AECOM
1360 E. Spruce Avenue
Suite 101
Fresno, CA 93720
www.aecom.com

559.448.8222 tel
559.448.8233 fax

MD-6 and MD-7 Consolidation
Treatment Siting Memo and Water Rate Summary

To:	Leopoldo Espino / Cristina Knudsen
From:	Mark Reitz, PE
Date:	4/29/2014 (Revised 10/7/14)

In the Feasibility Study Reports prepared for MD-6 and MD-7 dated January 2014 the recommended alternative was to consolidate MD-6 and MD-7 with BLWC. In order for this to be a viable option the two systems needed to supply approximately 120 gallons per minute (gpm) of potable water. This capacity was to be provided through a combination of the following:

- Installation of a uranium treatment system on the existing BLWC North Shore Well 1 for 40 gpm
- Construction of a new well in the BLWC service area to be known as Pines 3 for 40 gpm
- Installation of a treatment system for arsenic and uranium located on the site of the existing wells at MD-7 to restore 40 gpm. The treatment plant located at MD-7 would require blending with water from BLWC to meet primary and secondary drinking water standards.

In February 2014 the test well at Pines 3 located no significant water after drilling to a depth of 1,050 feet below ground surface. The unsuccessful drilling at Pines 3 combined with a comparison of water quality results from existing wells in the surrounding area make it highly unlikely that drilling another new well will supply the needed potable water. Since treatment would likely be required at any newly constructed well it was decided to locate treatment at one of the existing test wells at MD-6 or MD-7. Following is a brief discussion and recommendation about the process and siting of treatment facilities necessary to provide a supply of potable water for MD-6 and MD-7.

Recommended Treatment Process

The new test wells and the existing wells at both locations exceed the MCL for arsenic, uranium, and manganese. There are two treatment technologies commonly used to treat for these water quality issues. An overall water treatment plan to mitigate these contaminants will be designed using either adsorptive media filtration or oxidation/coagulation/filtration, or a combination of the two treatment technologies.

Oxidation and coagulation followed by filtration is a long-established treatment technology capable of removing a variety of contaminants including all of those requiring treatment in the water at MD-6 and MD-7. This process can be customized to remove arsenic, uranium, iron, and manganese. The primary disadvantage of a filtration style removal process is the generation of sludge when backwashing the filter. If the treatment process has been optimized to remove all of these contaminants, they will each be present in the backwash sludge in levels significantly higher than in the raw water. This adds complexity and expense for sludge disposal alternatives, especially at remote sites.

The proposed solution to this disposal issue is to utilize an adsorptive media treatment system upstream of the filtration step to remove uranium. Removing uranium through the adsorptive media eliminates uranium from the filter sludge, leaving a sludge containing only arsenic, manganese, and iron, which could be disposed of in a local landfill. The uranium that accumulates on the media is removed and disposed of offsite by the adsorptive media supplier, thus eliminating the burden of responsibility on the owner.

For either the MD-6 or MD-7 location, the proposed treatment process will be the same—adsorptive media for uranium removal followed oxidation, coagulation, and filtration for removal of arsenic, iron, and manganese.

A process flow diagram for the overall system, including the intertie to the BLWC, is shown in Figure 1.

Design Criteria

The recommendations for the chemical feed and storage systems below are based on the following water quality results from the test wells:

Design Criteria	**MD-6 Test Well A**	**MD-7 Test Well A**
Design flow rate	125 gpm	80 gpm
Arsenic in raw water	81 µg/L	20 µg/L
Manganese in raw water	98 µg/L	73 µg/L
Uranium in raw water	57 pCi/L	131 pCi/L
Chlorine residual	1.0 mg/L	1.0 mg/L

Treatment Building Size

The required treatment building size is not reduced significantly between the two locations (MD-6 and MD-7) due to the individual footprint of the treatment equipment and associated systems being relatively equal.

The total treatment system for MD-6 includes an adsorptive media system for uranium removal which is approximately 6 feet wide by 8 feet long with an overall height of less than 10 feet. This system will be installed adjacent to the filtration system, which consists of one filter vessel, and two reaction vessels. The filtration system will have a footprint of approximately 8 feet wide by 16 feet long with a maximum height of just under 12 feet. The system will also include a backwash reclaim tank located outside the building with associated freeze protection. This tank will have a volume of 8,812 gallons and be approximately 10 feet in diameter by 16 feet tall.

By comparison, the total treatment system at MD-7 consists of an adsorptive media system for uranium that is nearly identical to the system required at MD-6 with the footprint of the filtration system being approximately 6 feet 6 inches wide by approximately 15 feet long. The filtration systems for MD-6 and MD-7 are very close to the same size. Therefore, the building size necessary for either treatment system would be essentially the same.

Parcel Location

The parcel where MD-6 Test Well A is located is within approximately 200 feet of adjacent County Road 274 within an easement on an existing private parcel. There is currently safe access to the existing wells from a locked gate along a graveled road. The wells and potential treatment buildings and equipment

would not be visible to the public. There is also existing three-phase electrical power to this site. In order for a treatment plant and building to be constructed in this location, the easement will need to be enlarged. This part of the parcel is not usable to the property owner as it is much lower in elevation than the rest of the parcel and is divided by the County's easement to the existing wells. It is also very difficult to see or hear for any of the homeowners or from the road, making it an ideal site for the treatment facilities. A parcel approximately 1 acre in size would be needed for the treatment site improvements.

The MD-7 Test Well A parcel is located within the neighborhood on an existing vacant cul-de-sac lot. It has the advantage of already being owned by the County. However, since the site is visible from the street, it will require an elaborate and expensive building to blend with the adjacent houses as well as new piping to connect the existing wells off Fawn Point Lane directly to the cul-de-sac parcel for combined treatment, requiring trenching (approximately 1,560 feet) through the neighborhood. A backwash storage tank would also distract from this neighborhood setting.

Access

The location of MD-6 Test Well A and the proposed treatment plant are accessed directly from Road 274, eliminating the need for maintenance personnel, chemical delivery, and sludge removal trucks driving through the neighborhood.

The location of MD-7 Test Well A and any future treatment facilities are within the neighborhood and well uphill from the county road. Additionally, the lot is much higher than the edge of the cul-de-sac where the lot is located, requiring either a steep driveway or extensive grading of this lot.

Well Capacity

The test well at MD-6 was calculated to have a sustained capacity of 177 gpm after 120 days of pumping per the predictions made by Kenneth D. Schmidt and Associates after the 10-day pump test. The test well at MD-7 only has a sustained capacity of 80 gpm based on the 10-day pump test. The MD-6 well water level recovered more quickly after pump shutoff than the test well at MD-7. Therefore, it was considered more reliable over time.

Future Usage

If the treatment plant were to be installed at the MD-6 location, the lot at MD-7 could be sold and the money returned to the MD-7 reserve fund for future improvements to the water system by the County. The MD-7 well could also be capped and kept as an emergency backup well.

Cost

There are several factors influencing the cost of the alternative treatment locations. The following opinion of probable cost includes several of the key factors.

Site Construction Item	Cost (2014 Dollars)	
	MD-6 - 125 gpm ($)	MD-7 - 80 gpm ($)
Site demolition, clearing, and grubbing	50,000	50,000
Purchase adsorptive media system for uranium removal	248,000	225,000
Purchase filtration system including reclaim system	187,000	180,000
Treatment system installation and testing	50,000	50,000
Treatment system building	120,000	200,000
Site piping modifications/additions	75,000	75,000
Electrical modifications, metering, and telemetry modifications	80,000	80,000
Miscellaneous site work, paving, vaults, walls, landscaping	50,000	70,000
Chemical feed systems	27,000	27,000
Well pump, motor, and appurtenant piping	50,000	50,000
Piping to connect existing Well 2 (MD-7 only 1,560 LF)	-	100,000
Mobilization and demobilization @ 10%	94,000	111,000
Subtotal	**1,031,000**	**1,218,000**
Contingencies @ 20%	207,000	244,000
Opinion of Probable Construction Cost	**1,238,000**	**1,462,000**

As shown in the opinion of probable construction cost, the difference in the treatment system equipment for the two sites is relatively small, with the larger system located at MD-6 costing only $30,000 more than a smaller system located at MD-7. This difference, when compared with the additional cost for site work, building aesthetics, and the interconnection pipeline at MD-7 to the existing wells, exceeds the difference in treatment costs. The result being that it would actually cost more to install a treatment plant at MD-7 that would provide less capacity (80 gpm vs 125 gpm) to the combined water systems.

Recommendation

Based on the factors outlined previously, we recommend that the treatment facility be located at MD-6 to provide the largest amount of capacity for the least cost and impact on the communities. We recommend the owner(s) of the well lot at MD-6 be contacted to discuss methods to purchase an option to acquire a larger easement of approximately 1 acre of property around Well 4. A sketch of the approximate lot size required for the treatment equipment, including setbacks and grading slopes, is shown in Figure 2. Madera County is in the process of contacting the owner, Bank of America, for this purpose.

Pilot Study

The California Department of Public Health (CDPH) has requested a pilot study test be performed at the selected well site at MD-6 to confirm the treatability and to predict the O&M costs over time. This work is scheduled to take place during November 2014 to January 2015. Once this is completed, the project is expected to move ahead to final design, bidding, and construction. The project would include the treatment facilities at MD-6, a uranium removal system at the BLWC North Shore well, and an intertie pipeline from BLWC to MD-6 and MD-7 as well as a booster pump station and related controls and connections to the MD-6 and MD-7 water system piping and tanks.

Economic Analysis/Rate Impacts

Based on recent discussions with Madera County and CDPH, it is expected that the following grants/loans will be offered for funding of the proposed improvements.

Proposed Improvements	Responsible Party	Grant/Loan (%)
1. Intertie pipeline from BLWC to MD-6 and MD-7	MD-6, MD-7	80/20
2. Booster pump station with controls	MD-6, MD-7	80/20
3. Connections to MD-6 and MD-7 pipelines and tanks	MD-6, MD-7	80/20
4. Treatment system at MD-6 Well 4 and equipping well	MD-6, MD-7	80/20
5. Treatment system at BLWC North Shore Well 1	BLWC, MD-6, MD-7	80/20

Once the improvements are constructed and operational, the O&M costs will be shared on a per-customer basis with the combined BLWC customers and the MD-6/MD-7 customers. The interest rate on the loan portion of the State funding is expected to be between 0 and 2 percent and repayable over a 20- to 30-years period under the State Revolving Fund (SRF) Program.

Opinion of Probable Construction Costs

The following table provides an opinion of probable construction cost for the improvements to be paid for by the MD-6 and MD-7 customers assuming a 20-percent loan scenario.

MD-6/MD-7 Proposed Improvements	Cost ($)	80% Grant ($)	20% Loan ($)
1. Intertie pipeline from BLWC to MD-6 and MD-7 21,250' of 6" diameter pipeline @ $65/ft	1,381,250	1,105,000	276,250
2. Booster pumping station including electrical and controls	150,000	120,000	30,000
3. Connections to MD-6 and MD-7 pipelines and tanks with SCADA controls	125,000	100,000	25,000
4. Treatment system at MD-6 Well 4 and equipping well, excluding land cost	1,031,000	824,800	206,200
Subtotal	2,687,250	2,149,800	537,450
Contingencies @ 20%	537,450	429,960	107,490
Legal and construction management @ 10%	268,725	214,980	53,745
Total	3,493,265[1]	2,794,580	698,685

[1]Excludes purchase of additional land or easement.

BLWC Proposed Improvements	Cost ($)	80% Grant ($)	20% Loan ($)
Treatment system at North Shore Well 1	200,000	160,000	40,000
Subtotal	200,000	160,000	40,000
Contingencies @ 20%	40,000	32,000	8,000
Legal and construction management @ 10%	20,000	16,000	4,000
Total	260,000	208,000	52,000

Opinion of Annual Operation and Maintenance Costs

The following table provides an estimate of the annual O&M cost for the proposed treatment systems that will be operated by BLWC. A further breakdown of these costs is included in the Appendix.

Proposed Improvements	Yearly Cost Increase for 1,069 Customers ($)	Yearly Cost Increase per Customer ($)
1. Treatment system at MD-6 Well 4 (125 gpm) including power/chemical/labor/testing for iron, manganese, arsenic, and uranium	78,230	73
2. Treatment system at North Shore Well 1 for uranium	21,000	20
Total	99,230	93

MD-6 and MD-7 Water Rates

Current Rates

Residential connections (46 existing homes) in MD-6 presently pay a flat rate of $141 per quarter, or $47 per month billed on a quarterly basis. Residential connections (83 existing homes) in MD-7 pay a flat rate of $110 per quarter, or $36.67 per month billed on a quarterly basis.

BLWC Water Rates

Current Rates

BLWC residential connections (approximately 940 total service connections) currently pay a flat rate of $682.05 annually. The yearly rate is billed semiannually and works out to approximately $56.84 per month. As a private utility BLWC is subject to the California Public Utilities Commission (PUC) regulations and is in the process of a rate increase request to account for improvements to the system installed over the last 10 years. The new residential rates are expected to be $797.13, or $66.43 per month.

Future Rates

BLWC is in the design phase for a new 1-MGD membrane filtration plant. The design and construction of this plant will require a rate increase that should go into effect near the time the plant is completed in 2015 or 2016.

BLWC currently has two options for funding of the proposed improvements. First, they have a loan offer from a private bank. If this loan is accepted, it would increase the yearly fee, again pending PUC

approval, to approximately $1,353 a year, or $112.75 per month. The second alternative is a loan from CDPH through the SRF program. This loan is only available to BLWC if they consolidate MD-6 into their service area and assume all responsibility for the consolidated water system. The interest rate in this loan is much more attractive and would result in an estimated annual rate of $1,040.31, or $86.69 per month.

Water Rates after Completion of Alternatives

The following table shows the cost increase from the loan repayments at 0, 1, and 2 percent interest over a 20- or 30-year period. O&M costs for each alternative and the estimated total water rate after completion of the improvements are also shown considering the O&M costs to be spread over all BLWC customers.

Loan Repayment Scenarios per Year

	20-Year Repayment ($)			30-Year Repayment ($)		
Loan Amount	**0%**	**1%**	**2%**	**0%**	**1%**	**2%**
$700,000[1]	35,000	38,794	42,812	23,333	27,125	31,255
Per customer (129 customers)	271	301	332	180	210	242
$52,000[2]	2,600	2,882	3,180	1,733	2,015	2,322
Per customer (1,069 customers)	2.43	2.70	2.98	1.62	1.89	2.17

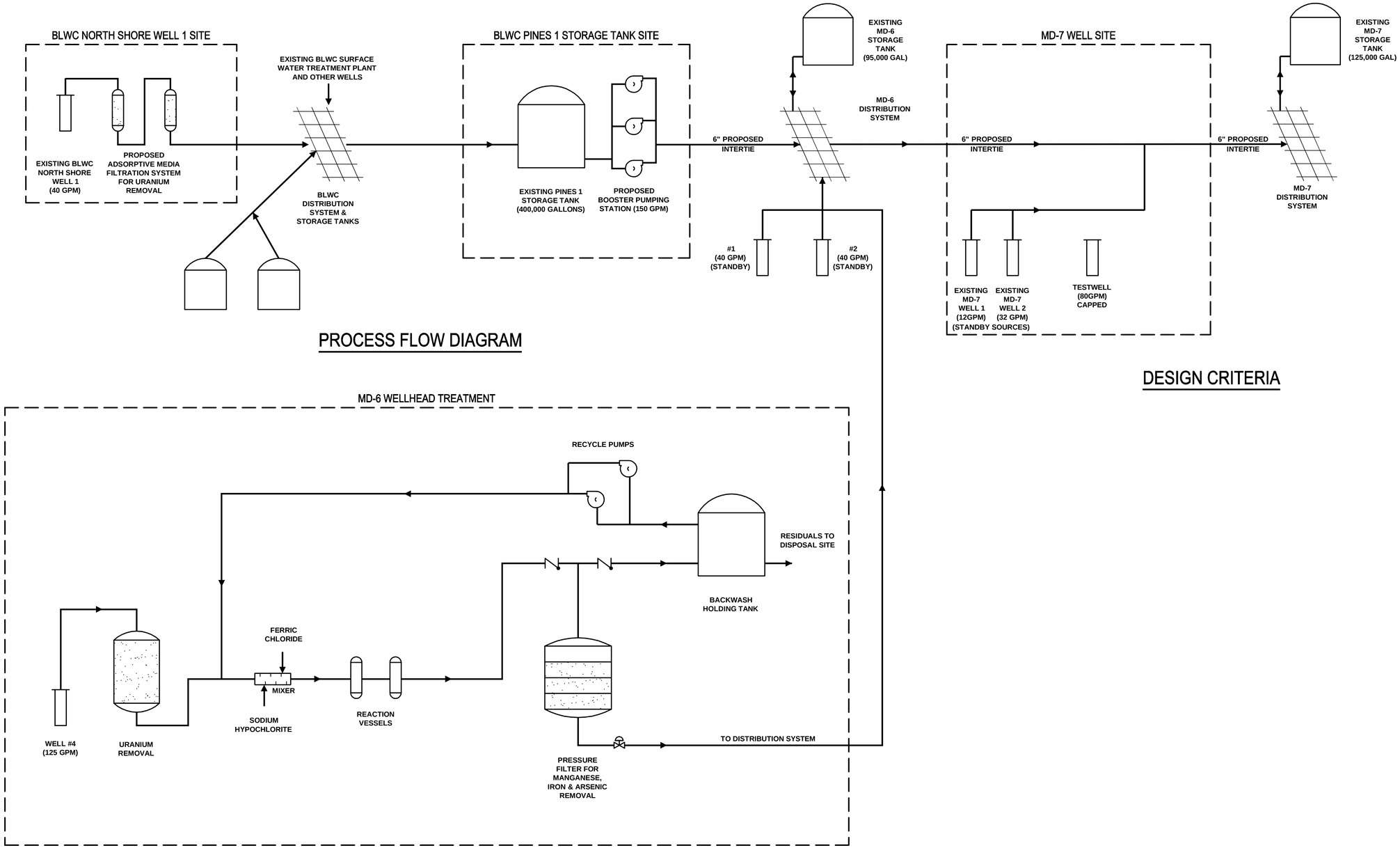
[1]Based on the $698,685 improvement costs to be repaid by MD-6 and MD-7.
[2]Based on the $52,000 improvement costs to be repaid by MD-6, MD-7, and BLWC.

Projected Annual Water Rates

	MD-6 ($)	**MD-7 ($)**	**BLWC ($)**
Current	564*	440*	1,040
O&M increase for treatment at MD-6 Well 4 and North Shore well	93	93	93
SRF loan repayment for improvements	180 to 332	180 to 332	--
SRF loan repayment North Shore well treatment only	2 to 3	2 to 3	2 to 3
Total per Year	839 to 992	715 to 868	1,135 to 1,136
Total per Month	$ 77 to 82	$ 60 to 72	$ 95

*These current rates may be decreased once the new system is constructed and operated as a consolidated system by BLWC. A one-time connection charge may also be implemented by BLWC to take over responsibility for future maintenance/replacement of the MD-6 and MD-7 systems.

Appendix



PROCESS FLOW DIAGRAM

DESIGN CRITERIA

10/14/14

REV	DATE	DESCRIPTION	APPR
7			
6			
5			
4			
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1			

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DESIGNED BY BMS
DRAWN BY BPD
CHECKED BY BMS
DATE July 14

PROJECT ENGINEER MARK P. REITZ
REG NUMBER C28196 EXP DATE 3-31-16
PROJECT NUMBER 60273608
CADD STANDARDS AECOM

REGISTERED PROFESSIONAL ENGINEER MARK P. REITZ No. C28196 Exp. 03/31/16 CIVIL STATE OF CALIFORNIA

AECOM
1360 E. Spruce Avenue, Suite 101
Fresno, California 93720
T 559.448.8222 F 559.448.8233
www.aecom.com

MADERA COUNTY
CONSOLIDATION IMPROVEMENTS BETWEEN BLWC, MADERA COUNTY MD 6 LAKESHORE, MADERA COUNTY MD 7 MARINA VIEW

PROCESS FLOW DIAGRAM - SYSTEM

DRAWING FIG 1
SHEET -
OF – SHEETS

DWG: V:\Madera, County of\60275645-MD-7\000 CAD\02-SHEETS\FIG-01.dwg USER: deandob
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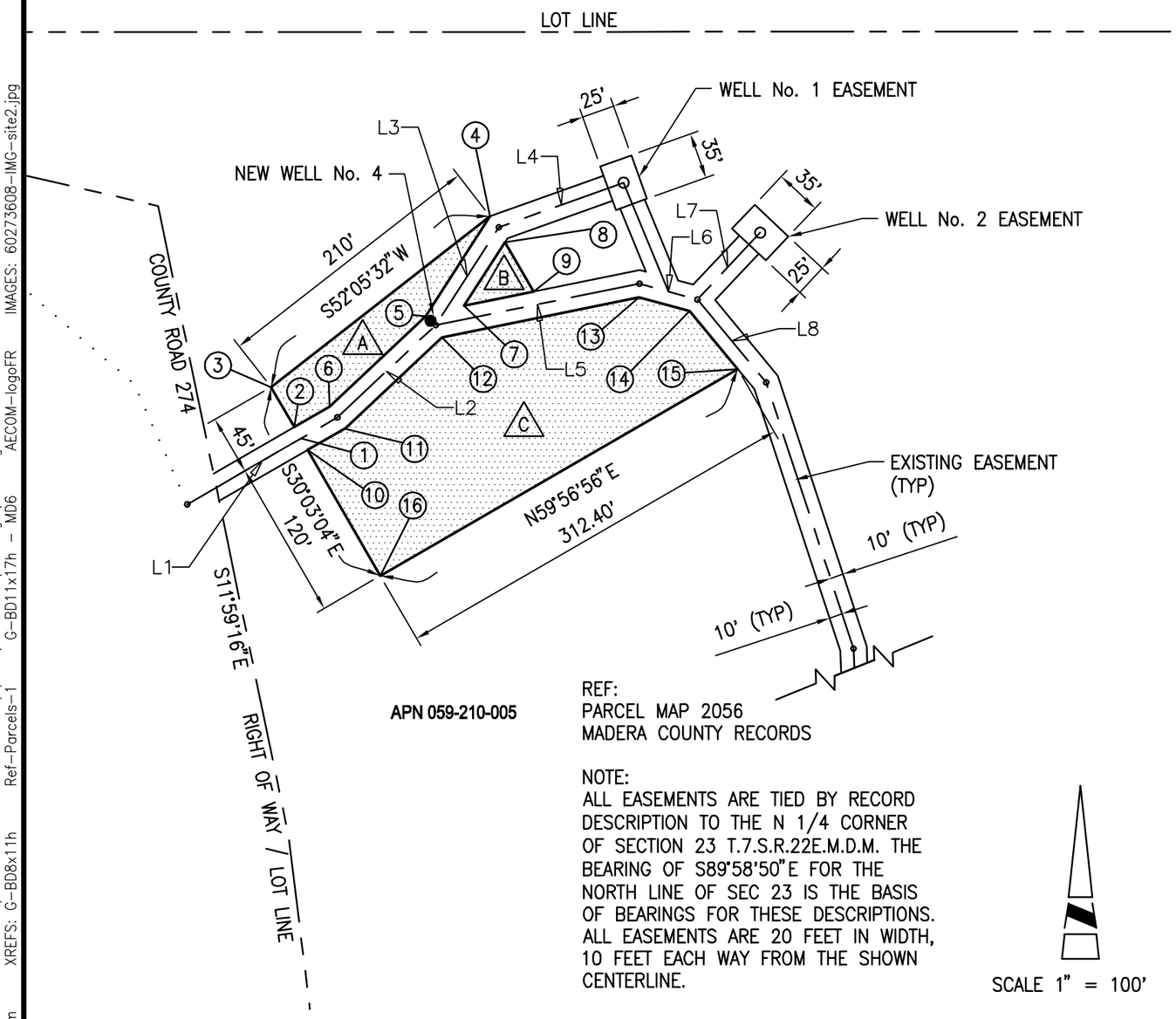

REF:
PARCEL MAP 2056
MADERA COUNTY RECORDS

NOTE:
ALL EASEMENTS ARE TIED BY RECORD DESCRIPTION TO THE N 1/4 CORNER OF SECTION 23 T.7.S.R.22E.M.D.M. THE BEARING OF S89°58'50"E FOR THE NORTH LINE OF SEC 23 IS THE BASIS OF BEARINGS FOR THESE DESCRIPTIONS. ALL EASEMENTS ARE 20 FEET IN WIDTH, 10 FEET EACH WAY FROM THE SHOWN CENTERLINE.

SCALE 1" = 100'

EXISTING EASEMENT DATA		
NUMBER	DISTANCE	BEARING
L1	131.17	N59° 59' 37"E
L2	102.07	N46° 52' 24"E
L3	87.91	N32° 51' 46"E
L4	100.26	N70° 19' 20"E
L5	157.25	N78° 33' 35"E
L6	45.33	S74° 35' 38"E
L7	69.50	N43° 15' 24"E
L8	81.40	S39° 42' 50"E
L9	128.49	S07° 57' 09"E

PARCEL SIZE		
NUMBER	S.F.	ACRE
A	5,707.80	0.13
B	1,103.75	0.03
C	33,381.53	0.77
	TOTAL	0.93

COORDINATE LIST		
NUMBER	NORTHING	EASTING
1	4691.89	10433.27
2	4700.55	10428.26
3	4730.85	10410.73
4	4859.87	10576.42
5	4784.17	10527.61
6	4715.96	10454.90
7	4792.24	10556.61
8	4840.42	10587.68
9	4802.96	10609.35
10	4683.24	10438.28
11	4699.40	10466.38
12	4768.48	10540.12
13	4798.75	10689.09
14	4788.18	10727.46
15	4744.47	10763.77
16	4588.03	10493.36

AECOM
AECOM
1360 E. Spruce Avenue, Suite 101
Fresno, California 93720
T 559.448.8222 F 559.448.8233
www.aecom.com

AECOM PROJECT NO.
60273608

COUNTY OF MADERA
MAINTENANCE DISTRICT 6 LAKE SHORE

LAND ACQUISITION FOR
WELL No. 4 TREATMENT

FIG.
2

DWG: V:\Madera, County of\60273608-MD-6\500 Submittals-Deliverables\Specs\Test Hole\Drawings\EXH.dwg USER: deandab
DATE: Oct 20, 2014 12:46pm XREFS: G-BD8x11h Ref-Parcels-1 AECOM-logoFR IMAGES: 60273608-IMG-site2.jpg G-BD11x17h - MD6

Appendix A

Opinion of Probable Operation and Maintenance Costs (Fe, Mn, As, Ur)

Reaction Vessels	2
Filter Vessels	1
Vessel Diameter	7 ft
Design Flow	125 gpm
Maximum Acceptable Flow	150 gpm
Assumed Duty Cycle	10.0%

	Cost (2013 Dollars)
Annual Cost of Power	$1,994
Annual Cost of Chemicals	$746
Annual Cost of Labor	$55,950
Annual Cost of Sampling	$9,540
Annual Cost of Misc/Future Issues	$10,000
Total Annual O&M Cost	$78,230

O&M Cost Calculations (Fe, Mn, As, Ur)

Additional Power	
Flow Rate	150 gpm
GAC System Headloss	11.00 ft
Pump Efficiency	70%
Additional Power Required due to Headloss	0.37 kW
Assumed Duty Cycle	10.0%
Power Unit Cost	$0.13/kWh
Annual Power Cost	$42

Annual Power Cost per Building Area	$2.44
Building Area	800 sq ft
Building Energy Costs	$1,952
Total Annual Power Costs	$1,994

Labor	
Site Inspection and Maintenance	20.0 hrs/week
Sampling	27 hrs/year
Reports and Logs	52 hrs/year
Total Annual Hours	1119 hrs/year
Unit Cost	$50.00/hr
Annual Cost	$55,950

Laboratory and Sampling	
Annual Fe, Mn, As, Ur Samples	96 samples
Annual Fe, Mn, As, Ur Sample Cost	$9,120
Annual BACT/HPC Samples	12 samples
Annual BACT/HPC Sample Cost	$420
Annual Cost	$9,540

O&M Cost Calculations (Fe, Mn, As, Ur)

Sodium Hypochlorite (12.5%)	
Flow Rate	125 gpm
Assumed Duty Cycle	10.0%
Dosage	0.75 mg/L
Daily Usage	0.11 gal/day
30 Day Storage Volume	3 gal
Unit Cost	$2.25/gal
Annual Cost	$93

Ferric Chloride	
Flow Rate	125 gpm
Assumed Duty Cycle	10.0%
Dosage	5.00 mg/L
Daily Usage	0.75 gal/day
30 Day Storage Volume	23 gal
Unit Cost	$2.25/gal
Annual Cost	$617

Sodium Bisulfite	
Flow Rate	125 gpm
Assumed Duty Cycle	10.0%
Dosage	0.30 mg/L
Daily Usage	0.05 gal/day
30 Day Storage Volume	1 gal
Unit Cost	$2.25/gal
Annual Cost	$37

Total Chemical Cost	$746

Opinion of Probable Operation and Maintenance Costs Alternative 3 North Shore Well 1

Design Flow	30 gpm
Maximum Acceptable Flow	50 gpm
Assumed Duty Cycle	50.0%

	Cost (2013 Dollars)
Annual Cost of Media Replacement	$2,684
Annual Cost of Power	$1,026
Annual Cost of Chemicals	$851
Annual Cost of Labor	$9,400
Annual Cost of Sampling	$1,560
Annual Cost of Misc Maintenance	$5,000
Total Annual O&M Cost	$21,000

O&M Cost Calculations Uranium

Additional Power	
Flow Rate	30 gpm
GAC System Headloss	11.00 ft
Pump Efficiency	70%
Power Required due to Headloss	0.09 kW
Assumed Duty Cycle	50.0%
Power Unit Cost	$0.13/kWh
Annual Power Cost	$50

Annual Power Cost per Building Area	$2.44
Buidling Area	400 sq ft
Building Energy Costs	$976
Total Annual Power Costs	$1,026

Labor	
Site Inspection and Maintenance	2.5 hrs/week
Sampling	06 hrs/year
Reports and Logs	52 hrs/year
Total Annual Hours	188 hrs/year
Unit Cost	$50.00/hr
Annual Cost	$9,400

Laboratory and Sampling	
Annual Samples Uranium	12 samples
Annual Uranium Sample Cost	$1,140
Annual BACT/HPC Samples	12 samples
Annual BACT/HPC Sample Cost	$420
Annual Cost	$1,560

O&M Cost Calculations Uranium

Sodium Hypochlorite (12.5%)	
Flow Rate	30 gpm
Assumed Duty Cycle	50.0%
Dosage	0.75 mg/L
Daily Usage	0.14 gal/day
30 Day Storage Volume	4 gal
Unit Cost	$2.25/gal
Annual Cost	$111

Corrosion Inhibitor	
Flow Rate	30 gpm
Assumed Duty Cycle	50.0%
Doasge	5.00 mg/L
Daily Usage	0.90 gal/day
30 Day Storage Volume	27 gal
Unit Cost	$2.25/gal
Annual Cost	$740

Total Chemical Cost	$851