

PRODUCTION WELL INSTALLATION REPORT

for the

FARMINGTON WATER COMPANY WELLS A & B

prepared for

NOLTE ASSOCIATES, INC.

prepared by

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DE Project No. 109-21
October 2010
Revision 0**

CERTIFICATION

This Production Well Installation Report for the Farmington Water Company Wells A & B in San Joaquin County, California was prepared under my direct supervision. I am a California Professional Geologist, pursuant to Section 7850 of the Business and Professional Code.

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document, and based on my direct knowledge or inquiry of other individuals immediately responsible for obtaining information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Signature of Professional Geologist

Date

Jaco Fourie, P.G.

Professional Geologist No. 8540, California

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1. INTRODUCTION

Dunn Environmental, Inc. (DE) was retained by Nolte Associates, Inc. (Nolte) on behalf of the Farmington Water Company (FWC) to oversee the activities related to the drilling, installation, development and initial sampling of two production wells, Well A & B in Farmington, California (project site). Well A is located approximately 700 feet east of Escalon-Bellota Rd and 1,200 feet north of Highway 4/Farmington Rd. Well B is located approximately 800 feet west of Escalon-Bellota Rd and 600 feet north of Highway 4/Farmington Rd.

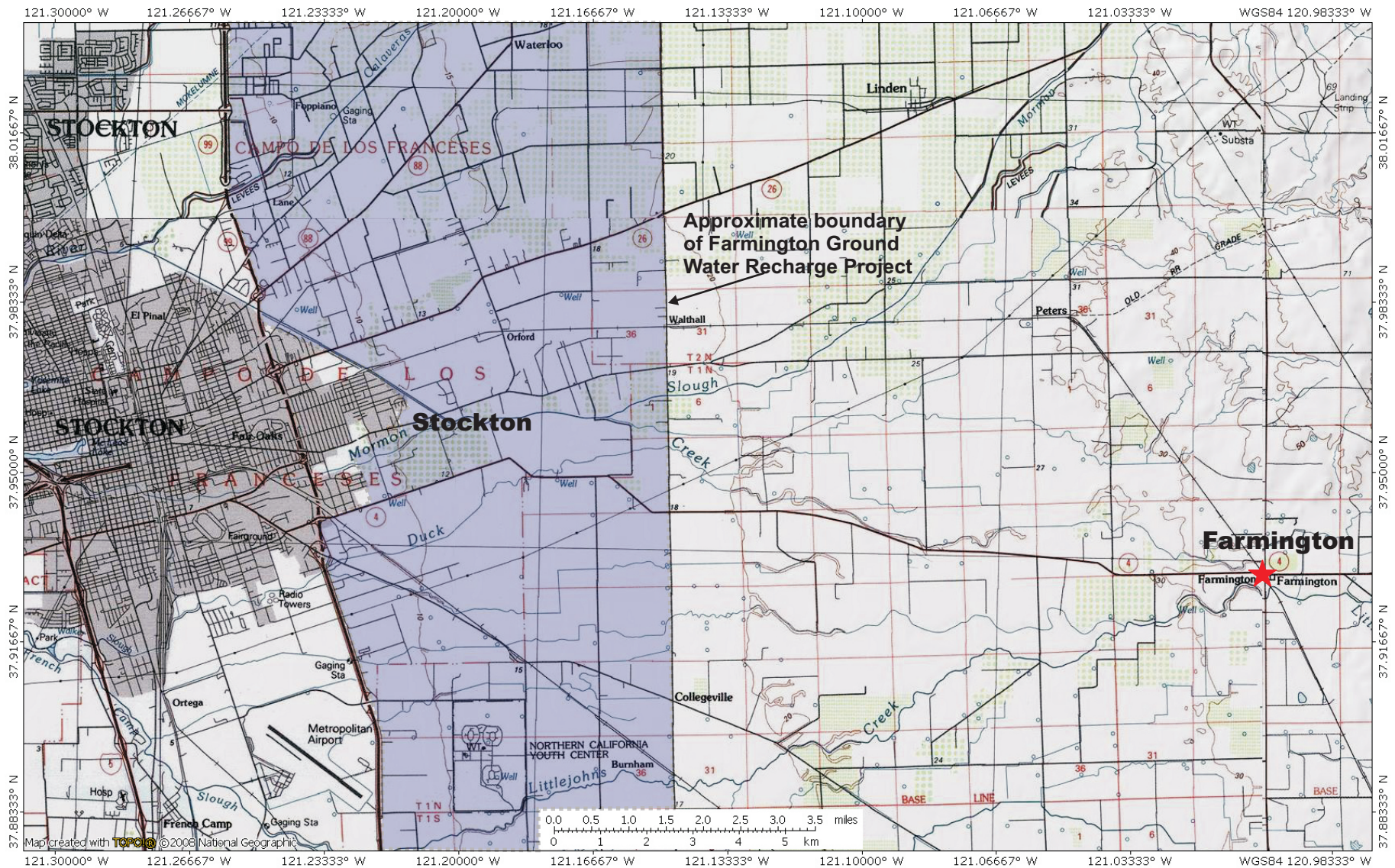
Well design and target depths were detailed in the *Technical Memorandum No. 1 - Proposed Well Design and Possible Contaminating Activities* (Tech Memo No. 1) prepared by DE during November 2009. Based on the referenced document, the production well screened intervals were originally proposed to be extended for two zones from 220 to 260 feet below ground surface (bgs) and 340 to 380 feet bgs. The proposed design was modified based on the borehole geology. The deviations from proposed design final well construction are detailed within.

1.1 PHYSICAL SETTING

FWC is a small community water system and provides potable water to the community of Farmington, California; refer to Figure 1 for location map. FWC has 84 service connections and services a population of approximately 270 people. The two new production wells were drilled on parcels acquired by FWC in the recent past. The grade elevation of the well sites ranged from 107 to 111 feet to Mean Sea Level (MSL). Refer to Figure 2 for depiction of Well A & B location.

1.2 GEOLOGIC SETTING

Farmington lies within the San Joaquin Valley of the Great Central Valley of California. The Great Central Valley consists of an asymmetrical trough in filled by sediment. Thickness of valley fill ranges from of less than 20 feet near the bedrock highs on the rolling hills to the east, to over 20,000 feet along the trough axis. These sediments are comprised of terrestrial, marine and volcanic sediments deposited during periodic inundation by the Pacific Ocean and erosion of the surrounding mountains respectively.



DATE: 08/12/2009
 SCALE: 1"=2 mi.
 PROJECT NO: 109-21
 DRAWN: JF
 CHECKED: PFD
 FIGURE: 1

LOCATION MAP
 FARMINGTON WATER COMPANY
 SAN JOAQUIN COUNTY, CALIFORNIA

Sediment deposits beneath the project site can be subdivided into consolidated and unconsolidated deposits, with the consolidated sediments underlying the unconsolidated sediments. With depth, the stratigraphy of unconsolidated sediments consists initially of Recent to Pleistocene Age alluvial deposits of the Modesto, Riverbank Formations. These sediments encountered are typically unconsolidated sands and gravels interbedded with significant silts and clays. These clays separate the upper sediments over the lower Late Plio-Pleistocene Age Laguna Formation and the older Eocene to Pliocene Age Mehrten Formation, these units are poorly consolidated sediments and are differentiated based on color and sand type. The Laguna Formation is typical light brown of color, and the differentiated characteristic of the Mehrten is the black sands derived from volcanic detritus. Valley Springs and Ione formation are known to exist below the Mehrten Formation. The formations have a distinct geologic dip and thickness to the west. The Laguna and Mehrten Formations ranges from 200 to 1,000 feet in thickness from east to west.

Geologic map for the area, Wagner et. al.¹ shows surface deposits are the Pleistocene aged Modesto Formation. The knolls and ridges to the north and the east represent outcrops of the Tertiary aged Laguna and Mehrten Formations.

1.3 HYDROGEOLOGIC SETTING

Per the California Department of Water Resources (DWR) Bulletin 118² and based on our knowledge of the area, the project site is located within the Eastern San Joaquin subbasin bounded by the San Joaquin River on the west, the Mokelumne River on the North, the Stanislaus River to the south, and the crystalline bedrock of the Sierra Nevada Mountains on the east. The Eastern San Joaquin subbasin stratigraphy consists of unconsolidated sediments of Recent to Pleistocene Age alluvial deposits of the Modesto, Riverbank Formations. These represent alluvial fan deposits and are composed of sands and gravels, with silts and clays found in interfan areas. These clay layers separate the upper sediments from the lower Late Plio-Pleistocene Age Laguna Formation and the older Eocene to Pliocene Age Mehrten Formation. Refer to Tech Memo No. 1 for additional on area hydrogeology, project area hydrogeology and conceptual hydrogeologic model.

¹ Wagner, D.L., Bortugno, E.J., and McJunkin, R.D., Geologic map of the San Francisco-San Jose quadrangle, California, 1:250,000, California Division of Mines and Geology, 1991.

² California's Groundwater, Bulletin 118 – Update 2003, State of California, The Resource Agency, Department of Water Resources, June 2003.

2. PRODUCTION WELL INSTALLATION

2.1 TESTHOLE DRILLING, DISCRETE ZONE SAMPLING, DOWNHOLE GEOPHYSICAL SURVEY AND FINAL WELL DESIGN

Activities related to the drilling, construction and development of the Well A & B were completed pursuant of the requirement specified in the *Farmington Water Company, Drilling, Development, and Testing of Production Wells, Contract Documents, Conformed Set, April 2010* prepared by Nolte with the well design by DE.

The well driller mobilized on June 28, 2010 and commenced drilling at Well B site. The well driller selected for the project was Calwater Drilling Co. Inc. (Calwater) of Turlock, California, C-57 License No. 434218, using a Midway drill rig. A direct mud rotary drilling technique was used for test hole drilling. An eight inch diameter drag drill bit or tri cone drill bit was used depending on encountered conditions. A mud pit was constructed on site. Drill cuttings were collected by the well driller at the borehole surface. Samples were collected every 10 feet; samples were placed into zip top bags, labeled and presented to the DE representative for geologic logging. DE compiled a geologic log of encountered formations, refer to Appendix A for geologic log for both Well A & B. The DWR well driller's logs for Well A & B have been submitted separately by the driller to the DWR.

Drilling of testhole at the Well B site commenced on June 28, 2010 using a drag bit. A significant gravel layer was found from 14 to 52 feet bgs. The gravel layers became unstable and collapsed into the borehole. Drilling was delayed while drilling fluid was circulated and drilling mud added to increase mud weight. Gravel and cobbles collected at the bottom of the well and could not be removed. As a result drilling was difficult and drill bit advance slow. At 60 feet the drill stem was pulled and the drill bit switched from a drag bit to a tri cone bit. After cleaning out most of the gravel and cobbles that had collected at the bottom of the borehole, drilling operation reverted back to a drag bit around 110 feet bgs. The borehole was completed on June 29, 2010 final borehole depth was 440 feet bgs. Medium grained black sand was identified from 348 to 440 feet, with a siltstone horizon found from 427 to 436 feet bgs. The sand horizon identified was composed of majority black grains with 10 to 15 percent red grains. Refer to Appendix A for geologic log with detailed lithological descriptions.

Once the test hole was complete the drill stem was pulled and a downhole geophysical survey was completed by Dewey Data Inc. of Stockton, California. The downhole survey recorded fluid resistivity, spontaneous potential (SP), gamma radiation, 64 inch resistivity and 16 inch resistivity. The geophysical survey met the contract

requirements. The geophysical survey supported the geologic logging and identified potential water production horizons from 362 to 438 feet bgs. Refer to Appendix A for copy of the geophysical log.

A change in work order was approved to allow for the collection of a zone discrete sample to address concerns related to arsenic, iron and manganese in ground water. A discrete zone sampling well was constructed using three inch diameter galvanized steel casing. The steel casing was placed down the well, the screened interval extended from 373 to 394 feet bgs. Approximately 2.5 cubic yards of sand was placed opposite the screen and extended from 355 to 440 feet bgs. A bentonite seal was placed to 342 feet bgs.

Development of the testhole commenced on June 30, 2010. The well was developed first by air development. Once heavy sediment had been removed a submersible electrical pump was placed down the well and development continued. A total of approximately 4,000 gallons (40 times the well casing volume was removed during development). Measurements of pH, conductance, temperature and turbidity were collected during test well development. Once the development was complete samples for water quality analysis were collected, final field parameters were pH 7.60, conductance 215 μ S, temperature 21.7° C and turbidity 1.84 NTU. Samples were transferred to Calwater personnel under chain of custody and submitted to GeoAnalytical Laboratories, Inc. of Turlock, California for analysis. Analysis reported arsenic, iron and manganese as non-detect. Refer to Appendix B for laboratory results.

Calwater mobilized to Well A site and commenced drilling on July 1, 2010. The test hole was advanced to 440 feet bgs and a downhole geophysical survey completed on July 1, 2010. The geophysical survey was completed by Dewey Data. Geologic logging of testhole cutting identified potential black sand horizons from 307 feet to 440 feet bgs. Sand were medium to fine grained and composed of black grains, visually identified as andesitic detritus, with minor red grains visually identified be rhyolite detritus. Geologic logging and driller observations also identified several siltstone layers. These layers were typically less than 2 feet in thickness and composed less than 10 percent of the total formation package. Refer to Appendix A for geologic log.

The Well A geophysical log parameters were the same as those recorded for Well B on June 29, 2010 and met the contact requirements. The geophysical survey identified zones for ground water production from 344 to 436 feet bgs. The geophysical survey also shows areas of low resistivity that can be correlated to siltstone horizons observed in drill cuttings. Based on the water quality results from testhole of Well B, DE did not consider in necessary to complete discrete zone sampling at Well A testhole.

Once the testhole drilling was complete DE submitted formation samples for grain size analysis to Sierra Testing Laboratories, Inc. of El Dorado Hills, California. Two samples were submitted a Well Site A 380 to 420 feet composite sample and Well Site B 390 to 420 feet composite. Grain size analysis showed the formation samples consisted of medium to fine sand with Well A reporting more fine sand material. Grain size analyses were used to finalize the gravel pack and well screen selection. The gravel pack was selected by using the 30 percent passed grain size and multiplying by factor of 4 to 10. The 30 percent passed grain size of the gravel pack had to meet this requirement. The screen was selected to allow five percent of greater of the gravel pack to pass through the screen. Grain size analysis with gravel pack grain size and screen slot size is depicted graphically in Appendix B. Based on the criteria above and the formation grain size, DE in concurrence with the well driller selected a SRI Supreme 8x12 gravel pack and a 0.040 inch slot screen. Once the testholes were completed the well driller demobilized.

2.2 PRODUCTION WELL CONSTRUCTION

The well driller mobilized again on July 12, 2010 to set the conductor casing at Well B site. A 24 inch diameter drill bit was used to advance the conductor borehole to 50 feet bgs. The conductor casing measured 20 inches in diameter and wall thickness was 0.25 inch. The conductor casing met the contract requirements. The conductor casing was placed to 50 feet bgs. The annular space outside the conductor was sealed using 10.5 sack cement sand slurry, approximately 2.5 cubic yards was placed as a sanitary seal. Cement sand slurry was supplied by Sunrise Redi-Mix of Modesto, California. Cement grout was placed using a grout pump and tremmie pipe. A San Joaquin County Environmental Health Department (SJCEHD) representative was present for sanitary seal placement.

Drilling of the conductor borehole at Well A site commenced July 13, 2010. The conductor borehole was advanced to 50 feet bgs. The first attempt to set conductor casing failed when 8 feet of material backfilled the borehole. The conductor casing was pulled. The conductor borehole was redrilled on July 14, 2010 and placement of the conductor casing was successful. A 10.5 sack cement sand slurry was placed using a grout pump and tremmie pipe. Approximately three cubic yards was placed as sanitary seal. Calwater demobilized once the conductor casing was set.

Test hole reaming of Well B commenced on July 20, 2010 and was completed by July 21, 2010. Testhole reaming was completed using a GEFCO drill rig using reverse circulation drilling method. A downhole caliper log was completed once the reaming was complete. The caliper log showed the borehole diameter ranged from 18.5 to 22.5

inches. The average borehole diameter was estimated at 18.75 inches. A two foot zone of wash out was noted at 238 to 242 feet bgs, borehole diameter increased from 18.75 to 22.5 over this four foot interval. No areas of washout were reported for screened or gravel pack areas. The caliper log reported a borehole depth of 443.1 feet, the drilled depth was 450 feet, it is believed that 6.9 feet of material accumulated at the bottom of the borehole. The geophysical survey was redone for Well B after Dewey Data reported surface electrical interference with the initial survey. The resurvey confirmed the findings of the initial downhole geophysical survey and did not affect the well design. Refer to Appendix A for resurvey geophysical log of Well B.

Once the caliper and geophysical resurvey were complete, the construction of Well B commenced. A tremmie pipe was placed prior to well construction. The well was constructed using 10.75 inches Outside Diameter (O.D.) Certainteed Certa-Lok™ SDR-17 polyvinyl chloride (PVC) well casing. The well screen consisted of 10.75 inches O.D. Certainteed Certa-Lok™ SDR-17 PVC slotted casing, slot openings were 0.040 inches and were manufacture cut. The well was constructed using 10 feet of blank casing as a sump, 60 feet of well screen and 369 feet of blank casing. Stainless steel centralizers were fitted every 60 feet; four centralizers were fitted 90° apart to maintain 2 inches separation between the borehole wall and well casing. Once the well casing was in place pouring of the gravel pack commenced. The gravel pack was place using a tremmie pipe. The gravel was allowed to free fall down the tremmie pipe from surface. The depth of gravel was checked periodically using a weighted line. The final depth of gravel was 350 feet bgs, this was 5 feet above the well design. The deviation from design was allowed by the DE representative. Gravel pack was chlorinated during placement using Indochlor® Dry Granular Chlorine with 68 percent Calcium Hypochlorite. Chlorination rate was approximately ten lbs per cubic yard of gravel. A transition seal consisting of Cemex™ # 30 sand was placed above the gravel pack, 13, 50 pound bags were used to bring the transition seal to 345 feet bgs. The well was secured and left overnight before the well seal placement the next day. Approximately 3.4 cubic yards of gravel pack was placed and approximately 8.7 cubic feet (0.3 cubic yards) of transition sand was placed. The well seal was placed on July 23, 2010. Nolte provided oversight during well seal placement and SJCEHD representative was present for well seal placement. Approximately 15 cubic yards of 10.3 sack cement sand slurry supplied by Sunrise Redi-Mix was placed. During cement seal placement and for a minimum of four hours after placement water was added to the well to dissipate heat generated during the cement curing process. Refer to Appendix A for Well B as built diagram showing depth intervals and construction material and amounts.

Testhole reaming at the Well A site commenced on July 27, 2010. The caliper survey was complete on July 29, 2010 by Dewey Data. The caliper survey showed borehole

diameter ranged from 18 to 19.5 inches, average borehole diameter was estimated at 18.5 inches. Refer to Appendix A for Well A caliper log. The well construction process followed the same sequence of events outlined above for Well B, and materials used in well construction were the same as for Well B. Well A was reamed to 440 feet, the caliper survey recorded borehole depth of 441.1 feet. The well was constructed using 10 feet of blank casing as a sump, 60 feet of well screen and 361 feet of blank casing. Stainless steel centralizers were fitted every 40 to 60 feet, four centralizers were fitted 90° apart to maintain 2 inches of separation between the borehole wall and well casing. The final depth gravel pack was 338 feet, this was 7 feet above the well design. The deviation for design was allowed by the DE representative. Transition sand was placed to 332 feet bgs. The well was secured and left overnight before the well seal placement the next day. Approximately 4.5 cubic yards of gravel pack and 8.7 cubic feet (0.3 cubic yards) of transition sand was placed. Approximately 15 cubic yards of 10.3 sack cement sand slurry supplied by Sunrise Redi-Mix was placed. Gravel pack was chlorinated during placement using Indochlor® Dry Granular Chlorine with 68 percent Calcium Hypochlorite. Chlorination rate was approximately ten lbs per cubic yard of gravel pack. DE provided oversight during well seal placement, a SJCEHD representative was present for well seal placement.

2.3 PRODUCTION WELL DEVELOPMENT

Development of Well B started on July 26, 2010, development was completed using swabbing and air development by Calwater. The swabbing tool consisted of a five feet steel cylinder with rubber flanges on the top and bottom. The well was swabbed and periodically purged with air. DE oversaw the final half hour of development. Field parameters could not be collected during Well B development. Total air development time was 12 hours. After swabbing and air well development was complete the pump contractor mobilized. The well development was continued using the variable speed submersible electrical pump. Pump development and subsequent pump testing was completed by Don Pedro Pump of Turlock, California, contractor license number 745963. The submersible pump was placed to 270 feet. The well was developed using the pump by surging the well. This was done by pumping the well and suddenly shutting off the pump allowing the water to surge inside the well casing, this was repeated every 10 minutes. Field parameters were collected during development, final field parameters were, pH 7.52, conductance 219 μ S, temperature 21.1° C and turbidity 3.00 NTU. Pump development time was approximately 8 hours, and in excess of 300,000 gallons was removed.

Development of Well A started August 2, 2010, the well was first developed using swabbing and air development by Calwater. The adjacent landowner requested that

development rate be kept as low as practical to reduce flow on to crop fields. No crops were planted at the time of well development. As a result development rate was less than for Well B. The well was swabbed and periodically purged with air. DE oversaw the majority of air development. At the end of 12 hours of development the turbidity was 127 NTU, development was stopped for the day and the site secured.

Development resumed on August 3, 2010, Calwater brought trash pumps to the site to spread development water more easily and the development rate was increased. After an additional 2 hours of development turbidity had decreased to 38.87 NTU. Air development was stopped, total development time was 14 hours. Don Pedro Pump mobilized and installed a submersible test pump in Well A. Pump development of Well A was completed on August 10 and 11, 2010, final development turbidity was 2.93 NTU. Total pump development time was eight hours.

Once the pump development of Well A and B was completed a step test and constant rate test were performed. Please refer to Section 3 for discussion of pump test procedure and results. Water sample for analytical testing was collected at the end of each constant rate test, refer to Section 3 for analytical parameter results.

2.4 VIDEO SURVEY AND FINAL CHLORINATION

Don Pedro Pump completed a video survey of the completed Well B on August 6, 2010. The video survey recorded the static water level as 118.1 feet below Top of Casing (TOC), the perforations were from 371.3 feet TOC to 429.4 feet TOC with the bottom of the well at 439.6 feet TOC. The video survey did not identify any damage within Well B. Once the camera survey was complete Calwater added nine lbs of dry granular chlorine to the well. The well was surged using a bailer for approximately 60 minutes to distribute the chlorine throughout the water column. After the bailer was removed one lbs of chlorine was added and the well capped using a PVC well cap, secured with set crews.

Don Pedro Pump completed a video survey of the completed Well A on August 16, 2010. A Nolte representative was present for video survey and chlorination activities. The video survey recorded the static water level as 119.4 feet TOC, the perforations were from 361.4 feet TOC to 419.4 feet TOC with the bottom of the well at 427.3 feet TOC. The video survey did identify a single PVC shaving present near the top of the screen interval. No evidence of casing damage was observed in association with the PVC shaving. Once the camera survey was complete Calwater added a total of 15 lbs of dry granular chlorine to the well which was mixed with the water column using the bailer. After the bailer was removed three lbs of chlorine was added and the well capped using a PVC well cap, secured with set screws.

3. ANALYTICAL AND AQUIFER TESTING

3.1 ANALYTICAL TESTING

ISOLATION ZONE SAMPLING

During the testhole drilling of Well B, isolation zone sample from the 373 to 394 feet bgs zone was completed. A water sample was collected after well development was completed using a submersible electrical pump. Sample was submitted to GeoAnalytical Laboratories, Inc. of Turlock, California for analysis. Sample was analyzed for shortened general mineral and metal parameters, analytical detection are shown in Table 1, with laboratory analytical report provided in Appendix B. As discussed in Section 2, zone sampling was completed to address concerns that elevated concentrations of arsenic could be present within the Mehrten Formation sands, due to the volcanic origin of detritus. Final field parameters observed were pH was 7.60, specific conductance was 215 $\mu\text{mho}/\text{cm}$, turbidity was 1.84 NTU and temperature was 21.7 °C. Field data sheets are provided in Appendix A. Water quality reported was suitable for water well development. Iron, manganese and arsenic were reported as non-detect; total dissolved solids was 177 mg/L.

COMPLETED PRODUCTION WELL SAMPLING

On August 3rd, 2010 after completion of the constant rate pump test, DE collected a ground water sample from Well B. The sample was collected in laboratory provided containers, labeled and placed on ice. The sample was submitted to California Laboratory Services of Rancho Cordova, California under chain of custody documentation. Complete analytical parameter list is presented in Table 1 and in the analytical reports provided in Appendix B. Analytical parameters were pursuant of California Code of Regulations (CCR) Title 22 Primary and Secondary Drinking Water Standards as outlined in letter by SJCEHD to FWC dated August 3, 2010. On August 13th, 2010 after completion of the constant rate test a water sample was collected from Well A. Sample methodology and parameter list was the same as for Well B. Field data sheets are provided in Appendix A. Chain of Custody forms are provided in Appendix B. Analytical results are summarized Table 1 and analytical reports are provided in Appendix B

Table 1
Isolation Zone Sample and Production Well Analytical Results
Farmington Water Company Well A & B

Analyte	Laboratory Date Units	Well A CLS 8/13/2010	Well B CLS 8/3/2010	Well B Zone Sampling 373- 394 ft. bgs GeoAnalytical 6/30/2010	Basin Plan Water Qual.	Title 22	Cal EPA	USEPA MCL
General Mineral, General Physical and Metals (EPA 200 & 300 Series)								
Aluminum	mg/L	< 0.05	< 0.05	NA		1	1	0.2
Antimony	mg/L	< 0.006	< 0.006	NA		0.006	0.006	0.006
Arsenic	mg/L	0.0025	0.0026	<0.002	0.01	0.01	0.05	0.01
Barium	mg/L	< 0.1	< 0.1	NA	0.1	1	1	2
Beryllium	mg/L	< 0.001	< 0.001	NA		0.004	0.004	0.004
Bicarbonate	mg/L	66	70	63				
Boron	mg/L	< 0.1	< 0.1	NA				
Cadmium	mg/L	< 0.001	< 0.001	NA	0.00022	0.005	0.005	0.005
Calcium	mg/L	15	17	13				
Carbonate	mg/L	< 5.0	< 5.0	<20				
Chloride	mg/L	11	12	9.2	250*		250*	250*
Chromium	mg/L	< 0.01	< 0.01	NA		0.05	0.05	0.1
Color	Color Units	< 1	< 1	NA	0.1			
Copper	mg/L	< 0.05	< 0.05	<0.05	0.01		1	1
Fluoride	mg/L	0.23	0.22	NA		2		
Hardness as CaCO3	mg/L	71	81	61				
Hydroxide as CaCO3	mg/L	< 5.0	< 5.0	<20				
Iron	mg/L	< 0.1	< 0.1	<0.1	0.3*		0.3*	0.3*
Lead	mg/L	< 0.005	< 0.005	NA	0.015		0.015	0.015
Magnesium	mg/L	8.2	9.2	7.2				
Manganese	mg/L	< 0.01	< 0.01	<0.02			0.05*	0.05*
Mercury	mg/L	< 0.001	< 0.001	NA		0.002		
Methylene Blue Active Substances	mg/L	< 0.10	< 0.10	<0.05	0.015*			
Nickel	mg/L	< 0.01	< 0.01	NA		0.1	0.1	0.1
Nitrate as NO3	mg/L	13	12	12	45	45	45	45
Nitrite as N	mg/L	< 0.10	< 0.10	NA		3	3	3
Perchlorate	mg/L	< 0.004	< 0.004	NA				
Potassium	mg/L	4.1	4.6	3.8				
Selenium	mg/L	< 0.005	< 0.005	NA	0.012	0.05	0.05	0.05
Silver	mg/L	< 0.01	< 0.01	NA	0.01		0.1	0.1
Sodium	mg/L	16	18	11.7				
Sulfate	mg/L	9.7	10	15.7			250	250
Thallium	mg/L	< 0.001	< 0.001	NA		0.002	0.002	0.002
Threshold Odor Number	T.O.N.	< 1	< 1	NA				
Total Alkalinity	mg/L	66	70	63				
Total Dissolved Solids	mg/L	190	190	177	125**		500*	500*
Vanadium	mg/L	0.022	0.021	NA				
Zinc	mg/L	< 0.05	< 0.05	207	0.1		5	5
Field Parameters								
pH	pH Units	7.05	7.35	7.60			6.5 to 8.5	6.5 to 8.5
Specific Conductivity	umhos/cm	234	227	215		900	900	900
Turbidity	NTU	0.86	2.91	1.84			1/5	1/5
Temperature	°C	20.6	19.7	21.7				
Primary VOCs (Title 22 Table 64444-A(a))								
THMs (Bromoform and Chloroform respectively)	µg/L	3.1	0.69	NA	Variable	Variable	Variable	Variable
Primary SOCs (Title 22 Table 64444-A(b)) waived except for:								
Ethylene Dibromide (EDB)	µg/L	ND	ND	NA				
1,2 dibromo 3 chloropropane (DBCP)	µg/L	ND	ND	NA	Variable	Variable	Variable	Variable
Radiological								
Gross Alpha	pCi/L	0.260±01.1	0.002±0.920	NA		15		
Gross Beta	pCi/L	0.924±01.24	0.298±0.920	NA		Variable	Variable	Variable

Note: **Bold** indicates an exceedance of either Cal EPA MCL or USEPA MCL
< or ND: Parameter Not Detected.
* Secondary Drinking Water Standard under the California and Federal Clean Water Act.
** Basin Plan water quality objective for surface water.
NA - data not available or parameter not analyzed.

Water quality was suitable for drinking water use. Parameters aluminum, antimony, barium, beryllium, boron, cadmium, carbonate, chromium, color, hydroxide, iron, lead, manganese, mercury, methylene blue active substances, nickel, nitrite, perchlorate, selenium, silver, thallium, odor and zinc were reported as non-detect. For the production well sampling total dissolved solids was 190 mg/L, arsenic was 0.0025 and 0.0026 µg/L for Well A and B respectively. Total Trihalomethanes (THM) were reported at 3.1 and 0.69 µg/L for Well A and B respectively. THM detections are likely related to chlorination of the gravel pack.

3.2 STEP, CONSTANT RATE PUMP TEST AND WELL EFFICIENCY

WELL A

After the well construction, air development and pump development was complete step and constant rate test were performed to assess the well efficiency and maximum sustained pumping rate. The submersible pump used for well development remained down the well at the conclusion of development and was used for both the step and constant rate tests. Pump equipment was provided and operated by Don Pedro Pump under direction from DE. The submersible pump was controlled using a Variable Frequency Drive (VFD) to obtain the desired flow rate. Discharge water was directed to adjacent agricultural field for disposal. A flow meter with totalizer was placed in discharge line to measure flow rate and volume. Depth to water measurements were collected using a Powers Water Level sounder, the sounder was calibrated in one foot increments, inches and fractions of inches were measured using a steel measuring tape. Refer to Appendix A for Pump Test Observation Forms for date, time, water level measurements and totalizer readings.

On August 11, 2010 static water level in Well A was measured at 121 feet 3 inches below measuring point (bmp). The top of PVC casing could not be used as reference point because it was inaccessible due the pump column head. The step test was started at 11:47 am and the first step pump rate was 200 gallons per minute (gpm), water level stabilized after 22 minutes and drawdown was 18.90 feet. The second step pump rate was 500 gpm, water level stabilized after 62 minutes and total drawdown observed was 40.75 feet, the final step pump rate was 825 gpm, duration was 85 minutes and total drawdown was 66.04 feet. The pump was shut down and recovery collected, the well recovered 95 percent within the first 91 seconds. Well A recovered 99.2 percent of drawdown within 36 minutes. It should be noted that the pump column was not fitted with non-return valves and this may have contributed to the initial rapid recovery

observed. A summary of step test results are provide below. The measurement intervals for water level soundings met the contract requirements.

Well A was allowed to recover overnight, and recovered above the pre-step test static water level. Flow rate of 750 gpm was selected for the constant rate test, pre-test static water level was 120.77 feet bmp. During refueling of the generator, a Don Pedro Pump employee accidentally bumped the VFD and increased the flow rate 800 gpm, approximately 14 hours of the pump test was completed at the increased flow. A Rossum sand test was connected to the discharge to measure sand content. Well A measured sand content was less than 0.01 ppm. The constant rate test duration was 24 hours (1,440 minutes), the average flow rate over the test duration was 794 gpm, total drawdown observed was 66.21 feet. The pump was shut-off after 24 hours and well recovery collected. Recovery was rapid the well recovered 97 percent of drawdown within the first 10 minutes and recovered 98.5 percent after 36 minutes.

Well A – Step and Constant Rate Test

Test	Start	Duration (min)	Flow (gpm)	Drawdown from Static (feet)	Specific Capacity (gpm/foot)
Step No. 1	8/11/2010 11:47 am	22	200	18.90	10.58
Step No. 2	8/11/2010 12:09 pm	62	500	40.75	12.26
Step No. 3	8/11/2010 1:09 pm	85	825	66.04	12.49
Constant Rate Test	8/12/2010 9:35 am	1,440	750 – 800 (avg. flow 794)	66.21	12.08

During the constant rate test of Well A a transducer was placed down the already completed Well B to monitor possible influences between the two wells. An Instrumentation Northwest PT-2X pressure transducer was placed down Well B. The transducer had a 15 psi range, static water level in Well B was 118.46 feet TOC, the transducer was placed to 149.5 feet TOC and recorded water head every two minutes. Refer to Appendix A for graphical display of data collected by the transducer.

During the Well A pump test, the observation well showed 0.65 feet of drawdown over the 24 hours. Based on knowledge of the area nearby irrigation, domestic and municipal wells may also have influence Well B response. During the Well A recovery Well B also recovered rapidly and recovered 0.6 feet or 92 percent within 184 minutes. Based on the limited drawdown observed and know pumping centers in the area DE has not attempted to calculate a transmissivity and storativity between Wells A and B

due to the limited area observation points and limited response observed in Well B during the pumping Well A.

WELL B

For the Well B step test and constant rate test the same equipment and procedures were used as described for Well A. It should be noted that Well B was completed and pump tested before Well A was constructed, therefore Well A could not serve as an observation well.

On July 30, 2010 static water level in Well B was measured at 117.75 below TOC. The top of PVC casing was as reference point for Well B pump testing. For the step test an Envirosupply water level sounder was used to collect water levels. The step test was started at 8:57 am and the first step pump rate was 300 gpm, water level stabilized after 39 minutes and drawdown was 11.60 feet. The second step pump rate was 600 gpm, water level stabilized after 83 minutes and total drawdown observed was 22.45 feet, the final step pump rate was 900 gpm, duration was 71 minutes and total drawdown was 33.37 feet. The pump was shut down but the water level sounder got stuck down the well before the first reading was collected and recovery could not be recorded. A summary of step test results are provide below. The measurement intervals for water level soundings met the contract requirements.

Well B – Step and Constant Rate Test

Test	Start	Duration (min)	Flow (gpm)	Drawdown from Static (feet)	Specific Capacity (gpm/foot)
Step No. 1	7/30/2010 8:57 am	39	300	11.60	25.86
Step No. 2	7/30/2010 9:36 am	83	600	22.45	26.73
Step No. 3	7/30/2010 11:59 am	71	900	33.37	26.97
Constant Rate Test	8/12/2010 9:35 am	1,204	600	23.21	25.85

Well B was allowed to recover over the weekend. For the constant rate test a Powers Water Level sounder and steel tape measure were used to measure depth to ground water. During the step test concerns were identified regarding the ability of the discharge area to accept the water volume produced without adversely affecting adjacent drainages. Based on these concerns the pump rate for the Well B constant rate of 600 gpm was selected, also DE and Don Pedro Pump personnel monitored the discharge area and adjacent drainages during the constant rate test to identify any

potential adverse conditions. Pre-test static water level was 118.21 feet TOC. A Rossum sand test was connected to the discharge to measure sand content. Well B measured sand content was less than 0.01 ppm. Based on the observed drawdown and concerns related to discharge impacts to drainage ways the constant rate test duration was shortened from 24 hours to 20 hours 2 minutes (1,204 minutes), the average flow rate over the test duration was 600 gpm, total drawdown observed was 23.21 feet. The pump was shut-off and well recovery collected. Recovery was rapid the well recovered 98.4 percent of drawdown within 142 minutes. The measurement intervals for water level soundings met the contract requirements. Refer to Appendix A for Pump Test Observation Forms.

WELL EFFICIENCY

Well efficiencies were calculated for Well A & B. Results fell above 100 percent efficient and outside normal ranges for well efficiency due to the slightly decreasing range in well capacity after each step test. Based on Kruseman & De Ridder³, if a well does not have a constant specific capacity with continued pumping, the efficiency calculation will not be valid. Based on the specific capacity for Well A & B shown in the tables above, specific capacity increased with increased pumping rate. There are inefficiencies inherent in every well design. Based on the rapid recovery of the well compared to drawdown during pumping, there appears to be some inefficiency which may be related to the well diameter. However these wells are productive and are capable of meeting the project production requirement.

³ Kruseman G.P., De Ridder N.A., Analysis and Evaluation of Pump Test Data, Second Edition, ILRI Publication 47, 1991.

4. SUMMARY

The following summary statements can be made regarding the test hole drilling, installation, development and pump testing of the Farmington Water Company Well A & B:

- Target horizons were identified in the 2009 conceptual ground water model as deep as 500 feet bgs. Two testholes were advanced to 440 feet bgs each. Horizons for ground water development were identified within the black sands of the Mehrten Formation. Refer to Appendix A for depiction of geologic log. Based on the volcanic origin of the black sands detritus, concerns did exist regarding elevated arsenic, iron and manganese within target horizons.
- Discrete zone sampling was complete on the Well B testhole, sampled interval was from 373 to 394 feet bgs. Ground water samples were submitted for general mineral and metal analysis. Samples reported arsenic, iron and manganese as non-detect, the remaining parameters were suitable for ground water development.
- The well design for Well A & B was finalized and varied somewhat from the 2009 proposed design. Based on observed borehole geology, water chemistry and known overdraft conditions in the area the deeper production zone was preferred. Refer to Appendix A for the As Built diagram for both wells.
- During well construction a SJCEHD representative was present for the placement of the well seal of both Well A & B. After well construction was complete the wells were developed. First the wells were developed through swabbing and air development, after which wells were fitted with a variable speed submersible electrical pump. Wells were then developed further using the submersible pump. Once the pump development was complete, the wells were pump tested. First a step test was completed with successive steps of increased flow. Based on the results of the step test, a pump rate for constant rate test was selected. Constant rate test duration ranged 20 to 24 hours and flow rate ranged from a sustained 600 to 800 gpm.
- Final turbidity at the end of the constant rate tests was 0.86 and 2.94 NTU for Well A and B respectively. Sand content was measured as less than 0.01 ppm for both wells using a Rossum sand tester. Ground water samples for analytical testing were collected at the end of the constant rate test for both wells. Samples were analyzed for parameters pursuant of California Code of Regulations Title

22 and San Joaquin County drinking water quality standards. Analytical results reported water quality suitable for drinking water sources. Total dissolved solids for both wells was 190 mg/L, arsenic concentration was 0.0025 and 0.0026 mg/L for the respective wells. Chloroform and bromoform were reported at concentrations of 0.69 and 3.1 µg/L respectively, this is less than the Title 22 Maximum Contaminant Limit (MCL) of 80 µg/L for both of the individual compounds. The detection of chloroform and bromoform are likely related to chlorination of the gravel pack.

- Once the pump testing was complete and test pump removed a downhole video survey was completed for both wells. The video survey confirmed well depth and screened interval. Video survey of both wells showed well casing is intact and in good condition. The video survey of Well A did identify a single PVC shaving present near the top of the screen interval. No evidence of casing damage was observed in association with the PVC shaving.
- Well construction materials and procedures met the contract requirements. Deviations were approved by DE and Nolte.
- The project was successful and identified zones for ground water production. Water quality from the constructed Wells A & B meets the water quality requirements of San Joaquin County and State of California. Ground water production goals were met. Well specific capacity ranged from 10.58 to 26.97 gpm/foot. Due to the lack of observation points during testing and the multiple influences in the area, aquifer transmissivity and storage were not calculated.
- However, ground water overdraft concerns have been identified in the East San Joaquin Ground Water subbasin. Overdraft could significantly affect the availability of ground water sources in the future. Also, ground water quality concerns could develop over time due to excessive recharge from agricultural run-off.

APPENDIX A

**Geologic Log
Well As Built
Geophysical Log
Field Data Sheets
Field Pump Test Observation Forms
Well Video Survey Log (Video Disk Available On Request)**

APPENDIX B

Grain Size Analysis Laboratory Report
Grain Size Analysis with Gravel Pack and Screen Design
Laboratory Analytical Report