel from the wall panels, lying on the floor

Example of heavy rust noduling on the interior wall

Interior plumbing in lower wall (note heavy amount of corrosion)

Example of a wall support, and the wooden beam that has detached

Example of a large piece of dealloyed steel fallen from the interior wall (approx. 2' x 1' piece)

Example of heavy dealloying on the interior wall panels

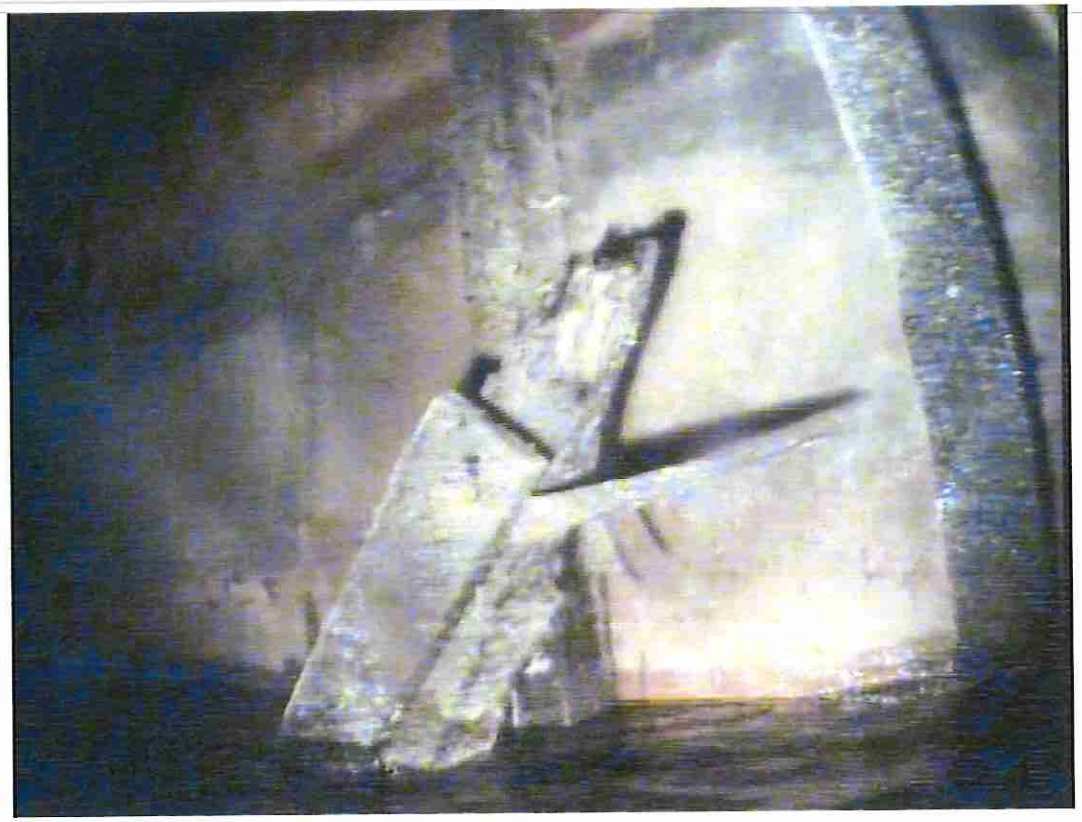
Example of corroded hardware and missing wood support on the interior wall column

Interior wooden wall column (many pieces of broken wood have fallen from the structure)

Interior wooden roof (many pieces of broken wood have fallen from the structure)

Example of an interior floor column with failed lateral wood supports

Example of a failed wooden support



Fractured and failed supports lying on the tank floor

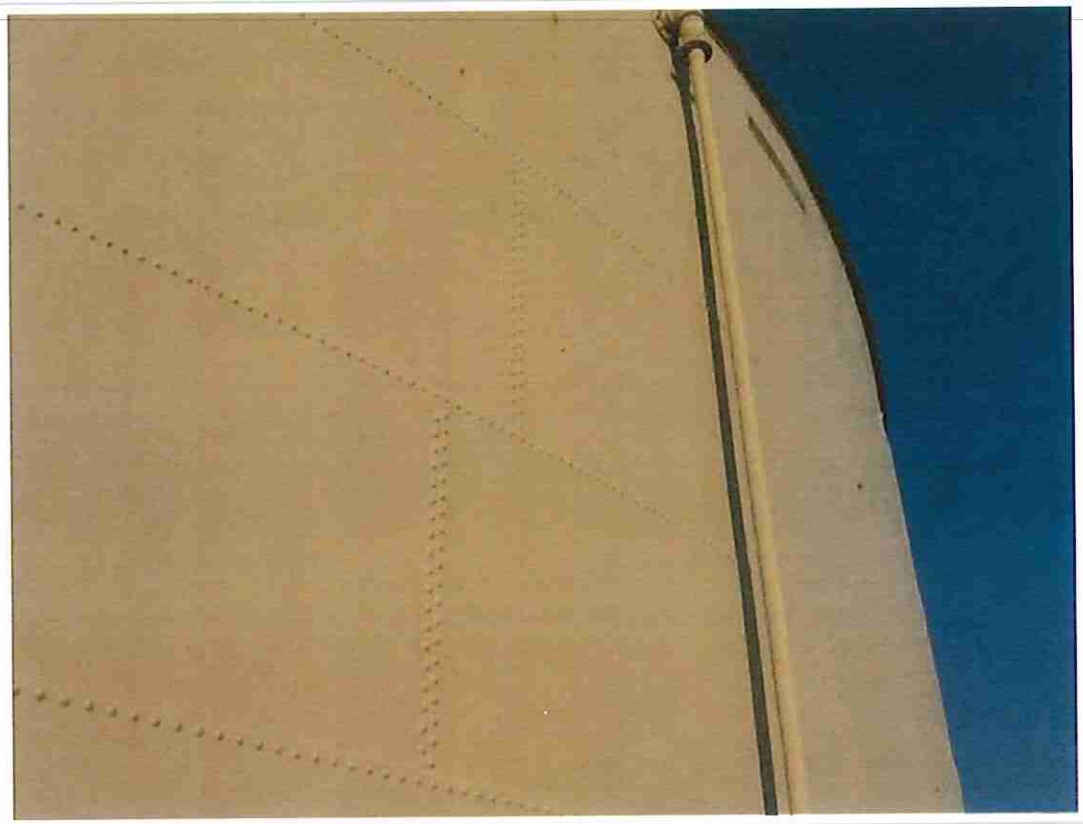
Example of corroded hardware and missing wood supports on a center support column

Example of heavy dealloying corrosion on the interior wall

Exterior ladder

Example of corrosion on the exterior wall rivet/panel with visible water penetration

Exterior walls and overflow penetration



Lower walls and overflow plumbing

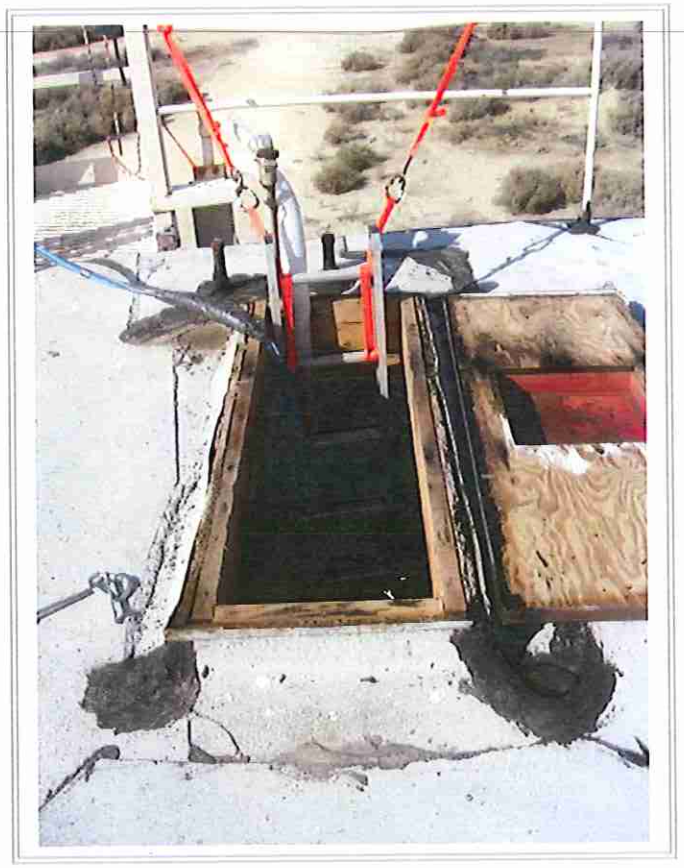
Exterior plumbing

Exterior plumbing penetration into the lower wall (note advanced severe corrosion damage)

Exterior center roof vent with severe corrosion

Close up view of the center roof vent

Exterior view of the roof hatch



Exterior view of the roof covering (Note sagging roof panels)

APPENDIX B

Liquid Engineering Corporation

Steel Potable Water Reservoir Inspection Report

Job Number: 44412 | Utility: LOST HILLS UTILITY DISTRICT | Tank: WESTERN TANK

Inspector: B. ADAMS | Dive Controller: C. FROMM | Date: 1/19/2013

AMERICAN WATER WORKS ASSOCIATION
ANSI/AWWA M42 / D101-53

SSPC Legend

Grade	Description
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

NACE Legend

Grade	Description
A	None
B	Uniform Surface Corrosion
C	Pitting
D	Concentration Cell Corrosion
E	Galvanic Corrosion
F	Stress Corrosion Cracking
G	Erosion Corrosion
H	Intergranular Corrosion
I	Dealloying

AWS Legend

Grade	Description
L	Satisfactory
M	Spatter
N	Porosity
O	Convexity / Concavity
P	Cracks
Q	Inclusions
R	Incomplete Fusion
S	Incomplete Penetration
T	Undercut
U	Underfill
V	Overlap
W	Unable to evaluate

INTERIOR RESERVOIR ROOF

SEE SUPPLEMENTAL REPORT

	QUADRANT 1			QUADRANT 2			QUADRANT 3			QUADRANT 4		
	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Vents	3	B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roof Panels	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roof Support	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
~~Roof Gussets~~	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
~~Painting Ring~~	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Overall Coating Rating Fair | Average Blister Diameter NONE | Average Pit Depth NONE

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☑ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

ROOF IS WOOD CONSTRUCTED AND IN FAIR CONDITION, RECOMMEND FINE MESH SCREEN FOR THE VENT

INTERIOR RESERVOIR WALLS

	QUADRANT 1			QUADRANT 2			QUADRANT 3			QUADRANT 4		
	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Wall to Roof ~~weld~~ SEAM	0	B,I	N/A	0	B,I	N/A	0	B,I	N/A	0	B,I	N/A
Lower Ring Panels	0	D,I,C	N/A	0	D,I,C	N/A	0	D,I,C	N/A	0	D,I,C	N/A
Middle Ring Panels	0	D,I,C	N/A	0	D,I,C	N/A	0	D,I,C	N/A	0	D,I,C	N/A
Upper Ring Panels	0	B,I	N/A	0	B,I	N/A	0	B,I	N/A	0	B,I	N/A
~~Interior Ladder~~	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Overall Coating Rating Poor | Average Blister Diameter NONE | Average Pit Depth 1/4"

Coating Deficiencies: Blistering ☐ Delamination ☑ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☑

INTERIOR RESERVOIR FLOOR CONCRETE

	QUADRANT 1			QUADRANT 2			QUADRANT 3			QUADRANT 4		
	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
~~Perimeter Weld~~ CONCRETE	N/A	D,X	N/A	N/A	D,X	N/A	N/A	D,X	N/A	N/A	D,X	N/A
Floor Panels	N/A	D,X	N/A	N/A	D,X	N/A	N/A	D,X	N/A	N/A	D,X	N/A

Overall Coating Rating Fair | Average Blister Diameter NONE | Average Pit Depth NONE

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

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Liquid Engineering Corporation

Steel Potable Water Reservoir Inspection Report

Job Number: 44412 | Utility: LOST HILLS UTILITY DISTRICT | Tank: WESTERN TANK

Inspector: B. ADAMS | Dive Controller: C. FROMM | Date: 1/19/2013

INTERIOR RESERVOIR SUPPORT COLUMNS

-SEE SUPPLEMENTAL REPORT

	QUADRANT 1			QUADRANT 2			QUADRANT 3			QUADRANT 4		
	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Column Structures	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Column Bases	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Column to Roof	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Overall Coating Rating ---- Average Blister Diameter Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☑ Growth ☐ Pinholes ☐ Staining ☐ Sags/Runs ☐

INTERIOR RESERVOIR PLUMBING COMPONENTS

	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Inlet Plumbing	2	D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Outlet Plumbing	2	D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manways	N/A	N/A	N/A	2	D	W	N/A	N/A	N/A	N/A	N/A	N/A
Floor Drains	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Interior Overflow	N/A	N/A	N/A	2	D	W	N/A	N/A	N/A	N/A	N/A	N/A

EXTERIOR RESERVOIR ROOF WOOD CONSTRUCTION

	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Vents	2	B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roof Panels	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Access Hatches	0	B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Overall Coating Rating Good Average Blister Diameter NONE Average Pit Depth NONE

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

ROOF IS WOOD AND APPEARS TO BE IN OVERALL SATISFACTORY CONDITION

WOOD AROUND ACCESS HATCH IS BEGINING TO DETERIORATE

EXTERIOR RESERVOIR WALLS

	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Wall to Roof Weld	9	B	N/A	9	B	N/A	9	B	N/A	9	B	N/A
Lower Ring Panels	9	B	N/A	9	B	N/A	9	B	N/A	9	B	N/A
Mid Ring Panels	9	B	N/A	9	B	N/A	9	B	N/A	9	B	N/A
Upper Ring Panels	9	B	N/A	9	B	N/A	9	B	N/A	9	B	N/A
Exterior Overflow	N/A	N/A	N/A	10	A	L	N/A	N/A	N/A	N/A	N/A	N/A

Overall Coating Rating Good Average Blister Diameter NONE Average Pit Depth NONE

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

FOOTINGS / FOUNDATION

Footings / Foundations:	Satisfactory ☑	Cracking ☐	Spalling ☐	Erosion/Exposed Aggregate ☐
Anchor Bolts:	Satisfactory ☑	Loose ☐	Rusted Corroded ☐	(If excessive) Diameter =

TOWER SUPPORT STRUCTURES

Tower Legs/Columns:	Satisfactory ☐	Alignment ----	Settling ----	Rust /Corrosion ----
Riser Pipe:	Satisfactory ☐	Alignment ----	Frost Casing ----	Rust /Corrosion ----
Rods & Turnbuckles:	Satisfactory ☐	Turnbuckle Tension ----	Rod Tension ----	Cotter Pins/Rod Nuts ----
Leg shoes/Brackets:	Satisfactory ☐	Coating ----	Rust/Corrosion ----	Pitting/Cracking ----

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Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report

Job Number: 44412 | Utility: LOST HILLS UTILITY DISTRICT | Tank: WESTERN TANK

Inspector: B. ADAMS | Dive Controller: C. FROMM | Date: 1/19/2013

Complies With: AWWA • OSHA • ANSI • NIOSH • NAVFAC • NFPAC

CONTAMINATION & HEALTH

Air Vents	Type: Mushroom	#: 1	Screen Condition(s): Good	
Hatches	Type: Square	#: 2	Secured Properly: Yes	Properly Sealed: Yes
Exterior Overflow	Flapper: No	Screen: No	Gasket: No	Condition: Good
~~**Cathodic Covers**~~	~~In- Place: ----~~	~~#: ----~~	~~Gasket: ----~~	~~Properly Sealed: ----~~
Roof to Wall Joint	Welded: No	Properly Sealed: Yes		
Roof Integrity	Holes: No	Cracking: No	Standing Water: No	
Wall Integrity	Holes: No	Cracking: No		
Manway Integrity	Leaks: No	Condition: Good		
Water Clarity	General Appearance: Good			Odor: None
Floating Surface Debris	Type: None			Source: N/A
~~**Hypalon Floating Cover**~~	~~Condition: ----~~	~~Holes: ----~~	~~Tears: ----~~	
Telemetry Penetrations	Properly Sealed: Yes			

FACILITY SAFETY COMPLIANCE

Exterior ~~Ladder~~ STAIRS

Overall Ladder	Condition: Good	#: 1	Offset Landing: No	Height: 30'	
Vandal Guard	Present: Yes	Vandal Guard Locked: Yes			
Ladder Rails & Rungs	Condition: Good	Missing/Damaged Rungs: No			
~~**Rung Spacing & Depth**~~	~~Spacing: in. *(max 12")*~~	~~Toe Depth: in. *(min 7")*~~			
Rail Spacing & Size	Width: 3 in. *(min 2")*	Thickness: 1/4 in. *(min 1/4")*	Rail to Rail: in.*(min 16")*		
Safety Climb System	Type: None	Condition: ----			
Number & Locations	Wall: 1	Leg:	Roof:	Riser Pipe:	Other:
Ladder Attachments	WELDED				

Manways

Type and size	Type: Round	#: 1	Size: 20.5	inches *(24" – 18'x22" min)*
Support Structure	Type: Bolted	Condition: Good		
Number & Locations	Wall: 1	Roof:	Riser Pipe:	Other:

Hatches

Hatch Type & Size	Type: Square	#: 1	Size: 17X17	in. *(24" – 24"x15" min)*
Hatch & Lid Lip Height	Hatch: 2 in. *(min 4")*	Lid: 1 in. *(min 2")*		

Balconies & Railing

Deck / Walkways	Condition: Good	Width: 36			
Hand Rails	Condition: Good	Height: 42	in. *(min 42")*	No. Rails: 2	*(min 2)*
Toe Rail	Condition: Good	Height: 4	in. *(min 4")*		
Welds / Attachments	Condition: Good				

Roof

Safety Tie-Off Points	Condition: Good	#: 1+
~~**Antennas**~~	~~Type: -------~~	~~#: ----~~

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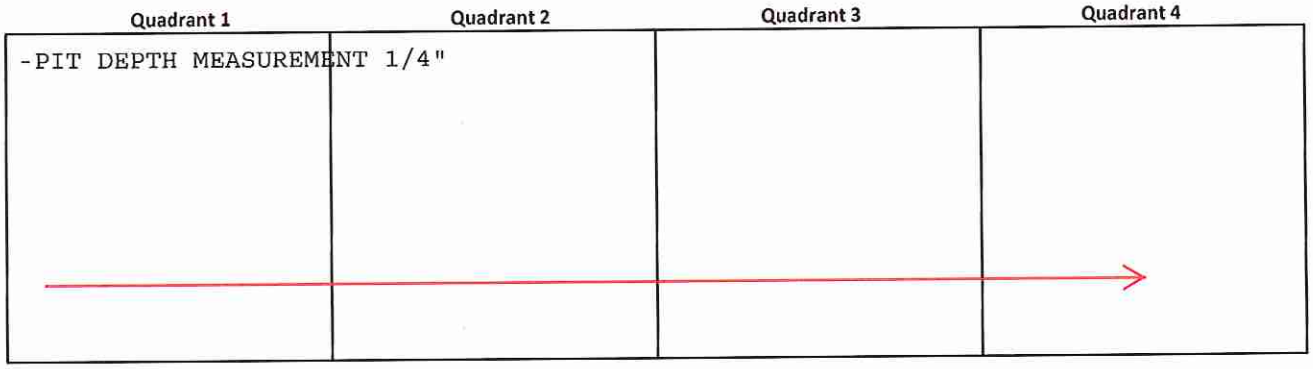
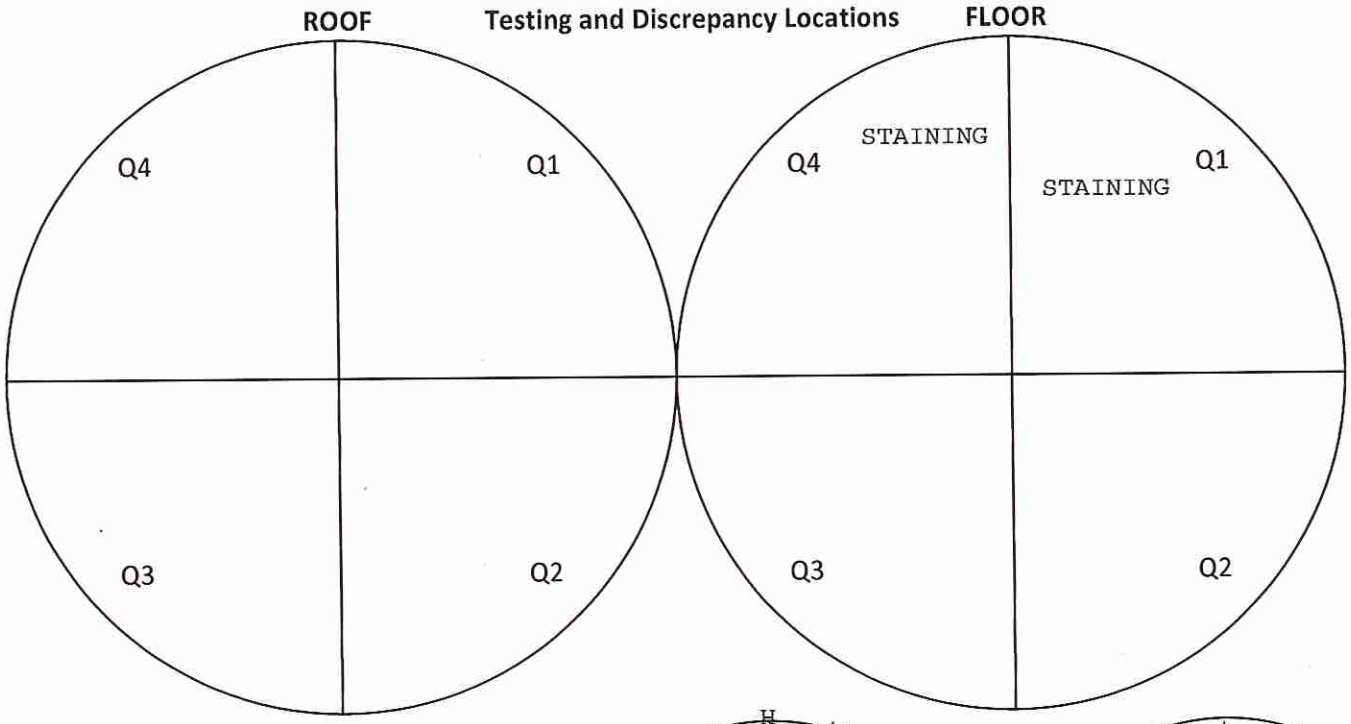
Liquid Engineering Corporation

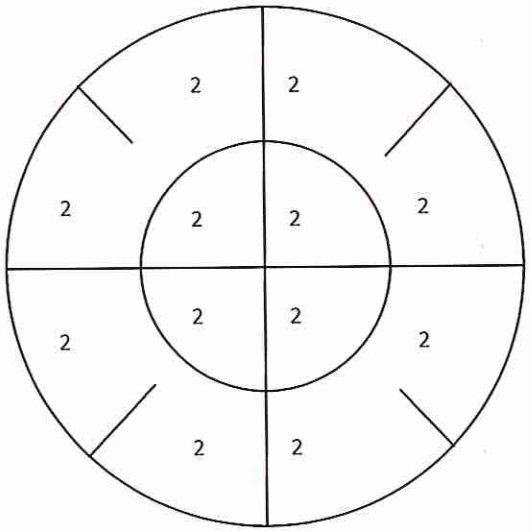
Circular Tank Diagram / Information Worksheet

Job Number 44412 Utility Name LOST HILLS UTILITY DISTRICT Tank Name WESTERN TANK



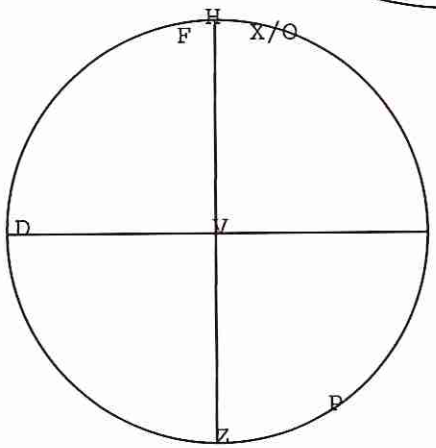
Testing and Discrepancy Locations





Sediment Depth Measurements

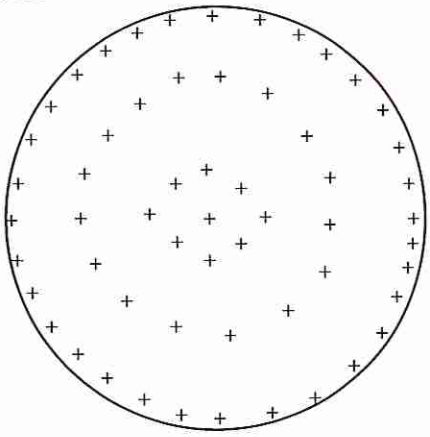
Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken



Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry



Column Placement

Type of Column

Base Structure

Top Structure

Column Construction ------

Avg. Depth 2" **Cubic Yardage** **Sediment Type** SAND/IRON/WOOD

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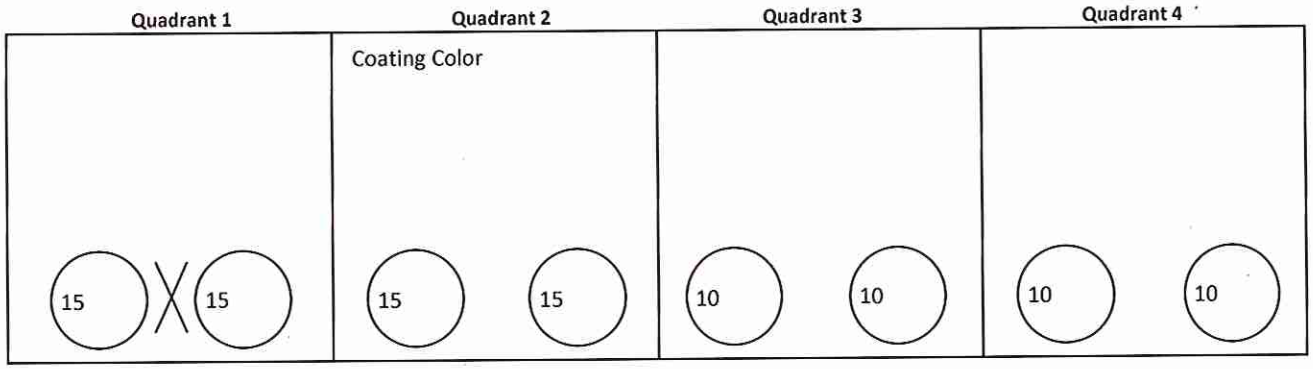
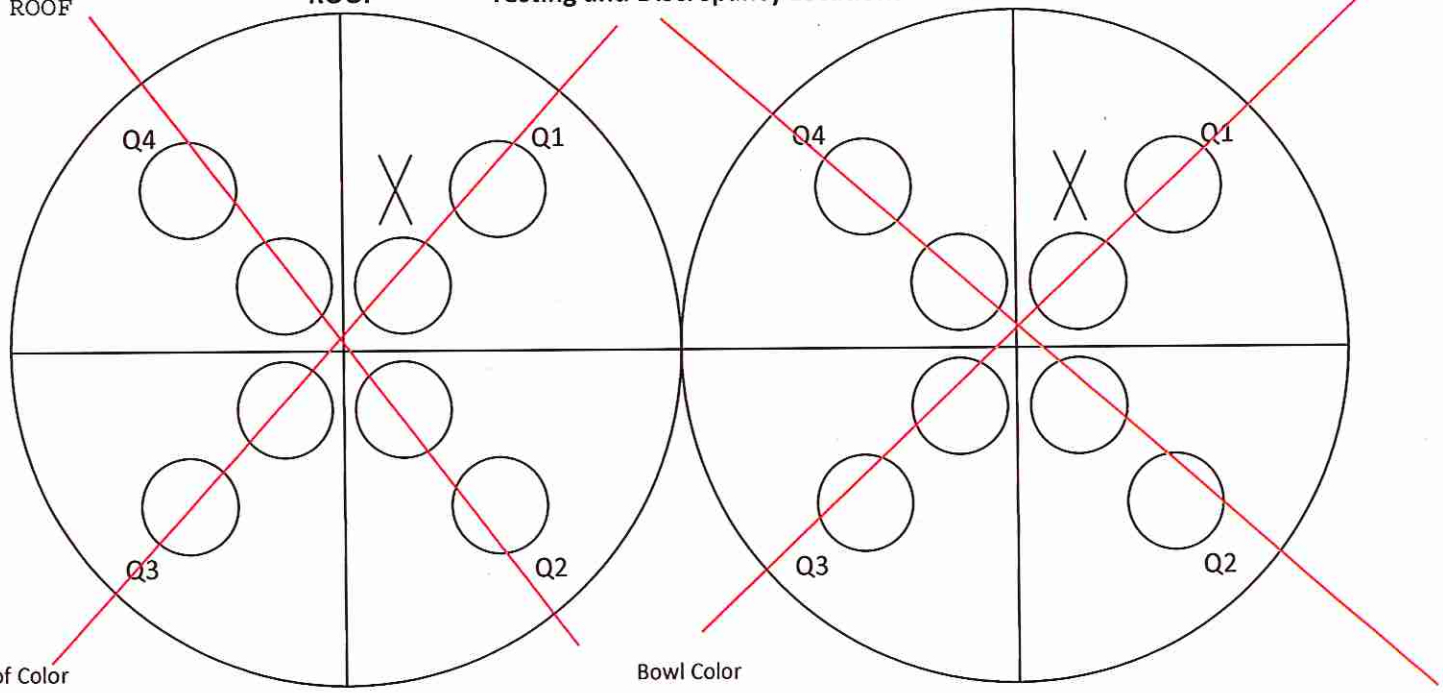
Circular Tank Diagram / NDT ☐ DFT ☑ Coating Adhesion ☐ Presence of lead ☐

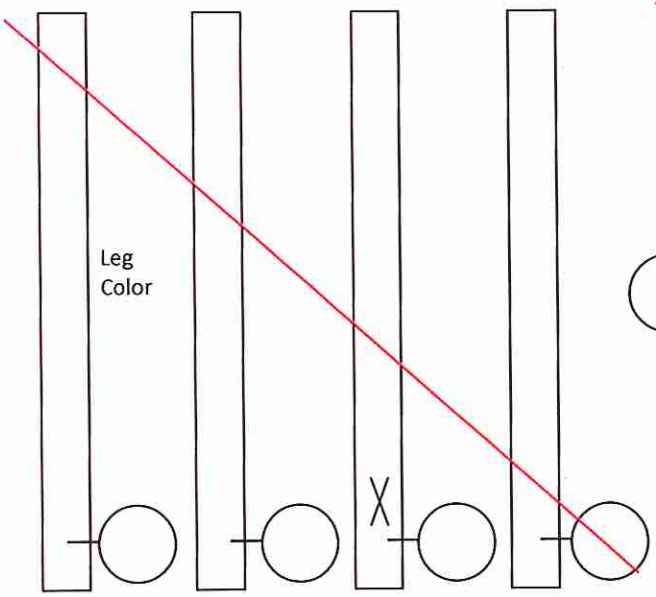
Job Number 44412 Utility Name LOST HILLS UTILITY DISTRICT Tank Name WESTERN TANK

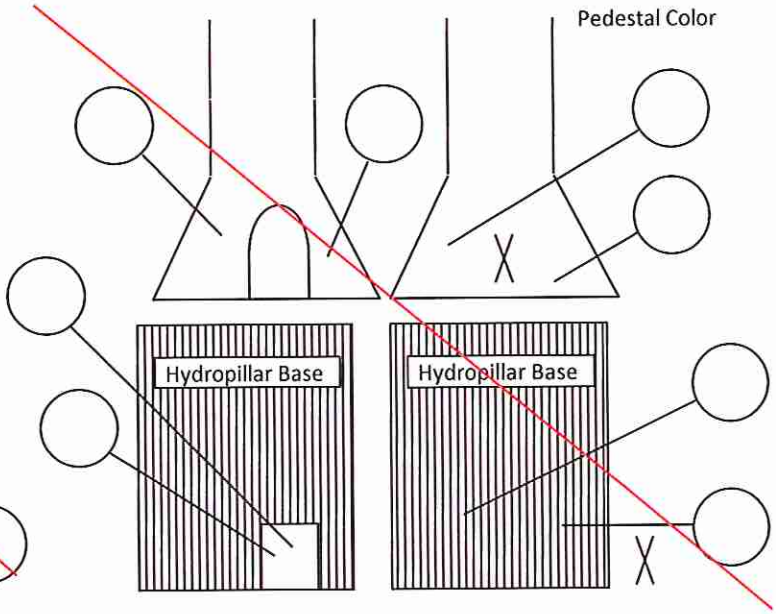


WOOD ROOF

ROOF **Testing and Discrepancy Locations** **BOWL**







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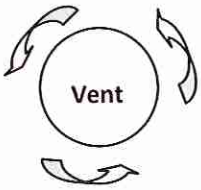
Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 44412 Utility Name LOST HILLS UTILITY DISTRICT Tank Name WESTERN TANK

Security

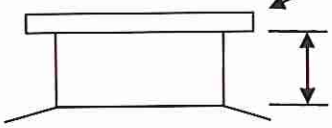
Is the area surrounding the tank well lit?	No
Is the tank surrounded by a Security Fence?	Yes
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	Yes
If so, is the Vandal Guard locked?	Yes
Are the vents equipped with security vent shrouds?	No
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	No
Does the surrounding geography of the tank obscure it from public view?	No
Does the exterior of the tank show signs of trespass?	No

Measurements



Outside Circumference

243 Inches



~~Flange Metal Thickness~~ ~~Inches~~

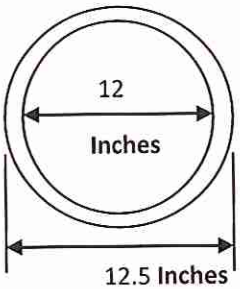
Roof to Screen or Flange 0 Inches

Flange No

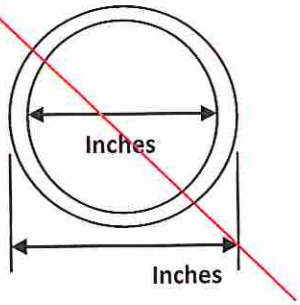
~~Number of Bolt Holes~~ ~~Inches~~

~~Size of Bolts~~ ~~Inches~~

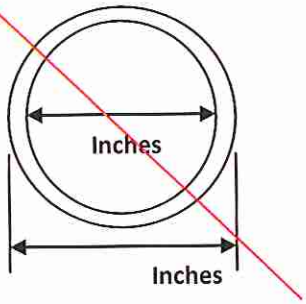
Inlet



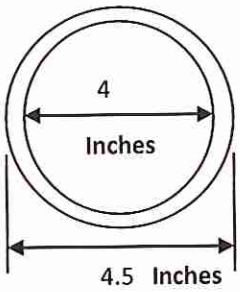
Outlet



Drain

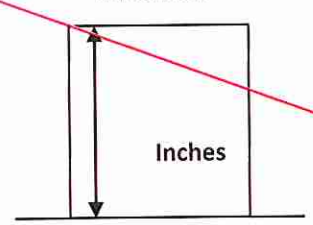


Overflow

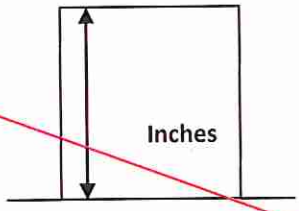


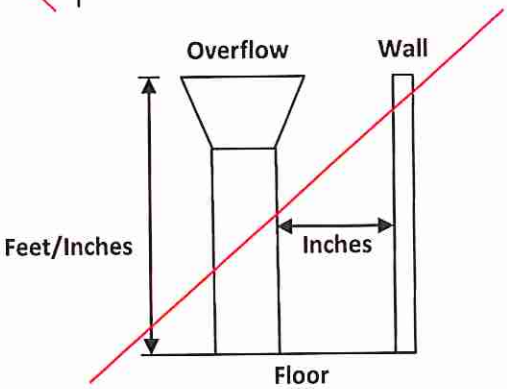
COMMON INLET/OUTLET

Inlet Riser



Outlet Riser





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Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 44412 | Utility: LOST HILLS UTILITY DISTRICT | Tank: WESTERN TANK

Inspector: B. ADAMS | Dive Controller: C. FROMM | Date: 1/19/2013

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation: NOT RECOMENDED
   - ☑ Vent Screen Repairs: RECOMENDED

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation: None Performed
   - ☐ Presence of Lead Test (Interior/Exterior): None Detected

3. **Destructive Testing Items**
   - ☐ % of Lead Test (Interior/Exterior) *(Coating samples are removed for laboratory analysis)* N/A
   - ☐ Coating Adhesion Test (Interior/Exterior): N/A

   Specific written authorization required to perform destructive testing. Destructive tests include touch-up of coating system.

4. **Repair Items**
   - ☐ Epoxy Coating Repairs: NOT RECOMENDED
   - ☐ Temporary Leak Repairs: None Needed
   - ☐ Float Operated Level Indicator Repairs / Maintenance: N/A
   - ☐ Hypalon Repairs: N/A

5. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☑ Tank vents are not equipped with a security vent shroud:
   - ☑ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Clean and Inspect Every Three Years

Security Items Mentioned Above

RECOMEND HEAVY RESTORATION OR REPLACEMENT OF RESERVOIR.

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Appendix B

Alternative Cost Estimates

Alternative 2a - Repair/Rehabilitate Tank						
Line Item	**No.**	**Unit**	**Unit Cost**	**Capital Cost**	**Unit Cost**	**O&M Cost**
Drain & Remove Sediment	1	LS	$10,000	$10,000		$0
Install New Columns	1	LS	$100,000	$100,000		
Sandblast, recoat Interior	1	LS	$160,000	$165,000		
Sandblast, recoat exterior	1	LS	$90,000	$90,000		
Temporary Tank	1	LS	$200,000	$200,000		
Mobilization/Demob/Strtup	1	LS	$51,000	$51,000		$0
Construction Subtotal				**$616,000**		**$0**
Construction Contigency (20%)				$123,200		
Construction Total				**$739,200**		
Non-Construction Costs				$161,000		
Project Total				**$900,200**		**$0**

Alternative 2b - Replace Tank						
Line Item	**No.**	**Unit**	**Unit Cost**	**Capital Cost**	**Unit Cost**	**O&M Cost**
Two Tanks (each@0.825MG)						
Mobilization	1	LS	$29,500	$26,500		
Site Work	1	LS	$53,100	$53,100		
Tank Foundations	2	EA	$49,150	$98,300		
2 - 0.83MG Tanks	2	EA	$400,000	$800,000		
Transmission Main	500	LF	$150	$75,000		
Drainage sump	1	EA	$15,000	$15,000		
Misc.	1	EA	$15,000	$15,000		
Electrical	1	EA	$20,000	$18,500		
SCADA	1	EA	$5,000	$5,000		
Construction Subtotal				**$1,106,400**		**$0**
Construction Contigency			10%	$111,000		
Construction Total				**$1,217,400**		
Non-Construction Costs				$258,000		
Project Total				**$1,475,400**		**$0**

Alternative 2c - Alternate Tank & Pump Station Location						
Line Item	**No.**	**Unit**	**Unit Cost**	**Capital Cost**	**Unit Cost**	**O&M Cost**
Two Tanks (each@0.825MG)						
Land Purchase	1.5	ACRE	$40,000	$60,000		
Mobilization	1	LS	$29,500	$26,500		
Site Work	1	LS	$53,100	$53,100		
Tank Foundations	2	EA	$49,150	$98,300		
2 - 0.83MG Tanks	2	EA	$400,000	$800,000		
Transmission Main	500	LF	$150	$75,000		
Drainage sump	1	EA	$15,000	$15,000		
Misc.	1	EA	$15,000	$15,000		
Electrical	1	EA	$20,000	$20,000		
Pump Sta. (Fire & Ops)	1	EA	$120,000	$120,000		
SCADA	1	EA	$8,000	$8,000		
Construction Subtotal				**$1,290,900**		**$0**
Construction Contigency			10%	$130,000		
Construction Total				**$1,420,900**		
Non-Construction Costs			10%	$258,000		
Project Total				**$1,678,900**		**$0**

Alternative 2a - Repair/Rehabilitate Tank						
Line Item	No.	Unit	Unit Cost	Capital Cost	Unit Cost	O&M Cost
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Install New Columns	1	LS	$100,000	$100,000		
Sandblast, recoat Interior	1	LS	$160,000	$165,000		
Sandblast, recoat exterior	1	LS	$90,000	$90,000		
Temporary Tank	1	LS	$200,000	$200,000		
Mobilization/Demob/Strtup	1	LS	$51,000	$51,000		$0
Construction Subtotal				**$616,000**		**$0**
Construction Contigency (20%)				$123,200		
Construction Total				**$739,200**		
Non-Construction Costs				$161,000		
Project Total				**$900,200**		**$0**

Alternative 2b - Replace Tank						
Line Item	No.	Unit	Unit Cost	Capital Cost	Unit Cost	O&M Cost
Two Tanks (each@0.825MG)						
Mobilization	1	LS	$29,500	$26,500		
Site Work	1	LS	$53,100	$53,100		
Tank Foundations	2	EA	$49,150	$98,300		
2 - 0.83MG Tanks	2	EA	$400,000	$800,000		
Transmission Main	500	LF	$150	$75,000		
Drainage sump	1	EA	$15,000	$15,000		
Misc.	1	EA	$15,000	$15,000		
Electrical	1	EA	$20,000	$18,500		
SCADA	1	EA	$5,000	$5,000		
Construction Subtotal				**$1,106,400**		**$0**
Construction Contigency			10%	$111,000		
Construction Total				**$1,217,400**		
Non-Construction Costs				$258,000		
Project Total				**$1,475,400**		**$0**

Alternative 2c - Alternate Tank & Pump Station Location						
Line Item	No.	Unit	Unit Cost	Capital Cost	Unit Cost	O&M Cost
Two Tanks (each@0.825MG)						
Land Purchase	1.5	ACRE	$40,000	$60,000		
Mobilization	1	LS	$29,500	$26,500		
Site Work	1	LS	$53,100	$53,100		
Tank Foundations	2	EA	$49,150	$98,300		
2 - 0.83MG Tanks	2	EA	$400,000	$800,000		
Transmission Main	500	LF	$150	$75,000		
Drainage sump	1	EA	$15,000	$15,000		
Misc.	1	EA	$15,000	$15,000		
Electrical	1	EA	$20,000	$20,000		
Pump Sta. (Fire & Ops)	1	EA	$120,000	$120,000		
SCADA	1	EA	$8,000	$8,000		
Construction Subtotal				**$1,290,900**		**$0**
Construction Contigency			10%	$130,000		
Construction Total				**$1,420,900**		
Non-Construction Costs			10%	$258,000		
Project Total				**$1,678,900**		**$0**

Attachment 1
Total Project Cost Estimate

Item		
Property Purchase / Lease Agreement		$ -
Easement Acquisition / Right of Way / Water Rights		$ -
Bond Counsel		$ 20,000
Legal Counsel		$ 5,000
Interest / Refinancing Expense		$ -
Other (Identify)		$ -
Environmental Services		
- CEQA Environmental Report	$ 4,000	
- NEPA Environmental Report	$ 2,000	
- Environmental Mitigation Contract Services		
Total Environmental Services		$ 6,000
Engineering Services		
- Preliminary Engineering Report		$ 18,000
- Preliminary and Final Design Phase		$ 90,000
- Bidding/Contract Award Phase Services		$ 20,000
- Construction & Post-Construction Phase Services (w/o inspection)		$ 45,000
- Resident Project Representative Services (resident inspector)		$ 50,000
Additional Services		
- Permitting		$ 4,500
- Regulatory Compliance Reports		$ 3,000
- Environmental Mitigation Services (Construction Phase)		$ 4,000
- Easement Acquisition/ROW's Services (Construction Phase)		$ -
- Surveying Services (Construction Phase)		$ 3,500
- Operation & Maintenance Manual(s)		$ 2,000
- Geotechnical Services		$ 12,000
- Material Testing Services (Construction Phase)		$ -
- Other Services - Advertisement		$ 6,000
Total - Engineering Services:		**$ 258,000**
Equipment/Materials (Direct Purchase using approved methods)		$ 800,000
Construction Cost Estimate		$ 216,400
Contingency		$ 169,739
Total Project Cost Estimate		**$ 1,475,139**

Preliminary Engineering Report for Well 3

DRAFT

Lost Hills Utility District

Cannon

May 2014

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Figure 5: Depth to Groundwater in T26S, R23E, Section 33
Figure 6: Comparison of Capital Cost and Non-Monetary Scoring

Acronyms

AsWTP	Arsenic Removal Water Treatment Plant
BMWD	Berrenda Mesa Water District
CDP	Census Designated Place
District	Lost Hills Utility District
gpm	gallons per minute
I-5	Interstate 5
LF	linear feet
LHUD	Lost Hills Utility District
psi	pounds per square inch
PVC	polyvinyl chloride
Town	Town of Lost Hills
VFD	variable frequency drive

1.0 Introduction

1.1 Purpose

The Lost Hills Utility District (District) has prepared a Preliminary Engineering Report (PER) for the United States Department of Agriculture's (USDA) Emergency Community Water Assistance Grant (ECWAG) to assist the District's construction of a new groundwater well to addrees short-term impacts from existing drought conditions and to provide more reliable water system infrastructure for the community.

1.2 Overview

Lost Hills is located 42 miles west-northwest of Bakersfield. The town is at the intersection of State Route 46 (SR 46) and Lost Hills Road. The Lost Hills Oil Field, which is the sixth largest by remaining reserves in California, lies west and northwest of town, extending about 10 miles along the range of the low Lost Hills Range, after which the town was named. Interstate 5 (I-5) is located near, but not adjacent, to Lost Hills. A rest stop by I-5 including restaurants, gasoline stations, and motels is located about 1 mile east from the town. A vicinity map is shown in Figure 1: Vicinity Map.

Lost Hills Utility District (District) provides water and sewer to the residents of the Town of Lost Hills, CA, (Town). The District provides water service to the I-5 Travel Center (east of the Town, along Hwy 46 on the west side of I-5) and residential, commercial, and industrial customers that were formerly part of the Berrenda Mesa Water District (BMWD). The District took over the BMWD domestic water system in 2013, and it is now part of the District's water system.

The District was formed in 1980 to provide sewer services to the Town of Lost Hills. In 1989, the District took over a water system built in the 1950s by an oil company that was active in the Lost Hills area. The primary system included two wells, one storage reservoir, one fire water tank with a booster station, and transmission and distribution pipelines. Water underlying the Town is not potable so the wells are located approximately 12 miles east of the Town and within the Semitropic Water District.

The water transmission main was in a state of disrepair at the time, and the District has made several upgrades since then, including upsize and replacement of the transmission main, upsize and replacement of some distribution pipelines, rehabilitation of both wells, and addition of an arsenic treatment system. The BMWD domestic water system includes a booster pump station near the District's storage reservoir, 18 miles of pipeline, and three distribution tanks, each with booster pump stations.

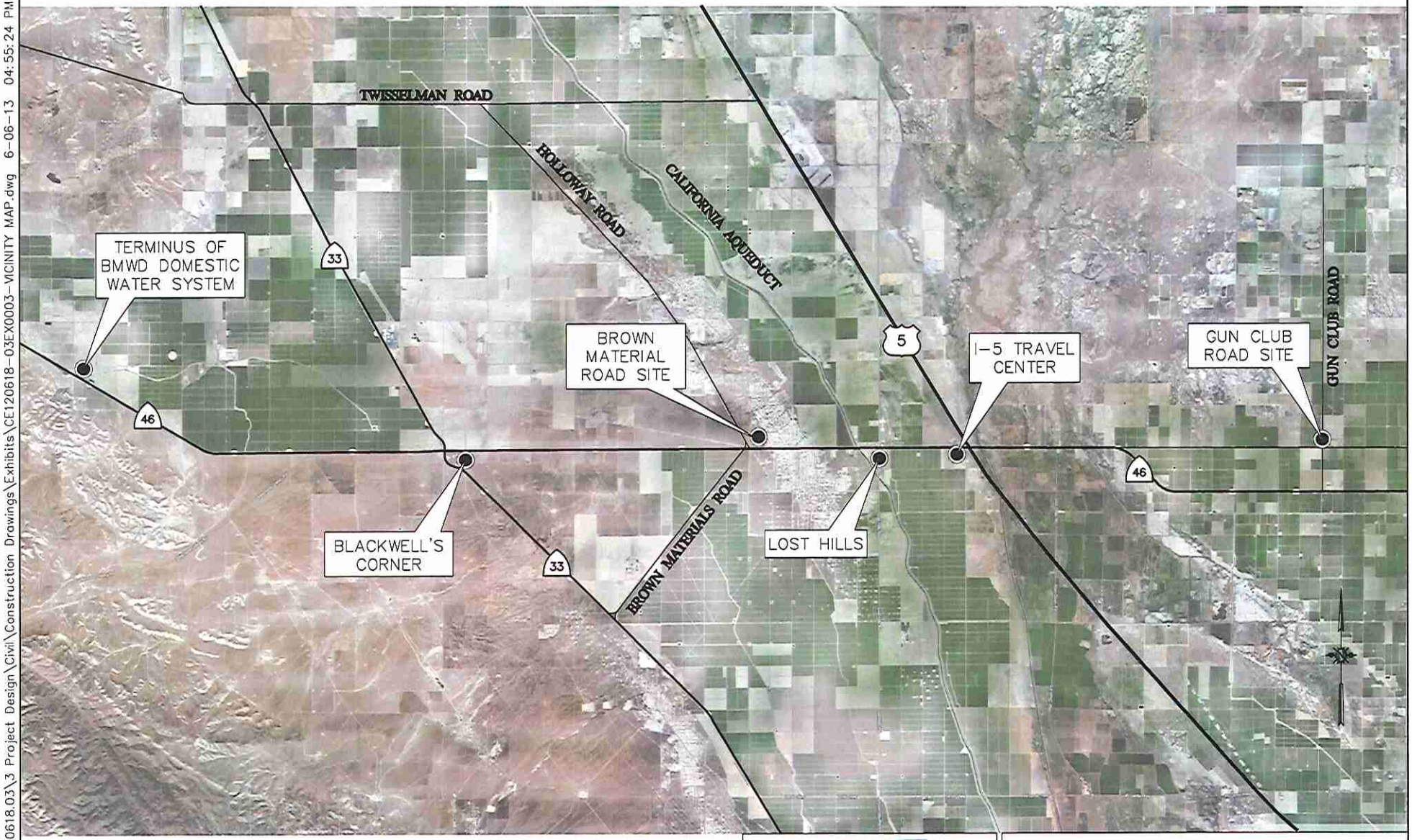
1.3 Project Location

As shown in Figure 3: New Well Site, the proposed Well 3 project site is located approximately 1,000 feet east of the existing East Well. The project site is located in the south half of the southwest quarter of Section 33 Township 26 south, Range 23 east, Mount Diablo Base Meridian. It is on the east side of the and adjacent to Gun Club Road, north of State Highway 46 and approximately 12 miles east of the community of Lost Hills in Kern County, California. The site is located on the western side of an 80-acre property owned by the District.

1.4 Environmental Resources Present

The District has not prepared a California Environmental Quality Act (CEQA) document for the proposed project yet. The document will be prepared during the Project's design phase. The District did complete Initial Study and Negative Declaration (IS/ND) in November 2004 (Jones and Stokes) for construction of the Arsenic Water Treatment Plant (AsWTP), which is located within 500 feet of the two existing wells. In addition, the District recently completed a Biological Reconnaissance Survey (McCormick Biological, 2013) for AsWTP dewatering facility additions. The content of this section is based on information included in each of these reports. The 80 acre site for the existing well, WTP and proposed wells is:

- Situated on deep ancient San Joaquin Valley Alluvium and alluvium of the Poso Creek fan.



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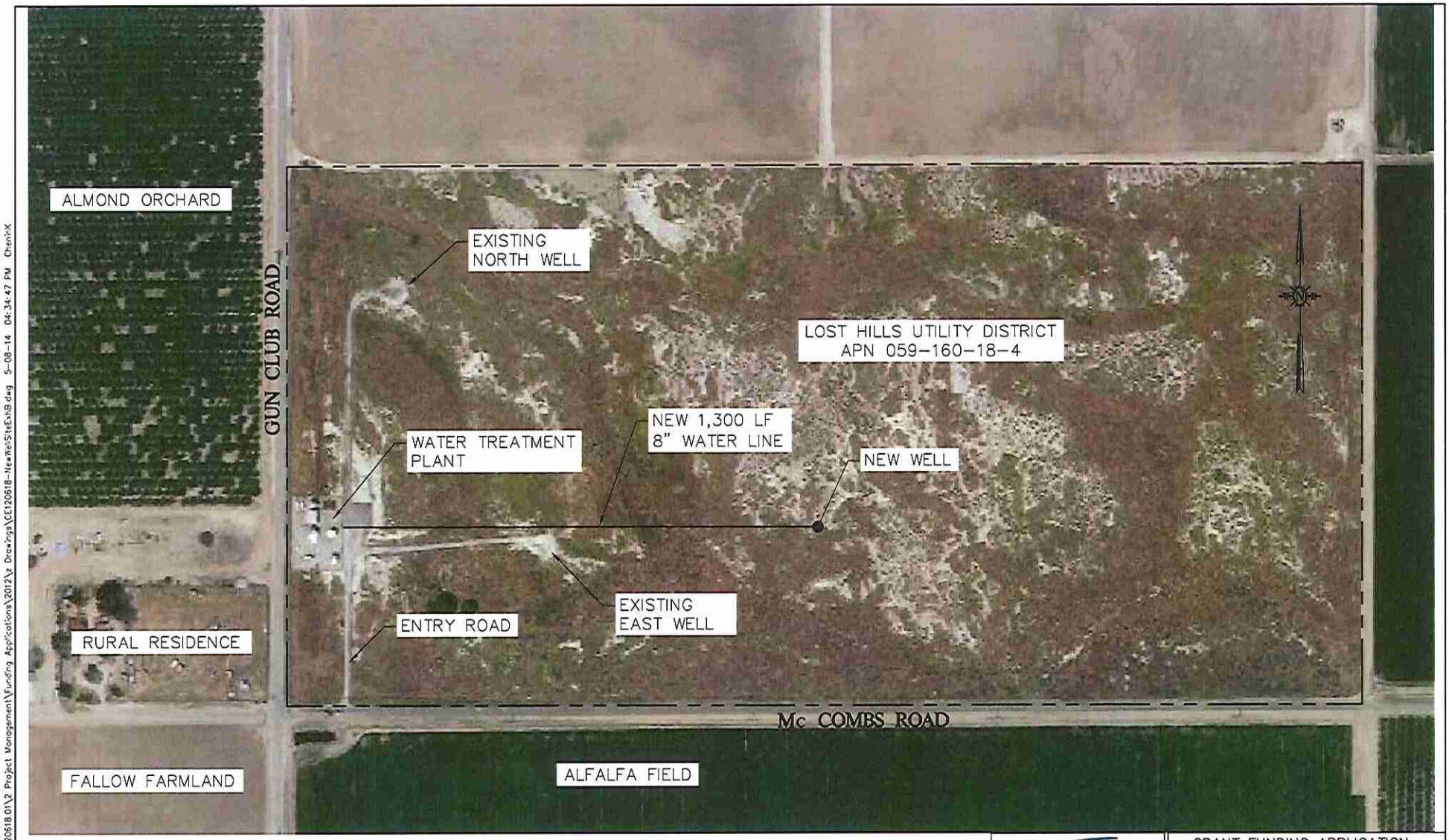
VICINITY MAP
FIGURE 1
LOST HILLS, CALIFORNIA

DRAWN BY	DATE	CA JOB NO.
CKM	06/06/13	120618.03
CHECKED BY	SCALE	SHEET
	NTS	1 OF 1

F:\proj\2012\120618\120618.03\3 Project Design\Civil\Construction Drawings\Exhibits\CE120618-03EX0003-VICINITY MAP.dwg 6-06-13 04:55:24 PM chenini



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GRANT FUNDING APPLICATION
NEW WELL SITE
FIGURE 3
LOST HILLS, CA

DRAWN BY	DATE	CA JOB NO.
AMK	10/30/2012	120618.01
CHECKED BY	SCALE	SHEET
	NTS	1 OF 1

F:\proj\2012\120618\120618.01\2 Project Management\Funding Applications\2012\2 Drawings\CE120618-NewWellSiteExhB.dwg 5-08-14 04:34:47 PM ChenKX

- Situated on deep ancient San Joaquin Valley Alluvium and alluvium of the Poso Creek fan.
- Located in an area known as the Semitropic ridge at an elevation of approximately 250 feet above mean sea level.
- Natural slope of the land is approximately 1 to 2 percent.
- Located within FEMA flood category Zone C, which is considered an area of minimal flooding.
- Soils are shown on NRCS soil maps as being Garces silt loam and Milham sandy loam. Both are well drained soils
- Native vegetation is mostly valley saltbush or alkali scrub and non-native annual grasses
- With the exception of the 80 acres owned by the District, the property in the vicinity is being actively farmed
- The 80-acre site owned by the District is characterized mostly as disturbed (ruderal) akali scrubland

The 2004 AsWTP IS/ND identified six special-status species that have the potential to occur within the AsWTP project site. The IS/ND summary of potential environmental impacts stated:

After close examination of the issues indicated in the CEQA Checklist and Initial Study – especially Biological Resources, Hydrology and Water Quality, and Hazards and Hazardous Materials – it is determined that there are no potential environmental impacts. The proposed project incorporates design and operational measures and pre-construction surveys and construction monitoring efforts to avoid any potential impacts. Therefore, the proposed project is self-mitigating and no significant adverse impacts are anticipated.

Lastly, the Biological Reconnaissance Survey for expansion of the AsWTP dewatering facility found no evidence of any listed or special-status species during the field survey and that "it is very unlikely that the project would result in direct impacts to special status species within the identified [AsWTP Dewatering] project footprint." Several measures were identified to avoid potential adverse impacts to special-status species, primarily:

- Contractor orientation on local special-status species and habitat requirements
- Pre-construction biological survey

As discussed above, an IS/ND is expected for the new Well 3 project. The IS/ND can be prepared and circulated in the fall/winter 2015, during the design phase, should this project is moved forward.

2.0 Existing Facilities

2.1 Existing System Components

The District's existing water system consists of four primary components:

- Gun Club Road Site (Wells and Treatment)
- Town and I-5 Travel Center Distribution System
- Brown Material Road Site (Distribution Reservoir and BMWD Booster Pumps)
- BMWD Domestic Water Distribution System

A schematic of the system is shown Figure 2: Water System Schematic.

2.1.1 Gun Club Road Site / Proposed Well 3 Location

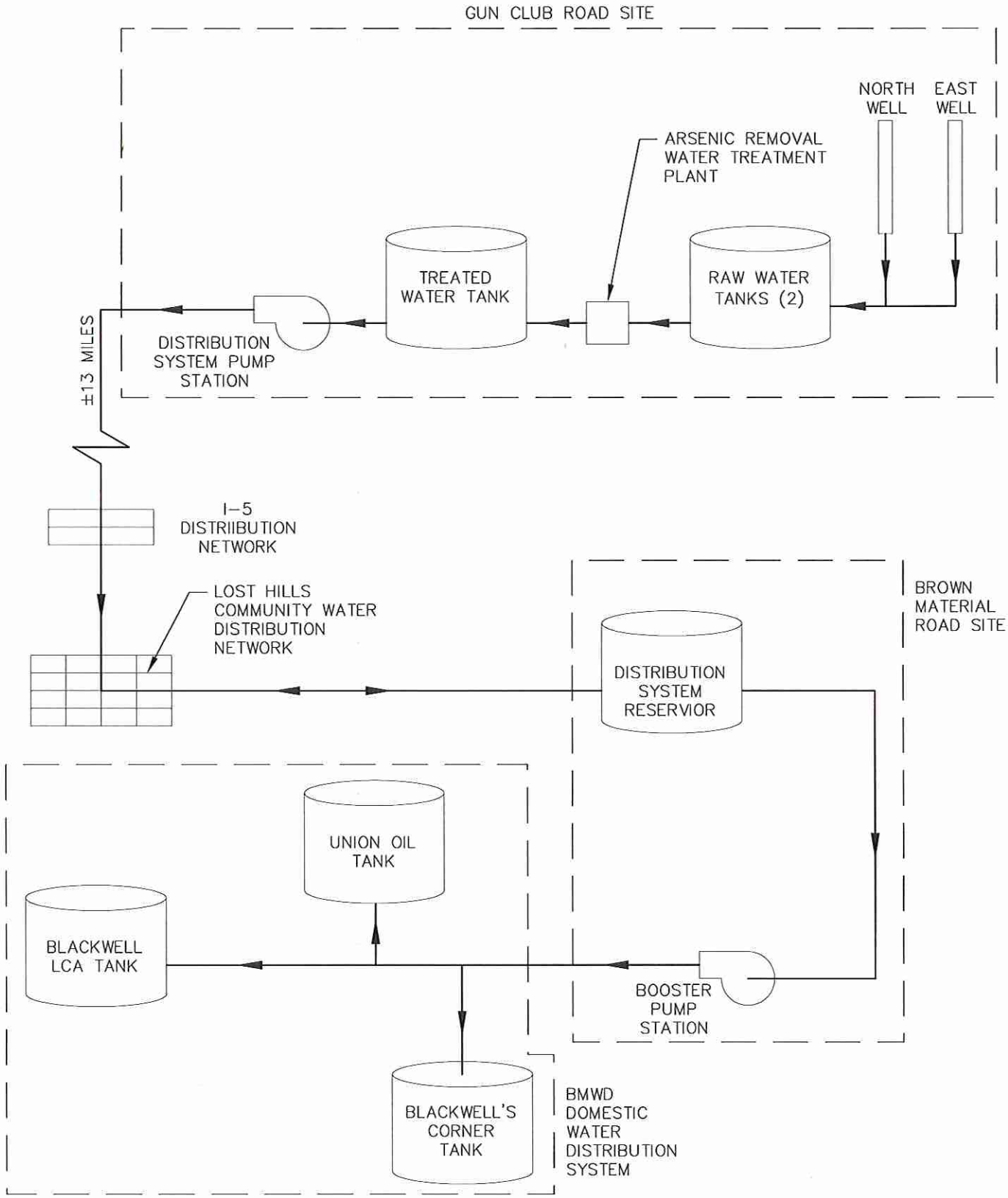
The Gun Club Road Site provides the water supply for the District and is located approximately 12 miles east of the Town. The facilities include two wells, raw water tanks, Arsenic Removal Water Treatment Plant (AsWTP), treated water tank, and distribution system pumps.

Two wells – North Well and East Well – pump groundwater from what is locally known as the lower or confined layer, which is a substantial clay layer at approximately 300 feet. Poor water quality exists above layer, and the water quality beneath the layer is adequate but deteriorates with depth. The wells are sited approximately 10 miles east of the Town due to groundwater with high total dissolved solids concentrations in the west side of San Joaquin Valley. High levels of arsenic occur locally and appear to be associated with lakebed areas that exist along the west side of the Valley. Concentrations vary from just below 10 ppb to 50 ppb and instigated the need for construction of the AsWTP in 2008.

The East Well was constructed in 1954 at a depth of 615 feet, and the North Well was drilled in 1988 to a depth of 623 feet and screened from 450 feet to 600 feet. Static water depth ranges between 200 and 300 below ground surface. Both well pumps are 75 hp and have a rated flow of 500 gpm at total design head of 384 feet. Generally, the East Well produces groundwater with lower arsenic concentrations than the groundwater produced by the North Well. Both wells were rehabilitated in 2008, including a new pump and replacement of worn columns, tubes, and shafts. The well was also pressure wash and motor rehabilitated.

Table 1: Groundwater Supply

	North Well	East Well	Well 3 (Proposed)
Pumping/Flow Rate (gpm)	520	560	300-800
Pump Motor Size (HP)	75	75	50-100
Current Water Table (ft bgs)	327[a]	317[b]	~317
Pump Depth (ft bgs)	420	420	520
Well Depth (ft bgs)	625	615	800
Screened Interval Depth (ft bgs)	450 - 600	450 - 600	TBD
Well Yield (gpm)	450[a]	450[a]	800
Well Casing Material	steel	steel	steel
Well Casing Diameter (in)	14	14	16
Age (years)	26	62	-



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WATER SYSTEM SCHEMATIC
FIGURE 2
LOST HILLS, CALIFORNIA

DRAWN BY	DATE	CA JOB NO.
KK	06/06/13	120618.03
CHECKED BY	SCALE	SHEET
	NTS	1 OF 1

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Regulatory Contaminants	Arsenic	Arsenic	Arsenic[d]

TBD To be determined during design / well development

Notes:

a. Measurement taken in December 2013.
b. Measurement taken in April 2014.
c. Existing well yields have fallen in recent years as the groundwater table has dropped.
d. Arsenic may be present at the new well location but the District intends to conduct zone pumping during well development and screen the well to minimize intake of high arsenic groundwater.

Recently, the District spent approximately $60,000 for minor improvements to the two existing wells. Work at the North Well and East well included:

- Removed pump from well
- Cleaned and tore down pump, tube, and shaft
- Replaced worn pump parts
- Repaired and replaced worn tube and shaft
- Replacement of 140 ft of 6" pump column pipe for the East Well
- Reassembled pump, tube, and shaft

Pumped groundwater is conveyed to two 42,000-gallon raw water tanks. One tank was added with the construction of the AsWTP, and the other tank was constructed in 1988. The tanks provide operational storage upstream of the AsWTP. The second tank was added as part of AsWTP project for redundancy to allow for shutdown of the either tank for repairs or rehabilitation.

The AsWTP is an Oxidation-Filtration Water Treatment System that commenced operation in 2008 to address the high levels of naturally occurring arsenic in the groundwater supply. The treatment component consists of two 625-gpm filter vessels. Two filters provide redundancy for O&M and flexibility of operating one or both wells. The AsWTP is operated to achieve final treated water arsenic concentration of less than 10 ppb and is designed to reduce concentrations to 8 ppb to provide a safety factor.

The AsWTP product water is stored in an 84,000-gallon Treated Water Tank. Water quality compliance testing occurs at the outlet of the tank. Two 375-gpm Distribution System Pumps feed the Town and I-5 Travel Center Distribution System, which is described in the following section.

Emergency Operations Plan

The District is currently implementing an Emergency Operations Plan to ensure the water system can operate with the Brown Material Road Reservoir offline. The plan includes installation of:

- Third Distribution System Pump with variable frequency drive (VFD); pump design flow of approximately 450 gpm is based on system analysis results in Section 4.3.1.
- VFD for one of two existing Distribution System Pumps
- An automatic transfer switch for connecting a mobile emergency generator at Gun Club Road Site facilities in case of power loss
- Plans for rental of an emergency generator when necessary

2.1.2 Town and I-5 Travel Center Distribution System

The Town and I-5 Travel Center (Town/I-5) distribution system consists of a 12-inch-diameter polyvinyl chloride (PVC) transmission pipeline that forms the backbone of the system. The line was installed in 1993 to replace the 8-inch transmission pipeline when the District took over the water system in 1989.

The distribution system within the Town consists of 2- to 10-inch pipelines, and the distribution system within the I-5 Travel Center consists of 6- to 8-inch pipelines. In 1999, approximately 17,000 LF of undersized pipelines within the Town were replaced with 8-inch pipelines as part of the Fire Loop Protection System to enable sufficient fire flow. Four-inch pipelines are typically the smallest size constructed under current distribution system standards for fire flow. Therefore, the Town's 2-inch pipelines are slated for replacement in the future. Plans have already been and will be implemented as funds are available.

2.1.3 Brown Material Road Site

The Brown Material Road Site is located approximately 3 miles west of the Town and includes a 2.2-MG distribution reservoir feeding the Town/I-5 distribution system and BMWD booster pumps. The Distribution System Reservoir is part of the system that the District took over in 1989. The reservoir lies approximately 100 feet higher than the Town and can provide low-pressure gravity supply back to the Town (100 feet of pressure is equivalent to approximately 40 psi). In January 2013, the District commissioned a reservoir inspection that determined the reservoir to be in dire need of repair or replacement. Replacement of the reservoir is discussed in Section xx. Until the rehabilitation or replacement of the existing reservoir, the District is implementing an Emergency Operations Plan to ensure the water system can operate without the reservoir.

2.1.4 BMWD Domestic Water Distribution System

The District took over ownership and operations of the BMWD Domestic Water Distribution System in 2013. The system consists of a booster pump station adjacent to the Brown Material Road Reservoir, approximately 18 miles of distribution pipeline, and three storage tanks, each with booster pump stations for local distribution. Approximately 49,000 LF of 6-inch PVC pipeline and 9,000 LF of 4-inch PVC pipeline were installed in 2011/12 to replace existing deteriorated pipe installed in the 1950s. The remainder of the distribution system pipeline consists of approximately 7 miles of 3- and 4-inch PVC pipe installed in the mid-1980s to replace the 1950s pipe. The LHUD has serviced this system with water since the creation of the water system in Lost Hills and BMWD operated the Domestic Water Distribution system.

The BMWD Domestic Water Pump Station consists of two, 50-gpm pumps and a single 100-gpm pump, all of which were installed in 2012. The three storage tanks with booster pump stations are: 1) Blackwell's Corner Tank; 2) Union Oil Tank; and 3) Blackwell LCA Tank. Blackwell's Corner Tank serves residential and commercial customers at the intersection of Hwy 46 and 33 and is approximately 6,500 LF south of the backbone pipeline. The Blackwell LCA Tank is at the end of the system, and the Union Oil Tank is approximately 3 miles from the Blackwell LCA Tank.

The District used to operate two pipelines from the booster pumps: 1) Belridge pipeline to customers south of Hwy 46; and 2) North pipeline to residential and commercial customers north of Hwy 46. Service to these lines was abandoned in 2010.

The District will continue to deliver water to Chevron north from the booster pump station, but the demand is small (less than 1 AFY).

2.1.5 Operations

The District's system operates based on set points monitored by the SCADA System, which was overhauled in 2008. The system operates based on three primary inputs:

- The well pumps operate based on level set points in Raw Water Tanks.
- The distribution system pumps operate based on levels in the Brown Material Road Reservoir. The Distribution System Reservoir has a maximum operating water level of 21 feet and a low operating water level of 17 feet.

- The BMWD domestic water system pumps operate based on BMWD domestic water system pressure of 191 psi. The pressure decreases as the distribution system storage tanks fill to meet local demands.

2.1.6 Surface Water

The District does not currently use any surface water for potable use. However, two of the largest irrigation areas within the District – Lost Hills Park and Lost Hills Elementary School – use untreated water from the State Water Project. The water supplied is not part of the District's water system.

2.1.7 Water Quality

As discussed above, the Arsenic Water Treatment Plant commenced operation in 2008 to address the high levels of naturally occurring arsenic in the groundwater supply. The AsWTP has been successful in reducing arsenic to below 8 ppb.

The District plans to conduct zone testing during development of the proposed new Well 3 to try to minimize pumping of zone of arsenic. The existing wells were constructed prior to the arsenic issue arising so they are screened continuously for approximately 150 feet. Selective screening could potentially reduce the arsenic concentration in pumped groundwater and the use of the AsWTP.

2.2 Water Demand

2.2.1 Historical Water Demand

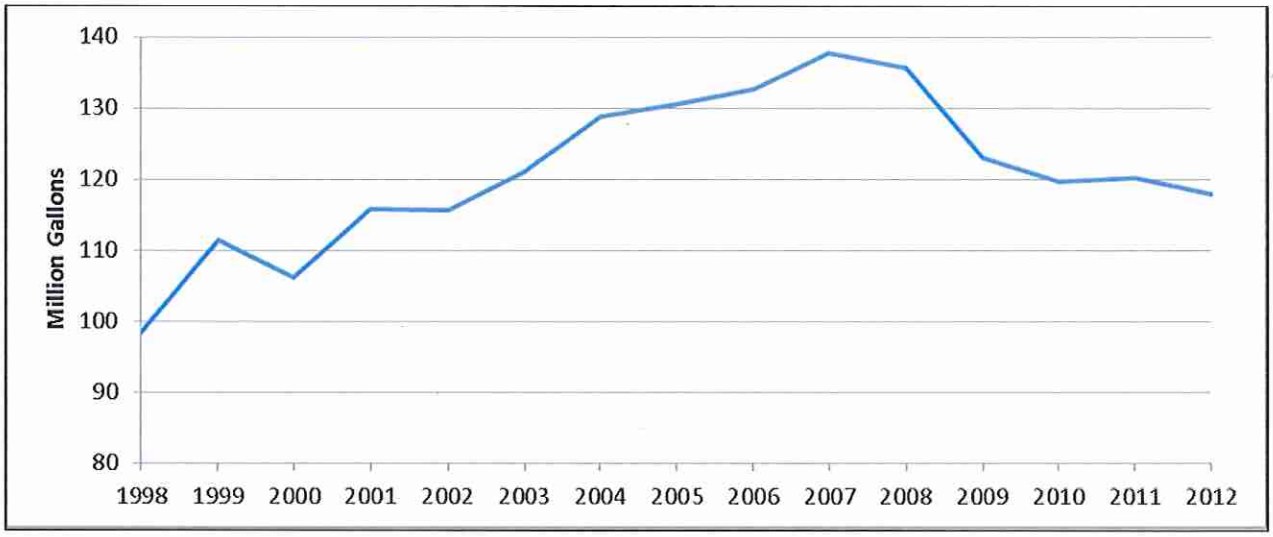
The District's water use comprises three primary demand groups:

- Residential and commercial use in the Town
- Commercial Use at the I-5 Travel Center
- Sales to residential, commercial, agricultural, and industrial customers to the west of the Brown Material Road reservoir, including Berrenda Mesa Water District (BMWD)[1] and Chevron

Historically, the Town accounts for roughly 60% of total District water use, I-5 Travel Center roughly 30%, and BMWD roughly 10%. The District's average annual water use over the past 15 years is 125 MG. Since 2002, the District's total annual water use has fluctuated between a low of 116 million gallons (MG) in 2001 to a peak of 138 MG in 2007, as shown in Figure 3. Total water use in 2010 and 2011 averaged approximately 120 MG per year and, of that, the Town has averaged approximately 72 MG per year.

[1] As discussed in Section 1, the District recently took over operations of the BMWD domestic water system.

Figure 3: Historical District Annual Water Use (Million Gallons per Year)



The range in historical average annual growth can be attributed to:

- Housing market correction and economic downturn starting in 2007, which eliminated housing growth, increased unemployment, and reduced transportation-related commercial activity
- No growth within the former BMWD service area due to limited water supply
- Elimination of delivery to several connections located west of the service area (Belridge and North lines)
- Reduced purchases by BMWD in 2009 as they switched to untreated SWP water for some of their non-potable water uses
- Decreased BMWD sales in 2012 after the reduction of water losses following replacement of 11 miles of deteriorated pipe

The latter three items are expected to remain in effect into the future; however, going forward, an economic and housing recovery is expected to contribute to future growth in water demand. Additionally, all three major components of the District's demand – Town, I-5 Travel Center, and BMWD Area – are expected to grow in the future through a combination of expansion within existing planning limits and through annexation.

2.2.2 *Projected Water Demand*

Projected water demand was estimated to increase at a rate of 1.8% per year in the Water System Master Plan (Cannon, January 2014) after an analysis of historical water use, historical population growth, historical per-capita water use, and remaining, infill and buildout development. Existing and future (buildout / 2030) demand conditions are summarized below.

Table 2: District Water Use Scenarios

Scenario	Basis	Existing		Future (2030)	
		120 MG/Yr		171 MG/Yr	
		MGD	gpm	MGD	gpm
Average Annual Demand		0.33	229	0.47	326
Max Month Demand (MMD)	Notes 1 & 2	0.54	375	0.77	535

Max Day Demand (MDD)	1.5 x MMD	0.80	558	1.15	797
Peak Hour Demand (PHD)	1.5 x MDD	1.20	837	1.72	1,195
MDD plus Fire Flow - Residential		MDD plus 1,000 gpm for 2 hours in Town			
MDD plus Fire Flow - Commercial		MDD plus 1,500 gpm for 2 hours at I-5 Center			

Notes:
1. Existing MMD based on 16.6 MG in August 2007 (Max Month since 2000)
2. 2030 MMD calculated by applying ratio of Existing MMD:AAD to 2030 AAD.

2.2.3 *Equivalent Dwelling Units / Unit Water Use*

The existing gallons per capita per day (gpcd) water use for the District is approximately 136 gpcd based on District water use of 120 MG in 2010 and Lost Hills CDP population of 2,412 in 2010.The 2020 targeted daily per-capita water use value established for the Tulare Lake hydrologic region is 188 gallons gpcd (Kennedy Jenks, 2011), so the District's water use is well within targeted use for the region.

Water use in an equivalent dwelling unit (EDU) basis is summarized below.

Table 3: Equivalent Dwelling Unit Estimates

	Average Total Use		Number of Connections	Average Use per Connection		Number of EDUs
	Annual	Monthly		Monthly	Daily	
User Type	**MG**	**MG**	**#**	**Gallons**	**Gallons**	**#**
Residential (Single-Family)	42.0	3.5	299	11,706	385	299
Multi-Family Residential	16.2	1.4	3	450,000	14,795	115
Commercial/ Institutional	65.6	5.5	85	64,314	2,114	467
Total	**123.8**		**387**			**881**

Notes: Based on actual use in 2013 as reported to the California Department of Water Resources on DWR Form 38 – Public Water System Statistics.

2.3 System Analysis

The District's two existing wells (with a combined capacity of 1,000 gpm) can meet the existing and future MDD (560 gpm and 800 gpm, respectively). However, water systems using only groundwater should be able to meet MDD with the highest capacity well offline (per California Waterworks Standards Section 64554), and one existing 500-gpm well does not meet this standard under existing conditions. The "existing" MDD occurred in 2007, and total demand has decreased by nearly 15% since 2007. A 15% decrease to the MDD from 2007 results in a revised "existing" MDD of 480 gpm. On this basis, either of the wells can meet this demand on its own under current conditions. However, a third well with a minimum 300-gpm capacity will be needed as new demands are added to the existing system.

Table 4: Max Day Demand vs. Well Capacity

Existing MDD	480 gpm to 560 gpm	**Existing:** One well can meet existing MDD under historical operating conditions; however, lower groundwater levels have

Future MDD	800 gpm	reduced existing well production. New pumps may need to be installed in the existing wells to maintain historic production. **Future:** An additional 300 gpm of pumping capacity is needed in addition to both of the existing wells operating at 500 gpm. An alternative approach is a new 500 gpm well that becomes the primary well and reduces reliance on the aging existing wells by relying on just one of the existing wells to meet future MDD.
North Well Production	530 gpm	
East Well Production	560 gpm	

3.0 Need for Project

The District has little control over management of their groundwater basin since agricultural pumping surrounds the community and agricultural pumping far exceeds the District's groundwater production. The District does not have any alternative water supplies to groundwater so the District must be conservative in anticipating groundwater basin issues affecting their sole water supply, such as significant decreases in groundwater levels. The groundwater levels for Section 33 of T26S, R23E are plotted below.

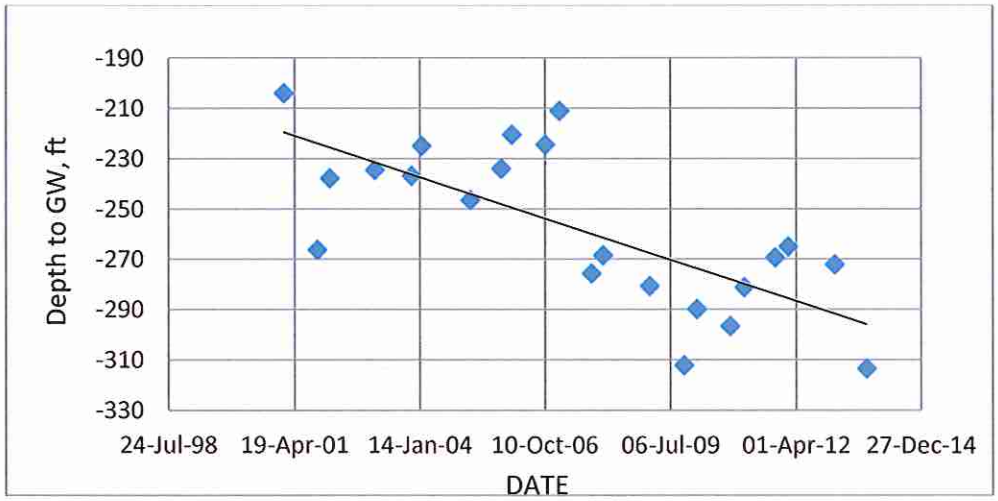


Figure 4: Depth to Groundwater in T26S, R23E, Section 33

(data provided by the Kern County Water Agency)

The District recently completed a Water System Master Plan that identified the need for a new well to meet maximum day demand (MDD) with the highest capacity well offline[2] and in case of significant failure of the East Well. The District currently meets the MDD capacity requirement but expects to require additional pumping capacity in the near future when water demand increases as the general economy improves and housing development restarts. A new well is ranked as the second highest priority project in the Master Plan. The highest priority project is replacement of the existing distribution system storage tank, which is in urgent need of repair and is currently in the project design phase.

The master plan did not address near-term impacts from the current drought, which has resulted in static groundwater levels decreasing by over 100 feet in the past 12 years (see graph below). Groundwater levels while pumping at the District's existing wells are within 70 feet of the pump net pressure suction head (NPSH) limit. NPSH is the minimum head above the pump inlet required to keep the pump from cavitating. The District staff measured the water table in December 2013 and April 2014. The depth to water table is 327 ft bgs in the North Well and 317 ft bgs in the east well.

The existing well pumps will be at risk of failure if groundwater levels continue to drop. To avoid this possibility, the District will need to lower the pump column and add pump bowls to increase the pump head output.

In addition, the drop in water levels has reduced flows from each well as the existing pumps have to increase total head. Reduced flows from the existing wells causes the District to be at risk of meeting MDD with the highest capacity well offline – particularly during the upcoming high demand season during

[2] California Waterworks Standards, Section 54554

the summer. In summary, to deal with lowering groundwater levels, the District will likely need to lower the pump column and add bowls to the existing pump to be able to pump but flows will be lower than historically and the District risks being unable to meet MDD with the highest capacity well offline.

The District could take the opportunity of lowering the pump column to install a new pump that is capable of providing higher flows to address meeting MDD. This approach costs more than just adding pump bowls but would provide more certainty for flow to meet existing demand conditions.

Finally, the District could construct a new well that is at adequate depth and with adequate flow capacity to address existing and future needs. This approach will cost more than the short-term fixes discussed above but will also address existing as well as future flow capacity shortfalls.

In addition, the well would be developed using zone testing to minimize the arsenic concentration being pumped. The existing wells were developed prior to the knowledge of the arsenic issue so the District has little control over arsenic concentrations being produced from existing wells. A new well has the potential to reduce the need for arsenic treatment and reduce the associated AsWTP O&M costs.

3.1 Water Conservation

The District has passed Ordinance May 1, 2014 which restricts the use of water in the following areas.

- Unattended outdoor watering is prohibited.
- Unattended hose must have a nozzle with automatic shutoff.
- Unattended hose nozzle must be in the off-position

The ordinance establishes the right to terminate and/or restrict water to water service connections outside the district boundaries. There are currently several water users outside the water service area (primarily west of lost hills).

The two largest irrigation areas within the District – Lost Hills Park and Lost Hills Middle School (K-8) – use untreated surface water from the State Water Project. The water supplied is not part of the District's water system. The Lost Hills Park implemented the use of the surface water over the last several years while the school has utilized surface water for many years. Additionally, the BMWD domestic water system was upgraded as described in Section 2.1.4. As a result, the system reduced water consumption by approximately 50 percent (or 5 MG). This is mainly attributed to the replacement of the 60 year old steel water transmission main that had reoccurring leaks.

As shown in Section 2.2, the peak water use for the LHUD occurred in 2007 and has experienced a steady decline. Although this cannot be attributed to a single effort, the 2013 annual water use is approximately 10% less than the 2007 water use of 137.9 MG.

4.0 Alternatives Considered

The drought conditions have caused groundwater levels to decrease severely in the vicinity of the District's wells. The decreased water levels have raised two primary urgent issues for the District:

- The existing well pumps will be at risk of failure if groundwater levels drop below minimum NPSH.
- Reduced flows from each existing well because the existing pumps have to increase total head, which causes the District to be at risk of meeting MDD with the highest capacity well offline,

In addition, the Master Plan identified the need for new well production capacity in the near-term to relieve use of the aging existing wells and to meet future MDD.

To address immediate issues caused by the falling groundwater levels, the District could:

- Lower the pump column and add pump bowls to increase the pump head output and restore historical well production capacity
- Lower the pump column and install a new pump to increase upon historical well production capacity

Another approach is to address longer-term issues at the same time that immediate issues are addressed. For example, the District could:

- Construct a new well that is at adequate depth and with adequate flow capacity to address existing and future needs.
- Acquire SWP rights and construct a WTP
- Import groundwater pumped by the City of Wasco, which is the closest municipal water supplier and located approximately 9 miles to the east

TABLE 5 below summarizes the alternatives considered to address the water supply issues caused by the drought conditions. The table is organized into the five categories identified in the PER guidance document.

Table 5: Alternatives Considered

Categories	Alternatives
(1) optimize the current facilities operation (no construction)	None identified
(2) upgrade the current facilities operation	Alternative 2a – Repair / Rehabilitate Well Alternative 2b – Deepen Well / Add Bowl(s) Alternative 2c – Deepen Well / Replace Pumps
(3) develop new source(s) of supply	Alternative 3b – New Well 3 Alternative 3b – State Water Project
(4) interconnect with other existing systems	Alternative 4 – Wasco Connections
(5) build new facilities for regional/joint management use	None Identified

4.1 Alternative 2a – Repair / Rehabilitate Existing Wells

Recently, the District spent approximately $60,000 for minor improvements to the two existing wells. Work at the North Well and East well included:

- Removed pump from well
- Cleaned and tore down pump, tube, and shaft

- Replaced worn pump parts
- Repaired and replaced worn tube and shaft
- Replacement of 140 ft of 6" pump column pipe for the East Well
- Reassembled pump, tube, and shaft

These actions increase the reliability of the two existing wells but do not address the water supply threats caused by falling groundwater levels.

4.2 Alternative 2b – Deepen Existing Wells / Add Bowl(s)

In order to test the existing well capacities, a field test can be conducted on the existing wells by replacing the existing motors with a mobile engine and gearbox. This will allow running the wells at a higher speed. Pactically speaking the existing system may only produce an additional 100 gpm maximum without over stressing the Column, Tube, & Shaft. This pump test will determine the potential for capacity increasing.

Lowering the pump column avoids the risk of well pump failure resulting from water levels dropping below the NPSH level. Adding pump bowls increases the pump head output to restore historical pumping capacity (500 gpm) and avoid the risk of being unable to meet MDD with the highest capacity well offline. The technical feasibility of the alternative considers that:

- Water quantity should not be an issue as long as the pump remains sufficiently below groundwater levels.
- Water quality will likely continue to be an issue due to the presence of arsenic in the groundwater. The existing wells were constructed prior to the arsenic issue arising so they are screened continuously for approximately 150 feet.
- No agreements are needed to implement this alternative.
- Design parameters include
    - Deepening the pump column for each well by 100 feet
    - Adding one or more pump bowls to each well pump to increase total dynamic head from the pump to restore production to 500 gpm
    - Motor upgrades to handle the increased horsepower requirements
- No direct or indirect environmental impacts are anticipated other than temporary construction impacts. The project is likely Categorically Exempt from CEQA since it is considered maintenance of existing facilities.
- No additional land is required.
- No potential construction problems have been identified since the project consists of improvements to existing facilities.

Based on the information listed above, the alternative is technically feasible.

4.3 Alternative 2c – Deepen Existing Wells / Replace Pumps

In order to test the existing well capacities, a field test can be conducted on the existing wells by replacing the existing motors with a mobile engine and gearbox. This will allow running the wells at a higher speed. Pactically speaking the existing system may only produce an additional 100 gpm maximum without over stressing the Column, Tube, & Shaft. This pump test will determine the potential for capacity increasing.

The District could take the opportunity of lowering the pump column described in Alternative 2b to install a new pump that is capable of providing higher flows than 500 gpm to address meeting future increases to MDD.

The technical feasibility of the alternative considers that:

- Water quantity should not be an issue as long as the pump remains sufficiently below groundwater levels.
- Water quality will likely continue to be an issue due to the presence of arsenic in the groundwater. The existing wells were constructed prior to the arsenic issue arising so they are screened continuously for approximately 150 feet.
- Design parameters include
    - Deepening the pump column for each well by 100 feet
    - Adding one or more pump bowls to each well pump to increase total dynamic head from the pump to increase production to 600 gpm
    - Motor upgrades to handle the increased horsepower requirements
- No direct or indirect environmental impacts are anticipated other than temporary construction impacts. The project is likely Categorically Exempt from CEQA since it is considered maintenance of existing facilities.
- No additional land is required.
- No potential construction problems have been identified since the project consists of improvements to existing facilities.

Based on the information listed above, the alternative is technically feasible.

4.4 Alternative 3a – New Well 3

This alternative proposes installation of new well approximately 500 feet east of the existing East Well. The new well would be sized to provide 300 to 800 gpm of flow with a 40hp to 100 hp motor, which accounts for the recent decrease in groundwater levels. The new well would serve multiple purposes:

- Provide adequate flows to meet existing MDD at current groundwater levels.
- Reduce reliance on 60+ year old East Well and, as a result, increase reliability of meeting increases to future MDD
- Reduce use of wells producing high arsenic concentrations

The technical feasibility of the alternative considers that:

- Water quantity should not be an issue since the pump will be located well below existing groundwater levels. Pumping from the new well will directly reduce pumping from the existing wells. The only increase to pumping will result from increased water demands over time as residential, commercial, and industrial activities grow within the District.
- Water quality may continue to be an issue due to the presence of arsenic in the groundwater. However, the District plans to conduct zone testing during development of the new well to try to minimize pumping of zone(s) of arsenic. Selective screening could potentially reduce the arsenic concentration in pumped groundwater and the associated cost of operating the AsWTP.
- Design parameters include
    - Develop well to a depth of 800 feet and 16 feet diameter
    - Place pump at approximately 540 feet
    - Screened intervals to be determined based on zone testing.
    - New motor (40 to 100 hp depending on capacity)
    - New 8-in diameter pipeline from the well to the existing AsWTP raw water tanks
    - Receipt of well development approval from CDPH

- No direct or indirect environmental impacts are anticipated other than temporary construction impacts. A Initial Study/Negative Declaration is anticipated with similar findings and measures required as for the recent AsWTP dewatering expansion project, which includes:
    - No evidence of any listed or special-status species during the field survey and that "it is very unlikely that the project would result in direct impacts to special status species within the identified project footprint."
    - Contractor orientation on local special-status species and habitat requirements
    - Pre-construction biological survey
- The District already owns the land surrounding the proposed project site.
- No potential construction problems have been identified since the District (and local contractors) has experience developing similar wells in the area. Also, the well and installation of the pipeline (approximately 1,000 ft) have a small footprint.

Based on the information listed above, the alternative is technically feasible.

4.5 Alternative 3b – State Water Project

This alternative consists of:

- Acquisition of SWP water rights
- Construction of a Water Treatment Plant
- Construction pipelines to convey the treated water from the WTP to the existing distribution system.

The District has not investigated this alternative in much detail due to extremely high cost and lack of drought benefit. However, for the purposes of this report, a 500 gpm (0.72 mgd) system is assumed with the ability to expand to 800 gpm (1.15 mgd) in the future.

The technical feasibility of the alternative considers that:

- Surface water supply from the SWP will likely be expensive to purchase, is highly unreliable, and would not provide a solution to the existing drought conditions due to the extremely low availability of SWP water in 2014.
- The raw surface water requires a surface water treatment plant to protect public health and meet drinking water regulations
- Several agreements would be necessary to implement the project, including for water rights and for a new diversion point from the canal or with an entity that operates an existing diversion. These agreements are expected to take at least 12 months to negotiate (and probably longer).
- Design parameters include
    - Diversion facility with near-term capacity of 500 gpm (0.72 mgd) and ability to expand to 800 gpm (1.15 mgd), or an agreement to expand an existing diversion facility
    - Pipeline or canal from the diversion facility to the WTP to convey 800 gpm (1.15 mgd),
    - WTP with near-term capacity of 500 gpm (0.72 mgd) and ability to expand to 800 gpm (1.15 mgd)
    - Pressure pipeline from the WTP to the District's distribution system to convey 800 gpm (1.15 mgd) at system pressure (minimum of 50 psi)
- An Environmental Impact Report is expected to be required to address impacts to the seller of the water rights and impacts to the SWP system. Development of such a document is expected to take at least 12 months (and probably longer).

- Land must be purchased for the new WTP site and easements must be acquired for the transmission pipeline(s). Land must also be purchased for a new diversion structure (if an existing structure is not shared with the District).
- Potential construction problems cannot be identified very accurately until a site for the diversion structure, WTP, and pipeline(s) are identified.

Based on the information listed above, the alternative is technically feasible; however, the project would not address water supply issues caused by the drought since SWP is severely impacted by the drought and the project could not be implemented promptly – it would be at least one year and likely two to three years before the system would be operational.

4.6 Alternative 4 – Wasco Connection

This alternative proposes to connect with the closest municipal water system, which is the City of Wasco. The City's sole source of potable water is groundwater. They have nine wells, operate six wells, and pumped 4,681 af in 2010 (4.2 mgd). The City projects to nearly quadruple water use to 17,397 afy (15.6 mgd) in 2035. The City plans to upgrade several existing and improve distribution system resiliency to meet the future demands.

An interconnection would require approximately 9 miles of new pipe from the City to the District's distribution system and likely would require a contribution toward upgrade of the City's existing wells. The District has not investigated this alternative in much detail due to high cost. However, for the purposes of this report, a 500 gpm (0.72 mgd) system is assumed with the ability to expand to 800 gpm (1.15 mgd) in the future. The District has not contacted the City about the potential for an interconnection.

The technical feasibility of the alternative considers that:

- Water quantity should not be an issue as long as the City's well pumps remain sufficiently below groundwater levels.
- The City does not operate one well due to high nitrate concentrations and does not operate another well due to high nitrate and dibromochloropropane (DBCP) concentrations. The City is conducting ongoing monitoring of nitrates, coliform, and organics (DBCP and ethylenedibromide (EDB)) as directed by CDPH based on previous detections. The District may need to contribute to wellhead treatment for these constituents if they exceed MCLs in the future.
- An agreement with Wasco is necessary and may face public resistance to 'exporting' local groundwater.
- Design parameters include
    - Pump station with near-term capacity of 500 gpm (0.72 mgd) and ability to expand to 800 gpm (1.15 mgd). The facility could be located at the beginning of the pipeline in Wasco or at the end of the pipeline at the existing AsWTP site. Either way, sufficient pressure must be provided to the distribution system.
    - 12-inch diameter pipeline to convey up to 800 gpm (1.15 mgd) over 9 miles
    - Upgrades to the City distribution system may be necessary to avoid negative impacts of conveying up to 800 gpm to the District's connection point.
- The need for an EIR or an MND is not clear at this time. Primary impacts would likely be decrease in groundwater levels below Wasco and temporary construction impacts from pipeline and pump station construction. A MND is probably if groundwater impacts are minimal but an EIR is anticipated, especially if public opposition exists.
- Easements for the pipeline are necessary and land purchase would be needed for the pump station if it is located near Wasco but not likely needed if located by the existing AsWTP.

- Potential construction problems are mainly associated with pipeline construction, which should be straight-forward since the probably alignment generally consists of public roads agricultural land.

4.7 Technically Infeasible Alternatives

No technically infeasible alternatives were identified.

4.8 Cost Estimates

Table 6: Cost Estimates

Alternative #	2a	2b	2c	3a	3b	4
	Repair / Rehabilitate Well	Deepen Wells / Add Bowls	Deepen Wells / Replace Pumps	New Well 3	State Water Project	Wasco Connection
Construction Costs	$ 56,000	$ 112,000	$ 280,000	$ 610,500	$ 5,672,500	$ 7,938,000
Non-Construction Costs	$	$ 12,000	$ 28,000	$ 275,100	$ 1,419,000	$ 1,985,000
Total Capital Costs	$ 56,000	$ 124,000	$308,000	$ 885,600	$ 7,091,500	$9,932,000
O&M Costs	$0	$1,000/yr	$ 1,000/yr	$2,000/yr	$40,000	$ 30,000

Notes:

1. Detailed cost estimates are included in Appendix A.
2. O&M costs included here are the increased above O&M costs for the two existing wells. To simplify the comparison, the electricity usage (and associated cost) of the two existing wells is assumed to be the same as for each of the alternatives.

5.0 Selection of Alternative

The District identified six technically feasible alternatives in the previous section. In addition to the costs estimates summarized in TABLE 6, the District considered several non-monetary factor to select a preferred alternative. The factors are:

- *Addresses Immediate Drought Risk:* Does the project reduce the potential impacts of continued decrease in groundwater levels and enable the District to meet minimum water demands for public health and safety (excludes irrigation).
- *Addresses Extended Drought Risk:* Does the project enable the District to meet existing maximum day demand (MDD).
- *Addresses MDD Growth:* Does the project enable the District to meet projected increases in maximum day demand (MDD).
- *Addresses East Well Age Risk:* Does the project enable the District to continue serving water if a significant failure of the East Well occurs? The well is over 60 years old.

Each of the non-monetary factors is discussed further.

Addresses Immediate Drought Risk

The District has little control over management of their groundwater basin since agricultural pumping surrounds the community and agricultural pumping far exceeds the District's groundwater production. The District does not have any alternative water supplies to groundwater so the District must be conservative in anticipating groundwater basin issues affecting their sole water supply, such as significant decreases in groundwater levels.

Lowering of groundwater levels close to the NPSH of the existing pumps would soon cause pump and well failure. Current groundwater levels are within approximately 70 feet of the North Well pump NPSH. The District is concerned that this level could be approached prior to the next wet season (2014/2015) due to the extreme drought conditions. The District would not have an alternate water supply if this occurs.

Addresses Extended Drought Risk

Decreased groundwater levels causing existing equipment to provide more head to meet necessary pressure requirements. Increased head produced from the same pump will decrease flow output. As a result, the District's maximum production capacity has reduced in recent years as groundwater levels dropped. The current production capacity risks dropping below being able to meet MDD with the largest well offline. New bowls can be added to existing pumps to increase the head produced but would not increase flow. A new pump would be necessary to meet increased head needs and restore flows to existing MDD. Also, a new motor would likely be needed due to higher horsepower needs.

If the drought continues and groundwater levels continue to fall, the District will need a new pump to restore the ability to meet existing MDD flows.

Addresses MDD Growth

The Water System Master Plan identified the need for a new well to meet MDD with the highest capacity well offline and in case of significant failure of the East Well. The District currently meets the MDD capacity requirement but expects to require additional pumping capacity in the near future when water demand increases as the general economy improves and housing development restarts. A new well is ranked as the second highest priority project in the Master Plan. The highest priority project is

replacement of the existing distribution system storage tank, which is in urgent need of repair and is currently in the project design phase.

This factor identifies the need to address near-term water supply issues for the District. A new source of water would address this concern.

Addresses East Well Age Risk

As discussed for the previous factor, the Water System Master Plan identified the need for a new well to meet MDD with the highest capacity well offline and in case of significant failure of the East Well. A new source of water would address this concern.

5.1 Alternatives Comparison

TABLE summarizes the cost and non-monetary factors for the alternative evaluation and FIGURE present capital costs compared with non-monetary scoring.

Table 7: Alternative Comparison Matrix

Alternative #		2a	2b	2c	3a	3b	4
		Repair / Rehabilitate Well	Deepen Well / Add Bowl(s)	Deepen Well / Replace Pumps	New Well 3	State Water Project	Wasco Connection
Cost Comparison							
Capital Cost		$56,000	$124,000	$308,000	$885,600	$7,091,500	$9,923,000
O&M Cost per yr		$0	$1,000	$1,000	$2,000	$40,000	$30,000
Non-Monetary Factors							
Addresses Immediate Drought Risk		Partially	Yes	Yes	Yes	Yes	Yes
Addresses Extended Drought Risk		No	No	Yes	Yes	Yes	Yes
Addresses MDD Growth		No	No	No	Yes	Yes	Yes
Addresses East Well Age Risk		No	No	No	Yes	Yes	Yes
Non-Monetary Scoring							
Addresses Immediate Drought Risk	20	5	10	10	10	10	10
Addresses Extended Drought Risk	15	--	--	10	10	10	10
Addresses MDD Growth	10	--	--	--	5	5	5
Addresses East	5	--	--	--	5	5	5

Well Age Risk							
Total		**20**	**20**	**35**	**50**	**50**	**50**

Notes:

1. Detailed cost estimates are included in Appendix X.
2. O&M costs included here are the increased above O&M costs for the two existing wells. To simplify the comparison, the electricity usage (and associated cost) of the two existing wells is assumed to be the same as for each of the alternatives.

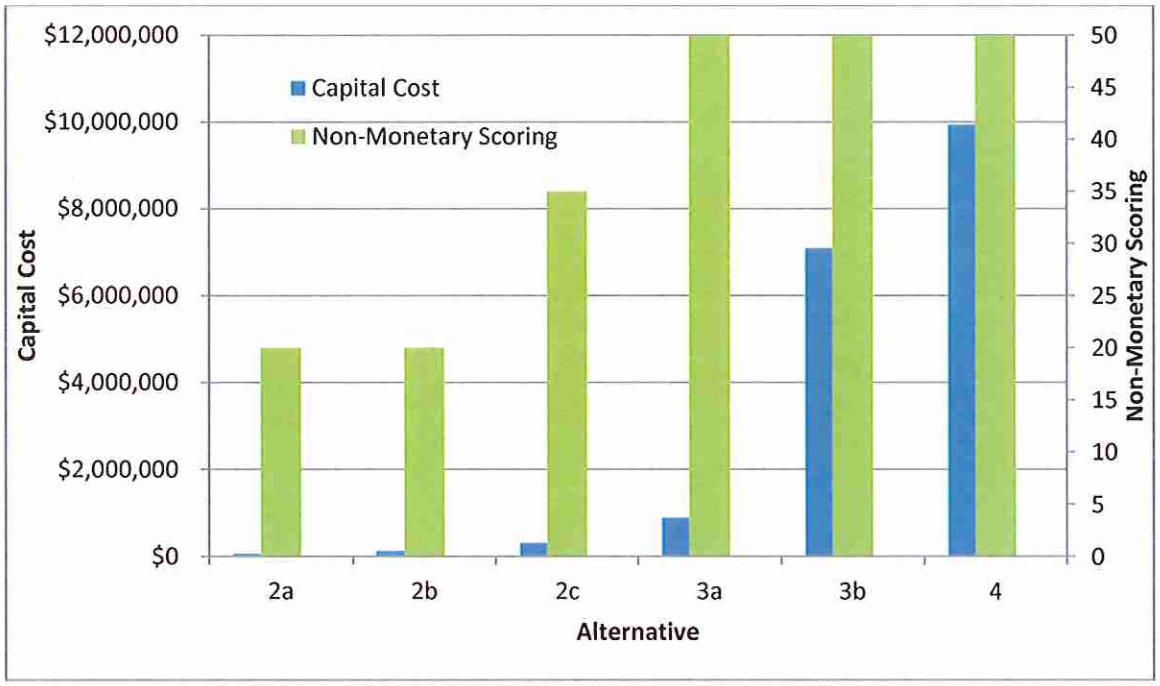


Figure 6: Comparison of Capital Cost and Non-Monetary Scoring

Two trends are evident in FIGURE 2:

- Higher costs are associated with higher non-monetary factor scoring for Alternatives 2a, 2b, 2c, and 3a
- Alternatives 3b and 4 provide the same non-monetary factor scoring at a significantly higher cost

The District's Preferred Alternative is 3a – New Well 3 since the project addresses drought impacts and near-term water supply issues at the same time at an acceptably higher cost.

With the understanding that available capital funds are limited, the District plans to continue to investigate and get contractor estimates for Alternative 2b – Deepen Wells / Add Bowls and Alternative 2c – Deepen Wells / New Pumps. Alternative 2c is preferred after Alternative 3a and Alternative 2b is preferred after Alternative 2c.

6.0 Proposed Project (Recommended Alternative)

6.1 Description

This alternative proposes installation of new well approximately 500 feet east of the existing east well. The new well would be sized to provide 300-800 gpm of flow with 40 to 100 hp motors, which accounts for the recent decrease in groundwater levels.

- Develop well to a depth of at 800 feet
- Place pump at 520 feet minimum
- Screened intervals to be determined based on zone testing.
- New 40-100 hp motor depending on final sizing
- New 8-in diameter pipeline from the well to the existing AsWTP raw water storage tanks
- Receipt of well development approval from CDPH

A layout map of the proposed project showing the location of the planned system components is located in Figure 2.

The new well would serve multiple purposes:

- Provide adequate flows to meet existing MDD at current groundwater levels.
- Reduce reliance on 60+ year old East Well and, as a result, increase reliability of meeting increases to future MDD
- Reduce use of wells producing high arsenic concentrations

Providing a well of 300 and 500 gpm will rely on the alternating use of the North and east well to supply MDDs. However, due to the age of the east well, it may not be a reliable supply source for much longer. Installing an 800 gpm well will allow for less dependence on the north and east well. Additionally, providing a new 800 gpm well may eliminate the need for Arsenic treatment altogether.

Water Quantity

Water quantity should not be an issue since the pump will be located well below existing groundwater levels. Pumping from the new well will directly reduce pumping from the existing wells. The only increase to pumping will result from increased water demands over time as residential, commercial, and industrial activities grow within the District.

Water Quality

Water quality may continue to be an issue due to the presence of arsenic in the groundwater. However, the District plans to conduct zone testing during development of the new well to try to minimize pumping of zone(s) of arsenic. Selective screening could potentially reduce the arsenic concentration in pumped groundwater and the associated cost of operating the AsWTP.

Environmental Impacts

No direct or indirect environmental impacts are anticipated other than temporary construction impacts. A Initial Study/Negative Declaration is anticipated with similar findings and measures required as for the recent AsWTP dewatering expansion project, which includes:

- No evidence of any listed or special-status species during the field survey and that "it is very unlikely that the project would result in direct impacts to special status species within the identified project footprint."
- Contractor training on local special-status species and habitat requirements

- Pre-construction biological survey

The proposed project is subject to compliance with CEQA. Because the proposed project would receive federal funding, the project is also subject to NEPA and other federal requirements. Federal requirements for reporting environmental information and analysis must be met as well as those for the State of California. The USDS Rural Development Program (RDP) will be responsible for meeting Federal information requirements using the information provided within the IS/ND prepared for the proposed project. This will facilitate a concurrent compliance effort with NEPA by the RDP.

Purchase of Land / Easements

The District already owns the land surrounding the proposed project site.

Agreements

No agreements are needed to implement this alternative.

Potential Construction Problems

No potential construction problems have been identified since the District (and local contractors) have experience developing similar wells in the area. Also, the well and installation of the pipeline (approximately 1,100 ft) have a small footprint.

6.2 Project Schedule

The following schedule has been developed for the construction of a new well.

Table 8: Proposed Project Schedule

Task	Start Date	End Date	Notes
Planning	April 1, 2014	Jun 2014	Preliminary Engineering Report
Design	Jul 2014	Dec 2014	C
CEQA/NEPA	September 2014	Dec 2014	To be conducted in parallel with Design
Permits	July 2014	Dec 2014	To be conducted in parallel with Design
Land/Easement Acquisition	--	--	Not applicable
Bid Advertise and Award	Jan 2015	March 2015	
Construction Start	April 2015	Sept. 2015	
Substantial Completion		July 2015	
Final Completion		Sept 2015	
Operational Startup	Sept 2015		

6.3 Permit Requirements

The only permit required for the construction and commissioning of a new well are from the Department of Public Health Services. No county permits are anticipated as the LHUD is a special utility district.

6.4 Total Project Cost Estimate

TABLE 9 below provides a construction cost estimate for the proposed project provides a total cost estimate for the proposed project.

Table 9: Construction Cost Estimate

Table 10: Total Project Cost Estimate (PER Guidance Document, Attachment 1)

Total Project Cost Estimate		
Item		
Property Purchase / Lease Agreement		
Easement Acquisition / Right of Way / Water Rights		
Bond Counsel		$ 20,000
Legal Counsel		$ 5,000
Interest / Refinancing Expense		
Other (Identify)		
Environmental Services		
- CEQA Environmental Report	$ 37,000	
- NEPA Environmental Report	$ 2,000	
- Environmental Mitigation Contract Services		
Total Environmental Services		**$39,000**
Engineering Services		
- Preliminary Engineering Report		$18,000
- Preliminary and Final Design Phase		$ 90,000
- Bidding / Contract Award Phase Services		$ 15,000
- Construction & Post-Construction Phase Services (w/o inspection)		$ 45,000
- Resident Project Representative Services (resident inspector)		$ 50,000
Additional Services		
- Permitting		$ 4,500
- Regulatory Compliance Reports		$ 3,500
- Environmental Mitigation Services (Construction Phase)		$ 4,000
- Easement Acquisition/ROW's Services (Construction Phase)		
- Surveying Services (Construction Services)		
- Operation & Maintenance Manual(s)		$ 4,200
- Geotechnical Services		$ 3,800
- Hydrogeologic Services		$ 31,100
- Material Testing Services		
- Other Services - Advertisement		$ 6,000
Total Engineering Services		**$ 275,100**
Equipment / Materials (Direct Purchase using approved methods)		$ 160,000
Construction Cost Estimate		$ 370,000
Contingency		$ 79,500
Total Project Cost Estimate		**$ 948,600**

6.5 Operations and Maintenance Costs

Table below summarizes estimated increases in O&M costs for the proposed project.

Table 11: Increased Annual Operations and Maintenance Cost Estimate

Item	Annual O&M Cost	Notes
Salaries	$ 0	
Benefits	$ 0	
Water Purchase	$ 0	
Taxes	$ 0	
Professional Service Fees	$1,000	For annual well assessment
Interest	$ 0	
Utilities	$2,000	Minor net increase in electricity use since existing well use will be offset. Use may decrease due to more optimal pump operation
Insurance	$ 0	
Annual Repairs & Maintenance	$10,000	Based on cost for existing
Supplies	($10,000)	Reduced operation of the AsWTP
Total Increased O&M	**$3,000**	

Note: Table does not include short-lived assets, which are discussed in the following section.

6.6 Short-Lived Asset Reserve

Table below presents a schedule of short-lived assets (useful life of less than 15 years) for components of the proposed project and a recommended annual reserve deposit to fund the replacement of the short-lived assets.

Table 12: Increased Annual Operations and Maintenance Cost Estimate

Equipment	Useful Life[1]	Replacement Cost	Annual Reserve[2]
Motor	10	$5,000	$500
Pump	10	$12,000	$1,200
		Total	$1,700

Note: Table does not address annual O&M costs, which are discussed in the previous section.

1. Useful Life is listed as 10 years.
2. Annual Reserve = Replacement Cost ÷ Useful Life

7.0 Conclusions and Recommendations

It is my professional opinion that it is imminent that the community will experience a significant decline in the quantity of water if the current drought conditions persist and result in continued decrease in groundwater levels and that such a significant decline is likely to occur within one year.

It is also my opinion that the proposed project is necessary to alleviate this upcoming problem as well as the long term supply requirements. The proposed project addresses both near-term drought impacts and near-term water system upgrades identified in the Water Master Plan. Cheaper projects are available that can respond only to near-term drought impacts – and could be implemented if insufficient capital funds are available – but these actions are temporary solutions. The recommended project provides a long-term solution in a cost effective manner.

8.0 References

- Jones and Stokes, 2004. Initial Study and Negative Declaration, Lost Hills Utility District Water System Modification. November. SCH: 2004121033.
- Lost Hills Utility District Water System Master Plan (Cannon, January 2014)
- McCormick Biological, Inc., 2013. Biological Reconnaissance Survey; Lost Hills Utility District Arsenic Treatment Facility. April 15, 2013.
- Title 22, Division 4, Chapter 16 – California Waterworks Standards (R-14-03; February 7, 2008)[3]

[3] www.cdph.ca.gov/services/DPOPP/regs/Pages/R-14-03-RevisionofWaterworksStandards.aspx

Technical Appendices

Appendix A: Alternative Cost Estimates

Appendix A

Alternative Cost Estimates

Alternative 2a - Repair / Rehabilitate Well						
Line Item	No.	Unit	Unit Cost	Capital Cost	Unit Cost	O&M Cost
East Well	1	LS	$29,000	$29,000		$0
West Well	1	LS	$27,000	$27,000		$0
Construction Subtotal				**$56,000**		**$0**
Construction Contigency			N/A			
Construction Total				**$56,000**		
Non-Construction Costs			N/A			
Project Total				**$56,000**		**$0**

Note: Project is complete. Construction values are from contractors invoices.

Alternative 2b - Deepen Wells / Add Bowl(s)						
Line Item	No.	Unit	Unit Cost	Capital Cost	Unit Cost	O&M Cost
East Well						
Well Pump Capacity Test	1	EA	$5,000	$5,000		
Extend Pump Column	50	LF	$400	$20,000		
Add Bowl(s)	2	EA	$2,000	$4,000		
New Motor	1	EA	$5,000	$5,000		
Cover Screened Interval	30	LF	$300	$9,000		
North Well						
Well Pump Capacity Test	1	EA	$5,000	$5,000		
Extend Pump Column	50	LF	$400	$20,000		
Add Bowl(s)	2	EA	$4,000	$8,000		
New Motor	1	EA	$5,000	$5,000		
Cover Screened Interval	20	LF	$1,000	$20,000		
Construction Subtotal				**$101,000**		**$0**
Construction Contigency			10%	$11,000		
Construction Total				**$112,000**		
Non-Construction Costs			10%	$12,000		
Project Total				**$124,000**		**$0**

Alternative 2c - Deepen Wells / Replace Pumps						
Line Item	No.	Unit	Unit Cost	Capital Cost	Unit Cost	O&M Cost
East Well						
New Col., Tube & Shaft	470	LF	$200	$94,000		
New Pump	1	EA	$8,000	$8,000		
New Motor	1	EA	$5,000	$5,000		
Cover Screened Interval	20	LF	$1,000	$20,000		
West Well						
New Col., Tube & Shaft	470	LF	$200	$94,000		
New Pump	1	EA	$8,000	$8,000		
New Motor	1	EA	$5,000	$5,000		
Cover Screened Interval	20	LF	$1,000	$20,000		
Construction Subtotal				**$254,000**		**$0**
Construction Contigency			10%	$26,000		
Construction Total				**$280,000**		
Non-Construction Costs			10%	$28,000		
Project Total				**$308,000**		**$0**

Alternative 3a - New Well 3						
Line Item	**No.**	**Unit**	**Unit Cost**	**Capital Cost**	**Unit Cost**	**O&M Cost**
Develop Well	800	LF	$200	$160,000	LS	$10,000
Zone Testing	10	EA	$1,000	$10,000		
Pump Casing (C, T & S)	520	LF	$120	$62,400		
Pump	1	EA	$8,000	$8,000		
Motor	1	EA	$5,000	$5,000		
Aboveground Piping & Valves	1	LS	$5,000	$5,000	1%	$50
I&E	1	LS	$10,000	$10,000	5%	$500
8" Pipeline	1100	LF	$100	$110,000	1%	$1,100
Construction Subtotal				**$370,400**		**$11,650**
Construction Contigency			15%	$56,000		
Construction Total				**$426,400**		
Non-Construction Costs			15%	$64,000		
Project Total				**$490,400**		**$11,650**

Alternative 3b - State Water Project						
Line Item	**No.**	**Unit**	**Unit Cost**	**Capital Cost**	**Unit Cost**	**O&M Cost**
SWP Water Rights	500	AFY	$200	$100,000		$0
Diversion Structure	1	LS	$100,000	$100,000	5%	$5,000
Pipe to WTP	1000	LF	$120	$120,000	1%	$1,200
WTP	1.15	mgd	$3,000,000	$3,450,000	$100,000	$115,000
Aboveground Piping & Valves	10%		of WTP	$345,000	1%	$3,450
Pump Station	1	EA	$100,000	$100,000	10%	$10,000
I&E	5%		of WTP	$172,500	10%	$17,250
12" Pipeline	1000	LF	$150	$150,000	1%	$1,500
Construction Subtotal				**$4,537,500**		**$153,400**
Construction Contigency			25%	$1,135,000		
Construction Total				**$5,672,500**		
Non-Construction Costs			25%	$1,419,000		
Project Total				**$7,091,500**		**$153,400**

Alternative 4 - Wasco Interconnection						
Line Item	**No.**	**Unit**	**Unit Cost**	**Capital Cost**	**Unit Cost**	**O&M Cost**
Wasco Distribution System Upgrac	1	LS	$50,000	$50,000	5%	$2,500
Wasco Well Upgrades	1	LS	$200,000	$200,000	5%	$10,000
Pump Station	1	LS	$100,000	$100,000	10%	$10,000
I&E	1	LS	$60,000	$60,000	10%	$6,000
12" Pipeline	47520	LF	$125	$5,940,000	1%	$59,400
Construction Subtotal				**$6,350,000**		**$87,900**
Construction Contigency			25%	$1,588,000		
Construction Total				**$7,938,000**		
Non-Construction Costs			25%	$1,985,000		
Project Total				**$9,923,000**		**$87,900**

DEE JASPAR & ASSOCIATES, INC.
CONSULTING CIVIL ENGINEERS
2730 UNICORN ROAD, BLDG A
BAKERSFIELD, CA 93308
PHONE (661) 393-4796
FAX (661) 393-4799

MEMORANDUM

To: Mario Gonzales, Public Works Director
City of McFarland
401 W. Kern Avenue
McFarland, CA 93250

From: Curtis M. Skaggs, Dee Jaspar & Associates, Inc.

Subject: Browning Road 1.0MG Storage Tank

Date: July 18th, 2014

Mr. Gonzales,

The City currently has one storage tank for the City Water Supply System. The storage tank has a gross capacity of 1.0MG and is located on the west side of Highway 99. The maximum day demand is approximately 2,474,000 gallons. The City Water Supply System should have a minimum amount of emergency storage to account for the maximum day demand in addition to storage for fire protection and operational capacity.

At this time it is recommended that a second 1.0MG AWWA D100 Welded Steel Storage Tank be constructed to provide additional storage capacity. The storage tank is recommended to be located at the Browning Road Well Site. The site was constructed to accommodate the future addition of a storage tank and booster pump station and is located on the east side of Highway 99. The benefits of adding the 1.0MG storage tank and booster pump station are outlined below:

- Additional system storage for operational capacity, fire protection capacity, and emergency capacity.
- Places storage and pumping capacity on the east side of Hwy 99. If PG&E power goes out on west side of Hwy 99, the east side of Hwy 99 is served by Southern California Edison (SCE) and would still be operational to provide some water supply for the City. If SCE power goes out on the east side of Hwy 99, the Browning Road facility is equipped with a diesel generator in order to keep the storage tank and booster pumping station operational.
- Improves the City's cost of pumping water by being able to take better advantage of time of use pumping and limit well pumping during the peak energy periods.
- In light of the drought, as grouwndwater levels continue to decline existing well pumps may be required to be lowered. Additional storage capacity will aid the City in having wells out of service while pumps are lowered.

- In light of the drought, as grouwndwater levels continue to decline water quality issues may arise. Of particular concern are Arsenic concentrations in the Taylor Well and Well No. 6 that are currently borderline of the Arsenic MCL at 8 ppb and 9 ppb respectively. If the water quality changes caused a well to be over the MCL for Arsenic or any other water quality constituent, the additional storage and pumping capacity will allow the City to temporarily inactivate the well until the drought was over and water quality improved.

The total estimated budget for this project is $2,037,500.00 and includes construction of a 1.0MG AWWA D100 Welded Steel Storage Tank, a 2,500 gpm booster pumping station, and a system intertie.

This project will enhance the water supply reliability for the City, aid the City in weathering the drought, help in protecting the water quality of the system, and improve the overall efficiency of the water system by taking advantage of time of use pumping.

GEI Consultants
Bookman-Edmonston Division

TECHNICAL MEMORANDUM

Geotechnical
Environmental and
Water Resources
Engineering

DATE: July 18, 2014

TO: Ram Venkatesan, PE
Engineer/Planner
North Kern Water Storage District

FROM: GEI Consultants, Inc.

SUBJECT: Calloway Canal Improvements, Lining Reaches A- D

Project Summary - The North Kern Water Storage District (North Kern), in partnership with Cawelo Water District (Cawelo), proposes to concrete line Reaches A through D of the Calloway Canal as part of the Calloway Canal Improvements.

The Calloway Canal Improvements program being undertaken by North Kern and Cawelo includes concrete lining12,554 linear feet utilizing local district funds supplemented with State and Federal grants. The lining program is expected to conserve groundwater water and provide an improved delivery route for surface water directly to irrigators in the three districts and by exchange with two additional districts. The estimated amount of water to be conserved from the lining of Reaches A through D is 4,400 acre-feet per year or approximately 220,000 acre-feet over the 50-year service life of the project, which is based on measurements and calculations.

The proposed project involves concrete lining of 12,554 linear feet of currently unlined portions of the Calloway Canal. The full length of the Calloway Canal to be lined is shown in Figure 3-1. Reaches A through D lie outside the service areas of both North Kern and Cawelo and overlies a portion of the regional groundwater basin that is of diminished quality due to past land uses, particularly industrial and petrochemical seepage on the northern end of the City of Bakersfield.

Minimizing seepage from the Calloway Canal will reduce the irrecoverable losses that result when high quality surface water seeps to poor quality groundwater and the degraded seepage cannot be recovered for later use without substantial treatment. Reducing losses will also enhance the districts' capability to deliver increased volumes of surface water from the State Water Project (SWP) to irrigators. In addition, delivery of surface water reduces requirements for groundwater pumping which produces important, related benefits of reducing groundwater pumping lifts and related greenhouse gases produced.

North Kern and Cawelo have complied with the California Environmental Quality Act (CEQA) requirements in formulating the plans for lining the Calloway Canal, and previously prepared CEQA documentation applies to the proposed Reaches A through D lining.

Federal and state funding for lining reaches of the Calloway Canal has been secured through a CalFed 2012 Grant for Reach A, a CalFed 2013 Grant for Reach B, State funding for Reaches A and B through a State of California Water-Use Efficiency Grant, and federal funding for lining of Reaches C1, C2, and D was secured in June, 2014 by Cawelo WD and North Kern WSD. The IRWM funding will match the secured local and federal funding to complete the entire Calloway Canal Lining Program, a total length of 12,554 LF.

Average Annual Acre-Feet of Water Supply: While North Kern's principal source of surface water is the Kern River, the program for lining the Calloway Canal was developed collaboratively with neighboring CVP and SWP contractors as part of the Poso Creek Integrated Regional Water Management (IRWM) Plan and the Water 2025 System Optimization Review for the Poso Creek IRWM Plan Area.

North Kern has utilized Kern River water under a schedule of long-standing diversion rights, with this water being supplemented from time to time by water from Poso Creek, which traverses the northern portion of the District and contributes, primarily through infiltration, to the underlying groundwater supply. While North Kern is not a CVP-Friant Unit contractor, the District has purchased and diverted "surplus" CVP-Friant water when available.

Historical water supplies to North Kern from the Kern River have ranged from less than 10,000 acre-feet per year to nearly 400,000 acre-feet per year. As a result of this highly variable water supply, North Kern has developed an extensive groundwater recharge and extraction program utilizing groundwater to regulate its water supplies by pumping an estimated average of 80,000 acre-feet of groundwater per year to meet the District total demand for irrigation water which is on the order of 180,000 acre-feet. North Kern has successfully operated this conjunctive management program for over 50 years.

Cawelo WD has a contract for 38,200 acre-feet of SWP water. Direct delivery of this water is now accomplished by conveyance from the California Aqueduct via the Cross Valley Canal to Pump Station A where the water is delivered into North Kern's Beardsley Canal, which becomes the Lerdo Canal at North Kern's southern boundary. Under agreement with North Kern, water is conveyed in the Lerdo Canal to Cawelo's Pump Station B where water is lifted into the Cawelo system. The program for lining the Calloway Canal will shorten the pathway for delivering water from the California Aqueduct to Cawelo, reduce energy demands by avoiding the need to lift water along a portion of the CVC and from the CVC to the Beardsley Canal at Pump Station A, and increase operational flexibility for both North Kern and Cawelo. North Kern growers will benefit from routing water through the Calloway Canal as it will give them flexibility and access to surface water that can be made available to North Kern through exchange of a portion of its Kern River supply for a portion of Cawelo's SWP water routed through the Calloway Canal.

Estimated amount of water saved following project completion: The estimated amount of water conserved by lining Reaches A through D of the Calloway Canal is 4,400 acre-feet per year. This volume is estimated by examining the 2,515 acre-foot average annual seepage now lost to irrecoverable groundwater in Reaches A through D and adding the additional 1,885 acre-feet per year expected to be conserved once construction of the CVC to Calloway Canal Intertie

and the Calloway Canal Lining are completed and the lined Calloway Canal becomes the primary regional route for water conveyance, as seen on Figure 3-1.

Estimated amount of water conserved by the project is 4,400 acre-feet per year.

Estimated amount of water better managed following project completion: Water better managed by the Project, including the projected use of the CVC-Calloway Intertie upon completion, can be represented by the average annual amount of 24,833 acre-feet surface water delivered to the North Kern WSD and Cawelo WD District when the lined Calloway Canal becomes the primary regional route for water conveyance which will avoid the use of CVC lifts and PS-A, shown on Figure 3-1.

A primary on-farm benefit is the improved capacity to deliver surface water to irrigated lands that also rely on groundwater drawn from an aquifer immediately underlying the irrigation service area. The Calloway Canal allows for delivery of water directly to North Kern, Cawelo, and Shafter-Wasco Irrigation District and by exchange to Kern Tulare Irrigation District and Delano Earlimart Irrigation District.

Delivery of surface water allows irrigators to conserve groundwater, support groundwater levels and reduce the operating costs associated with groundwater pumping, for all groundwater users within the common service areas. The benefits accruing from this Project are directly associated with the 4,400 acre-feet that will be delivered to an in-district demand as a result of lining Reaches A through D and not recharged in a location with irrecoverable groundwater.

Duration of project implementation and estimated completion date: The canal lining can begin by November 1, 2014 and be completed 8 months from the start time. The construction portion of the Project can start November 2014 with construction being completed by July 2015.

Anticipated design and construction duration of less than one year from notice of funding by DWR. Construction is scheduled for completion by July 2015.

Background Data

Map of the area, showing the location of the project - North Kern WSD, shown in Figure 3-0, is located in Kern County along the eastern side of California's southern San Joaquin Valley. The District lies between the City of Bakersfield on the South and the City of Delano on the north, and between Highway 99 on the east and the cities of Wasco and Shafter on the west.

The location of the 12,554 LF of the Calloway Canal lining and the secured funding for Reaches A through D are identified in Figure 3-1.

Major crops and total acres served - The cropping pattern within North Kern's 55,000-acre water service area has changed significantly from row crops to permanent plantings over the past 25 years. Currently, about 75 percent of the District's irrigated lands are planted to permanent crops, primarily almonds, grapes and pistachios.

Applicant's water delivery system (i.e., miles of canals, laterals, and existing irrigation improvements) - In North Kern, surface water is delivered through approximately 130 miles of unlined canals heading at two diversion points on the Kern River, 20 miles of pipeline, and 20 miles of lined canal. The District's principal supply artery, and most important upstream point of diversion on the Kern River, is the Beardsley-Lerdo system. This system is entirely gravity flow and consists of the diversion structure or headworks on the Kern River, 9.5 miles of concrete-lined canal (the Beardsley Canal) between the headworks and the District's southern boundary, followed by an unlined canal section (the Lerdo Canal) that continue along North Kern's eastern or "high" side.

Up to 850 cfs has been conveyed through the Beardsley Canal and delivered to the District, and this represents the practical maximum delivery in this system. By agreement with North Kern, Cawelo Water District may use up to 240 cfs of this capacity. The second point of diversion, 4.5 miles downstream, is the Calloway headworks, which services the relatively large, now unlined section of the Calloway Canal shown on Figure 3-1. This facility is also entirely gravity flow and extends for 10.4 miles before entering North Kern at Seventh Standard Road. The unlined Calloway Canal is used as a "wet year" facility and has a capacity of 1,000 cfs at its headworks. As described throughout this grant application, the central purpose of the program for lining a portion of the Calloway Canal is to enable this portion of the Calloway Canal to serve as a conveyance link between two recently constructed regional Interties, the CVC-Calloway Intertie and the Calloway to Lerdo Canal Intertie, and to allow the districts an improved conveyance route for use in all water-year types; wet, normal, and dry.

Project Description

Project Work and Approach

Project Summary - The proposed project would line 12,554 LF of the Calloway Canal from Reaches A through D. Underlain by a portion of the regional groundwater basin that has marginal quality water, it is advantageous to limit the amount of seepage in these canal reaches. Construction would consist of trimming the existing canal profile to provide a trapezoidal prism with a 50-foot-wide bottom width, 3-to-1 side slopes, and a nominal depth of 8.5 feet. The canal section would be lined using 4-inch thick unreinforced concrete.

Project Approach - Several tasks are defined below to accomplish the Project Work and are organized to track Budget and Schedule items. North Kern has completed the design of Reaches A and B of the Project under the direction of GEI Consultants, Inc. in association with Zeider's Consulting. If grant funding is awarded for lining of Reaches A through D, a grant agreement is expected to be signed by October 15, 2014; construction bidding would take place in early fall of 2014 with construction scheduled for start November 1, 2014 and completed by July 2015.

The following are a list of anticipated tasks associated with the project work:

Task 1: Administration

Coordination of all Project activities, including budget, schedule, communication, and grant and cost-share administration. ***Expected Deliverables: Preparation of invoices and other deliverables, as required.***

Task 2: Reporting

Report on project financial status on a quarterly basis and prepare significant development reports and a Final Project Report. In addition, the Project will comply with any other reporting requirements specified in the potential grant agreement between North Kern and DWR. ***Expected Deliverables: Submission of quarterly status reports, significant development reports, and a Final Project Report as specified in the potential grant agreement.***

Task 3: Design

Design of the project features has been completed for Reaches A and B to the 100 percent design level, including project sizing and preliminary cost estimates based on previous construction experience and information received from manufacturers. Remaining work includes completion of design plans specific to Reaches C and D and construction specifications, as indicated on the Project Schedule. ***Expected Deliverables: Design documents will be prepared and approved at the 100 percent design level for all Reaches A through D.***

Task 4: Environmental Documentation

Pursuant to CEQA guidelines, an Initial Study on the Calloway Canal was completed in 2006 and North Kern adopted a Negative Declaration that year; North Kern served as the lead agency for CEQA since conveyance facilities are shared by North Kern and Cawelo in a 59-41 split, respectively. Reclamation has prepared NEPA documentation for Reaches A and B of this project since it received federal grant funding. Reclamation announced funding for Reaches C and D in June, 2014 and will commence completing the NEPA documentation for Reaches C and D. For Reaches B, C, and D of the Calloway Canal, Reclamation recommended and North Kern and Cawelo concurred and then obtained participation in the Metropolitan Bakersfield HCP (Habitat Conservation Plan) to obtain environmental concurrence with California Department of Fish and Game regarding potential Kit Fox dens near Canal Reaches B, C, and D. ***Expected Deliverables: Confirm environmental compliance through Reclamation's permitting process, obtain concurrence with California Department of Fish and Game, and provide the results of the pre-activity biological survey prior to the commencement of construction.***

Task 5: Permits/Approval

The Project is located exclusively within maintained canal rights-of-way or other rights-of-way owned and operated by North Kern WSD, therefore, completion of permitting and approvals for lining of Reaches A thorugh D are straightforward.

- Bids for construction will be solicited through a competitive bidding process on the basis of final plans and specifications. The language in the standard specifications relating to permitting state "The Contractor is an independent contractor and shall, at his sole cost and expense, comply with all laws, rules, ordinances and regulations of all governing bodies having jurisdiction over the work, obtain all necessary permits and licenses therefore…" This would include, but is not limited to, any required NPDES permitting and the preparation of a Stormwater Pollution Prevention Plan.
- A pre-activity survey will be ordered and conducted by a qualified biologist shortly before the start of construction; this would include, but is not limited to, protocol-level surveys for the San Joaquin Kit Fox and the Western Burrowing Owl.

- It is noted that the District is not subject to the County's or City's jurisdiction with regard to building and grading permits relative to water resource projects. Accordingly, no City- or County-issued permits will be required.

Expected Deliverables: Complete necessary permitting and approval activities prior to any construction activities.

Task 6: Construction

Construction involves furnishing and installing of all Project works, primarily all works pertaining to the physical lining of Reaches A through D of the Calloway Canal. A contract for this task will be awarded to the successful bidder. ***Expected Deliverables: (Reference Construction Management task below).***

Task 7: Construction Management

Construction Management involves everything from the advertisement for bids from qualified construction firms to filing a Notice of Completion for the Project works and preparation of "As-Builts" drawings. Construction management activities can generally be categorized as field inspection and contract administration, where the latter includes items such as the Notice to Proceed, pre-construction conference, correspondence with the Contractor, submittal review, progress payments, periodic meetings with the Contractor, Contract Change Orders, etc. ***Expected Deliverables: Multiple deliverables including a (1) abstract of bids received; (2) successful bid proposal; (3) construction progress pay estimates; (4) start-up and testing verification; (5) Notice of Completion; and (6) "As-Builts" drawings.***

The proposed Project will be implemented under the direction of North Kern WSD, in conjunction with Cawelo WD. GEI Consultants, Inc. (GEI) will provide design, construction management, administrative, reporting assistance, and coordination with local firms, as needed. Richard Diamond, North Kern's General Manager, will have responsibility for overall Project Management, while Ram Venkatesan, North Kern's Engineer (a California-licensed Civil Engineer), will provide the technical Project Management on behalf of North Kern and will work closely with the designated construction manager.

Project Schedule - Based on the above-described tasks, this Project has an 8 month schedule for the construction component. As such, construction contract documents will be provided by early fall 2014 for bidding purposes, anticipated start of construction and completion of construction is anticipated by end of June 2015 with all project work being completed and a Final Project Report delivered by September 2015. For purposes of this Proposal, assuming the Project is approved for grant funding, the contract start date is anticipated to be October 15, 2014.

The Project is not expected to deviate from Reclamation's proposed schedule of a start date of October 1, 2014 and completion within the 24-month project duration.

Engineering Plans - Engineering design drawings have already been prepared for segments of the Calloway Canal that received funding in previous years. In particular, Reach A, Reach B, and a 500 feet portion of Reach C have final design drawings and contract documents prepared for bidding. Due to the severity of the 2014 drought, the districts responsible for lining these reaches have delayed bidding until later in 2014. If grant funding is awarded for lining of

Reaches C and D, North Kern WSD would complete the design for these reaches based the designs completed to date because the canal sections used in the completed designs are of the same dimensions as those of Reaches C and D. An example of the design that has been completed for Reaches A and B is included in Appendix A.

Evaluation Categories

Category 1: Benefits

Water Conservation and Efficiency

Quantifiable Water Savings - The amount of water conserved by lining Reaches A through D is estimated at 4,400 acre-feet per year, based on seepage losses representing irrecoverable average annual losses for historic use of the Calloway Canal.

Historical data was collected at various locations along the Calloway Canal and reported in the *North Kern Water Storage District Calloway Canal Diversion Summary* available from the annual *Kern River Report* prepared by the City of Bakersfield. The reports used in this analysis are from 1990 to 2010 and have been summarized in Table 5-1. The Diversion Summary demonstrates that the Calloway Canal has been predominantly used by the regional districts, including North Kern, during "wet" hydrologic years when excess surface water supplies were distributed around the region for groundwater recharge. By contrast, the canal has been little used during dry periods, largely because of the high seepage losses associated with its current unlined condition.

To determine the average annual seepage losses two different flow measurement locations along the canal were compared, specifically the Buck Owens Weir and the Olive Drive Weir, which includes the Reaches A through D. Taking into account deliveries and inflows to the Calloway Canal, the difference in water measures at the two weir locations was considered the amount of water lost due to seepage (with evaporative losses considered to be negligible). As summarized in Table 5-2, the 6.2 mile canal length between the weirs lost on average 6,975 acre-feet annually (1,125 acre-feet per year per mile of canal). However, because the canal was only operated for parts of the year, average annual or monthly values are not reflective of daily seepage rates. Table 5-3 considers only the summer periods when the canal was typically operated for an entire month. During these periods, the average monthly loss was 1,994 acre-feet per month or 322 acre-feet per month per mile, a rate equivalent to an average daily seepage rate of 11 acre-feet per day per mile.

As noted in the Diversion Summary, Calloway Canal operations averaged 3.14 months per year (96 days per year). The length of Reaches A through D to be lined as part of this project is roughly 12,554 feet (2.38 miles). Therefore, the amount of water saved along this reach can be calculated as 2,515 acre-feet per year (11 acre-feet per day-mile x 2.38 miles x 96 days per year) based solely on the historical use of these facilities. Table 5-1 also shows the average annual flow in this reach of the Calloway Canal is 31,458 acre-feet. Therefore the percentage of the historical flow to be conserved by lining Reaches A through D is about 8.0 percent (2,515 acre-feet water saved along the reaches / 31,458 acre-feet annual flow).

SWP water from the Cross Valley Canal has historically been delivered to Cawelo WD through North Kern's system by pumping water from the Cross Valley Canal to the Lerdo Canal, as shown in Figure 3-1. A new intertie linking the CVC and the Calloway Canal will be completed

in 2014 and will enable water to be conveyed from the CVC to the Calloway Canal and then lifted to the Lerdo Canal at the Calloway Canal to Lerdo Canal Intertie. This new conveyance route will allow the use of the Calloway Canal to Lerdo Canal Intertie 8-1 Lateral Pumping Plant, which is more efficient in terms of energy, and delivery of water can be accomplished by exchange with North Kern, avoiding the pumping lift entirely. Because the new operational scheme will utilize the portion of the Calloway Canal proposed to be lined, this future use will result in conservation of water above and beyond the volumes that would be conserved under the current mode of operation and would significantly enhance water management and flexibility of operation.

The volume of water conserved from future conveyance in the Calloway Canal was estimated by examining historical data for water conveyance along the current delivery route and assuming a similar quantity will be delivered through the "new" delivery route (shown in Figure 3-1). The average annual conveyance shown in Table 5-5 of 24,833 acre-feet reflects the average annual delivery to Cawelo, North Kern and the KCWA, that typically occurs over 3.1 months per year. Comparing these monthly operations (Table 5-5) with Calloway Canal historical monthly operations (Table 5-1) suggests that that the Calloway Canal could see an increased operation of around 2.4 months per year (72 days per year). As such, the amount of avoided seepage due to increased water use in canal would be approximately 1,885 acre-feet per year (11 acre-feet per day-mile x 2.38 miles x 72 days), representing 7.6 percent of the expected deliveries (1,885 acre-feet water saved along reaches / 24,833 acre-feet of increased annual flow).

Adding the projected average annual additional flows of 24,833 acre-feet to the historic wet year flows of 31,458 conveyed in the Calloway Canal yields, an average of 56,291 acre-feet per year with water conservation benefits due to lining of Reaches A through D being credited to the full amount while the additional flow value of 24,833 acre-feet would be credited as being better managed. The conserved water represents about 7.8 percent of the combined historic and future flows (4,400 acre-feet water saved along reach / 56,291 acre-feet of total flow along canal). Note that the post-project seepage losses are expected to be negligible since the concrete lining will dramatically decrease the current seepage losses. The conserved water will be applied towards meeting existing irrigation demands.

Estimated 4,400 acre-feet per year of water conserved by lining Calloway Canal Reaches A through D (decreased seepage losses). Assumes 2,515 acre-feet per year based on historical use of canal, and 1,885 acre-feet per year based on increased use once construction of CVC-Calloway Intertie is completed in 2014.

Percentage of Total Supplies - As stated above, the amount of water conserved is estimated at 4,400 acre-feet per year which equates to conservation of 220,000 acre-feet over the expected 50-year service life of the project. Relative to the total annual volume of water to be conveyed through Reaches A through D of 56,291 acre-feet, the 4,400 acre-feet per year to be conserved by lining Reaches A through D represents 7.8 percent of the water being conveyed.

Estimated 7.8% of North Kern and Cawelo annual surface water supplies, delivered via the Calloway Canal upon completion of the Intertie, would be conserved by lining of Reaches A through D.

Improved Water Management - Completion of the new CVC-Calloway Intertie (expected in June 2014) will allow North Kern and Cawelo to convey approximately 24,833 acre-feet of

water along the Calloway Canal and Lerdo Canal to PS-B resulting in better water management by avoiding pumping lifts and shortening the conveyance route. Delivery of water through the Calloway Canal will improve management of water across the range of hydrologic year types as a result of increased conveyance flexibility.

Measuring points are already in place to monitor the Project's performance. Monthly flow volumes will continue to be measured at these locations, based on sharp-crested weirs equipped with stage recorders, and the discharge ratings at each location will continue to be checked by stream gaging. Following completion of the project, the reduction in seepage losses will be measured by comparing the pre-Project average of 11 acre-feet per day per mile during months when flows were measured at the Buck Owens and Olive Drive weirs to post-project seepage.

So that the pre-Project and post-Project seepage estimates are comparable, post-Project estimates will be made during months where the canal is in use all month to reduce errors in measurement during periods when the canal is filling. Seepage estimates will also be adjusted to account for evaporation losses, particularly during summer months.

Reasonableness of Costs

Total Project Costs - The total cost for the Reach D lining project is estimated at $8,787,800, which is described in the Budget Proposal. This estimated cost, includes the cost of construction plus all costs associated with design, construction management, environmental compliance, and other items. The cost estimate is based on the costs incurred during lining the CVC to Calloway Intertie and estimates developed for lining of other reaches of the Calloway Canal.

Volume of Water Conserved - As computed above, it is estimated the Project would conserve about 4,400 acre-feet per year.

Expected Life of the Improvement - Lining of Reaches A through D of the Calloway Canal will be designed to standards intended to achieve a service life of at least 50 years. Over this service life, the volume of conserved water is estimated to be 220,000 acre-feet.

Water Better Managed - Water better managed by the Project, including the projected use of the CVC-Calloway Intertie upon completion, can be represented by the average annual amount of 24,833of surface water that will be delivered while avoiding the use of the CVC lifts and PS-A.

Cost of Benefits - Using simple formulas to assess the projected costs for estimated benefits; the estimated cost of conserved water is $39.09 per acre-foot and of water better managed is $6.93 per acre-foot better managed. Please see calculation below.

Water conserved = $8,787,800 total project costs / (4,400 acre-feet conserved per year x 50 year life)] = $39.95 per acre-foot.

Water better managed = $8,787,800 total project costs / (24,833 acre-feet water better managed per year x 50 year life) = $7.08 per acre-foot.

An estimated $39.95 per acre-feet of conserved water, and $7.08 per acre-foot of water better managed.

Other Benefits

Energy-Use - As previously explained, lining of Reaches A through D of the Calloway Canal would result in a net increase to annual water supplies of approximately 4,400 acre-feet based on avoided seepage to unusable groundwater. The 'additional' yearly supply would be applied to meet existing irrigation demands thereby decreasing groundwater pumping requirements and reducing the energy consumed for groundwater pumping.

Based on prior analyses completed by the District, as part of the Poso Creek IRWM Plan, historical water supply and water level data imply a 1 foot water level rise for every 0.18 acre-feet per acre of surface water imported into northern Kern County. As stated earlier, the lining of Reaches A through D of the Calloway Canal is expected to have a useful life of 50 years resulting in an additional 220,000 acre-feet in storage at the end of 50 years. Over North Kern's gross irrigated area of about 55,000 acres, this amounts to 4.0 acre-feet per acre (220,000 acre-feet / 55,000 acres). The corresponding water level rise at the end of 50 years would be about 22.2 feet (4.0 acre-feet per acre / 0.18 acre-feet per acre per foot of water level rise). The average water level rise over this period would be one-half of this amount, or about 11.1 feet. Based on an average pumping lift of 250 feet and average energy cost of $0.12 per kWh, both typical values for water users in the District, the value of the decreased pumping lift along with reduced groundwater pumping of 4,400 acre-feet per year represents an average annual energy savings of $381,527 per year as shown on Table 5-6. This correlates to an average annual energy savings of 3,179 MWh and a reduction of GHG of 1,436 MT CO2e.

Given the hydraulic continuity of the underlying groundwater with adjoining districts (i.e., shared regional groundwater basin); it is not likely that North Kern would realize all of this benefit; however, it would be realized by the region as a whole. While the lift benefit would be less on a regional basis, more groundwater pumping would be involved in the larger area. Accordingly, making the energy benefit calculations strictly on the basis of North Kern is believed to be representative of the magnitude of the benefit.

Reduced groundwater pumping in the District of 4,400 acre-feet per year represents an annual energy savings of $381,527 per year (based on average energy costs of $0.12 per kWh and 3 kWh/acre-foot).

Endangered or Threatened Species:

What is the extent to which the proposed project would reduce the likelihood of listing or would otherwise improve the status of the species? - The proposed Project would indirectly benefit federally-listed threatened or endangered species by improving the regulation of water supplies that have been rendered less reliable owing to the imposition of measures designed to protect threatened and endangered species. These measures include seasonal pumping restrictions in the Sacramento River-San Joaquin River Delta (Delta) and restoration of flows below Friant Dam on the San Joaquin River. The pumping restrictions reduce the amount and constrain the timing of deliveries of State Water Project and Central Valley Project (CVP) water pumped from the Delta and the deliveries of CVP-Friant Division supplies. The Poso Creek Region, to which North Kern and Cawelo below, includes districts with contracts for water from both of these

sources.

What is the relationship of the species to water supply? - Relative to the CVP-Friant supplies, the San Joaquin River Restoration Program includes a *water management goal* which is to reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided by the restoration program. San Joaquin River restoration efforts envision a program whereby water which flows from the San Joaquin River into the Delta would be picked up and conveyed in the California Aqueduct and diverted into the Cross Valley Canal for delivery to Friant Division contractors. Owing to mismatches in timing between supply and demand, regulation will be necessary to correct these imbalances. The Poso Creek Region includes three contractors, which collectively account for about 25 percent of the Friant Division's Class 1 supply. Two of these entities have already entered into banking arrangements with North Kern WSD to regulate their contract water supplies and thereby mitigate adverse water supply impacts. This directly supports the Settlement Agreement through furtherance of the *water management goal*. With regard to the San Joaquin River, the relevant species is the Federally-threatened (spring run)/endangered (winter run) Chinook Salmon.

For projects that will directly accelerate the recovery of threatened or endangered species or address designated critical habitats, please include the following elements:

- **How is the species adversely affected by a Reclamation project?**
- **Is the species subject to a recovery plan or conservation plan under the Endangered Species Act?**

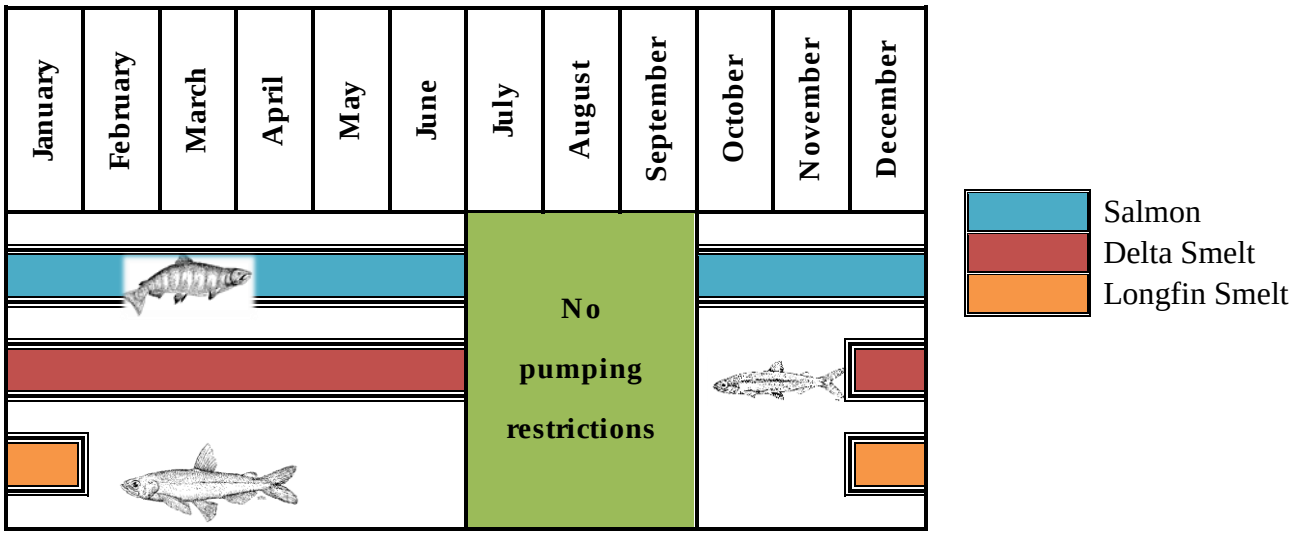
The proposed Project contributes to accomplishment of the State's co-equal goals, as defined in the Amended Memorandum of Agreement Regarding Collaboration on Planning, Design and Environmental Compliance for the Delta Habitat Conservation and Conveyance Program in Connection with the California Bay Delta Conservation Plan (First Amendment MOA Collaboration BDCP, December 15, 2011). The implementation of co-equal goals is intended to provide reliable water supply for California while enhancing, protecting, restoring, and enhancing the Delta ecosystem and habitat (SB1, Steinberg- Section 85054). Upon the pending completion of the intertie between the Cross Valley Canal and the Calloway Canal, any water diverted from the California Aqueduct for direct delivery to North Kern WSD or Cawelo WD would be conveyed through the reaches of the Calloway Canal which are proposed for lining under various programs including this Project.

Lining of the Calloway Canal will minimize seepage losses which are particularly problematic because of the poor quality of the groundwater underlying the canal. Any measures which minimize seepage to poor quality groundwater and enable delivery of conserved surface water directly to water users improves the efficiency of water management in the region, reduces demand on the Delta and, supports the environmental objectives of the California Bay-Delta Conservation Plan and the San Joaquin River Restoration Program.

With regard to the Delta, relevant species include the following:

- Delta Smelt, Federally endangered
- Longfin Smelt, Candidate
- Chinook Salmon, Federally threatened (spring runs)/endangered (winter runs).

The diagram below, illustrates the pumping restrictions that are currently in force in the Delta in an effort to restore these fish species' populations.



What is the extent to which the proposed project would reduce the likelihood of listing or would otherwise improve the status of the species? – By reducing seepage to marginal quality groundwater, reducing pumping demand on higher quality groundwater and helping support groundwater elevations underlying irrigated lands, the proposed Project has the ability to benefit local species. Kern County has more than two dozen threatened and endangered species. As demonstrated by the Kern Water Bank, actions that support local groundwater may assist in restoring wetland and upland habitat via in-lieu groundwater recharge. Species that may benefit include:

- San Joaquin Kit Fox;
- Tipton Kangaroo Rat, and
- San Joaquin Wooly Threads

Other Contributions to Water Supply Sustainability

The Project will reduce conveyance losses, regardless of year type.

Will the project make water available to address a specific concern, e.g. water supply shortages due to climate variability and/or heightened competition for finite water supplies; will it market water to other users, or generally make more water available in the water basin where the proposed work is located? - Yes, the loss of water supply reliability (owing to climate change, and regulatory and judicial actions) was the fundamental regional concern identified in the Poso Creek IRWM Plan. The proposed Project will aid in addressing this concern by increasing the capacity to introduce high quality surface water into the region, to deliver this water to irrigation users, and to protect water quality by eliminating canal seepage in an area underlain by poor quality groundwater. As a result, more surface water will be brought into the region than under the no-Project condition and this increased volume of imported water will be available for delivery to irrigators with little water lost to seepage.

Where will the conserved water go? Where is that water currently going (e.g., back to the stream, spilled at the end of the ditch, seeping into the ground)? - The conserved water will be delivered to irrigators in the North Kern WSD and in Cawelo WD. Without the lining project, water is seeping into the ground in an area where the quality of the seepage will be degraded when mixed with the underlying groundwater.

How does this more sustainable water supply benefit other water users in the basin? - Other water users in the basin rely on the shared groundwater; therefore, any surface water delivered into the region, or conserved within the region, helps to preserve groundwater.

Does the project promote and encourage collaboration among parties? Is there widespread support for the project? Will the project help to prevent a water-related crisis or conflict? The Project is the result of collaboration among neighboring water agencies. In particular, in 2005, North Kern WSD and Cawelo WD joined with four neighboring water agencies to develop an Integrated Regional Water Management Plan (Plan) for the region. In addition to North Kern

and Cawelo, the agencies that developed and adopted the Plan included, Shafter-Wasco Irrigation District, Semitropic Water Storage District, Kern-Tulare Water District, and Delano-Earlimart Irrigation District. Collectively, these agencies represent about 350,000 irrigated acres and a gross area on the order of 0.5 million acres. Further, these agencies represent State Water Project, Central Valley Project, and local Kern River water supplies.

As recognized in the Plan, projects that result in improved management of surface water supplies in the region benefit all users because of the widespread reliance on the underlying common groundwater resource. Therefore, a project such as lining of Reaches A through D that reduces losses to unrecoverable groundwater, produces conserved water that can be delivered directly to irrigators. Although surface water imported into the region is the primary source of recharge to the groundwater basin, seepage to unrecoverable groundwater from locations such as Reaches A through D does not contribute to sustaining local groundwater supplies without added cost to recover the contaminated groundwater.

Will the project increase awareness of water and/or energy conservation and efficiency efforts? Will the project serve as an example of water and/or energy conservation and efficiency within a community? Will the project increase the capability of future water conservation or energy efficiency efforts for use by other users? - This integrated water and energy project (water conservation reduces both groundwater pumping volumes and pumping lifts) will serve as an excellent example to the water community of the value of such conservation projects. As part of the regional planning process the North Kern WSD has presented project details and benefits to the other members of the Poso Creek IRWM group who have expressed interest in developing similar programs that could further leverage the approach taken in this project.

Other Benefits

No other benefits have been identified.

Category 2: On-Farm Efficiencies

North Kern does not have programs for direct assistance to growers nor does it coordinate grower assistance activities. Rather on-farm assistance is generally administered directly between growers and the NRCS. One such on-farm assistance program is the Environmental Quality Incentives Program (EQIP), a voluntary conservation program that provides financial and technical assistance to farmers and ranchers who face threats to soil, water, air, and related natural resources on their land. Because applicants to NRCS programs remain confidential until awarded funding, districts are frequently unaware of grower participation in these programs until the funding has been awarded. Nevertheless, the North Kern strongly supports these programs as efficient management of water on-farm is a key to attainment of the District's objective of efficient management of water district-wide.

If on-farm facilities or irrigation practices are to be improved as a result of this project, include a detailed listing of the fields and acreage to be improved. Provide a detailed explanation of how the proposed project will enable or enhance these on-farm efficiency improvements - North Kern growers have already adopted improved irrigation systems, such as, micro-spray and drip. However, a need exists for evaluation of the performance of these systems to assist growers to continue to attain high levels of water use efficiency as these systems age. On-farm irrigation system evaluations using the Mobile Lab service operated by Brian Hockett

of the North West Kern Resources Conservation District (NWKRCD) can be a valuable tool in aiding growers in keeping their systems functioning effectively.

North Kern is in the NWKRCD service area and has funded irrigation system evaluation assistance to growers for many years. This project offers an opportunity to couple the increased access to surface water provided through canal lining with Mobile Lab services aimed at assisting growers attain the greatest benefit from their increased access to surface water by improving the operation of their on-farm systems. An additional, benefit of enhanced support for the Mobil Lab will be the potential to improve on-farm nutrient management both through improving the performance of irrigation systems and by recommending nutrient management practices best suited to the type and condition of the irrigation systems.

Describe in detail the on-farm improvements that can be made as a result of this project. Describe any similar planned or on-going efforts by farmers/ranchers that receive water from the applicant - NRCS support would enable funding of additional 1) Mobile Lab assessments of the performance of drip and micro-spray irrigation systems now used by growers in the District, and 2) assistance to growers in applying best management practices to improve nutrient management.

Fully describe the on-farm water conservation or water use efficiency benefits that would result from the enabled on-farm component of this project. Estimate the potential on-farm water savings that could result in acre-feet per year. Include support or backup documentation for any calculations or assumptions - A primary on-farm benefit is the improved capacity to deliver surface water through District conveyance facilities to irrigated lands in North Kern and in several neighboring districts all of whom rely on groundwater pumped from an aquifer immediately underlying the irrigation service area. Lining of the Calloway Canal makes it practical to deliver water directly to North Kern, Cawelo and Shafter-Wasco and by exchange to Kern Tulare Irrigation District and Delano Earlimart Irrigation District. Surface water deliveries directly to irrigators allow groundwater to be conserved and reduce the energy required for groundwater pumping. The reduction in groundwater pumping is a direct benefit to growers who, as well owners, bear the cost of well operation.

The potential on-farm water savings that can be related to the conserved water delivered to irrigators in North Kern is the 520 acre-feet per year conserved by lining of Reach D that will replace an equal amount of groundwater pumped for irrigation.

Projects that include significant on-farm irrigation improvements should demonstrate the eligibility, commitment, and number or percentage of shareholders who will participate in the available NRCS funding programs. Applicants should provide letters of intent from farmers/ranchers in the affected project areas - Applicant letters were not requested by North Kern; however, the District encourages the direct coordination that occurs between the NRCS and growers.

Category 3: Supplemental Water Supply Need

Describe in detail water supply related issues in your area. This includes quality and quantity of surface and groundwater sources. Recognize overdraft issues if present. Specifically, how does this project address those issues? - The Poso Creek IRWM Plan identified and evaluated the adverse impacts of "recent" regulatory and judicial actions which

have, or have the potential to, adversely impact the three principal surface water sources for the region; the Kern River, the SWP, and the CVP. These actions include court-ordered reductions in pumping from the Sacramento-San Joaquin Delta; implementation of the San Joaquin River Settlement Agreement; Kern River water rights litigation; and the imposition by the USACE of storage restrictions on Isabella Dam and Reservoir in response to dam safety concerns.

The Poso Creek Plan indicates that an average annual reduction on the order of 100,000 acre-feet, or more, in the surface water supplies to the region is likely in the future amounting to elimination of about 15 percent of the region's historical surface water supply. With groundwater levels over the last 25 years being relatively stable, the anticipated decline in surface water supply is expected to result in an increased reliance on pumped groundwater which is likely to induce a long-term decline in groundwater levels. As a response to these projections, the districts in the Poso Creek region are actively pursuing exchange arrangements, conservation projects, and banking programs to make the best use of available supplies. Lining of the Calloway Canal is a vital improvement that will benefit each of the six districts in the Poso Creek IRWM Plan.

Describe the current and projected water demand for the applicant - Based on North Kern's draft Agricultural Water Management Plan, the current and projected water demand for the District is on the order of 180,000 acre-feet per year to meet the crop ET demand, leaching requirements and other factors.

Address water shortages and impacts of those water shortages -

DWR Bulletin 160-09 (2009) articulated some of the water supply "challenges" facing the Tulare Lake Basin, of which North Kern is a part. These challenges include the following:

- Water quality and environmental needs for the Delta are reducing the export volume of water pumped and available for delivery. For example, new biological opinions for endangered species and statutory requirements in December 2008 reduced export pumping by around 20-30 percent.

- Changes in the OCAP (Operations Criteria and Plan, USBR) could worsen delivery reliability issues of imported water from the CVP and SWP.

- The San Joaquin River Settlement will reduce CVP water diverted into the Friant-Kern Canal, possibly by as much as 15 percent (on average) as interim flows began October 1, 2009, which also affects the availability of CVP 215 water.

According to the 2011 State Water Project Delivery Reliability Report (DWR 2012), the long-term reliability of surface water supplies to Southern California from the Delta is expected to average 60 percent of the contractual amounts.

Include a description of applicant's water rights and water supply allocations over the last four years (2008 - 2012). Provide information on all water sources used in the district. (Surface water, groundwater, transferred water, upslope drain water, contract water, etc). Include all state, Federal, and local water supplies - The following table presents information on North Kern's sources of water supply over the period from 2008 through 2012. The sole

source of surface water during this period were the District's diversions from the Kern River with the volumes measures at Seventh Standard Road, the District's south boundary.

WATER SUPPLIES (AF)

Source	2008	2009	2010	2011	2012
Kern River	93,321	84,909	180,110	358,165	93,499
District Deep Wells	88,611	95,463	6,448	0	107,429
Non-District Deep Wells*	4,522	3,184	0	0	10,436
Total	186,454	183,556	186,558	358,165	211,364

* Groundwater pumped by private landowners that is discharged to North Kern canals for wheeling within the District.
Source: 2014 Draft North Kern WSD Agricultural Water Management Plan; Table 30.

Category 4: Implementation and Results

Identify and describe any engineering or design work performed specifically in support of the proposed project - Engineering design drawings have been prepared for segments of the Calloway Canal that have received funding in previous years. Reach A, Reach B, and a 500 foot-long portion of Reach C have had final design drawings and contract documents prepared for bidding. Due to the severity of the 2014 drought, the participating districts have delayed putting lining projects out for bid until later in 2014. Reach A, Reach B, and an extension north of Hageman Road have canal sections of the same dimensions as Reach D. If funded, North Kern will complete the design for Reach D based on the designs that have already been completed. An example of the completed design for Reach B is included in Appendix A.

Describe the implementation plan of the proposed project. Include an estimated project schedule that shows the stages and duration of the proposed work, including major tasks, milestones, and dates. Specify the date when construction can begin - The Project will be implemented as shown on the schedule (Figure 5-6). The projected schedule shows that activity would begin around October 1, 2014, contract documents would be completed by mid-year 2015, construction would extend to June 2016, and all project work and reporting would be completed by September 2016.

Describe how the project conforms to and meets the goals of any applicable State or integrated regional water management plans, and identify any aspect of the project that implements a feature of an existing water plan(s) - North Kern WSD adopted, by Resolution of its governing Board of Directors, the Poso Creek IRWM Plan in July 2007. This plan was developed in collaboration with neighboring districts, the Poso Creek Regional Water Management Group, over a period of two years in accordance with guidelines published by the State of California. Subsequently, a Reclamation-funded System Optimization Review (SOR) was conducted for this group[1].

[1] Semitropic Water Storage District acted as lead agency on the grant from Reclamation to help fund this work.

Integrated Regional Water Management Plan - The Plan's Executive Summary lists the following as the first strategy to be employed to mitigate projected reductions in the Region's surface water supplies:

"Maximize use of available surface water supplies through the use of existing absorptive capability by coordinating mismatches between supply and demand within the Region, i.e., matching supply that exceeds demand in one district with demand that exceeds supply in another district. This applies to both irrigation absorptive capability as well as spreading absorptive capability."

By expanding the flexibility of water management options available in the region, limiting seepage to impaired groundwater, and reducing groundwater pumping volumes and lifts, the proposed Project is entirely consistent with, and in furtherance of, this strategy.

System Optimization Review (SOR) - The focus of the SOR was to (1) prioritize the implementation of structural water management measures for the region based on their expected benefits to the region's water supply reliability, and (2) identify and resolve institutional constraints to exchange water between districts and enhance the use of district groundwater banking facilities that will help mitigate the projected loss of water reliability to the region. The study is complete, a memorandum was prepared in March 2010 regarding the Plan of Action resulting from the SOR, and a Final Report was submitted to Reclamation in early 2011. The Plan of Action identified lining of the Calloway Canal as one of the structural measures required to optimize management of water supplies to the region.

Performance measures are methods an applicant can use to quantify actual benefits upon completion of the project. Provide a detailed plan on how performance measures and project monitoring will be used to demonstrate, verify, and report project performance and results. Post-project data verification needs to be included - Historically, flow has been measured at various locations along the Calloway Canal and the resulting volumes have been recorded and reported in annual Hydrographic Reports for the Kern River which cover the period from 1990 through 2010. These reports document that the Calloway Canal has been used to convey water only in "wet" years due largely to the high seepage losses associated with the unlined canal.

To evaluate the average annual seepage losses, two different flow measurement locations along the canal were compared: 1) the Buck Owens Weir, and 2) the Olive Drive Weir. These sharp-crested weirs are equipped with stage recorders, and the discharge ratings at both locations are periodically checked by stream gaging carried out by North Kern. As the two established measurement points span Reach D, comparison of the flows measured at the Buck Owens and Olive Drive weirs, when adjusted for inflows and diversions occurring between the two weirs, provides an accurate accounting of pre-Project seepage and will enable accounting of seepage during construction and after completion of the canal lining.

As summarized in Table 6-2, the 6.2-mile-long reach between the Buck Owens Weir and the Olive Drive Weir lost an average of 6,975 acre-feet per year during the period from 1990 through 2010. After adjusting for periods when there was no flow in the canal, average monthly losses during the 66 months when flow was measured over both weirs for the entire month, primarily during the summer, equal approximately 1,994 acre-feet per month over the 6.2 mile-

long reach, a rate equivalent to 11 acre-feet per day per mile of canal or 3 acre-feet per day for the 1,490 foot length of Reach D.

Occasional stream gage measurements taken recently at locations between the Buck Owens Weir and the Olive Drive Weir suggest loss rates slightly higher than those computed from the long-term record, but confirm the order of magnitude of the estimated loss rate.

Category 5: Innovation

Explain how this project demonstrates innovative techniques and approaches to produce benefits that address water supply - The proposed canal lining project is a regional water conveyance facility improvement that will allow state, federal, and previously banked water supplies to be delivered directly to North Kern WSD, Cawelo WD, and Shafter-Wasco ID, and to Kern-Tulare ID and Delano-Earlimart ID using exchange agreements. The Poso Creek IRWM Plan, RWMG has completed both CEQA and NEPA documents that allow the districts to bank, exchange, and transfer water supplies over a 25-year period. Lining the Calloway Canal is integral to improving how water deliveries occur in the region.

What are the applicant's plans to assist others in adopting and implementing the methods and techniques used by the project? - Project information and status is shared with the Poso Creek IRWM Plan RWMG at regular meetings. Technical information regarding the canal lining is presented in papers to the United States Committee of Irrigation and Drainage and at local engineering luncheons.

How will the applicant continue to expand and build upon the project when Federal assistance ends? - The applicant has successfully aligned state funding and local funds to match the federal assistance. The applicant intends to apply for additional drought-related IRWM funds that are to become available through the State of California. The District will maintain and operate the Calloway Canal with District funds once constructed.

Category 6: NRCS Collaboration

Although North Kern does not have a capital program to fund on-farm enhancements, the District coordinates with local NRCS staff working directly with growers who have applied to the NRCS for funding of on-farm improvements. Because the names of applicants to NRCS programs remain confidential until funding has been awarded, the District does not have advance knowledge of the number of growers within the District who have requested NRCS funding or of the location of lands where on-farm improvements may be located. The local NRCS staff collaborating with North Kern and local growers on on-farm improvements are Sarah Tanuvasa and James Booth, USDA, NRCS, Bakersfield Service Center, 5000 California Ave., Bakersfield, CA.

Because North Kern growers have already converted much of the District to low volume irrigation systems such as drip and micro spray, the District proposes that growers would be well served by NRCS support of on-farm irrigation system evaluations using the Mobile Lab service operated by Brian Hockett of the North West Kern Resources Conservation District (NWKRCD). These evaluations would enable growers to improve operation of their existing systems, improvements that would both increase the efficiency of their on-farm water management and enhance their management of nutrients such as nitrogen. North Kern is in the NWKRCD service area and has funded irrigation system evaluations to growers for many years.

NRCS funding would enable expansion of this Mobile Lab program. Appendix B contains a summary letter provided by NWKRCD which is part of their annual report to North Kern of the on-farm irrigation system evaluations.

A primary on-farm benefit is the improved capacity to deliver surface water to irrigated lands that also rely on groundwater pumped from wells drawing from an aquifer immediately underlying the irrigation service area. The Calloway Canal allows for delivery of water directly to North Kern, Cawelo, and Shafter-Wasco and by exchange to Kern Tulare Irrigation District and Delano Earlimart Irrigation District. Surface water deliveries to irrigators allow groundwater to be conserved. North Kern practices conjunctive use, as do the neighboring districts, which means surface water, when available, replaces pumping of groundwater to meet irrigation demand. If more surface water is available, less groundwater is pumped, resulting in less energy for the same total water use.

Describe the extent to which this project complements an existing or newly awarded NRCS Agricultural Water Enhancement Program (AWEP) - Recently, there were two local AWEP projects that may have had complimentary functionality with local Kern water storage districts. One was for water quality protection on dairies, primarily focused on development of nutrient management plans. The other AWEP was for installation of micro-irrigation on tomato crops. Neither AWEP project is currently active in this NRCS area, nor is either scheduled to be re-funded at this time.

Appendix B. Tables

Table 5-1 Calloway Canal Flow at Buck Owens Weir

(values in acre-feet)

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	-	-	-	-	-	-	-	-	-	-	-	-	0
1991	-	-	-	-	-	-	-	-	-	-	-	-	0
1992	-	-	-	-	-	-	-	-	-	-	-	-	0
1993	-	-	2,737	3,314	4,395	13,793	15,872	4,149	859	3,175	1,857	-	50,151
1994	-	-	-	-	-	-	-	-	-	-	-	-	0
1995	1,656	4,587	5,088	10,227	18,621	19,900	20,604	17,669	10,975	10,468	10,143	1,674	131,612
1996	1,370	1,638	766	792	12,948	11,700	12,355	7,857	1,222	1,065	-	-	51,713
1997	7,842	10,145	13,866	5,829	9,677	12,474	12,058	7,090	1,004	-	-	-	79,985
1998	5,461	5,011	5,827	5,940	8,279	18,434	22,526	20,013	10,584	1,764	-	-	103,839
1999	6,651	4,533	63	541	3,511	5,342	6,044	4,810	2,839	3,820	371	-	38,525
2000	-	476	1,081	-	-	-	-	-	-	168	20	4	1,749
2001	-	-	16	-	-	-	-	-	-	-	-	2,184	2,200
2002	1,486	-	-	-	-	-	-	-	-	-	36	44	1,566
2003	-	-	-	-	-	-	-	-	-	-	-	-	0
2004	-	-	-	-	-	-	-	-	-	-	-	-	0
2005	18	2,440	1,341	264	1,457	18,488	19,241	4,201	-	1,087	522	10,038	59,097
2006	12,113	-	559	1,656	22,387	29,151	26,337	5,687	327	-	-	-	98,217
2007	-	-	-	-	-	-	-	-	-	-	-	-	0
2008	-	-	-	-	-	-	-	-	-	-	-	-	0
2009	-	-	-	-	-	-	-	-	-	-	-	-	0
2010	-	-	4	454	12,174	10,488	14,104	-	-	-	-	4,744	41,968
Total	36,597	28,830	31,348	29,017	93,449	139,770	149,141	71,476	27,810	21,547	12,949	18,688	660,622
Average	1,743	1,373	1,493	1,382	4,450	6,656	7,102	3,404	1,324	1,026	617	890	31,458
Non-Zero Average	4,575	4,119	2,850	3,224	10,383	15,530	16,571	8,935	3,973	3,078	2,158	3,115	55,052

Source: *Annual Hydrographic Reports for Kern River.*

Table 5-2 Seepage Losses between Buck Owens and Olive Drive Weirs

(values in acre-feet)

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	-	-	-	-	-	-	-	-	-	-	-	-	0
1991	-	-	-	-	-	-	-	-	-	-	-	-	0
1992	-	-	-	-	-	-	-	-	-	-	-	-	0
1993	-	-	2,238	1,496	878	1,153	1,492	1,431	573	1,211	972	-	11,444
1994	-	-	-	-	-	-	-	-	-	-	-	-	0
1995	1,656	2,905	1,889	1,645	1,940	1,722	1,828	1,676	1,613	1,658	1,507	688	20,727
1996	926	678	587	710	2,021	1,560	1,598	1,710	778	1,305	-	-	11,873
1997	1,416	1,138	1,271	1,291	1,287	1,226	996	1,210	743	95	65	-	10,738
1998	1,862	1,244	1,269	986	1,287	1,601	1,271	1,037	1,214	914	560	-	13,245
1999	1,484	1,276	63	541	1,149	1,752	1,496	1,037	1,149	1,593	194	-	11,734
2000	-	476	1,081	-	-	-	-	-	-	168	20	4	1,749
2001	-	-	16	-	-	-	-	-	-	-	-	2,166	2,182
2002	1,363	-	-	-	-	-	-	-	-	-	36	44	1,443
2003	-	-	-	-	-	-	-	-	-	-	-	-	0
2004	-	-	-	-	-	-	-	-	-	-	-	-	0
2005	18	2,440	1,341	264	1,457	8,297	2,378	1,466	-	1,087	522	3,152	22,422
2006	2,152	-	559	1,656	3,979	3,675	3,423	2,747	327	-	-	-	18,518
2007	-	-	-	-	-	-	-	-	-	-	-	-	0
2008	-	-	-	-	-	-	-	-	-	-	-	-	0
2009	-	-	-	-	-	-	-	-	-	-	-	-	0
2010	-	-	4	454	7,611	4,913	5,045	-	-	-	-	2,376	20,403
Total	10,877	10,157	10,318	9,043	21,609	25,899	19,527	12,314	6,397	8,031	3,876	8,430	146,478
Average	518	484	491	431	1,029	1,233	930	586	305	382	185	401	6,975
Non-Zero Average	1,360	1,451	938	1,005	2,401	2,878	2,170	1,539	914	1,004	485	1,405	12,207
Maximum	2,152	2,905	2,238	1,656	7,611	8,297	5,045	2,747	1,613	1,658	1,507	3,152	22,422

Source: *Annual Hydrographic Reports for Kern River.*

Table 5-3 Seepage Loss between Buck Owens and Olive Drive Weirs (Full Flow Months)

(values in acre-feet)

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Months			
1990	-	-	-	-	-	-	-	-	-	-	-	-	0				
1991	-	-	-	-	-	-	-	-	-	-	-	-	0				
1992	-	-	-	-	-	-	-	-	-	-	-	-	0				
1993	-	-	2,238	1,496	-	1,153	1,492	1,431		1,211		-	9,021	6			6
1994	-	-	-	-	-	-	-	-	-	-	-	-	0				
1995	1,656	2,905	1,889	1,645	1,940	1,722	1,828	1,676	1,613	1,658	1,507		20,039	11			11
1996	-	-	-	-	2,021	1,560	1,598	1,710		1,305	-	-	8,194	5			5
1997	1,416	1,138	1,271	1,291	1,287	1,226		1,210				-	8,839	7			7
1998	1,862	1,244	1,269	-	1,287	1,601	1,271	1,037	1,214			-	10,785	8			8
1999	1,484	1,276	-		1,149	1,752	1,496	1,037	1,149	1,593		-	10,936	8			8
2000	-	-	1,081	-	-	-	-	-	-				1,081	1			1
2001	-	-		-	-	-	-	-	-	-	-	2,166	2,166	1			1
2002	1,363	-	-	-	-	-	-	-	-	-			1,363	1			1
2003	-	-	-	-	-	-	-	-	-	-		-	0				
2004	-	-	-	-	-	-	-	-	-	-	-	-	0				
2005		2,440	1,341		1,457	8,297	2,378	1,466	-	1,087		3,152	21,618	8			8
2006	2,152	-		1,656	3,979	3,675	3,423	2,747		-	-	-	17,632	6			6
2007	-	-	-	-	-	-	-	-	-	-	-	-	0				
2008	-	-	-	-	-	-	-	-	-	-	-	-	0				
2009	-	-	-	-	-	-	-	-	-	-	-	-	0				
2010	-	-			7,611	4,913	5,045	-	-	-	-	2,376	19,945	4			4
Total	9,933	9,003	9,089	6,088	20,731	25,899	18,531	12,314	3,976	6,854	1,507	7,694	131,619	1,994	322	**10.72**	66
																11	

Source: *Modified from Table 1*

Months	66	
years	21	
Months per year	3.14	
Days per year	95.57429	
	96	30.4167
Length	2,431	Feet
Miles	0.4604	
Loss AFY	486.20	

Table 5-4 Calloway Canal Seepage Losses by Segments

Calloway Canal	Canal Loss			
	Buck Owens	Rosedale Hwy	Coffee Rd	Olive Dr
Measurement Date	Rosedale Hy	to Coffee Rd	to Olive Dr	to 7th Std
	CFS	CFS	CFS	CFS
06/08/11	25	18	18	20
06/10/11	23	27	14	11
06/14/11	25	18	14	42
06/16/11	34	13	14	24
06/29/11	39	26	32	33
07/08/11	22	39	38	19
07/13/11	25	19	23	24
Average	28	23	22	25
Stationing US - ft	5,530	22,200	26,455	37,947
Stationing DS - ft	22,200	26,455	37,947	51,121
Distance - miles	3.2	0.8	2.2	2.5
CFS loss per mile	8.7	**28.4**	10.0	9.9
AF loss per mile	17.3	56.3	19.9	19.7

Table 5-5 Cross Valley Canal to Beardsley Canal though Cawelo Pump Station A

(values in acre-feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976	0	657	1,567	2,452	3,951	6,925	8,867	7,030	1,643	0	629	1,914	35,635
1977	0	279	412	0	0	446	1,099	1,978	813	424	99	0	5,550
1978	0	0	67	0	0	0	248	4,759	1,627	0	0	0	6,701
1979	0	0	0	0	0	0	0	0	1,162	6,129	3,477	3,404	14,172
1980	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	476	248	0	1,279	4,760	8,360	9,047	9,376	7,740	4,433	926	0	46,645
1982	0	56	1,406	0	0	0	0	0	0	0	0	0	1,462
1983	0	0	0	4	0	0	0	0	0	0	0	0	4
1984	10	0	0	0	0	0	0	0	0	0	0	0	10
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	12	4,117	5,015	3,818	4,348	5,090	0	0	0	0	0	0	22,400
1992	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	607	1,572	30	0	2,209
1995	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	6	0	0	0	0	0	0	0	0	0	0	0	6
1998	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	1,549	6,006	9,445	9,362	8,957	8,253	8,053	9,574	3,400	0	64,599
2000	0	0	0	1,573	4,963	4,770	5,086	4,393	1,254	0	0	0	22,038
2001	0	0	0	0	0	1,250	924	454	2,277	0	0	0	4,905
2002	0	1,755	167	151	329	8,295	9,221	9,838	6,795	8,160	40	0	44,751
2003	0	0	772	107	0	1,603	0	0	0	0	627	0	3,108
2004	0	2,424	4,534	0	0	5,554	6,311	2,763	0	0	0	0	21,586
2005	472	1,531	5,950	9,199	0	0	0	0	0	0	0	0	17,152
2006	0	3,117	8,888	2,473	0	0	4,421	9,025	5,147	9,423	9,537	6,821	58,852
2007	1,615	0	0	0	4,381	4,092	1,099	151	0	0	0	0	11,338
2008	0	0	0	0	0	0	0	0	0	0	0	0	0
1976-2008	79	430	919	820	975	1,689	1,675	1,758	1,125	1,203	569	368	11,610
max. af	1,615	4,117	8,888	9,199	9,445	9,362	9,221	9,838	8,053	9,574	9,537	6,821	64,599
max. cfs	27	68	147	152	156	155	152	163	133	158	158	113	1,068
1998-2007	**209**	**883**	**2,186**	**1,951**	**1,912**	**3,492**	**3,602**	**3,488**	**2,353**	**2,716**	**1,360**	**682**	**24,833**

Table 5-6 Energy Calculation

Annual Operational Electrical Energy Savings

Project	Water hp	Q	TDH (ft)	OPE	Input hp	kWh/AF	AF	kWh	MWh	CO2e (MT)	Cost
Well Pumping	135	5	238.9	56.4%	240	433	58800	25,482,089	25,482	11510	$ 3,057,851

Pre-Project	Water hp	Q	TDH (ft)	OPE	Input hp	kWh/AF	AF	kWh	MWh	CO2e (MT)	Cost
Well Pumping	142	5	250	56.4%	251	454	63200	28,661,482	28,661	12946	$ 3,439,378
								28,661,482	28,661	12946	$ 3,439,378
						Difference =	**(4,400)**	**(3,179,393)**	**(3,179)**	**(1436)**	**$ (381,527)**

Assumptions

Average Pre-project pumping depth = 250'
Average Project pumping depth = 238.9' adjusting for the 11.1'
Average Pre-project pumping of 63,200 AFY
4,400 AFY of reduced groundwater pumping
Emission Factor conversion from MWh to kgCO2e = 451.7
Ag Energy Rate Average = $0.12/kWh