# Technical Memorandum
# Feasibility Assessment of Iron and Manganese Removal Facilities at the El Rio Water Treatment Plant

**United Water Conservation District (UWCD)**
**Prepared by: Robert Richardson, PE**

**Draft Issue: March 10, 2016**
**Final Issue: August 11, 2016**

**Technical Memorandum**
**Feasibility Assessment of Iron and Manganese Removal Facilities**
**at the El Rio Water Treatment Plant**


## Acknowledgements (United Water Conservation District Staff):

Contributors:
Robert Richardson, PE, Associate Engineer – Primary author
John Lindquist, PG, CHG, Senior Hydrogeologist – Author of Lower Aquifer System drawdown evaluation
Dan Detmer, PG, CHG, Supervising Hydrogeologist – Well Nos. 12, 13 and 14 existing water quality data
Brian Collins, Instrumentation and Electrical Supervisor – Coordination of Well Nos. 12, 13 and 14 VFD proposals from Rockwell Automation

Reviewers:
Anthony Emmert, Deputy General Manager
Jim Grisham, PE, Engineering Manager
Mike Ellis, O&M Manager
John Carman, Chief Water Treatment Operator
Craig Morgan, PE, Senior Engineer
Kaili Taniguchi, PE, Assistant Engineer

Administrative Support:
Kris Sofley, Administrative Assistant

Operations Support:
Mike Ellis, O&M Manager
John Carman, Chief Water Treatment Operator
Brian Collins, Instrumentation and Electrical Supervisor
Ruben Sanchez, Water Treatment Operator III

## Acknowledgements (Other):

Daniel Chase, PE, Stantec Consultants – Information regarding existing El Rio sewer. Mr. Chase was the design engineer.

Layne Christensen Company – Pilot Plant Testing

**Technical Memorandum**
**Feasibility Assessment of Iron and Manganese Removal Facilities**
**at the El Rio Water Treatment Plant**

This Technical Memorandum was prepared by the following Registered Professional Engineer:

**Technical Memorandum**
**Feasibility Assessment of Iron and Manganese Removal Facilities**
**at the El Rio Water Treatment Plant**

# Contents


Abbreviations ..... 6

1. Preface and Pilot Plant Update ..... 7

2. Purpose and Background ..... 8
   2.1 Purpose of this Technical Memorandum ..... 8
   2.2 Regulatory Drivers ..... 8
      2.2.1 Domestic Water Supply Wells under the Surface Water Treatment Rule ..... 8
      2.2.2 Nitrates ..... 8
      2.2.3 Iron and Manganese ..... 9
   2.3 Description of Existing Facilities and Process ..... 10
   2.4 Existing Water Quality ..... 13
      2.4.1 Source of Iron and Manganese in Groundwater ..... 13
      2.4.2 Upper Aquifer System Wells ..... 13
      2.4.3 Lower Aquifer System Wells ..... 14
   2.5 Existing Demand and Operational Modes ..... 17
      2.5.1 Existing Demand ..... 17
      2.5.2 Operational Prioritization of Wells ..... 17
      2.5.3 Description of Existing El Rio Water Treatment Process ..... 18

3. Discussion ..... 19
   3.1 Proposed Design Criteria ..... 19
   3.2 Available Types of Treatment ..... 21
      3.2.1 Chemical Sequestration ..... 22
      3.2.2 Oxidation ..... 22
      3.2.3 Clarification ..... 26
      3.2.4 Filtration ..... 27
   3.3 Integrating New Treatment Process into Existing Facilities ..... 32
      3.3.1 Consideration of Greensand Filter Treatment ..... 32
      3.3.2 Potential Locations ..... 33
      3.3.3 Hydraulic Considerations (Existing Well Nos. 12, 13, 14 and Booster Pumps) ..... 35
      3.3.4 Demand Considerations ..... 38
      3.3.5 Supply Considerations and Drawdown Evaluation (LAS Groundwater Supply) ..... 38
      3.3.6 Oxidant Considerations (Existing Chlorination System) ..... 40
      3.3.7 Control Considerations ..... 41
      3.3.8 Electrical Considerations ..... 41
      3.3.9 Sewer Considerations ..... 43
      3.3.10 Cost Considerations ..... 44

4. Conclusion ..... 46

5. Recommendations (Next Steps) ..... 47

6. References ..... 48

7. Appendices .......... 49
- 7.1 Additional Water Quality Data for Well Nos. 12, 13 and 14 .......... 49
- 7.2 Historic Static and Pumping Water Levels at Well Nos. 12, 13 and 14 .......... 49
- 7.3 Lower Aquifer System Drawdown Impact Calculations .......... 49
- 7.4 Proposed Greensand Filtration Plant with Chlorine Oxidation .......... 49
- 7.5 Conceptual Plans - Iron and Manganese Treatment Plant .......... 49
- 7.6 Head Loss Calculations .......... 49
- 7.7 Layne Christensen Pilot Study Report .......... 49
- 7.8 Silt Density Index (SDI) Test Data .......... 49
- 7.9 SWRCB Letter in Response to Proposition 1 Groundwater Grant Funding Pre-Application .......... 49

# Abbreviations Used

| | |
|---|---|
| µg/L | Micrograms per Liter |
| AEP | Annual Exceedance Probability |
| AWWA | American Water Works Association |
| CCR | California Code of Regulations |
| CFS | Cubic Feet per Second |
| CMWD | Calleguas Municipal Water District |
| CWET | California Waste Extraction Test |
| DDW | Division of Drinking Water (State Water Resources Control Board) |
| DO | Dissolved Oxygen |
| DWS | Domestic Water Supply |
| DWSRF | Drinking Water State Revolving Fund |
| FCGMA | Fox Canyon Groundwater Management Agency |
| gpm | Gallons Per Minute |
| GSP | Groundwater Sustainability Program |
| HAA | Haloacetic acid |
| kWh | Kilowatt Hour |
| LAS | Lower Aquifer System |
| M&I | Municipal and Industrial |
| MCL | Maximum Contaminant Level |
| MG | Million Gallon |
| mg/L | Milligrams per Liter |
| NTU | Nephelometric Turbidity Unit |
| O-H | Oxnard-Hueneme |
| PHWA | Port Hueneme Water Agency |
| PLC | Programmable Logic Controller |
| ppm | Parts Per Million |
| PTP | Pumping Trough Pipeline |
| PVC | Polyvinyl Chloride |
| RMWTP | Round Mountain Water Treatment Plant (Camarillo) |
| RO | Reverse Osmosis |
| RPM | Rotations Per Minute |
| SCADA | Supervisory Control and Data Acquisition |
| SCE | Southern California Edison |
| SDI | Silt Density Index |
| SDR | Pressure rating applied to PVC pipe where “S” is wall thickness and “D” is outside diameter |
| SWF | Steckel Water Facility (Santa Paula) |
| SWRCB | State Water Resources Control Board |
| SWT | Surface Water Treatment |
| TDS | Total Dissolved Solids |
| THM | Trihalomethanes |
| TM | Technical Memorandum |
| TOC | Total Organic Carbon |
| TOU | Time of Use |
| UAS | Upper Aquifer System |
| USEPA | United State Environmental Protection Agency |
| UWCD | United Water Conservation District |
| VFD | Variable Frequency Drive |
| WHO | World Health Organization |

# 1. Preface and Pilot Plant Update

This Technical Memorandum (TM) was initially issued on March 10, 2016 to all Oxnard-Hueneme Pipeline customers for review and comment. No written comments have been received to date. On February 23, 2016, UWCD solicited for proposals for on-site pilot testing of a manganese greensand (or $MnO_2$ sand) filtration plant which could include other types of media. Five firms submitted proposals including: Performance Water Products, Hungerford and Terry, Pureflow Filtration Division, and Layne Christensen. Pilot testing was awarded to Layne Christensen which was conducted for a period of one week from May 16 to May 20, 2016. Two types of granular filter media were tested, Anthracite/Greensand Plus and LayneOx. The final report prepared by Layne Christensen is included in **Appendix 7.7**.

The following is a summary of observations made by UWCD staff during pilot plant testing:

- Well No. 12 and 13 iron and manganese concentrations during pilot plant testing were slightly less than historical averages. Sampling in the past was taken during well flushing events and may have contained higher concentrations of iron and manganese.
- There is evidence of scaled material in the casings for Well No. 12 and 13 which may have interfered, to a small degree, with chlorine demand. This is not expected to significantly affect well or filtration performance.
- Iron and manganese can be removed to non-detect levels using Greensand Plus or LayneOx granular media.
- Clarification is not needed to remove bulk iron and manganese precipitates prior to filtration.
- The highest filter loading rates that can be sustained for a 16 hour duration (minimum) without iron and manganese breakthrough was 6 gpm/ft$^2$ for Greensand Plus and 9 gpm/ft$^2$ for LayneOx. This exceeds the typical AWWA design standard of 3 gpm/ft$^2$ for manganese greensand.
- Both Greensand Plus and LayneOx filter effluent passed silt density index (SDI) testing. However, LayneOx's SDI results were considerably higher than Greensand Plus. Most reverse osmosis (RO) membrane manufacturers use SDI testing to determine fouling potential. Lower SDI values indicate less fouling potential and longer periods of time between cleanings. Nitto Hydranautics, a leading RO membrane manufacturer, recommends that the average SDI value in the feed water not exceed 2.5. The average filter effluent SDI values were 1.72 and 3.42 for Greensand Plus and LayneOx respectively. All SDI test data is contained in **Appendix 7.8**.
- Additional chlorine contact for full manganese oxidation is not necessary. The catalytic properties of either media is sufficient for removal of manganese below detection limits.
- The potential hazard of the backwash sludge was not evaluated. However, low levels of arsenic and radionuclides were observed in raw well water.

This report has been updated in several areas based on pilot plant test results which is denoted by the "✐" or pencil icon.

# 2. Purpose and Background

## 2.1 Purpose of this Technical Memorandum

The purpose of this Technical Memorandum (TM) is to provide an assessment on the feasibility of constructing iron and manganese removal facilities for deep wells at the United Water Conservation District's (UWCD) El Rio Groundwater Recharge and Booster Facility located at 3561 N Rose Avenue in Oxnard, California. In particular, it is intended to summarize key information relevant to the proposed treatment of deep wells and attempts to establish conceptual level criteria for design. This TM should not be interpreted as detailed design work and costs presented should only be used for budgetary purposes.

## 2.2 Regulatory Drivers

The UWCD El Rio Facility is permitted to operate and provide drinking water to Oxnard-Hueneme (O-H) Pipeline customers under the State of California State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) Domestic Water Supply (DWS) Permit No. 04-06-15P-005 as issued on April 2, 2015. The permit is subject to Title 22, Division 4 - Environmental Health of the California Code of Regulations (CCR).

### 2.2.1 Domestic Water Supply Wells under the Surface Water Treatment Rule

The El Rio Facility receives surface water from the Santa Clara River for groundwater recharge. The DWS permit requires that for any domestic water supply well located within 150 feet of a recharge basin, it must comply with Surface Water Treatment (SWT) Regulations (CCR Title 22, Division 4, Chapter 17). A total of eight wells at the El Rio Facility are subject to this rule (Well Nos. 2A, 4, 5, 6, 8, 15, 16 and 17). Well 11 is excluded because it is more than 150 feet away from an active recharge basin. The SWT rule requires at least a 3 log (99.9%) removal of Giardia and a 4 log (99.99%) removal of viruses. The El Rio Recharge Basins are considered slow sand filters and are credited with a 2 log (99.0%) removal of Giardia and a 1 log (90.0%) removal of viruses. Therefore, the remaining credits must be provided by the disinfection process. It should be noted that in order to comply with the SWT rule, the treated water cannot exceed 1 Nephelometric Turbidity Unit (NTU) and the instantaneous filtration rate cannot exceed 0.1 gallons per minute per square foot which shall be reported on an annual basis.

### 2.2.2 Nitrates

Plant effluent from the El Rio Facility must comply with the California Primary Maximum Contaminant Level (MCL) for nitrates which is stated in the DWS permit as 45 mg/L ($NO_3$). Individual wells may exceed the MCL provided that the plant effluent (blended wells) remains below the MCL. Individual wells must be monitored on a weekly basis while the plant effluent must be monitored on a daily basis. Exceedance of the MCL may trigger public notification if not corrected within 24 hours. It should be noted that DDW now requires reporting of nitrates to be represented in terms of nitrogen (NO3 as N) which is 10 mg/L. However, no corrections to the permit have been made to date.

### 2.2.3 Iron and Manganese

Plant effluent from the El Rio Facility must comply with the California Secondary MCL for iron and manganese which is stated in CCR Title 22, Division 4, Chapter 15 as 0.3 mg/L and 0.05 mg/L respectively. Individual wells may exceed the MCL provided that the plant effluent remains below the MCL. If the plant effluent exceeds the MCL, UWCD must survey its customers and apply for a waiver for secondary MCL compliance. If more than 50% of the number of customers surveyed request iron and manganese removal, then UWCD must construct a treatment facility.

On March 20, 2015, UWCD sent letters to all O-H pipeline customers with a survey containing two options: (1) DDW grant a 5-year waiver to UWCD for continuation to exceed secondary MCL standards for iron and manganese or (2) construct treatment facilities to remove iron and manganese. The letter was sent to a total of eight (8) O-H pipeline customers, and seven (7) responses were received as presented in **Table 1**. On January 5, 2016, DDW granted UWCD a 1-year waiver to postpone iron and manganese treatment until December 31, 2016.

**Table 1 - O-H Pipeline User Customer Survey (March, 2015)**

| O-H Pipeline Customer | 2015 Sub-allocation (AF/YR) | Waiver Option | Treatment Option |
|---|---|---|---|
| City of Oxnard | 6,803 | | X |
| Cypress Mutual Water Company | 73 | X | |
| Dempsey Road Mutual Water Company | 148 | X | |
| El Rio School District | 23 | | No Response[3] |
| Naval Base Ventura County | see PHWA | X[1] | |
| Port Hueneme Water Agency (PHWA)[2] | 3,532 | X[1] | |
| Saviers Road Mutual Water Company | 21 | X | |
| Vineyard Avenue Estates | 203 | X | |

Notes: (1) Requested a 1-year waiver be granted instead of 5-years
(2) Includes Channel Islands Community Beach Services District (CICBSD)
(3) A non-response counts as a request for treatment as indicated in the UWCD survey letter

It is worth mentioning that Primary MCLs were established because of health concerns with contaminants having known acute or chronic toxicities. Secondary MCLs were established to address contaminants that affect aesthetics such as taste, color and odor. While contaminants regulated by secondary MCLs do not pose an immediate risk to public health, an American Water Works Association (AWWA) task group suggested limits of 0.05 mg/L for iron and 0.01 mg/L for manganese to provide water that is more “ideal” for public use. The World Health Organization (WHO) reports discoloration at iron concentrations of 0.05 mg/L and taste detection above 0.3 mg/L.

✎ Pilot Plant testing demonstrated that removal of iron and manganese to non-detect levels was possible with Greensand Plus and LayneOx media. Detectable levels of iron and manganese are 0.03 mg/L and 0.01 mg/L respectively. This satisfies both AWWA and WHO recommendations.

Furthermore, facilities using reverse osmosis report scaling and a large decrease in efficiency when iron concentrations reach 0.05 to 1.0 mg/L (combined soluble and insoluble species). The PHWA, an O-H Pipeline customer shut down their Brackish Water Reclamation Demonstration Facility in July 2015 due to reported high levels of iron and manganese.

## 2.3 Description of Existing Facilities and Process

The El Rio Facility and well field was originally constructed in 1954 for the purpose of groundwater recharge. The site was selected because of its location in the Oxnard Forebay, an unconfined portion of the Oxnard Plain basin. The Oxnard Forebay is unique because it contains a hydraulic connection between the Upper Aquifer System (UAS) and Lower Aquifer System (LAS) and exhibits excellent recharge capabilities. Source water for groundwater recharge at El Rio comes from surface flows from the Santa Clara River or from Lake Piru Reservoir conservation releases (approximately 32 miles upstream) which are both intercepted at the Freeman Diversion (approximately 5 miles upstream). The surface water is distributed into a series of basins at the El Rio Groundwater Recharge Facility totaling approximately 80 acres. **Figure 1** shows a simplified system schematic from Lake Piru to the El Rio Facility.

From 1954 to 1986, most of the wells at El Rio extracted groundwater from the UAS except Well Nos. 9 and 10. Well Nos. 9 and 10 were abandoned. The UAS consists of an upper Oxnard aquifer and a lower Mugu aquifer. Most of the recharge at El Rio occurs in the upper Oxnard aquifer. There is concern over nitrates in the UAS wells especially during periods of extended drought. The most likely source of nitrate loading originates from adjacent agricultural operations to the north and east of the El Rio Recharge Basins. As the groundwater elevation falls and there is less water for groundwater recharge, nitrates become more concentrated. Nitrates are highly mobile in solution and move with groundwater flow. A series of recent reports on nitrates suggested that scattered clay lenses have had some effect on prohibiting vertical movement of nitrates resulting in varying water quality between the Oxnard and Mugu aquifers. A complete listing of UAS wells is shown in **Table 2**.

**Table 2 – Existing El Rio Facility UAS Production Wells**

| Well No. | Well Capacity (gpm) | Specific Capacity[1] (gpm/ft) | Well Depth (ft) | Pump Bowl Depth (ft) | Motor Size (HP) |
|---|---|---|---|---|---|
| 2A | 3,200 | 223 | 320 | 176 | 100 |
| 4 | 2,300 | 181 | 307 | 155 | 100 |
| 5 | 2,600 | 128 | 306 | 177 | 100 |
| 6 | 2,470 | 203 | 304 | 187 | 100 |
| 8 | 3,100 | 100 | 319 | 187 | 100 |
| 11 | 3,500 | 87 | 360 | 163 | 150 |
| 15 [2] | 3,500 | 96 | 330 | 192 | 150 |
| 16 | 2,150 | 279 | 340 | 178 | 100 |
| 17 | 2,150 | 100 | 300 | 190 | 100 |

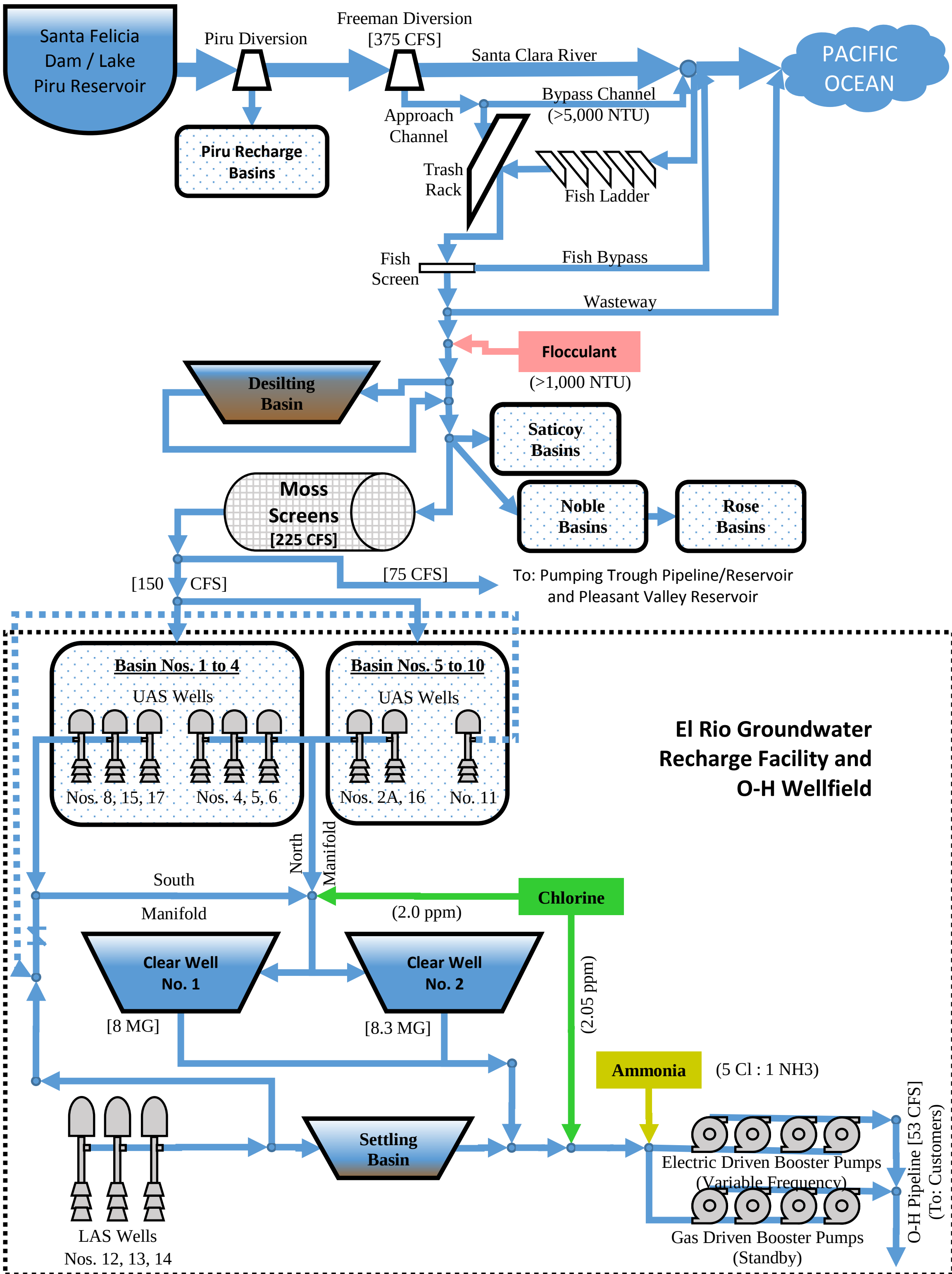
Notes: (1) Estimated based on most recent available Southern California Edison Pump Tests (2014). Extended drought, falling groundwater surface elevations has a significant impact on well production.
(2) Well No. 15 replaced Well No. 10 (LAS)

In 1983 to 1984 three deep wells (Nos. 12, 13 and 14) were constructed in the lower aquifer system (LAS) as part of the Pumping Trough Pipeline (PTP) system to meet irrigation needs for agricultural users in the Oxnard Plain. The wells were not operational until 1986. The main purpose of the PTP system was to combat seawater intrusion by replacing or substituting the use of agricultural user's private UAS wells in favor of Santa Clara River surface water. The deep wells were intended to augment production for PTP users when there was a lack of surface water deliveries from the Santa Clara River. However, the deep wells were also constructed with the ability to provide a supplemental source of drinking water for O-H

Pipeline users. It was projected that O-H demands would increase over time, but increased demand was offset by PHWA's import of State Water Project water from the Calleguas Municipal Water District (CWMD). Additionally, the Fox Canyon Groundwater Management Agency has cut back on pumping allocations in recent years. Because the three deep wells exceed the secondary MCLs for iron and manganese, these wells have not historically provided water for O-H pipeline users except during periods of extreme drought or increasing nitrate levels in UAS wells. These wells are the focus of this TM and more detailed information is provided in **Table 3**.

**Table 3 - Existing El Rio LAS Production Wells**

| Parameter | Well No. 12 | Well No. 13 | Well No. 14 |
|---|---|---|---|
| Year of Installation | 1986 | 1986 | 1986 |
| Well Depth | 1,112 ft | 1,418 ft | 1,470 ft |
| Screen Depth | 751.5 to 1,091.5 ft | 857 to 1,397 ft | 577.5 to 1,477.5 ft |
| Screen Length | 340 ft | 540 ft | 900 ft |
| Screen Slot Size | 0.065 in | 0.065 in | 0.055 to 0.065 in |
| Pump Manufacturer | Peerless Pump | Peerless Pump | Peerless Pump |
| Discharge Size | 12 in | 12 in | 14 in |
| Column Size | 12 in | 12 in | 14 in |
| Column Length | 470 ft | 341 ft | 380 ft |
| Bowl Assembly | 14 HXB | 14 HXB | 16 HXB |
| Bowl Stages | 7 | 6 | 5 |
| Bowl Length | 7 ft 10 in | 6 ft 11 in | 6 ft 10 in |
| Bowl O.D. | 13-5/8 in | 13-5/8 in | 15-1/4 in |
| Capacity (Rated) | 2,500 gpm | 2,500 gpm | 3,500 gpm |
| Total Head (Rated) | 468 ft @ 2,500 gpm | 360 ft @ 2,500 gpm | 432 ft @ 3,500 gpm |
| Discharge Head (2014 SCE Test) | 38 ft @ 2,500 gpm | 61 ft @ 2,250 gpm | 112 ft @ 3,500 gpm |
| Specific Capacity (2014 SCE Test) | ~23 gpm/ft | ~18 gpm/ft | ~26 gpm/ft |
| Min. Efficiency | 83% | 83% | 84% |
| Pump Pad Elevation | 116.69 ft | 109.42 ft | 100.49 ft |
| Motor Manufacturer | US Motors | US Motors | US Motors |
| Motor Model | Titan Line Vertical | Titan Line Vertical | Titan Line Vertical |
| Motor HP | 400 HP | 300 HP | 500 HP |
| Motor RPM | 1800 RPM | 1800 RPM | 1800 RPM |
| Space Heater? | Yes | Yes | Yes |
| Service Factor | 1.15 | 1.15 | 1.15 |
| Insulation | Class F | Class F | Class F |




Note: All capacities shown as [X] are maximum design and do not represent average or daily values.

**Figure 1 - Overall UWCD System Schematic (Existing)**

## 2.4 Existing Water Quality

### 2.4.1 Source of Iron and Manganese in Groundwater

Iron constitutes 4.5% of the lithosphere (the outermost portion of the Earth's crust) and occurs in igneous rocks. Manganese constitutes 0.1% of the lithosphere and occurs in metamorphic and sedimentary rocks. Higher concentrations of both iron and manganese are typically found in lower alkalinity groundwater. Iron causes reddish-brown stains on plumbing fixtures, dishware and clothing while manganese causes brownish-black stains.

In groundwater supplies, iron is typically found in the soluble ferrous form ($Fe^{2+}$) and oxidizes to its insoluble ferric form ($Fe^{3+}$). Manganese is typically found in the soluble manganous form ($Mn^{2+}$) and oxidizes to its insoluble manganic ($Mn^{3+}$) and $Mn^{4+}$ forms. As groundwater depth increases, iron and manganese are increasingly found in their soluble form due to the lack of dissolved oxygen present. In the presence of air, iron typically precipitates as insoluble ferric oxide ($Fe_2O_3$, or commonly known as "rust") and manganese typically precipitates as insoluble manganese dioxide ($MnO_2$).

### 2.4.2 Upper Aquifer System Wells

Data ranging from 2003 to 2015 on El Rio UAS well water quality was compiled for this report. The greatest water quality concern in UAS wells is nitrate concentrations which have historically increased during times of drought. This trend is demonstrated in **Figure 2** during a period of extended drought starting in 2012. While the actual nitrate concentration leaving the El Rio Plant into the O-H Pipeline has not exceeded primary MCLs, this trend is somewhat alarming in that there is reduced operational flexibility to meet regulatory standards during this time. Should the trend continue, the El Rio Plant could be in violation of its drinking water permit which might result in Tier 1 public notices and mandatory shutdowns. Tier 1 public notification would inform users that the water contains high levels of nitrates and should not be consumed by pregnant women or infants under 6 months due to the risk of "blue-baby" syndrome.

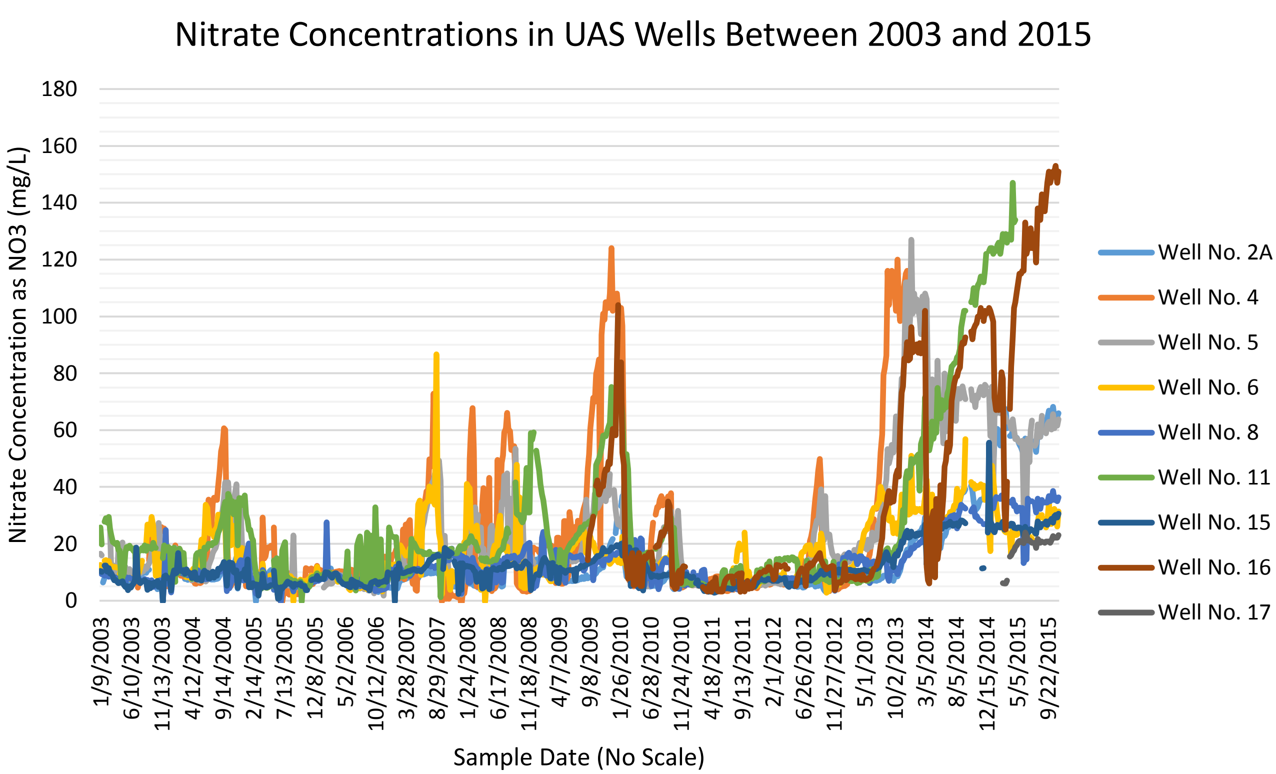



**Figure 2 - Nitrate Concentrations in UAS Wells Between 2003 and 2015**

UAS wells have low levels of iron concentrations (0.074 mg/L on average) and negligible levels of manganese. This iron concentration is 25% of the secondary MCL and does contribute to the iron concentration in the finished product water from the El Rio Plant. The pH, TDS and turbidity in UAS well water is stable with averages of 7.5, 1,110 mg/L and 0.6 NTU respectively. TDS in UAS well water exceeds the secondary MCL upper limit of 1,000 mg/L while sulfate concentrations remain slightly below the upper limit of 500 mg/L. **Table 4** compares the water quality between UAS and LAS wells.

### 2.4.3 Lower Aquifer System Wells

Data ranging from 2003 to 2015 on El Rio LAS well water quality was compiled for this report. The greatest water quality concern in LAS wells is iron and manganese concentrations. These concentrations have remained relatively stable as shown in **Figure 3** and **Figure 4**. The average iron and manganese concentration in LAS wells is 0.64 mg/L and 0.2 mg/L respectively. Both concentrations exceed the secondary MCLs. The pH, TDS and turbidity in LAS well water is stable with averages of 7.7, 1,050 mg/L and 3.0 respectively. TDS in LAS well water exceeds the secondary MCL while sulfate concentrations remain slightly below. Recent sampling of Well Nos. 12, 13 and 14 dated December 29, 2015 suggested negligible concentrations of ammonia and hydrogen sulfide while Total Organic Carbon (TOC) measured 0.5 to 1.0 mg/L. **Table 4** compares the water quality between UAS and LAS wells. Additional LAS well water quality data is presented in **Appendix 7.1**.

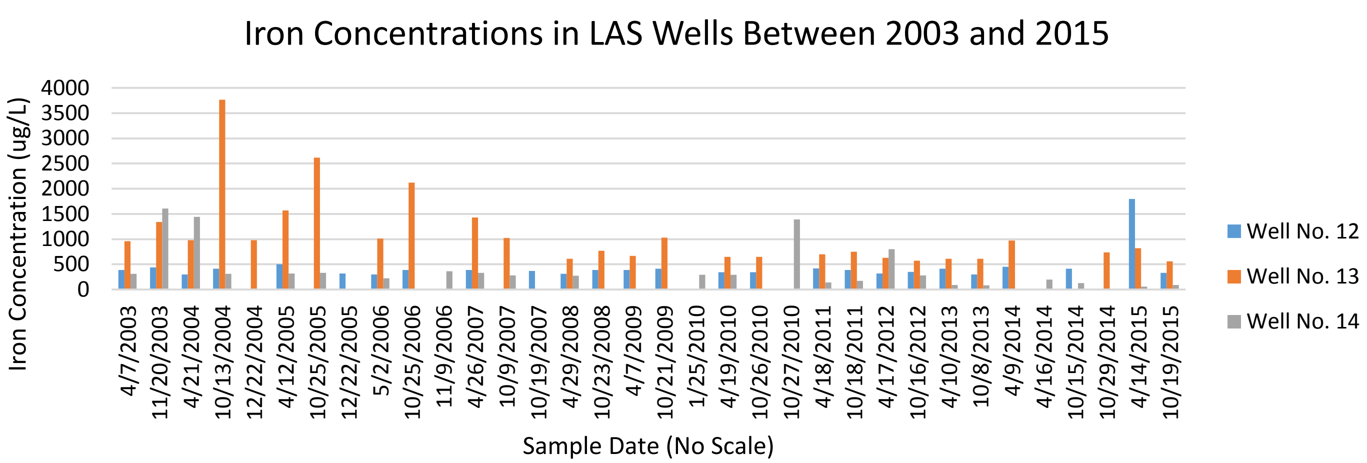



**Figure 3 - Iron Concentrations in LAS Wells Between 2003 and 2015**

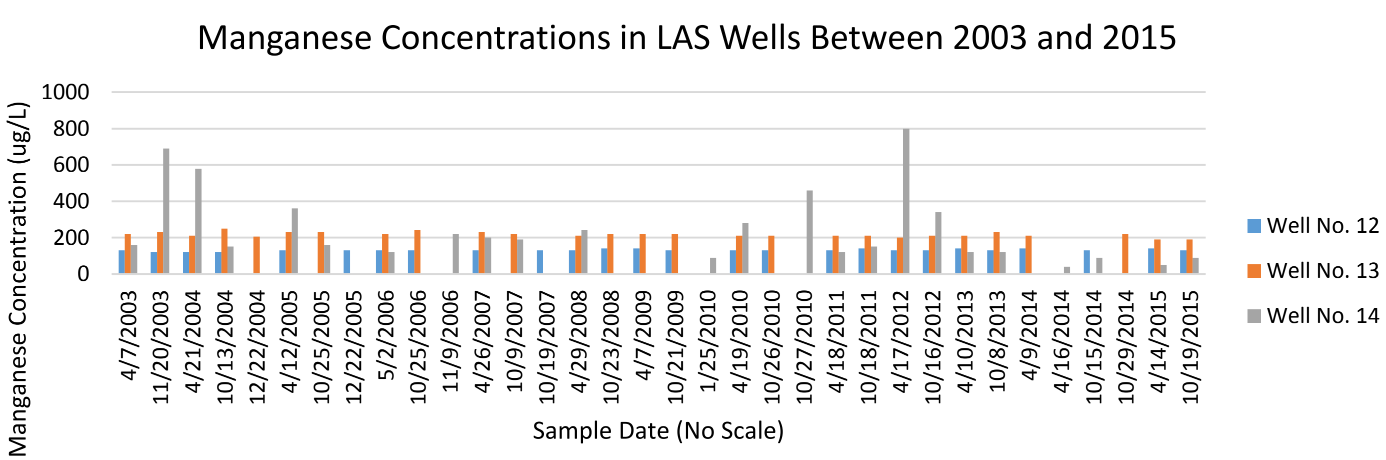



**Figure 4 - Manganese Concentrations in LAS Wells Between 2003 and 2015**

- Pilot Plant testing indicated that the iron and manganese concentrations in raw well water was lower than historical averages. The average iron concentration was 0.35 mg/L and 0.49 mg/L for Well No. 12 and 13 respectively. The average manganese concentration was 0.15 mg/L and 0.21 mg/L for Well No. 12 and 13 respectively. Well No. 13 had slightly higher TDS and turbidity concentration than Well No. 12. The average TDS was 900 mg/L and 995 mg/L for Well No. 12 and 13 respectively. The average turbidity was 1.6 NTU and 3.4 NTU for Well No. 12 and 13 respectively.

  On the first day of testing using Well No. 13 as the feed source to all columns, there was 0.2 mg/L chlorine residual from the Greensand Plus columns and no chlorine residual from the LayneOx columns. All columns were fed with the same source water containing the same chlorine concentration. After a longer run time with Well No. 13 and adjusting the chlorine dosage, all columns were observed to have a chlorine residual. There was some concern during testing that biofilm or some other constituent was interfering with chlorine demand. Biofilm is not likely as the average TOC concentration was 0.7 mg/L and 0.8 mg/L for Well No. 12 and 13 respectively. However, there is some evidence of scaled material on blank carbon steel sections of column pipe as shown in **Figure 5** and **Figure 6**. Additional sampling and investigation is needed to substantiate the claim.

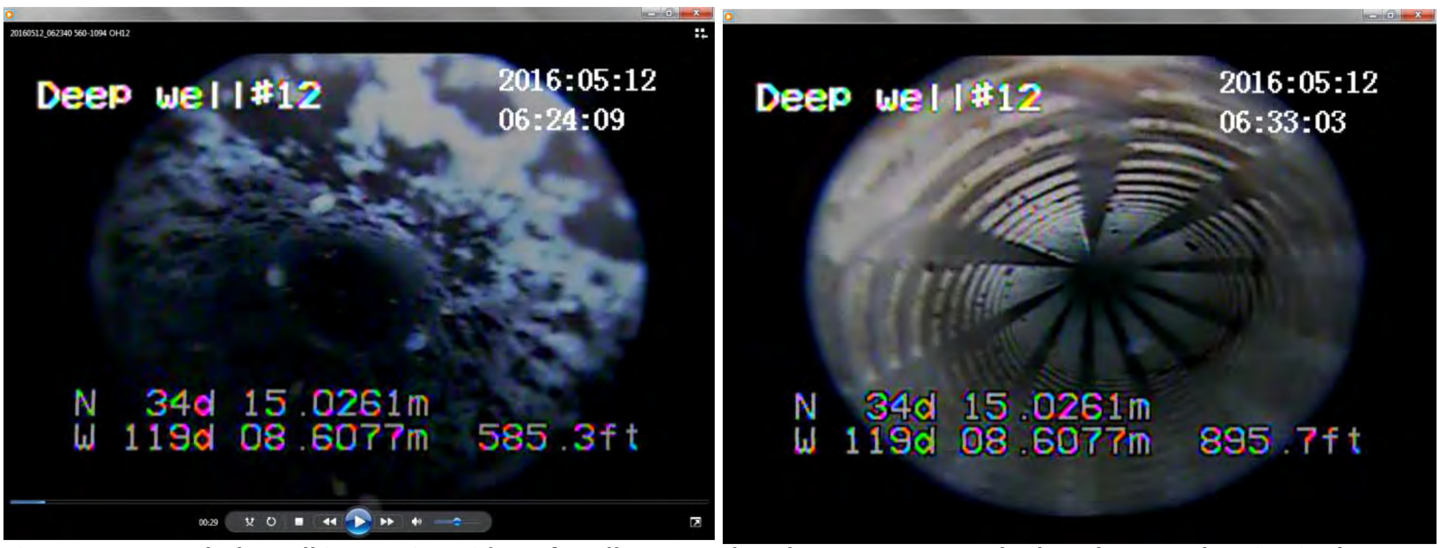



**Figure 5 - Down hole well inspection video of Well No. 12, dated May 12, 2016. Blank carbon steel casing is shown on the left, and louvered stainless steel casing is shown on the right.**

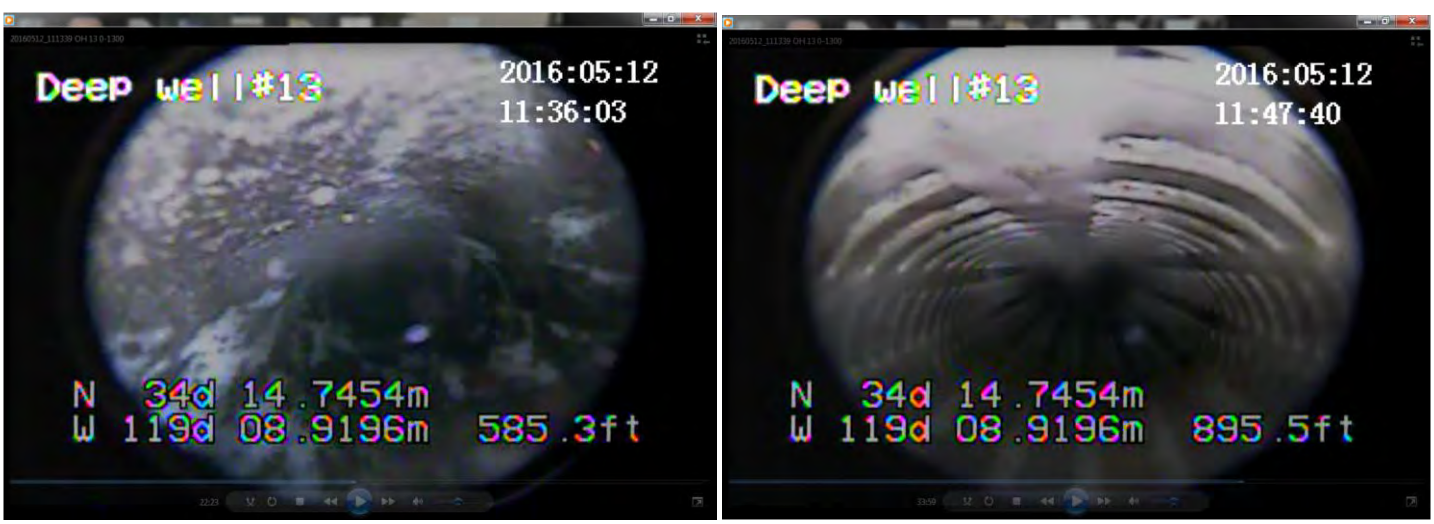



**Figure 6 - Down hole well inspection video of Well No. 13, dated May 12, 2016. Blank carbon steel casing is shown on the left, and louvered stainless steel casing is shown on the right.**

**Table 4 - El Rio Well Production and Water Quality [1]**

| Well No. | Aquifer | Depth | Existing Production | Nitrate (as NO3) | | | | Iron (Fe) | | | | Manganese (Mn) | | | | pH | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MCL[2] = 45 mg/L | | | | MCL[3] = 300 µg/L | | | | MCL[3] = 50 µg/L | | | | n/a | | |
| | | feet | cfs (gpm) | Min | Avg | Max | AEP[4] | Min | Avg | Max | AEP[4] | Min | Avg | Max | AEP[4] | Min | Avg | Max |
| 2A | UAS | 320 | 7.1 (3,200) | <0.5 | 13.4 | 68.2 | 7.1% | <30 | 84 | 250 | 0.0% | <10 | <10 | <10 | 0.0% | 6.5 | 7.5 | 8.1 |
| 4 | UAS | 307 | 5.1 (2,300) | <0.5 | 22.1 | 124 | 14.2% | <30 | 74 | 140 | 0.0% | <10 | <10 | <10 | 0.0% | 7.2 | 7.5 | 8.3 |
| 5 | UAS | 306 | 5.8 (2,600) | <0.5 | 25 | 127 | 17.9% | <30 | 75.7 | 110 | 0.0% | <10 | <10 | <10 | 0.0% | 5.8 | 7.5 | 8.3 |
| 6 | UAS | 304 | 5.5 (2,470) | <0.5 | 16.5 | 86.7 | 0.9% | <30 | 76.3 | 120 | 0.0% | <10 | <10 | <10 | 0.0% | 6.4 | 7.5 | 8.6 |
| 8 | UAS | 319 | 6.9 (3,100) | <0.5 | 12.8 | 38.6 | 0.0% | <30 | 61.4 | 80 | 0.0% | <10 | <10 | <10 | 0.0% | 6.8 | 7.6 | 8.4 |
| 11 | UAS | 360 | 7.8 (3,500) | <0.5 | 26 | 147 | 15.9% | <30 | 67.5 | 110 | 0.0% | <10 | <10 | <10 | 0.0% | 5.9 | 7.5 | 8.6 |
| 12 | LAS | 1,112 | 5.6 (2,500) | <0.5 | 2.8 | 11.7 | 0.0% | 300 | 429.6 | 1800 | 88.5% | 120 | 131 | 140 | 100.0% | 6.2 | 7.7 | 8.3 |
| 13 | LAS | 1,390 | 5.6 (2,500) | <0.5 | 1.9 | 5.6 | 0.0% | 560 | 1079.3 | 3770 | 100.0% | 190 | 217 | 250 | 100.0% | 6.2 | 7.7 | 8.3 |
| 14 | LAS | 1,495 | 7.8 (3,500) | <0.5 | 5.1 | 10 | 0.0% | 60 | 407.9 | 1610 | 41.7% | 40 | 243 | 800 | 91.7% | 6.4 | 7.6 | 8.3 |
| 15 | UAS | 330 | 7.8 (3,500) | <0.5 | 11.7 | 30.6 | 0.0% | <30 | 70 | 110 | 0.0% | <10 | <10 | <10 | 0.0% | 6.8 | 7.6 | 8.4 |
| 16 | UAS | 340 | 4.8 (2,150) | 3.1 | 42 | 153 | 34.0% | <30 | 82.5 | 120 | 0.0% | <10 | <10 | <10 | 0.0% | 6.4 | 7.5 | 8.2 |
| 17 | UAS | 300 | 4.8 (2,150) | 6 | 18.7 | 23.9 | 0.0% | <30 | 75 | 100 | 0.0% | <10 | <10 | <10 | 0.0% | 6.7 | 7.2 | 7.8 |

Notes:

(1) All information presented is from available sampling data ranging from 2003 to 2015
(2) CCR Title 22 Primary Drinking Water Standard (USEPA lists MCL as Nitrogen)
(3) CCR Title 22 Secondary Drinking Water Standard (requires waiver for exceedance)
(4) Annual Exceedance Probability (AEP) based on number of times sampling data exceeded MCL
(5) 1 mg/L = 1,000 µg/L

## 2.5 Existing Demand and Operational Modes

### 2.5.1 Existing Demand

From 1984 to 2014, the average annual well production from the El Rio Plant well field was approximately 14,000 AC-FT (see **Figure 7**). The majority of the water produced was delivered through the O-H Pipeline for potable drinking water purposes. Production from the LAS wells was divided among O-H Pipeline and PTP system customers which is not accounted for in **Figure 7**. Some correlation can be made between intense rainfall years and lower overall well production, but this is not consistently the case. There is a direct correlation between extended drought years and increased operation of the LAS wells.

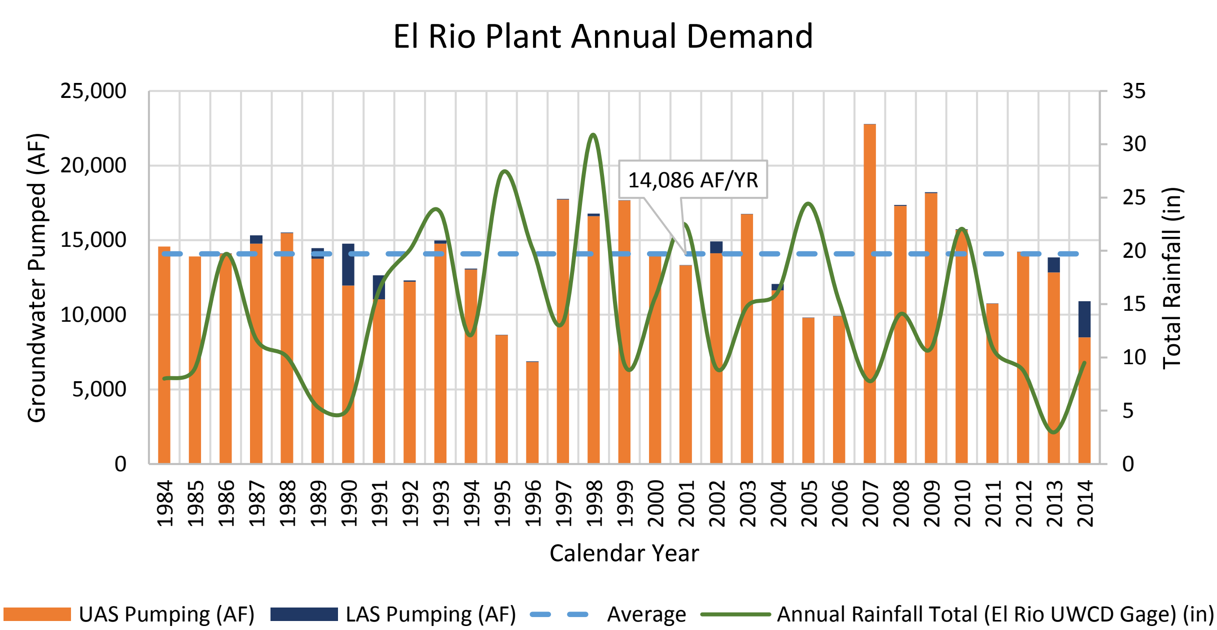



**Figure 7 - El Rio Wellfield Annual Production**

### 2.5.2 Operational Prioritization of Wells

In the last five years, the average annual water production was closer to 13,000 AC-FT as shown in **Table 6**. This is likely due to extended periods of drought and water conservation efforts. It should be noted that emphasis has been historically placed on production from wells that: (1) have the lowest levels of nitrate concentrations and (2) have the highest specific capacities (hydraulically efficient). **Table 5** summarizes the operational priority of the El Rio well field in the last five years.

**Table 5 - Operational Priority of El Rio Wells**

| Rank | UAS | LAS |
|---|---|---|
| 1. | Well No. 15 | Well No. 14 |
| 2. | Well No. 8 | Well No. 12 |
| 3. | Well No. 16 | Well No. 13 |

| Table 6 - El Rio Plant Annual Well Production | | | | | | | |
|---|---|---|---|---|---|---|---|
| Well No. | Aquifer | 2014 | 2013 | 2012 | 2011 | 2010 | **Average** |
| 2A | UAS | 1,188 | 766 | 1,250 | 1,102 | 1,162 | **1,094** |
| 4 | UAS | 0 | 129 | 183 | 647 | 740 | **340** |
| 5 | UAS | 80 | 248 | 51 | 510 | 440 | **266** |
| 6 | UAS | 653 | 1,509 | 201 | 949 | 2,037 | **1,070** |
| 7 | UAS | 1,174 | 425 | 119 | 673 | 1,181 | **714** |
| 8 | UAS | 2,059 | 2,077 | 3,269 | 1,575 | 1,595 | **2,115** |
| 11 | UAS | 286 | 1,895 | 2,264 | 1,004 | 1,254 | **1,341** |
| 12 | LAS | 466 | 878 | 3 | 3 | 5 | **271** |
| 13 | LAS | 4 | 122 | 3 | 2 | 22 | **31** |
| 14 | LAS | 1,949 | 3 | 3 | 3 | 6 | **393** |
| 15 | UAS | 2,549 | 4,666 | 3,782 | 2,203 | 4,659 | **3,572** |
| 16 | UAS | 507 | 1,134 | 3,082 | 2,076 | 2,627 | **1,885** |
| 17 | UAS | 0 | 0 | 0 | 0 | 0 | **0** |
| | **Totals** | **10,915** | **13,852** | **14,210** | **10,747** | **15,728** | **13,090** |

### 2.5.3 Description of Existing El Rio Water Treatment Process

The El Rio Plant receives surface water through diversions at the Freeman Diversion structure. This water is distributed into two parallel series of basins (Nos. 1 through 4 and Nos. 5 through 10) as shown in **Figure 1**. These basins, which are divided by earthen levees, have high percolation rates which recharges the UAS. While the UAS and LAS are connected hydraulically in the Oxnard Forebay, the LAS is understood to recharge much slower. Stored water is extracted through either UAS wells or LAS wells.

Since UAS wells are recharged through surface water deliveries, they must meet 3 log removal of Giardia (protozoa) and 4 log removal of viruses. This is achieved through the natural filtration of the basins and disinfection in the clearwells. The basins act as slow sand filters with surface loading rates less than 0.1 gpm/ft$^2$. This slow surface loading rate is from the effect of screening and sedimentation on the surface which helps to remove parasitic protozoa that are typically less than 50 micrometers in size. Water has to travel approximately 150 feet downward through the filtration basins before being drawn by an extraction well. Water then flows to the clearwells in series (or can be operated in parallel) which consist of lined earthen basins with floating covers. Gaseous chlorine is dosed to a concentration of approximately 2.0 ppm upstream of the clearwells and 2.05 ppm downstream of the clearwells. Chlorine is a strong oxidant that damages and destroys protozoa and viruses. Sufficient contact time in the clearwells is provided through a serpentine path created by a baffle in the center of each clearwell. One part of ammonia for every five parts of chlorine is added in the post-chlorinated water from the clearwells to create chloramines. The chloraminated finished water from the clearwells enters a pump trough that feeds one of eight booster pumps that provide the pressure needed for O-H Pipeline customers (four electric and four gas-driven). Typically the gas-driven standby booster pumps are only run during power outages.

The LAS wells are not physically located at the El Rio Plant. These wells are operated remotely and only to augment UAS well production. An existing settling basin is sometimes used to remove settleable solids. While these wells are not subject to the SWT Rule, the water can be blended with UAS water in the clearwells for water quality consistency.

# 3. Discussion

## 3.1 Proposed Design Criteria

The goal of the proposed project is to satisfy the regulatory drivers as described in Section 2.2. While the final position of O-H customers towards treatment for iron and manganese is not known at this time, it will be assumed for the purposes of this TM that the objective is to meet both primary and secondary MCLs as mandated by DDW. In order to demonstrate how these regulatory drivers might be satisfied, eight different operating scenarios have been presented in **Table 7** and **Table 8** below. Each operating scenario excluding the first (the do nothing option) will include partial or full treatment of water from LAS wells. All of the operating scenarios are based on the following assumptions:

- Annual O-H pipeline demand is constant at 14,086 acre-feet per year or 12.6 million gallons per day (annual average from 1984 to 2014). See **Section 3.3.4** for a discussion on potential future demand changes;
- Total peak production from UAS wells is 24,970 gpm. With nine (9) UAS wells total, average production from each UAS well is 2,775 gpm. The total peak production from LAS wells is 8,500 gpm. With three (3) LAS wells total, average production from each LAS well is 2,833 gpm. Since Well Nos. 12 and 13 are limited to 2,500 gpm, this number will be used instead.
- UAS and LAS wells will operate 24 hours per day, 7 days per week, 365 days per year (24/7/365). Interruptions to the proposed treatment process of LAS wells could potentially cause fouling of filtration units. Not all the LAS wells have to operate at the same time.
- In some scenarios, variable speed is proposed for the LAS wells. These scenarios were proposed under the assumption of operating 24/7/365 to potentially reduce the overall treatment capacity for iron and manganese removal. However, it can also be inferred that this could include a strategic operation wherein the LAS wells are not run during on-peak electrical rate hours.
- Typical water quality data is assumed from **Table 4**.
- Only LAS wells will be treated. Anticipated concentrations of iron and manganese from proposed treatment process is at non-detectable levels. UAS will not be treated, and will be blended with LAS wells.

**Table 7 – Descriptions of Theoretical Operating Scenarios**

| Scenario | Description | # of UAS Wells Operational | # of LAS Wells Operational |
|---|---|---|---|
| 1 | Do Nothing. No change to existing operations. | 2 @ 2,634 gpm or<br>4 @ 1,317 gpm (1) | 1 @ 1,500 gpm (1) |
| 2 | Treat one LAS well @ 50% | 3 @ 2,494 gpm | 1 @ 1,250 gpm (50% speed) |
| 3 | Treat one LAS well @ 75% | 3 @ 2,285 gpm | 1 @ 1,875 gpm (75% speed) |
| 4 | Treat one LAS well @ 100% | 3 @ 2,078 gpm | 1 @ 2,500 gpm (100% speed) |
| 5 | Treat two LAS wells @ 100% | 2 @ 1,866 gpm | 2 @ 2,500 gpm (100% speed) |
| 6 | Treat one LAS well @ 50%<br>Blend one LAS well @ 50% | 3 @ 2,078 gpm | 2 @ 1,250 gpm (50% speed) |
| 7 | Treat one LAS well @ 75%<br>Blend one LAS well @ 50% | 3 @ 1,869 gpm | 1 @ 1,875 gpm (75% speed)<br>1 @ 1,250 gpm (50% speed) |
| 8 | Treat one LAS well @ 100%<br>Blend one LAS well @ 50% | 2 @ 2,491 gpm | 1 @ 2,500 gpm (100% speed)<br>1 @ 1,250 gpm (50% speed) |

Note: (1) Values represent averages based on total annual production divided by the typical number of wells operational.

| Table 8 - Theoretical Operating Scenarios and Their Respective Water Qualities | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scenario | | Well System | Annual Production (ac-ft/year) | Nitrate (NO3) in mg/L MCL = 45 mg/L | | | | Iron (Fe) in µg/L MCL = 300 µg/L | | | | Manganese (Mn) µg/L MCL = 50 µg/L | | |
| | | | | Min | Avg | Max | AEP[9] | Min | Avg | Max | AEP[9] | Min | Avg | Max | AEP[9] |
| 1 | Do Nothing (2014 Blend) | UAS | 8,496 | 1.0 | 20.9 | 88.8 | 10.0% | 0.0 | 74.0 | 126.7 | 0.0% | 0.0 | 0.0 | 0.0 | 0.0% |
| | | LAS | 2,419 | 0.0 | 3.3 | 9.1 | 0.0% | 306.7 | 638.9 | 2393.3 | 76.7% | 116.7 | 196.9 | 396.7 | 97.2% |
| | | Blend | 10,915 | 0.8 | 17.0 | 71.1 | 7.8% | 68.0 | 199.2 | 629.0 | 17.0% | 25.9 | 43.6 | 87.9 | 21.5% |
| 2 | Treat one LAS well @ 50%, 24/7/365 | UAS | 12,070 | 1.0 | 20.9 | 88.8 | 10.0% | 0.0 | 74.0 | 126.7 | 0.0% | 0.0 | 0.0 | 0.0 | 0.0% |
| | | LAS | 2,016 | 0.0 | 3.3 | 9.1 | 0.0% | 0.0 | 15.0 | 30.0 | 0.0% | 0.0 | 5.0 | 10.0 | 0.0% |
| | | Blend | 14,086 | 0.9 | 18.4 | 77.4 | 8.6% | 0.0 | 65.6 | 112.8 | 0.0% | 0.0 | 0.7 | 1.4 | 0.0% |
| 3 | Treat one LAS well @ 75%, 24/7/365 | UAS | 11,062 | 1.0 | 20.9 | 88.8 | 10.0% | 0.0 | 74.0 | 126.7 | 0.0% | 0.0 | 0.0 | 0.0 | 0.0% |
| | | LAS | 3,024 | 0.0 | 3.3 | 9.1 | 0.0% | 0.0 | 15.0 | 30.0 | 0.0% | 0.0 | 5.0 | 10.0 | 0.0% |
| | | Blend | 14,086 | 0.8 | 17.1 | 71.7 | 7.9% | 0.0 | 61.4 | 105.9 | 0.0% | 0.0 | 1.1 | 2.1 | 0.0% |
| 4 | Treat one LAS well @ 100%, 24/7/365 | UAS | 10,053 | 1.0 | 20.9 | 88.8 | 10.0% | 0.0 | 74.0 | 126.7 | 0.0% | 0.0 | 0.0 | 0.0 | 0.0% |
| | | LAS | 4,033 | 0.0 | 3.3 | 9.1 | 0.0% | 0.0 | 15.0 | 30.0 | 0.0% | 0.0 | 5.0 | 10.0 | 0.0% |
| | | Blend | 14,086 | 0.7 | 15.9 | 66.0 | 7.1% | 0.0 | 57.1 | 99.0 | 0.0% | 0.0 | 1.4 | 2.9 | 0.0% |
| 5 | Treat two LAS wells @ 100%, 24/7/365 | UAS | 6,021 | 1.0 | 20.9 | 88.8 | 10.0% | 0.0 | 74.0 | 126.7 | 0.0% | 0.0 | 0.0 | 0.0 | 0.0% |
| | | LAS | 8,065 | 0.0 | 3.3 | 9.1 | 0.0% | 0.0 | 15.0 | 30.0 | 0.0% | 0.0 | 5.0 | 10.0 | 0.0% |
| | | Blend | 14,086 | 0.4 | 10.8 | 43.2 | 4.3% | 0.0 | 40.2 | 71.3 | 0.0% | 0.0 | 2.9 | 5.7 | 0.0% |
| 6 | Treat one LAS well @ 50%, Blend one LAS well @ 50%, 24/7/365 | UAS | 10,053 | 1.0 | 20.9 | 88.8 | 10.0% | 0.0 | 74.0 | 126.7 | 0.0% | 0.0 | 0.0 | 0.0 | 0.0% |
| | | LAS | 2,016 | 0.0 | 3.3 | 9.1 | 0.0% | 306.7 | 638.9 | 2393.3 | 76.7% | 116.7 | 196.9 | 396.7 | 97.2% |
| | | LAS | 2,016 | 0.0 | 3.3 | 9.1 | 0.0% | 0.0 | 15.0 | 30.0 | 0.0% | 0.0 | 5.0 | 10.0 | 0.0% |
| | | Blend | 14,086 | 0.7 | 15.9 | 66.0 | 7.1% | 43.9 | 146.5 | 437.3 | 11.0% | 16.7 | 28.9 | 58.2 | 13.9% |
| 7 | Treat one LAS well @ 75%, Blend one LAS well @ 50%, 24/7/365 | UAS | 9,045 | 1.0 | 20.9 | 88.8 | 10.0% | 0.0 | 74.0 | 126.7 | 0.0% | 0.0 | 0.0 | 0.0 | 0.0% |
| | | LAS | 2,016 | 0.0 | 3.3 | 9.1 | 0.0% | 306.7 | 638.9 | 2393.3 | 76.7% | 116.7 | 196.9 | 396.7 | 97.2% |
| | | LAS | 3,024 | 0.0 | 3.3 | 9.1 | 0.0% | 0.0 | 15.0 | 30.0 | 0.0% | 0.0 | 5.0 | 10.0 | 0.0% |
| | | Blend | 14,086 | 0.6 | 14.6 | 60.3 | 6.4% | 43.9 | 142.2 | 430.4 | 11.0% | 16.7 | 29.3 | 58.9 | 13.9% |
| 8 | Treat one LAS well @ 100%, Blend one LAS well @ 50%, 24/7/365 | UAS | 8,037 | 1.0 | 20.9 | 88.8 | 10.0% | 0.0 | 74.0 | 126.7 | 0.0% | 0.0 | 0.0 | 0.0 | 0.0% |
| | | LAS | 2,016 | 0.0 | 3.3 | 9.1 | 0.0% | 306.7 | 638.9 | 2393.3 | 76.7% | 116.7 | 196.9 | 396.7 | 97.2% |
| | | LAS | 4,033 | 0.0 | 3.3 | 9.1 | 0.0% | 0.0 | 15.0 | 30.0 | 0.0% | 0.0 | 5.0 | 10.0 | 0.0% |
| | | Blend | 14,086 | 0.6 | 13.3 | 54.6 | 5.7% | 43.9 | 138.0 | 423.4 | 11.0% | 16.7 | 29.6 | 59.6 | 13.9% |

**Table 8** suggests that operating scenarios two (2) through five (5) will not result in any probable exceedance of iron and manganese MCLs. Operating scenarios six (6) through eight (8) all resulted in a probable exceedance of nitrate, iron and manganese MCLs. It might be concluded that the design criteria be based on operating scenario five (5) because it produced the highest quality water. However, this scenario requires double the treatment capacity of scenarios two (2) through four (4) which all pose a low probability for exceedance of the nitrate MCL. Additionally, operating scenario five (5) does not eliminate the risk of exceedance of the nitrate MCL. Out of these operating scenarios two (2) through four (4), scenario four (4) poses the lowest probability for exceedance of the nitrate MCL and is therefore the recommended operating scenario. The proposed design criteria is presented in **Table 9** below.

**Table 9 - Proposed Design Criteria**

| Parameter | Value | |
|---|---|---|
| No. of LAS Wells Operating Simultaneously | One (1) | |
| Treatment Capacity | 3,500 gallons per minute (maximum production of Well No. 14) | |
| Iron Load | DAILY: 0.64 mg/L | MAX: 3.8 mg/L |
| Manganese Load | DAILY: 0.2 mg/L | MAX: 0.8 mg/L |

## 3.2 Available Types of Treatment

The general process for removal of iron and manganese follows three basic steps: (1) the oxidation of iron and manganese particles from soluble to insoluble forms, (2) clarification to remove the bulk of insoluble iron and manganese particles and protect downstream filtration systems and (3) filtration to remove the remainder of insoluble particles to the desired concentration levels which is typically to satisfy regulatory and consumer standards. An overview of the available treatment technologies is shown in **Figure 8**.

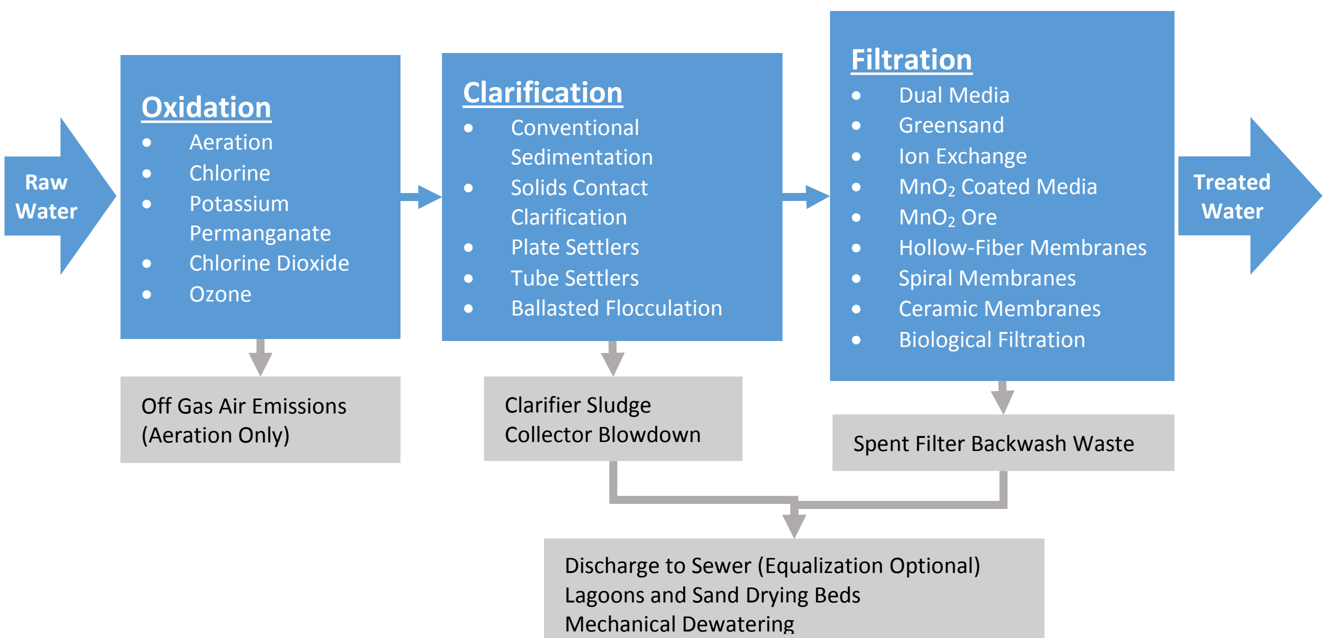



**Figure 8 - Available Types of Treatment for Iron and Manganese Removal (AWWA Handbook)**

This TM will briefly discuss each part of the process for treatment of iron and manganese and attempt to eliminate technologies that are not practicable to UWCD's El Rio Facility.

### 3.2.1 Chemical Sequestration

Chemical Sequestration is a form of treatment whereby a sequestrant (typically a polyphosphate) bonds with dissolved iron and manganese ions and forms a complex molecule that is soluble in water. This formed molecule removes the ability of iron and manganese to react with oxygen and therefore does not precipitate. Higher temperatures from heat sources such as boilers can break down the molecule and release iron and manganese making them available for precipitation. UWCD currently uses a product called AQUA MAG at Well No. 14 for this purpose.

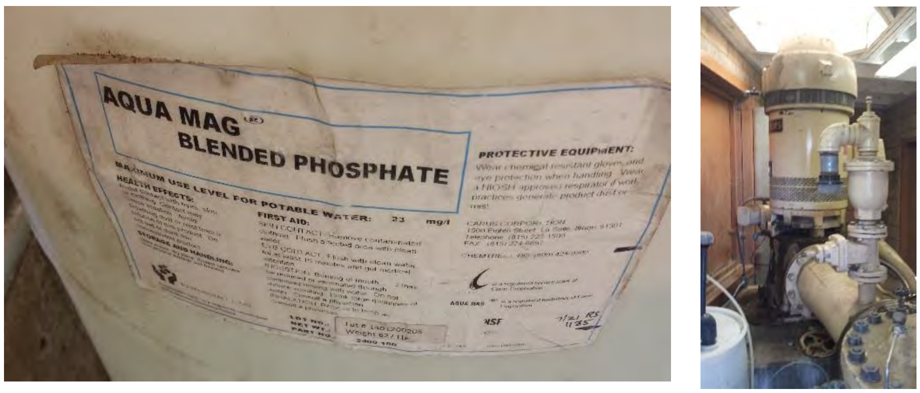



**Figure 9 - Well No. 14 and use of AQUA MAG Blending Phosphate**

- Benefits:
    - Can be implemented easily by feeding into water source with controlled injection equipment;
    - Typically works well on concentrations that do not exceed:
        - 600 µg/L of iron;
        - 100 µg/L of manganese;
    - Low energy input;
    - Low capital cost.
- Draw-backs:
    - Iron and Manganese are not removed and remain in water supply;
    - Heat can inadvertently reverse sequestration (at about 302ºF for AQUA MAG);
    - Continuous purchase of proprietary chemical is needed to mitigate iron and manganese;
    - Does not work on concentrations higher than those noted above.

### 3.2.2 Oxidation

Oxidation is the process whereby electrons are removed from iron and manganese atoms and transferred to atoms of an oxidant. This makes the iron and manganese atoms more available to bond with other atoms. Most oxidation reaction rates vary with pH, and all oxidation reactions are susceptible to other constituents that may attract the oxidant such as organic matter (compounds containing carbon). **Table 10** presents the most common oxidants used for iron and manganese treatment.

**Table 10 - Oxidants Typically Used for Iron and Manganese Removal**

| Parameter | Oxygen ($O_2$) | Ozone ($O_3$) | Chlorine (HOCl) | Potassium Permanganate ($KMnO_4$) | Chlorine Dioxide ($ClO_2$) |
|---|---|---|---|---|---|
| Oxidant (mg) needed to oxidize 1.0 mg of $Fe^{2+}$ | 0.14 | 0.43 | 0.64 | 0.94 | 1.20 |
| Oxidant (mg) needed to oxidize 1.0 mg of $Mn^{2+}$ | 0.29 | 0.88 | 1.30 | 1.92 | 2.50 |
| Total Oxidant (mg) needed to oxidize 0.64 mg of $Fe^{2+}$ and 0.2 mg of $Mn^{2+}$ | 0.15 | 0.45 | 0.66 | 0.98 | 1.26 |
| pH needed to oxide Fe | >7.5 | n/a | >8.0 | >5.5 | >5.5 |
| pH needed to oxide Mn | >9.0 | n/a | >8.0 | >5.5 | >5.5 |
| pH needed for both | >9.0 | n/a | >8.0 | >5.5 | >5.5 |
| Reaction time for Fe | 15 min | Instantaneous | 15-30 min | <20 sec | 10 sec |
| Reaction time for Mn | >1 hr | 10-30 sec | 2-3 hr | <20 sec | 10 sec |

Oxygen

Oxygen is naturally abundant in the atmosphere (approximately 20% by volume) and is one of the most efficient oxidants for iron and manganese on a mass basis. Oxidation with oxygen often requires air that is forced from blowers or through turbulence and mixing caused by physical features. There are five different commercially available types of aerators on the market: (1) Aerated Basins, (2) Forced Air Tower, (3) Cascading Step Aerator, (4) Porous-Tube Pressure Aerator and (5) Venturi Device. The last two mentioned (4 and 5) will not be discussed further as they require substantial maintenance to avoid the accumulation of precipitate.

In an aerated basin, elevated steps can create the turbulence needed to infuse oxygen. This often requires a pump to lift the water to the top of the steps. Another option is coarse or fine bubble nozzles that infuse the air into a tank. Air to the nozzles must be provided through the use of compressors. In some instances, pure oxygen can be used for higher transfer efficiency. Examples of both types are shown in **Figure 10**.

**Figure 10 - Cascading aerator at Lake Havasu (left) and in-tank aerator offered by EP Aeration (right)**

A forced air tower and cascading step aerator operate in similar principal to the examples mentioned previously. WesTech (WesTech) Engineering offers both forced air towers and cascading step aerators. According to WesTech, a 2,500 gpm forced air tower would require 11 feet by 11 feet of space and 9,075 SCFM of air. The approximate motor input power for a motor this size ranges from 300 to 400 HP.

**Figure 11 - Induced Draft Aerator (left) and Cascade Aerator (right) (WesTech Engineering)**

Although there is not presently a cost for extracting oxygen from the air, all options require some footprint either small or large and require some energy input through pumps or compressors. Additionally, the simultaneous precipitation of iron and manganese using oxygen best occurs at a pH above 9.0. Some pH adjustment may be needed through the use of chemical. All of these factors would increase capital and operational costs.

<u>Ozone</u>

Ozone is an aggressive oxidant that naturally occurs in the Earth’s stratosphere. Under normal lower atmospheric conditions, dissolved ozone in water is unstable and will break down into dioxygen gas with a half-life of 8 to 30 minutes. Ozone is one of the best choices for rapid oxidation of iron and manganese and does not have a pH preference. Additionally, ozone serves as a powerful disinfectant capable of destroying pathogens. Ozone is typically generated on-site using pure oxygen gas as it cannot be stored easily with its short half-life. Additionally, it requires a contactor built with materials capable of withstanding the aggressive chemical. The Calleguas Muncipal Water District (CMWD) owns and operates an ozone system as shown in **Figure 12**.

**Figure 12 - Ozone generator (left) and pure oxygen storage (right) at CMWD's Lake Bard Treatment Plant**

The use of ozone would require construction of an on-site generator, pure oxygen storage and contactor tanks. All of these factors would increase capital and operational costs.

Chlorine

Chlorine is the most common oxidant used in water treatment. It comes in several forms including gaseous chlorine, solid calcium hypochlorite (68%) and liquid sodium hypochlorite (12%). It is an efficient oxidant for removal of iron and manganese on a mass basis as shown in **Table 10**. The rate of iron and manganese oxidation is affected by the pH of the water. Additional chlorine is sometimes added to bring the pH up to 8.0 for optimal conditions. In the presence of organic matter (or compounds containing carbon), chlorine has the potential to form disinfection byproducts such as trihalomethanes (THMs) and haloacetic acids (HAAs) which are potentially cancer causing compounds. However, the risk of these compounds forming is lessened through chloramination.

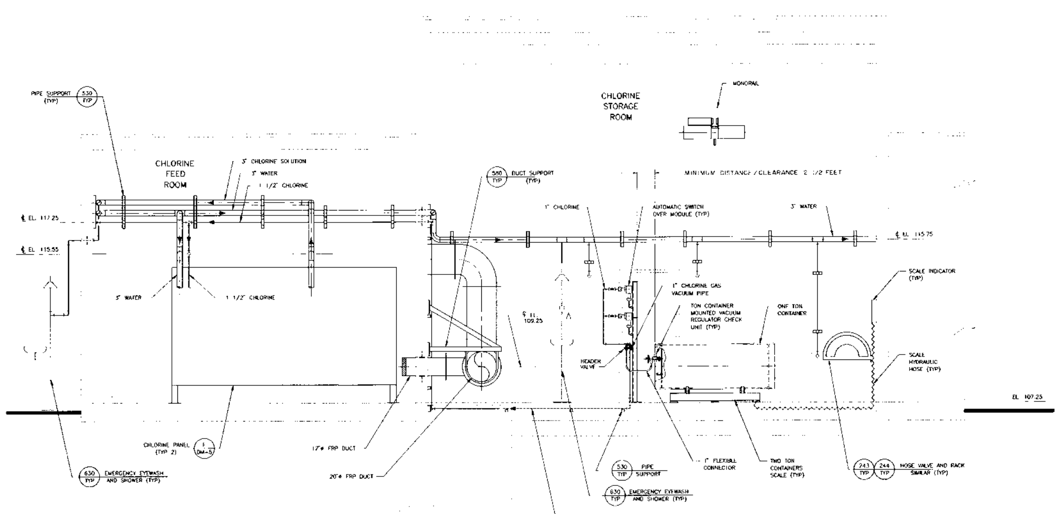


**Figure 13 - El Rio Plant Existing Gaseous Chlorine Disinfection System ("As-Built" Plans)**

Gaseous chlorine is currently used for disinfection at the El Rio Plant. The current cost of chlorine is approximately $0.31 per pound. Since the facilities are already in place, there would only be the capital cost of plant piping and controls and operational cost of additional chlorine demand for iron and manganese treatment.

Potassium Permanganate

Some water utilities are using potassium permanganate ($KMnO_4$) for disinfection. $KMnO_4$ may be selected in some cases because it does not have the same potential to form disinfection byproducts like chlorine. It comes in solid and liquid forms and exhibits a unique purple color that can sometimes cause discoloration of the treated water. On a mass basis, potassium permanganate is not as efficient as chlorine for the oxidation of iron and manganese. However, $KMnO_4$ reacts more vigorously than chlorine with iron and manganese implying a shorter reaction time and $KMnO_4$ is not pH dependent. Therefore, in some instances, $KMnO_4$ can be a more effective oxidant.

$KMnO_4$ can be magnitudes higher in cost than chlorine on a mass basis (4 to 5 times higher). One supplier, Parchem, has quoted $3.06 per pound for crystalline $KMnO_4$ for quantities over one ton in drums or pails. If $KMnO_4$ were proposed at the El Rio Plant, it would not contribute to the chloramine residual in the O-H Pipeline. Additional chlorine would be needed to provide this residual. The construction of potassium permanganate facilities would increase the capital cost of an iron and manganese treatment plant and may result in higher chemical costs.

Chlorine Dioxide

Chlorine dioxide may be used for iron and manganese oxidation because it is not pH dependent and has a rapid reaction rate. The presence of organics in the source water competes for the oxidant which can greatly slow down the reaction time. One advantage of chlorine dioxide over chlorine is that it does not have the potential to form THMs with organics. However, there is a potential to form chlorite in the presence of the manganese ion which has an MCL of 1.0 mg/L. Chlorine dioxide does not react with ammonia to form chloramines. Chlorine dioxide comes in gaseous and liquid forms. The gaseous form is typically generated on-site because of its explosion potential. Although there might be some merit in the use of chlorine dioxide for iron and manganese treatment, there would be increased capital costs for the retrofitting of the existing chlorination facility.

### 3.2.3 Clarification

Clarification is needed when high concentrations of iron and manganese are present which would result in low filter run times and very large quantities of backwash water used to maintain efficient filter operation. The AWWA suggests that when combined concentrations of iron and manganese are greater than 5.0 mg/L, a cost-benefit analysis should be conducted to determine whether clarification is beneficial. The proposed design criteria in **Table 9** suggests that this is not the case with a combined iron and manganese load that averages 0.84 mg/L and 4.6 mg/L at a maximum. There are several types of clarification as indicated in **Figure 8** that include conventional sedimentation basins, plate and tube settlers, solids-contact clarifiers, dissolved air flotation and ballasted flocculation. All of these clarification types operate on the same principle, which is to provide quiescent space for particles to reach settling velocity (approximately 0.053 feet per minute for iron and manganese precipitates). All of these options were reviewed in terms of surface loading rates and space requirements as presented in **Table 11**.

**Table 11 - Comparison of Different Clarification Options**

| Item | Conventional Sedimentation Basin | Plate and Tube Settlers | Solids Contact Clarifier | Dissolved Air Flotation | Ballasted Flocculation |
|---|---|---|---|---|---|
| Coagulant | Not Required | Not Required | Required | Required | Required (1) |
| Surface Loading Rate (gpm/ft$^2$) | 0.4 to 0.5 | 0.4 to 2.0 | 1.0 to 3.0 | 6.0 to 10 | Up to 30 |
| Space Required @ 3,500 gpm | ≤ 8,750 ft$^2$ | ≤ 1,750 ft$^2$ | ≤ 4,375 ft$^2$ | ≤ 583 ft$^2$ | ≥ 291 ft$^2$ |
| Detention Time | 240 min | -- | -- | -- | < 15 min |
| Depth Required | 12.83 ft | -- | -- | -- | -- |

Notes: (1) In addition to coagulants, requires the recycled flow of sand to act as a “ballast” for flocculated particles.

There is a significant capital cost to construct a conventional sedimentation basin which has been estimated at $1.3M (based on USEPA cost curve data). Plate and tube settlers are estimated to be approximately 70% of conventional sedimentation basin costs. Other options may prove to be less capital cost intensive, but since the combined concentration of iron and manganese to be treated does not exceed 5.0 mg/L, these options were not investigated further.

✎ Pilot plant testing has confirmed that removal of iron and manganese to non-detect levels is possible without clarification using Greensand Plus or LayneOx granular media.

### 3.2.4 Filtration

Biological Based Filtration

There are many types of bacteria that can oxidize iron and manganese ions into precipitate forms. Under normal circumstances, these bacteria are found in wells and distribution systems and are a nuisance. However, the bacteria can also be used in treatment. In the case of iron, bacteria will typically oxidize the ferrous ($Fe^{2+}$) form to the ferric ($Fe^{3+}$) form. In the case of manganese, bacteria will typically oxidize the manganese to manganese dioxide ($MnO_2$). The following are the most common types of bacteria used:

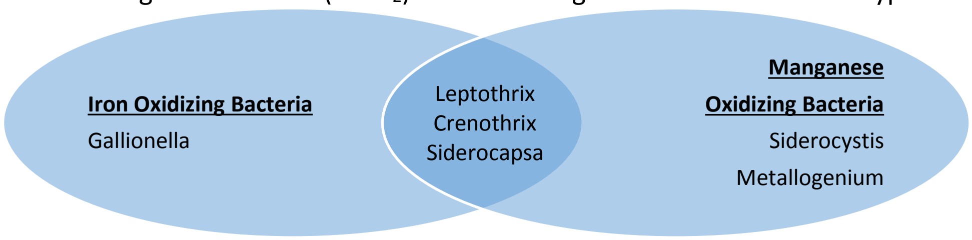



**Figure 14 - Species of Iron and Manganese Oxidizing Bacteria**

Bacteriological filtration requires precise control over the operating environment to best suit the iron and manganese oxidizing bacteria species. This often requires the addition of air to increase dissolved oxygen content. Infilco Degremont manufactures two separate systems for the removal of iron and manganese under the FERAZUR® and MANGAZUR® names respectively (see **Figure 15**). The benefits and drawbacks of these systems are mentioned in the following paragraphs.

**Figure 15 - Infilco Degremont (now Suez) FERAZUR® and MANGAZUR® System**

Benefits:

- Does not require the addition of chemical;
- Highest purported filter rates ranging from between 8 to 24 gpm/ft$^2$;
- Process forms denser iron precipitates offering increased capacity and longer run times;
- Media life is typically around 10 to 15 years;

Draw-backs:

- Requires a two-stage process as the environmental conditions to support iron and manganese oxidizing bacteria vary:
  - Fe: DO of 1 to 3 mg/L, pH of 6.5 to 7.2

    - Mn: DO greater than 5, pH greater than 7.5
- Increased energy cost through aeration;
- Susceptible to compounds that are toxic to bacteria such as: chlorine, hydrogen sulfide, heavy metals, ammonia, phosphates, organics and hydrocarbons;
- Creates a waste sludge from backwashing filters that must be dewatered and disposed off-site;
- Intermittent operation is difficult as bacteria can only survive up to 6 months.

It should be noted that a biological filtration option exists for removal of nitrates. While this could potentially be used to treat UAS wells and mitigate the need to treat the LAS wells for iron and manganese, the scale of such a plant would be magnitudes larger due to the volume of water being treated. Additionally, it would not provide supply flexibility in the event of UAS supply shortages.

<u>Granular Based Filtration</u>

Granular media is the most common method of filtration for iron and manganese removal in large water systems. Ion exchange is also used, but is less cost effective on large scales. The most common types of granular media are shown in **Table 12**. Most granular media is coated with manganese dioxide ($MnO_2$) to act as a catalyst and accelerate the oxidation of iron and manganese. An oxidant (potassium permanganate or chlorine) is used to continuously or intermittently regenerate the manganese dioxide coating. Iron and manganese precipitates are filtered out while soluble manganese can be adsorbed into the coating. In the presence of organics, iron can react with the organics creating complexed forms that are not removed and the organic material may block adsorption sites. A recent water quality report dated December 15, 2015 from Well Nos. 12, 13 and 14 indicated Total Organic Carbon (TOC) concentrations as 0.9 mg/L, 1.0 mg/L and < 0.5 mg/L respectively. This could have some bearing on oxidant demand and ability of granular media to effectively remove the iron and manganese.

| Table 12 - Comparison of Common Granular Media Types used for Iron and Manganese Removal | | | | |
|---|---|---|---|---|
| Parameter | Dual Media | Greensand | $MnO_2$ Sand | Pyrolusite |
| Became Commercially Available | 1900s | 1930s | 2005 | 1930s |
| Description | Anthracite (A) and Sand (S) | Glauconite ore coated with $MnO_2$ | Sand coated with $MnO_2$ | $MnO_2$ Ore |
| Effective Size | 1.2 (A) and 0.55 (S) | 0.30 to 0.35 mm | 0.30 to 0.35 mm | 0.3 to 0.5 mm |
| Uniformity Coefficient | 1.6 (both) | 1.6 | < 1.6 | 1.7 |
| Specific Gravity | 1.6 (A) and 2.6 (S) | 2.4 | 2.4 | 4.0 |
| Typical Bed Depth(1) | 24 in (A) and 12 in (S) | 18 in | 18 in | 36 to 48 in |
| Regeneration(1) | $KMnO_4$ or HOCl | $KMnO_4$ required | $KMnO_4$ or HOCl | $KMnO_4$ or HOCl |
| Manufacturers | Clack, WI | Inversand, NJ(2) | Inversand, NJ Clack, WI | Clack, WI, Layne |
| Air Scour(1) | Optional | Optional | Optional | Required |
| Abrasion Resistance | High | Low | High | High |
| Filter Loading Rate(1) | 2.5 to 6 gpm/ft$^2$ | Up to 3 gpm/ft$^2$ | Up to 12 gpm/ft$^2$ | Up to 12 gpm/ft$^2$ |
| Backwash Rate(1) | 10 gpm/ft$^2$ | Up to 12 gpm/ft$^2$ | > 12 gpm/ft$^2$ | 25 gpm/ft$^2$ |
| Filter Media Capacity(1) | Unavailable | 64,800 mg/ft$^2$ | Up to 77,800 mg/ft$^2$ | 19,440 mg/ft$^3$ |
| Filter Media Life(1) | Unavailable | > 10 years | > 10 years | > 10 years |

Notes:

(1) Purported based on manufacturer literature or available pilot testing reports

(2) Does not manufacture manganese greensand (glauconite) as of November 1, 2012

Dual media (containing anthracite and sand) is commonly used for iron and manganese removal. Greensand is more commonly used. The only North American manufacturer of original Greensand made of glauconite (a soft mica material) stopped production in 2012. An alternative to Greensand is $MnO_2$ sand (often referred to as "Greensand") which exhibits higher abrasion resistance and can tolerate higher filter loading rates. Pyrolusite is an ore consisting of nearly pure $MnO_2$ which does not require regeneration. However, because of the higher specific gravity, large backwash rates are needed to fluidize the bed which sometimes needs air scouring.

A local example of $MnO_2$ sand filtration is the Steckel Water Facility (SWF) at 200 South Tenth Street in Santa Paula, California. UWCD staff visited this location on November 11, 2015 and pictures are provided in **Figure 16**. The SWF is fed by three wells with capacities of approximately 3,000 gpm. Feed water is dosed with sodium hypochlorite prior to filtration which contains iron and manganese concentrations that are approximately 0.1 mg/L and 0.2 mg/L respectively. The plant consists of three horizontal tanks that are 10 ft in diameter and 25 ft in length. Each tank consists of 3.5 ft of free board, 0.5 ft of anthracite coal, 2.0 ft of GreensandPlus (by Inversand Company), 1.5 ft of support gravel and 2.5 feet of concrete fill. Two tanks are actively used with filter surface loading rates of 8 to 10 gpm/ft$^2$. Filter run times exceed two days and are backwashed at over 4,000 gpm. Water quality reports of the filter effluent show non-detectable levels of iron and manganese. The SWF was designed with a peak treatment capacity of 10 mgd. The Greensand equivalent media was only replaced once after 15 years of service.

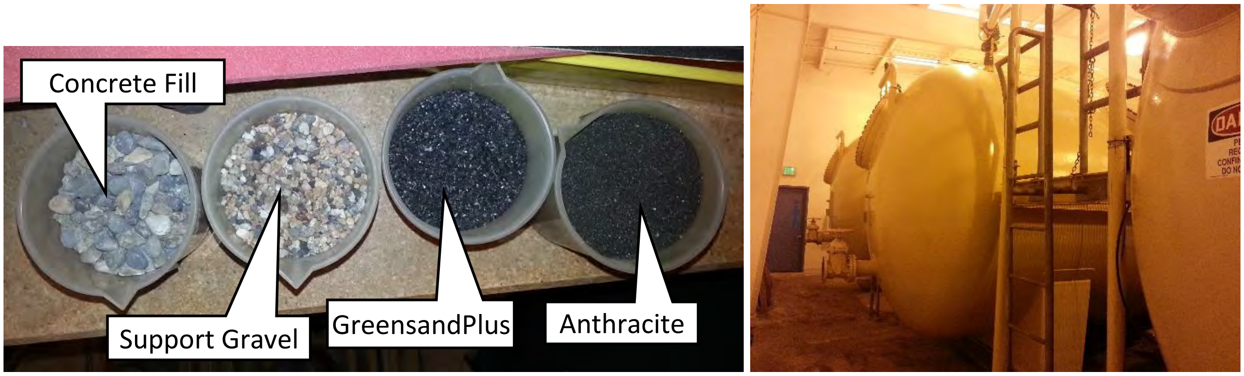



**Figure 16 - Santa Paula Steckel Water Facility Filter Media (left) and horizontal tanks (right)**

Proprietary granular media systems are available through manufacturers such as Filtronics. A local example of a proprietary granular media system is the Round Mountain Water Treatment Plant (RMWTP) located near the California State University Channel Islands Campus and operated by the Camrosa Water District. UWCD staff visited the RMWTP on January 5, 2016 and a picture is provided as **Figure 17**. The RMWTP started operating in 2014 and cost $4.3 million to construct. The RMWTP consists of wells that are pre-treated using sodium hypochlorite and Filtronics Electromedia® before cartridge filters and reverse osmosis. Filtronics purports that Electromedia® can achieve filter surface loading rates of up to 18 gpm/ft$^2$. Feed water at the RMWTP is pre-chlorinated at a concentration of 3 mg/L and contains iron and manganese concentrations that are approximately 0.5 mg/L. The RMWTP is currently operating at surface loading rates of 9 gpm/ft$^2$ with backwash rates of 2,000 gpm for 10 minutes. Total design capacity at the RMWTP is 1.0 mgd.


**Figure 17 - Filtronics Electromedia System at Camrosa's RMWTP in Camarillo**

<u>Membrane Based Filtration</u>

Membrane filtration is not commonly employed for iron and manganese removal because of the tendency for oxidized iron to foul membranes. Acid is sometimes used to prevent fouling. Some membranes require pre-treatment systems upstream to remove high concentrations of iron and manganese. Additionally, membranes require higher feed pressures than other types of filtration and they may not fully remove manganese. Membranes do offer some benefits which are summarized below:

Benefits:

- Reduction in turbidity;
- Pathogen removal due to filter opening sizes of 0.05 to 1.0 microns;
- Less backwash water and higher recovery versus granular media;
- Not pH dependent.

Drawbacks:

- Iron oxide can foul membranes;
- Sometimes requires acid for backwashing;
- Membranes are sensitive to damage from strong oxidants which may require a tank upstream of the membranes to oxidize iron and manganese;
- Requires higher feed pressures than other types of filtration;
- May not fully remove manganese.

There are several manufacturers of membranes used to remove iron and manganese including Pall, Koch and GE. Considering the need for an oxidation tank upstream of membranes, and the risks of fouling and incomplete removal, pursuing this option is not recommended at this time.

<u>Resin Based Filtration</u>

Packaged ion exchange systems for iron and manganese removal are very common household and industrial treatment solutions. Ion exchange systems also soften the water (removes dissolved calcium and magnesium ions) making it more desirable for consumers. Ion exchange can use either cationic (basic and donates electrons) or anionic (acidic and receives electrons) exchange resins. Resins are often made from synthetic materials and are saturated in concentrated amounts of sacrificial exchange ions. The most common ion exchange system used for the removal of and iron and manganese is cationic with sodium ions used to regenerate the exchange resin. The benefits and draw-backs of ion-exchange are listed below:

Benefits:

- Can remove hardness;
- May potentially remove nitrates with the appropriate exchange resin;
- Not pH dependent;
- Filter surface loading rates of 6 to 12 gpm/ft$^2$ may be achieved;

Drawbacks:

- Metal oxides can plug exchange resins;
- Backwash must be non-chlorinated water;
- Requires frequent regeneration of exchange resins at high concentrations of iron and manganese;
- Sodium chloride which is commonly used for regeneration results in a brine discharge that is problematic for sewers;
- Typical exchange resin life is 4 to 8 years;
- Long term shut down requires exchange resin to be in an exhausted state and a regeneration cycle is needed at start-up.

## 3.3 Integrating New Treatment Process into Existing Facilities

### 3.3.1 Consideration of Greensand Filter Treatment

Although there are several treatment solutions that may be an appropriate fit for the El Rio Facility, this TM will investigate the use of an established technology as a baseline comparator, Greensand Filtration. In this case, the word "greensand" implies newer alternative manganese dioxide coated granular media. Preliminary design criteria were developed based on information available from filter media manufacturers. The target design capacity was provided by **Table 9**. A conservative value of 3 gpm/ft$^2$ was initially used, however, it has since been updated based on pilot plant testing results. The preliminary greensand filter design calculations are presented in **Table 13** below.

✎ Pilot Plant testing has confirmed that a higher filter surface loading rate of 6 gpm/ft$^2$ can be reasonably maintained using Greensand Plus media. The LayneOx media achieved a filter surface loading rate of 9 gpm/ft$^2$ with full removal of iron and manganese, but had difficultly passing SDI testing. Therefore, all preliminary design calculations have been updated based on 6 gpm/ft$^2$.

**Table 13 - Greensand Filter Preliminary Design Calculations**

| Parameter | Value | Description |
|---|---|---|
| Type of Operation | Catalytic oxidation using continuous regeneration (chlorine) | |
| Filtration Media | 15-18 inches of anthracite<br>15-24 inches of manganese dioxide coated greensand (glauconite) | |
| Filtration Capacity | 64,800 mg/ft$^2$ of Fe and Mn (combined) | GreensandPlus by Iversand Company |
| Design Flow Rate | 3,500 gpm | From **Table 9** |
| Estimated Chlorine Demand | 1.2 mg/L<br>52.2 lb/day | |
| Design Filter Surface Loading Rate | 6 gpm/ft$^2$ | Conservative value due to high iron and manganese concentrations |
| Total Filter Surface Area | 584 ft$^2$ | Active surface area |
| Number of Filters | 6 | Four active, one in backwash, one for standby |
| Surface Area per Filter | 146 ft$^2$ | |
| Horizontal Cylindrical Tank Dimensions | 12 ft diameter x 12.2 ft length | 12 feet is considered a wide load by truck |
| Total Treatment Capacity per Filter | 9.5 kg of Fe & Mn (combined) | |
| Estimated Filter Run Time | 2.4 days (avg. daily)<br>0.4 days (max daily) | |
| Backwash Rate | 12 gpm/ft$^2$ | |
| Backwash Duration | 10 min | |
| Total Backwash Volume | 29,700 gal/day | Decant to be sent back to groundwater recharge basins. |
| Total Mass of Iron and Manganese Precipitates Generated | 35 lb/day | |

### 3.3.2 Potential Locations

Three potential locations for an iron and manganese treatment plant have been considered as part of this TM. These locations resulted from multiple discussions with staff. The key factors for consideration are space available, grading requirements, proximity to feed wells, chlorination, clarification (existing settling basin), backwash water (O-H Pipeline booster pumps), plant effluent (existing clearwell manifold) and conflicting utilities. The three potential locations are shown as "A", "B" and "C" in **Figure 18** below. In evaluating each location based on the key criteria, weights were assigned to emphasize the significant impact to capital costs. A weight of "1" is likely to have little significant impact to capital costs whereas "3" will likely have the highest significant impact to capital costs. Each location has been ranked for all key factors and the results are presented in **Table 14**.

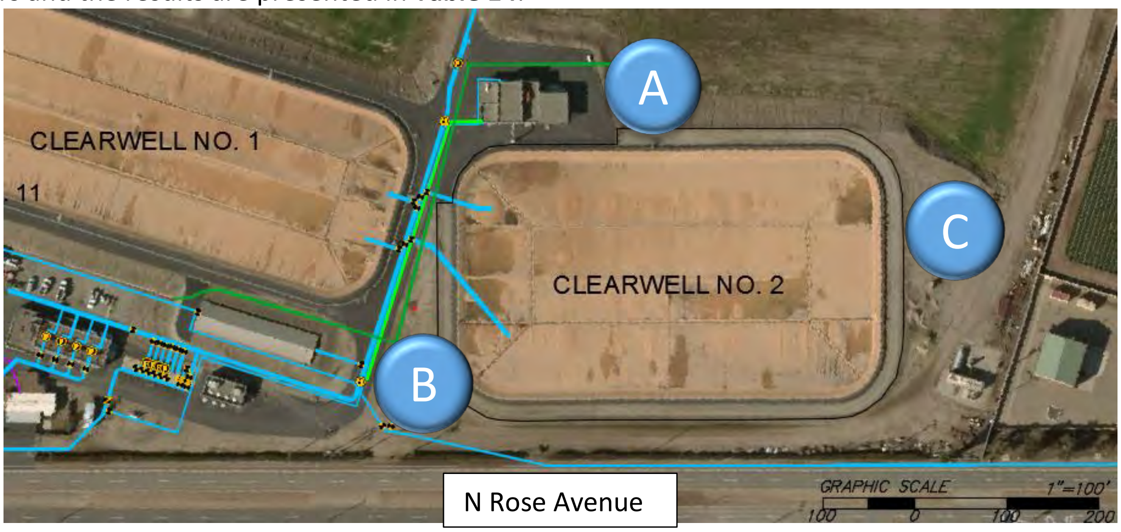



**Figure 18 - Potential Locations**

**Table 14 – Comparison and Ranking of Potential Site Locations**

| Description | Weight | Location A | Location B | Location C |
|---|---|---|---|---|
| Space Constraints[1] | 1 | ① East & South | ③ All Directions | ② North, East & South |
| Available Space[1] | 2 | ① Unconstrained | ② 19,000 sq ft | ③ 18,000 sq ft |
| Site Grading Requirement | 3 | ② Bulk Grading | ① Minor Grading | ① Minor Grading |
| Distance from Well No. 12 & 13 | 3 | ② 4,500 ft | ② 4,500 ft | ① 4,200 ft |
| Distance from Well No. 14 | 3 | ② 3,500 ft | ① 3,000 ft | ③ 3,600 ft |
| Oxidation: Distance to Existing Chlorine Building | 1 | ① <100 ft | ② >300 ft | ② >300 ft |
| Clarification: Distance to Existing Settling Basin | 3 | ② >500 ft | ① <100 ft | ③ >800 ft |
| Backwash: Distance to Existing O-H Pipeline | 2 | ② >900 ft | ① >400 ft | ③ >1,100 ft |
| Plant Effluent: Distance to Clearwell Influent Manifold | 2 | ① >200 ft | ② >250 ft | ③ >600 ft |
| Potential Utility Conflicts | 2 | ② 4xStormdrains (3x24",1x6") | ③ Communications Bank; Electrical Bank; Stormdrain (24"); Well No. 12 & 14 Flushing Pipe (12") | ① None |
| **Weighted Rank** | | **②** | **①** | **③** |

Note: (1) This factor accounts for possibility of expansion.

Location A appears to be a suitable location as it is unconstrained allowing for expansion and close to the existing chlorination building and clearwell influent manifold. However, this site requires the greatest degree of bulk grading to provide a foundation for the new treatment plant. Additionally, it would require the relocation of four stormdrains that discharge into Basin No. 8 (see **Figure 19**). Since stormdrains are elevation controlled structures, it might be more reasonable to select a location west of the chlorination building. However, this would increase the distance to important facilities and storm drains can be relocated.

**Figure 19 - Location A Stormdrain Utility Conflicts**

Location C is distant from the chlorination building, existing settling basin, O-H pipeline and clearwell influent manifold. However, this location is less constrained compared to Location B allowing expansion and requires minimal grading. Additionally, it is closer to Well No. 13 which has the greatest degree of hydraulic limitation.

Location B appears to be the best choice for a new treatment plant. This location is the closest to the existing settling basin and O-H pipeline. While the site is further away from the chlorination facility than Location A, this presents only a minor capital cost considering the small pipe diameter needed for chlorine injection. The greatest challenges with this location will be managing the utility conflicts and connection to the existing clearwell influent manifold. All of these utilities can be relocated at cost and are shown in **Figure 20**.

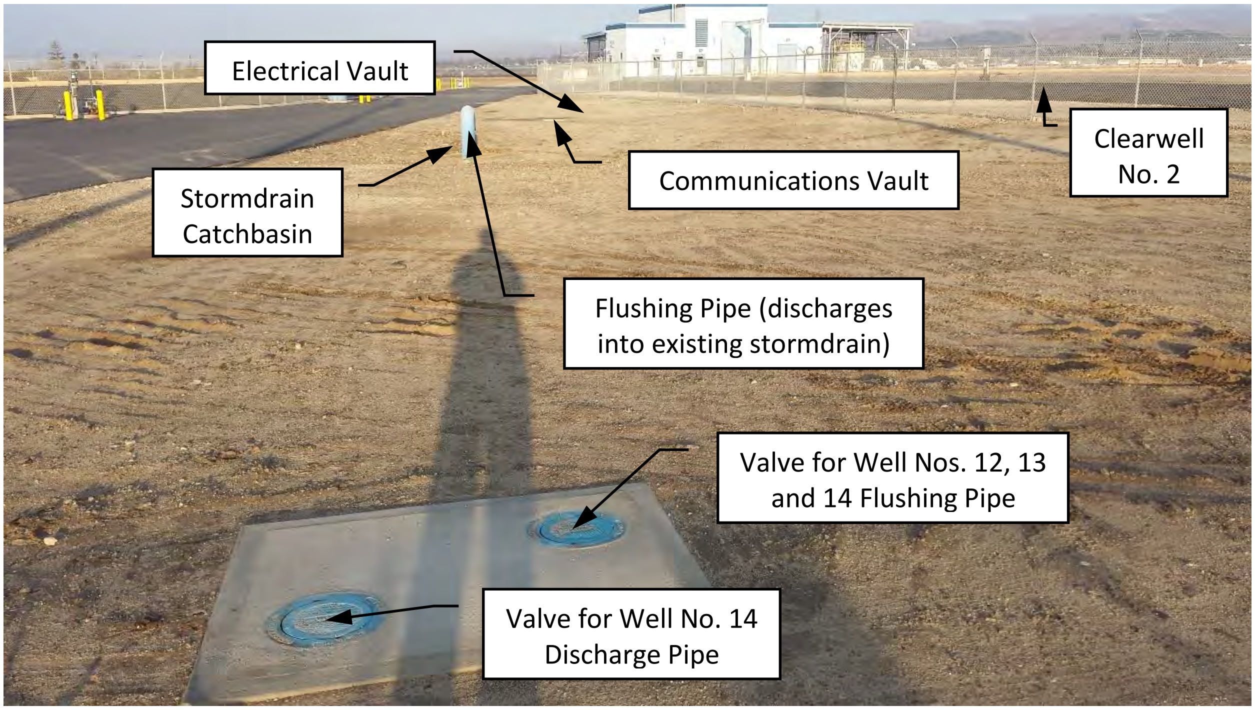


**Figure 20 - Location B Existing Utility Conflicts**

### 3.3.3 Hydraulic Considerations (Existing Well Nos. 12, 13, 14 and Booster Pumps)

A conceptual level hydraulic analysis was conducted as part of this TM. The analysis only considered Location B as presented in **Section 3.3.2** for the future site of a greensand pressure filter treatment system. An overall hydraulic profile schematic is shown in **Figure 21**. The intent of the analysis is to provide guidance on key improvements that might be needed to complete the design.

Greensand filters are typically constructed with mixed media including anthracite and gravel. For this analysis, assumptions were made regarding filter media material, media depths and head losses as shown in **Table 15**. Detailed design might indicate head losses that are lower or higher than the figures shown in the table.

**Table 15 - Head Loss Through Conceptual Greensand Filter (Clear Water)**

| Media Material | Media Depth | Normal Flow (3 gpm/ft^2) | High Rate Flow and Backwash (12 gpm/ft^2) |
|---|---|---|---|
| Anthracite | 18 in | 0.2 ft | 0.9 ft |
| Greensand | 24 in | 2.1 ft | 8.8 ft |
| Fine Gravel | 18 in | Negligible | 0.2 ft |
| Coarse Gravel | 36 in | Negligible | Negligible |
| **Total for All Media** | **96 in** | **2.3 ft** | **9.9 ft** |

The existing operation consists of Well Nos. 12, 13 and 14 either discharging into the existing settling basin or into the clearwell influent manifold. The proposed operation would divert water using the existing well effluent manifolds and into one of six parallel filters as shown in **Appendix 7.5**. Head loss calculations were performed through the proposed conveyances to the new greensand filters (see **Appendix 7.6**). A summary of these calculations is presented in **Table 16**.

| Table 16 - Available Head at Wells and Booster Pumps Based on 2014 Data | | | | | |
|---|---|---|---|---|---|
| **Description** | **Head at Rated Capacity** | **Head Loss Through Conveyance to Filters** | **Available Head** | | |
| | | | **At Filter Influent[1]** | **At Filter Effluent (Normal Flow)** | **At Filter Effluent (High Rate Flow)** |
| Well No. 12 | 468 | 17.7 | 48.7 | 46.4 | 38.8 |
| Well No. 13 | 360 | 3.6 | 7.8 | 5.5 | -2.1 |
| Well No. 14 | 432 | 53.9 | 76.9 | 74.6 | 67 |
| Booster Pumps | 109 | 5.1 | 73.5 | 63.6 | 63.6 |
| Note: (1) Based on 2014 groundwater levels and SCE tests. | | | | | |

Well Nos. 12, 14 and booster pumps all appear to have sufficient head to feed pressure filters. However, static and pumping groundwater levels have been dropping particularly during an extended period of drought between 2011 and 2014 (see **Appendix 7.2**). In 2014, the pumping groundwater level at Well No. 13 dropped to the top of the pump bowls rendering it incapable of providing sufficient head to proposed pressure filters. Additional column pipe and pump bowl stage is recommended at Well No. 13.

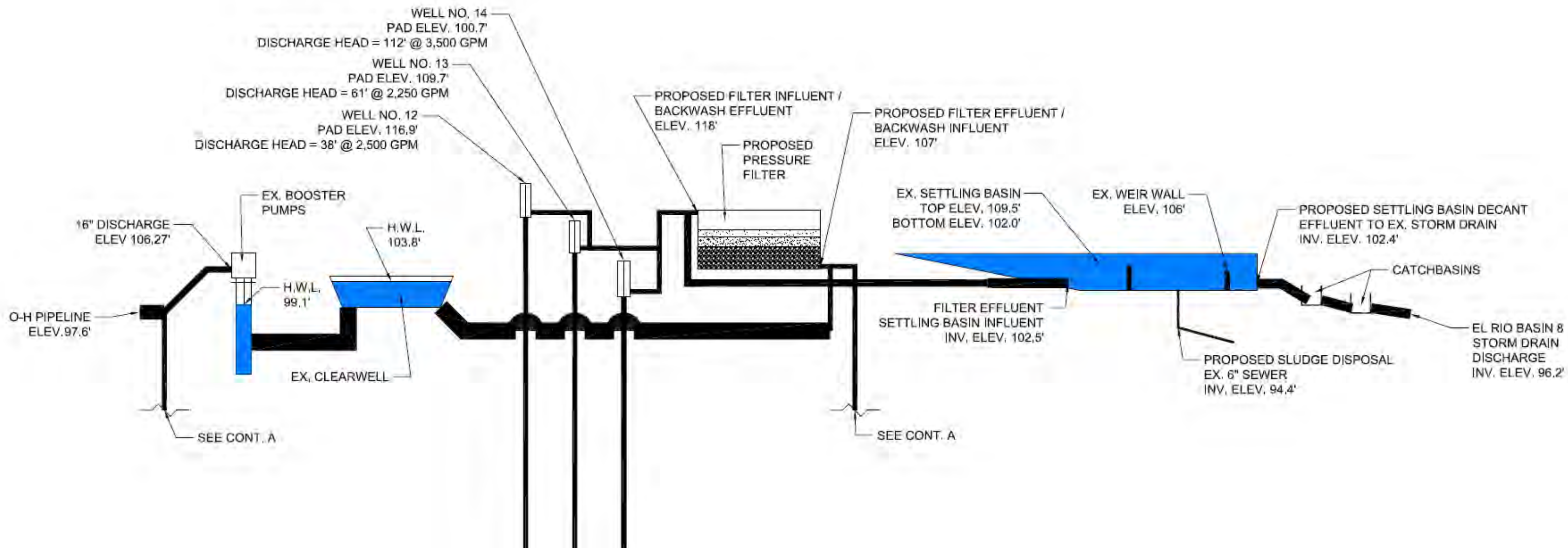



**Figure 21 - Hydraulic Profile Schematic with Proposed Pressure Filter Treatment**

### 3.3.4 Demand Considerations

O-H Pipeline demand has remained fairly consistent at 14,000 ac-ft per year on average as shown in **Figure 7**. All of the operating scenarios discussed in **Section 3.1** were based on this average annual demand. However, there is a potential scenario that O-H Pipeline demand will increase in the future. This increase may arise from new Municipal and Industrial customers in the Oxnard Plain. Peak demand may also be a significant factor as some of the O-H Pipeline customers partially rely on imported State Water Project water which is vulnerable to earthquakes or other disasters. In an emergency situation, demand would need to be met with the only other available sources of water which is local supplies or water pumped from the El Rio well field. This could imply an increase in demand for LAS well water at the El Rio Facility and potentially require a larger iron and manganese treatment system. This may make locations such as Location A and C as discussed in **Section 3.3.2** more favorable as they have more room to expand compared to Location B.

O-H Pipeline demand is also subject to decreases in demand resulting from a number of factors such as: (1) increased water conservation, (2) conversion of agricultural user’s irrigation water source from the Municipal and Industrial (M&I) O-H Pipeline supply to alternative sources and (3) Fox Canyon Groundwater Management Agency (FCGMA) ordinances resulting in a reduction in pumping allocations. In order to best accommodate for decreases in demand, the future iron and manganese treatment plant would need to be compartmentalized with the ability to shut down tanks or sections of tanks for efficiency purposes.

### 3.3.5 Supply Considerations and Drawdown Evaluation (LAS Groundwater Supply)

Perhaps one of the most pressing concerns in Ventura County is the overdraft of the upper and lower aquifer systems. Potable demand depends on a number of factors and is affected by population growth, land use, drought and water conservation. The LAS has been affected by agricultural irrigation demand which has been increasing in recent years. The static groundwater levels in the LAS at Well Nos. 12, 13 and 14 have been falling at a rate of approximately 0.67 to 1.17 feet per year. This brings into question the sustainability of operating one of the LAS wells at 2,500 to 3,500 gpm in lieu of UAS pumping, 24 hours per day, 365 days per year. This would equate to the withdrawal of 4,033 to 5,645 ac-ft of water from the LAS each year.

A theoretical evaluation was performed on the additional groundwater drawdown resulting from continuous pumping of 3,500 gpm from the LAS at Wells Nos. 12, 13, and 14. Impacts to groundwater levels resulting from the increased pumping at Wells Nos. 12, 13, and 14 were evaluated using the Cooper-Jacob (Cooper and Jacob, 1946) simplified solution to the Theis equation for time-dependent drawdown in a confined aquifer, below:

$$s = \frac{2.3Q}{4\pi T} * log\frac{2.25Tt}{r^2 S}$$

Where:

- $s$ = theoretical drawdown at a specified distance from a pumped well
- $Q$ = pumping rate at the pumped well
- $T$ = transmissivity of the aquifer
- $t$ = time since the start of pumping
- $r$ = the specified radius (distance) from the pumped well for which drawdown is being calculated

$S$ = storage coefficient for the aquifer

Input values for the Cooper-Jacob solution were determined as follows:

- $Q$ (pumping rate)—Specified values for which additional drawdown (resulting from pumping at rates higher than current amounts) was forecasted.
- $T$ (aquifer transmissivity)—A map of aquifer "transmissibility" prepared by the California Department of Water Resources (CDWR, 1975) shows transmissivities in the El Rio area in the range from 50,000 to 100,000 gallons per day per foot (gpd/ft). The average of transmissivity values yielded by aquifer tests conducted at Wells Nos. 12, 13, and 14 at the time of their construction (Geotechnical Consultants, Inc., 1983a, 1983b, and 1983c) was 48,000 gpd/ft. Specific capacity of the wells was reevaluated during step draw-down pumping tests conducted in 2014 (Southern California Edison) and found to be higher than the 1983 values, on average, indicating an average transmissivity of approximately 70,000 gpd/ft. This value was used in the drawdown analysis, and is near the midpoint of the transmissivity range reported by CDWR (1975).
- $t$ (time since start of pumping)—The elapsed time for the evaluation was specified as 10 years, although drawdowns at other time frames were also evaluated, for comparison.
- $r$ (radius)—Distances between pumped wells were estimated from maps. The value for $r$ used to calculate theoretical drawdown at a well resulting from pumping at that well was 1.17 feet, which is the radius of the casing in Wells Nos. 12, 13, and 14.
- $S$ (storage coefficient)—Aquifer storage coefficient was conservatively assumed to be 0.0001, which is at the lower end of typical storage coefficient values for confined aquifers. A storage coefficient of 0.001 was input to the analysis to test sensitivity of this parameter, and calculated drawdowns were approximately 15 feet (10 to 15 percent) less.

Using the principle of superposition (Todd, 1980), drawdown at a particular point resulting from pumping of multiple wells was calculated as the sum of drawdowns caused by each well individually. The theoretical drawdown in the aquifer takes the form of a "cone of depression" around each pumping well; pumping from more than one well results in intersecting cones of depression. Additional drawdown within a pumped well results from head (water-level) losses caused by turbulent flow through the well screen and in the aquifer immediately adjacent to each pumped well, due to the steep hydraulic gradients in these areas. The ratio of theoretical to total drawdown in a well is termed well efficiency--efficiency of most production wells is in the range from 50 to 80 percent, meaning that total (actual or measured) drawdown is typically 1.25 to 2 times the theoretical drawdown predicted by the Theis equation (or Cooper-Jacob simplified solution). For this evaluation of drawdown, the total drawdown *at each pumped well* caused by pumping *at that well* was calculated using the following equation:

$$s_{Total} = \frac{s_{Theoretical}}{well\ efficiency}$$

Where:

$s_{Total}$ = total drawdown resulting from both theoretical drawdown and well losses
$s_{Theoretical}$ = theoretical drawdown estimated using the Cooper-Jacob solution
$well\ efficiency$ = well efficiency reported by Southern California Edison (2014)

Forecasted total additional drawdown after 10 years at Well Nos. 12, 13, and 14 resulting from increased pumping at those wells ranges from 106 to 130 feet, based on this evaluation. **Appendix 7.3** provides details regarding the individual components of drawdown resulting from each well, and indicates that most of the additional drawdown forecasted to occur at each well (60 to 80 feet) is caused by pumping at that well, with smaller (20 to 30 feet) drawdown components caused by pumping at the other pumping wells. The decrease in LAS static groundwater level over 10 years, assuming constant conditions throughout the Oxnard Plain, is anticipated to be approximately 30 feet. This was calculated based on the difference between the theoretical 10-year and 30-day drawdowns.

### 3.3.6 Oxidant Considerations (Existing Chlorination System)

The existing chlorination facility at the El Rio Plant has a total storage capacity of 18,000 lb. of gaseous chlorine. Currently, the facility operates with only 8 cylinders of chlorine for a total of 16,000 lb. An additional cylinder can be added without modifications. There are two banks of chlorine cylinders containing two cylinders each that feed the chlorinators. The maximum feed rate from each bank is approximately 1,120 lb. per day, but can only realistically feed only 800 lb per day due to freezing of the feed lines. The other four cylinders are not connected to any bank and are kept within the facility on standby. The standby cylinders are exchanged by use of overhead crane and staff wears respiratory gear while performing the exchange. The facility was constructed with an emergency fume scrubber that can evacuate and treat 2,350 lb of chlorine gas.

**Figure 22 - Existing Chlorine Gas Cylinders (Left) and Pumps (Right)**

The average chlorine demand at the El Rio Plant as shown in **Figure 23** is approximately 240 lb. per day which equates to 8.2 lb./ac-ft or 3 mg/L. The chlorine residual leaving the plant is approximately 2.05 mg/L and therefore nearly 1 mg/L of chlorine is consumed for disinfection. The peak demand occurs in the summer when the O-H Pipeline demand is high which was 458 lb in 2015. The lowest demand occurs in the winter. The average and peak chlorine demand suggests that under normal conditions, the El Rio Facility has a minimum one month supply of chlorine. If an additional 50 to 200 lb. of chlorine were added on a daily basis, the available stored supply could drop as low as 24 days. Given that there are other factors to consider such as emergency power availability, this concern would need to be discussed and addressed with DDW during design.

- Chlorine demand for iron and manganese removal using greensand was originally estimated at 1.2 mg/L. The actual chlorine demand during pilot plant testing was 0.73 mg/L for Greensand Plus and 1.2 mg/L for LayneOx. Considering the average concentrations of iron and manganese during pilot plant testing were slightly lower than historical averages, the original estimate is conservative and will be used for design purposes.

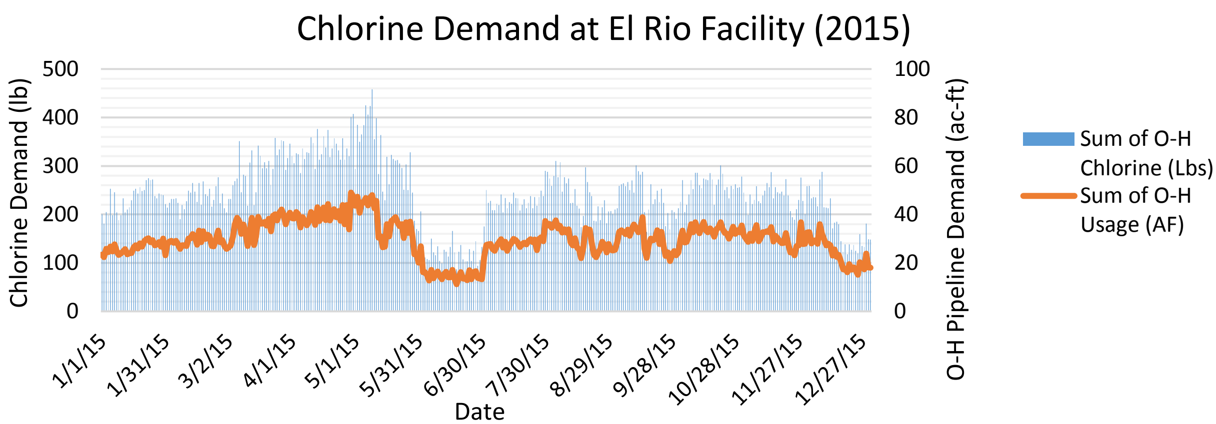



**Figure 23 - Chlorine Demand at El Rio Facility (2015)**

Although it is not currently anticipated that another form of oxidant will be needed for iron and manganese treatment for greensand filtration, it is possible that the slow reaction of chlorine with manganese would require additional contact time or upstream detention.

✎ During pilot plant testing, the chlorine injection point was moved upstream to allow for an additional 30 seconds of contact time. Based on laboratory testing results, full manganese removal was achieved with and without the additional contact time. Shorter filter run times were observed with the additional contact time due to a "blinding effect" or accumulation of iron precipitates on the filter surface.

### 3.3.7 Control Considerations

The El Rio Facility uses Rockwell FactoryTalk® Supervisory Control and Data Acquisition (SCADA) software and an Allen Bradley ControlLogix™ Programmable Logic Control (PLC) for data acquisition. Process PLCs are connected to the main PLC using a fiberoptic backbone and various forms of Ethernet. The nearest network switch to the proposed location "B" is less than 300 feet away as shown in **Figure 24**. A new Allen Bradley CompactLogix™ PLC for the proposed Greensand Filtration Plant can be connected to the master PLC at this location.

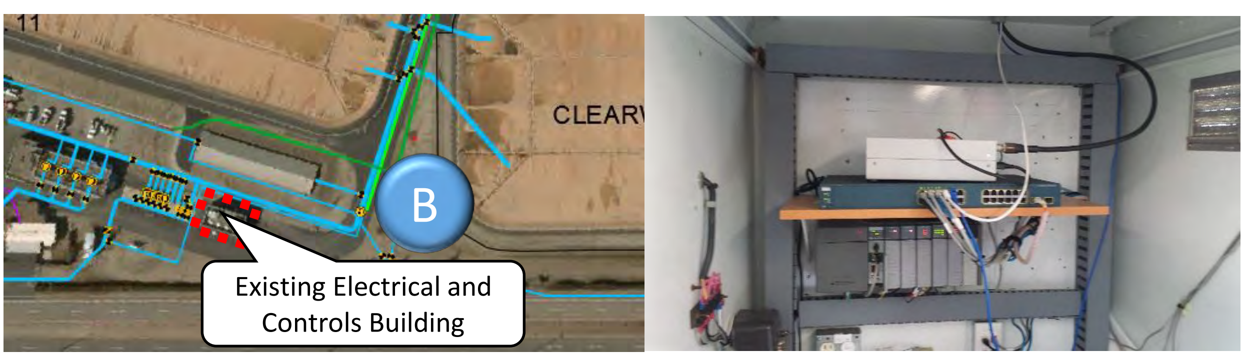



**Figure 24 - Existing Electrical and Controls Adjacent to Proposed Location "B", Existing Switch (Right)**

### 3.3.8 Electrical Considerations

In the same building shown in **Figure 24**, the existing "MCC-C" contains a spare 480 volt 80 amp breaker that is available for the greensand filtration plant (see **Figure 25**). At this time, it is not anticipated that any large motors will be necessary for operation of the proposed plant.


**Figure 25 - Existing MCC-C (Left) and Spare Circuit Breaker (Right)**

The El Rio Facility is subject to Southern California Edison's (SCE) Time-of-Use (TOU) charges. The TOU program is a statewide initiative to ensure all users have a reliable source of power when needed. During the summer months (June to September), there are different rates for three discrete periods of time. During the winter months (October to May), there are different rates for two discrete periods of time. **Figure 26** shows the estimated rates based on SCE billings. The highest rate occurs during the "On-Peak" hours of 12:00 PM and 6:00 PM. Not surprisingly, demand on the O-H Pipeline is high during these on-peak hours (see **Figure 27**). This may require the strategic operation of the proposed greensand filtration plant to avoid on-peak electrical rates. One strategy is to shut down the greensand filtration plant during on-peak hours. Another strategy is to reduce production from LAS wells during on-peak hours. It should be noted that start up and shut down operation of greensand filters will likely result in additional backwashing needed to prevent the accumulation of fines on the filter surface.

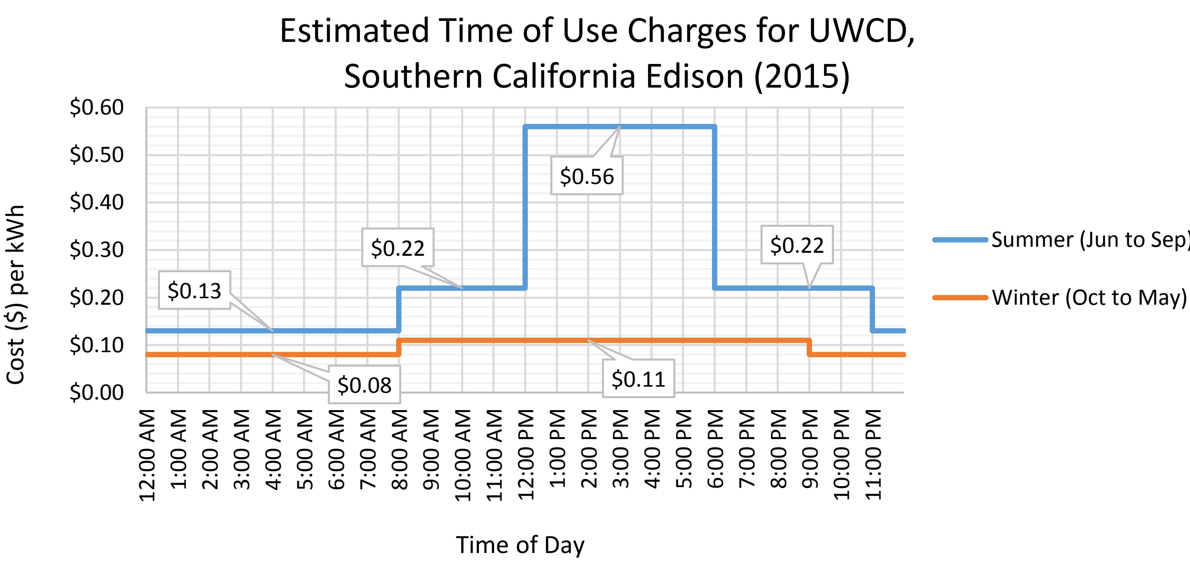



**Figure 26 - Time of Use Charges, SCE, 2015**

Well Nos. 12, 13 and 14 are currently only capable of operating at constant speed. The addition of Variable Frequency Drives (VFDs) would enable plant operations to trim production during on-peak TOU hours.

Since the existing motors are not inverter duty rated, the motors would need new windings to facilitate the VFDs. Both improvements are recommended and quotes were obtained for this TM.

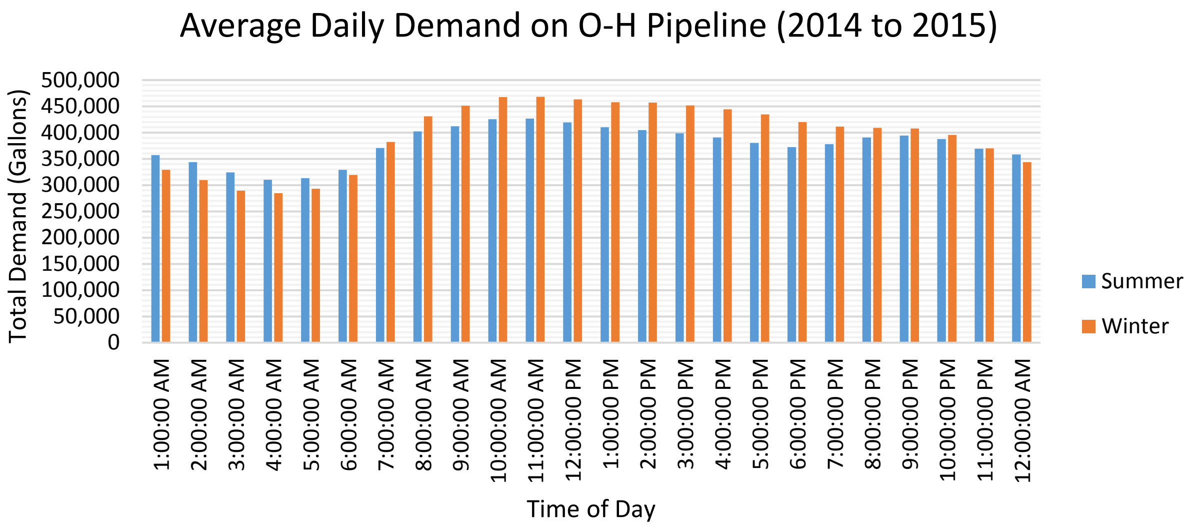



**Figure 27 - Average Daily Demand on O-H Pipeline (2014 to 2015)**

### 3.3.9 Sewer Considerations

Connection to an existing sewer along George Street was added to the El Rio facility in July 2010. The County of Ventura owns and operates the connected collection system which is conveyed approximately 7 miles away to the City of Oxnard's wastewater treatment plant located at 6001 South Perkins Road. The existing SDR 35 PVC sewer has a diameter of 8 inches with a slope of approximately 0.4%. From the point of connection, the pipe runs northeast in between the El Rio Operations Building and employee housing to a manhole over 200 feet away in distance (maintaining the same slope and diameter). From this point, the pipe diameter decreases to 6 inches and runs another 85 feet at a slope of 2.25%. In the absence of available hydraulic capacity information on the sewer collection system, the capacity can be determined based on the limiting 8 inch portion. The total hydraulic capacity if the pipe were at full depth is:

$$Q_{Full} = \left(\frac{1.49}{0.011}\right)\left(\pi \frac{8}{24}^{2}\right)\left(\frac{\pi \frac{8}{24}^{2}}{2\pi \frac{8}{24}}\right)^{2/3} \sqrt{0.004} = 0.91\ CFS\ or\ 406\ GPM$$

The City of Oxnard's design standards only permits peak flow rates when the pipe (10 inches or less) is flowing at one-half the depth. Therefore, the peak design capacity is:

$$\frac{d}{D} = 0.5 \ \rightarrow \ \frac{Q}{Q_{Full}} = 0.41 \ \rightarrow \ Q = 0.41 \times 0.91 = 0.37\ CFS\ or\ 167\ GPM$$

At first glance, the sewer does appear to have sufficient capacity for receiving backwash sludge. The entire backwash volume (without decanting) is anticipated to be approximately 30,000 gpd, or 21 gpm. The actual backwash volume with decanting is anticipated to much less. It is understood based on a recent conversation with the design engineer at Stantec Inc., that the pipe was oversized to accommodate grade constraints. Since the existing load is from an operations building with a few offices and two residences, the added load is not anticipated to exceed peak design capacity.

It is not anticipated that the sludge generated from greensand filtration would be considered hazardous. Radon (a naturally occurring radionuclide in the Earth) has been detected in LAS well water, but at levels that are narrowly above detection limits. Recent sampling data indicates that arsenic is within the non-detectable range. The alternative to using the existing sewer connection is to periodically use trucks to haul sludge offsite for appropriate disposal. At 35 pounds per day of iron and manganese precipitates generated at 3% total solids concentration, this would equate into 140 gallons per day or approximately one 5,000 gallon tanker truck per month.

✎ Pilot Plant testing did not confirm the hazard of sludge generated. The California Waste Extraction Test (CWET) can be used to determine the potential hazard. However, the CWET test might not be necessary as low levels of arsenic, radon, and radium (226 and 228) were encountered in the raw well water during pilot plant testing.

### 3.3.10 Cost Considerations

A conceptual level construction cost estimate was prepared based on USEPA cost curve data published in 1978. The cost data was multiplied by a projected RS Means 2016 cost index factor of 102/25.90, or 3.94. A location index factor was not applied due to uncertainty in the sourcing of materials. Design assumptions are based on **Appendix 7.4.**

✎ All costs were updated based on a filter surface loading rate of 6 gpm/$ft^2$ that was observed during pilot plant testing.

| Table 17 - Conceptual Level Construction Cost Estimate for a Greensand Treatment Plant at El Rio Facility | | | |
|---|---|---|---|
| **Item** | **Estimated Cost** | | **Description** |
| **Capital Costs** | | | |
| Fully Enclosed Building[(1)] | $ | 448,000 | Concrete block construction[(1)] |
| Manufactured Equipment | $ | 678,000 | Pressure filters |
| Plant Piping and Valves | $ | 182,000 | Filter valves and piping |
| Electrical and Instrumentation | $ | 139,000 | Control panel and instrumentation |
| Yard Piping and Valves | $ | 336,000 | Various pipes, fittings and valves |
| Well No. 12 Upgrades | $ | 54,000 | VFD and motor rewind |
| Well No. 13 Upgrades | $ | 130,000 | VFD, motor rewind, new stage |
| Well No. 14 Upgrades | $ | 107,000 | VFD and motor rewind |
| *Labor (six months construction)* | *$* | *375,000* | |
| **Subtotal** | **$** | **2,449,000** | |
| *General Conditions @ 10%* | *$* | *245,000* | |
| *Mobilization and Insurance @ 10%* | *$* | *245,000* | |
| **Subtotal** | **$** | **2,939,000** | |
| *Bonds @ 2%* | *$* | *59,000* | |
| *Contractor Overhead and Profit @ 8%* | *$* | *236,000* | |
| *Contingency @ 20%* | *$* | *588,000* | |
| **Total** | **$** | **3,822,000** | |
| **Operation and Maintenance Costs** | | | |
| Process Energy | $ | 496,000 | per year (assumes 24/7/365) |
| Building Energy | $ | 40,000 | per year |
| Chemical | $ | 30,000 | per year |
| Maintenance Material | $ | 28,000 | per year |
| **Total** | **$** | **594,000** | **per year** |

Note: (1) The ideal scenario is to provide a temperature controlled environment for oxidation and filtration efficiency. However, this is not a requirement. Alternatives that would reduce costs include a building that would partially enclose filtration units or a canopy.

The construction costs shown in **Table 17** do not include design and construction administration costs. UWCD will solicit for proposals from engineering firms to obtain costs for design. Design costs for engineering projects are typically estimated at 8 to 15 percent of the construction cost (depending on complexity), or in this case, $306k to $573k. Construction administration may be implemented by UWCD staff or may be contracted separately. If contracted separately, construction administration is estimated to be 3 to 5 percent of the construction cost, or $115k to $191k.

$80 million in potential grant funding is available through California's Proposition 1 Groundwater Sustainability Program (GSP). Project specific award amounts have not been announced and grant funding requires agencies to share 50% of the cost. UWCD submitted a pre-application to the SWRCB on January 8, 2016. The SWRCB will consider pre-applications in April or May of 2016. The first round grant solicitation for applications is anticipated in Fall 2016 to 2017 with award of grants anticipated in 2017.

✎ The SWRCB has responded to the GSP pre-application with a letter dated July 20, 2016 (see **Appendix 7.9**). To summarize, the project was not considered further for GSP funding and better fits the criteria for the Drinking Water State Revolving Fund (DWSRF) program.

# 4. Conclusion

The primary drivers for iron and manganese treatment at the El Rio Facility are: (1) the increasing risk of exceeding the nitrate MCL during periods of water supply shortages, (2) concerns over the fouling of reverse osmosis systems due to the use of iron laden LAS groundwater and (3) compliance with secondary MCLs concerning taste, odor and color. The project objectives are to reduce if not eliminate the concern over increasing nitrate levels within UAS wells and to increase supply flexibility by addressing water quality concerns associated with the LAS wells.

UWCD issued a survey to all of its O-H Pipeline customers concerning options to address LAS well exceedance of secondary MCLs. The City of Oxnard responded by requesting treatment be implemented while others were either undecided or were willing to accept the water as is. The results of the survey prompted an investigation on the feasibility of constructing an iron and manganese treatment plant at the El Rio Facility.

After analyzing available water production and water quality data, it was determined that iron and manganese treatment of LAS wells is feasible at the El Rio Facility. Several scenarios were developed to identify the optimal size of such a facility and it was determined that the treatment of one LAS well is sufficient to achieve the project objectives. The existing configuration of the LAS wells would allow systematic cycling of the LAS wells (one at time) ensuring reliability and redundancy. A theoretical evaluation was performed on the additional LAS drawdown resulting from continuous operation of one LAS well. The result was a LAS static groundwater level decrease of approximately 30 feet over 10 years.

A variety of typical iron and manganese treatment methods were reviewed. As a result of the review, it is recommended to proceed with using the existing gaseous chlorine system for oxidation and construct a granular filtration system. Pilot testing has confirmed that $MnO_2$ sand and pyrolusite are suitable media for the removal of iron and manganese below detection limits. The filter loading rates were higher than expected (6 gpm/ft$^2$ and greater) and could be sustained for a minimum of 16 hours. However, concerns over high SDI values and the presence of fines in the filter effluent from pyrolusite media suggest that $MnO_2$ sand is a more suitable pre-treatment for downstream reverse osmosis systems.

Greensand filtration ($MnO_2$ sand) was used as the basis of analysis in this report because of its widespread use in municipal iron and manganese treatment. Several locations were analyzed for suitable siting. It is recommended that the area nestled between Clearwell No. 2 and the existing settling basin be selected for construction of a greensand filtration plant. The proposed greensand filtration plant would have a capacity of 3,500 gpm and include six (6) 12-ft diameter by 13-ft long pressure filter tanks that would be fully or partially enclosed in a 3,500 ft$^2$ building. Well Nos. 12, 13 and 14 would all require VFDs and motor rewinds. Additionally, Well No. 13 would require rehabilitation that may include additional column pipe and pump stages. The conceptual level construction cost estimate to construct such a facility is \$3.82 million while the operation and maintenance cost nears \$600,000 annually. These estimates should be considered conservative and may be further refined during detailed design. Additionally, capital costs could be reduced by selecting a partial building enclosure and operation and maintenance costs could be reduced by not operating the system during on-peak electrical hours. All of these factors should be taken into account in final design.

# 5. Recommendations (Next Steps)

Given the current state of increasing nitrate concentrations in UAS wells at the El Rio Facility and uncertainty regarding rainfall in 2016, it is recommended that iron and manganese treatment of LAS wells be pursued in order to ensure a reliable supply of water for O-H Pipeline users in the future that will continue to meet SWRCB DDW drinking water regulations.

The next step is to design and construct an iron and manganese treatment plant based on design criteria set forth in **Table 9**. Additional capacity could be added in the future as needed. Pilot plant testing suggests that LayneOx filter media would require 33% less surface area than Greensand Plus. However, there are concerns over higher SDI values observed in LayneOx filter effluent as compared to Greensand Plus. Higher SDI values pose a greater degree of fouling potential for RO systems which may cause problems for PHWA and others that might construct RO systems using O-H Pipeline water in the future. Therefore, Greensand Plus is recommended for the design of the iron and manganese treatment plant.

# 6. References


1. California Department of Water Resources. *Compilation of Technical Information Records for the Ventura County Cooperative Investigation, Volume II, Plate 8*. 1975.
2. Civardi, John, and Mark Tompeck. *Iron and Manganese Removal Handbook*. Second Edition. Denver. AWWA. 2015.
3. Cooper, H.H., and Jacob, C.E. *A Generalized Graphic Method for Evaluating Formation Constants and Summarizing Well Field History, in Transactions of the American Geophysical Union, Volume 27, pp. 526-534*. 1946.
4. Detmer, Daniel. *Nitrate Observations in the Oxnard Forebay and Vicinity, 1995-2006*. United Water Conservation District. Jul 2008.
5. EarthTech. *Well 29 Pilot Study Report*. Madison Water Utility. March 2007.
6. Geotechnical Consultants, Inc. *Summary of Operations, Construction of Municipal Well No. 1, Seawater Intrusion Abatement Program Lower Aquifer Well System, Project No. 4070.* 1983a.
7. Geotechnical Consultants, Inc. *Summary of Operations, Construction of Municipal Well No. 2, Seawater Intrusion Abatement Program Lower Aquifer Well System, Project No. 4070.* 1983b.
8. Geotechnical Consultants, Inc. *Summary of Operations, Construction of Municipal Well No. 5, Seawater Intrusion Abatement Program Lower Aquifer Well System, Project No. 4070.* 1983c.
9. Gordon, Erik J. *Pilot Study Report for Iron and Manganese Removal by Hungerford & Terry GreensandPlus Adsortive Media Filtration.* Feb 2010.
10. Groundwater Department. *Nitrate Study of El Rio Area – Phase I – Nitrates Through Time Areas of Occurrence*. United Water Conservation District. Jun 1998.
11. Groundwater Resources Department. *Groundwater and Surface Water Conditions Report – 2013*. United Water Conservation District. May 2014.
12. Gumerman, Robert, Russel Culp and Sigurd Hansen. *Estimating Water Treatment Costs.* Municipal Environmental Research Laboratory, USEPA. August 1979.
13. James M. Montgomery, Consulting Engineers, Inc. *Water Treatment Principles and Design.* John Wiley and Sons, Inc. 1985.
14. HDR Engineering, Inc. *Handbook of Public Water Systems*. Wiley.
15. Lindeburg, Michael R. *Civil Engineering Reference Manual*. Eleventh Edition. Professional Publications, Inc. 2008.
16. Milner-Villa Consulting. *Urban Water Management Plan Update (2010)*. United Water Conservation District. Jun 2011.
17. Rader, Larry. *How to Operate and Maintain Manganese Greensand Treatment Units.* National Drinking Water Clearinghouse. 2009. <http://www.nesc.wvu.edu/pdf/dw/publications/ontap/2009_tb/how_to_manganese_greensand.pdf>.
18. Seelig, Bruce, Russel Derickson, and Fred Bergsrud. *Treatment Systems for Household Water Supplies: Iron and Manganese Removal.* University of Minnesota. 2013. <http://www.extension.umn.edu/environment/water/treatment-systems-for-household-water-supplies-iron-and-manganese-removal/>.
19. Todd, D.K. *Groundwater Hydrology, Second Edition, John Wiley & Sons, New York.* 1980
20. *Water Treatment Plant Design*. Second Edition. McGraw-Hill. 1990.

# 7. Appendices

7.1 Additional Water Quality Data for Well Nos. 12, 13 and 14
7.2 Historic Static and Pumping Water Levels at Well Nos. 12, 13 and 14
7.3 Lower Aquifer System Drawdown Impact Calculations
7.4 Proposed Greensand Filtration Plant with Chlorine Oxidation
7.5 Conceptual Plans - Iron and Manganese Treatment Plant
7.6 Head Loss Calculations
7.7 Layne Christensen Pilot Study Report
7.8 Silt Density Index (SDI) Test Data
7.9 SWRCB Letter in Response to Proposition 1 Groundwater Grant Funding Pre-Application

**APPENDIX 7.1 Additional Water Quality Data for Well Nos. 12, 13 and 14**

**Table 18 - Complete Water Quality Data for Well Nos. 12, 13 and 14**

| Description | Unit | Sampling Value or Average Well No. 12 | 13 | 14 | Sampling Date(s) | Practical Detection Limit | Primary MCL[1] | Secondary MCL[1] |
|---|---|---|---|---|---|---|---|---|
| **General Mineral and Physical** | | | | | | | | |
| Alkalinity, Total (as $CaCO_3$) | mg/L | 197 | 217 | 208 | April 2003 to October 2015 | 10 | -- | -- |
| Bicarbonate (as $HCO_3$) | mg/L | 240 | 263 | 252 | April 2003 to October 2015 | 10 | -- | -- |
| Calcium, Ca | mg/L | 126 | 145 | 148 | April 2003 to October 2015 | 1 | -- | -- |
| Chloride, Cl | mg/L | 43.4 | 51.2 | 51.3 | April 2003 to October 2015 | 1 | -- | 250-500-600 |
| Fluoride, F | mg/L | 0.22 | 0.33 | 0.53 | April 2003 to October 2015 | 0.1 | 2 | -- |
| Hardness, Total (as $CaCO_3$) | mg/L | 467 | 518 | 554 | April 2003 to October 2015 | 2.5 | -- | -- |
| Magnesium, Mg | mg/L | 37.1 | 38.1 | 44.9 | April 2003 to October 2015 | 1 | -- | -- |
| Nitrate, $NO_3$ | mg/L | 2.8 | 1.9 | 5.1 | April 2003 to October 2015 | 0.5 | 45 | -- |
| pH, Field | Std. Unit | 7.7 | 7.9 | 7.6 | December 15, 2015 | -- | -- | -- |
| pH, Lab | Std. Unit | 7.7 | 7.7 | 7.6 | April 2003 to October 2015 | -- | -- | -- |
| Potassium, K | mg/L | 4.04 | 4.62 | 4.79 | April 2003 to October 2015 | 1 | -- | -- |
| Sodium, Na | mg/L | 94 | 116 | 101 | April 2003 to October 2015 | 1 | -- | -- |
| Specific Conductance | µmhos/$cm^2$ | 1,232 | 1,381 | 1,384 | April 2003 to October 2015 | 1 | -- | 900-1600-2200 |
| Sulfate, $SO_4$ | mg/L | 415 | 472 | 487 | April 2003 to October 2015 | 10 | -- | 250-500-600 |
| Temperature, Field | ºF | 64.8 | 66.0 | 64.9 | December 15, 2015 | -- | -- | -- |
| Total Dissolved Solids, TDS | mg/L | 966 | 1,093 | 1,090 | April 2003 to October 2015 | 20 | -- | 500-1000-1500 |
| Turbidity, Lab | NTU | 1.9 | 4.7 | 2.3 | April 2003 to October 2015 | 0.2 | -- | 5 |
| **Regulated Inorganic** | | | | | | | | |
| Aluminum, Al | mg/L | 0.39 | 0.1 | ND | April 14, 2015 | 0.01 | 1 | -- |
| Antimony, Sb | mg/L | ND | ND | ND | April 14, 2015 | 0.001 | 0.006 | -- |
| Arsenic, As | mg/L | 0.004 | ND | ND | April 14, 2015 | 0.002 | 0.01 | -- |
| Barium, Ba | mg/L | 0.0309 | 0.0303 | 0.0202 | April 14, 2015 | 0.0002 | 1 | -- |

| Table 18 - Complete Water Quality Data for Well Nos. 12, 13 and 14 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Description | Unit | Sampling Value or Average Well No. 12 | 13 | 14 | Sampling Date(s) | Practical Detection Limit | Primary MCL[1] | Secondary MCL[1] |
| Beryllium, Be | mg/L | ND | ND | ND | April 14, 2015 | 0.001 | 0.004 | -- |
| Cadmium, Cd | mg/L | ND | ND | ND | April 14, 2015 | 0.0002 | 0.005 | -- |
| Chromium (Total Cr) | mg/L | ND | ND | ND | April 14, 2015 | 0.001 | 0.05 | -- |
| Copper, Cu | mg/L | 0.02 | ND | ND | April 14, 2015 | 0.01 | -- | 1 |
| Cyanide, Total | mg/L | ND | ND | ND | April 14, 2015 | 0.004 | 0.15 | -- |
| Iron, Fe | mg/L | 0.43 | 1.08 | 0.41 | April 2003 to October 2015 | 0.03 | -- | 0.3 |
| Lead, Pb | mg/L | 0.0014 | 0.0005 | ND | April 14, 2015 | 0.0005 | 0.015 | -- |
| Manganese, Mn | mg/L | 0.13 | 0.22 | 0.24 | April 2003 to October 2015 | 0.01 | -- | 0.05 |
| Mercury, Hg | mg/L | ND | ND | 0.00002 | April 14, 2015 | 0.00002 | 0.002 | -- |
| Nickel, Ni | mg/L | 0.002 | 0.002 | 0.001 | April 14, 2015 | 0.001 | 0.1 | -- |
| Nitrate + Nitrite as N | mg/L | ND | ND | 0.9 | April 14, 2015 | 0.1 | 10 | -- |
| Nitrite as N (Nitrogen) | mg/L | ND | ND | ND | April 14, 2015 | 0.2 | 1 | -- |
| Perchlorate, $ClO_4^-$ | mg/L | ND | ND | ND | April 14, 2015 | 0.002 | 0.006 | -- |
| Selenium, Se | mg/L | 0.001 | 0.002 | 0.004 | April 14, 2015 | 0.001 | 0.05 | -- |
| Silver, Ag | mg/L | ND | ND | ND | April 14, 2015 | 0.001 | -- | 0.1 |
| Thallium, Tl | mg/L | ND | ND | ND | April 14, 2015 | 0.0002 | 0.002 | -- |
| Zinc, Zn | mg/L | ND | ND | ND | April 14, 2015 | 0.02 | -- | 5 |
| **Regulated Organics** | | | | | | | | |
| MTBE | mg/L | ND | ND | ND | April 14, 2015 | 0.001 | 0.005 | -- |
| **Inorganics** | | | | | | | | |
| Aggressiveness Index, AI | mg/L | 11 | 11.1 | 11.2 | April 14, 2015 | -- | -- | -- |
| Ammonia Nitrogen | mg/L | ND | ND | ND | December 15, 2015 | 0.2 | -- | -- |
| Boron, B | mg/L | 0.6 | 0.5 | 0.7 | April 14, 2015 | 0.1 | -- | -- |
| Langelier Index at 20 ºC | mg/L | -0.9 | -0.8 | -0.7 | April 14, 2015 | -- | -- | -- |
| Silica, $SiO_2$ | mg/L | 26 | 31 | 34 | December 15, 2015 | 1 | -- | -- |

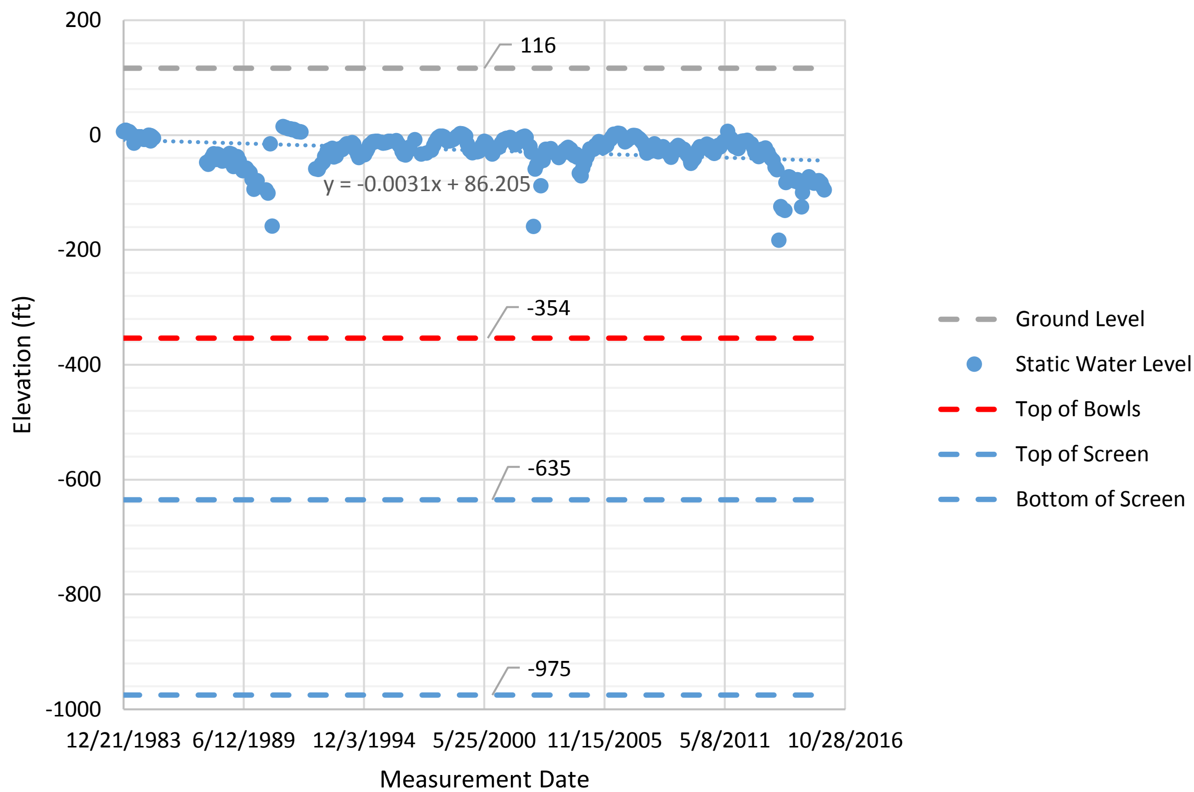
| Table 18 - Complete Water Quality Data for Well Nos. 12, 13 and 14 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Description | Unit | Sampling Value or Average Well No. | | | Sampling Date(s) | Practical Detection Limit | Primary MCL[1] | Secondary MCL[1] |
| | | 12 | 13 | 14 | | | | |
| Sulfide, Total | mg/L | ND | ND | ND | December 15, 2015 | 0.1 | -- | -- |
| Vanadium, V | mg/L | -- | -- | -- | No Data | -- | -- | -- |
| **Organics** | | | | | | | | |
| Total Organic Carbon, TOC | mg/L | 0.9 | 1.0 | ND | December 15, 2015 | 0.5 | -- | -- |
| **Radiological** | | | | | | | | |
| Radium 226+228, Combined | pCi/L | -- | -- | -- | No Data | -- | 5 | -- |
| Radon 222 ± Counting Error | pCi/L | 315±21.8 | 262±19.7 | 351±22.5 | April 14, 2015 | 100 | -- | -- |
| Strontium-90, Sr | pCi/L | -- | -- | -- | No Data | -- | 8 | -- |

Notes:

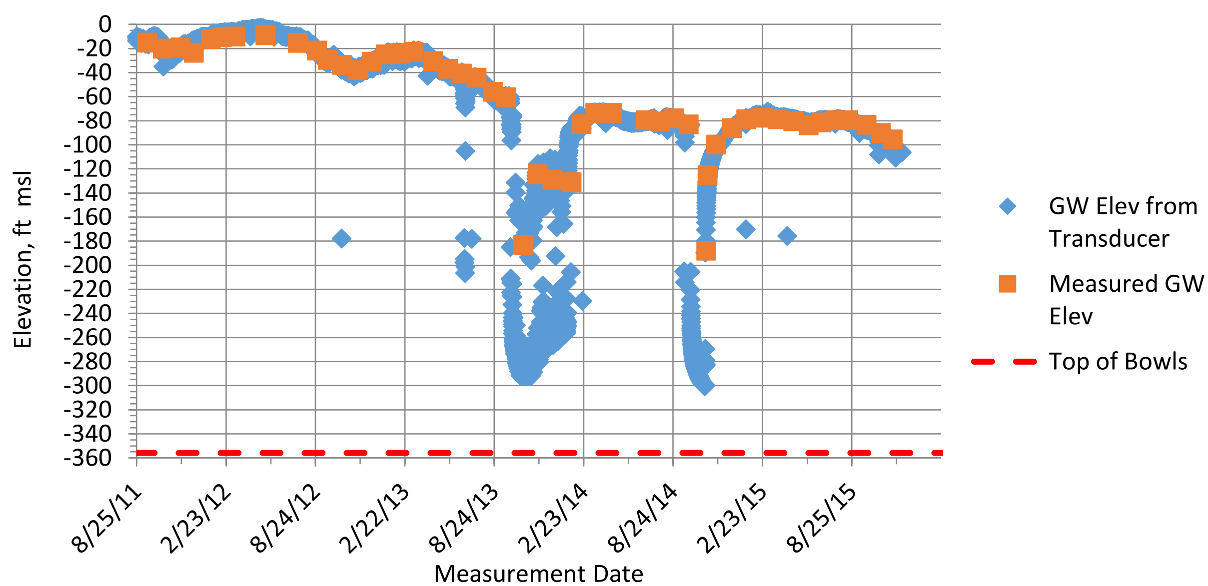
1. MCL = Maximum Contaminant Level as regulated by the U.S. Environmental Protection Agency and the California Division of Drinking Water
2. ND = Not Detected at or above the Practical Detection Limit

**APPENDIX 7.2 Historic Static and Pumping Water Levels at Well Nos. 12, 13 and 14**

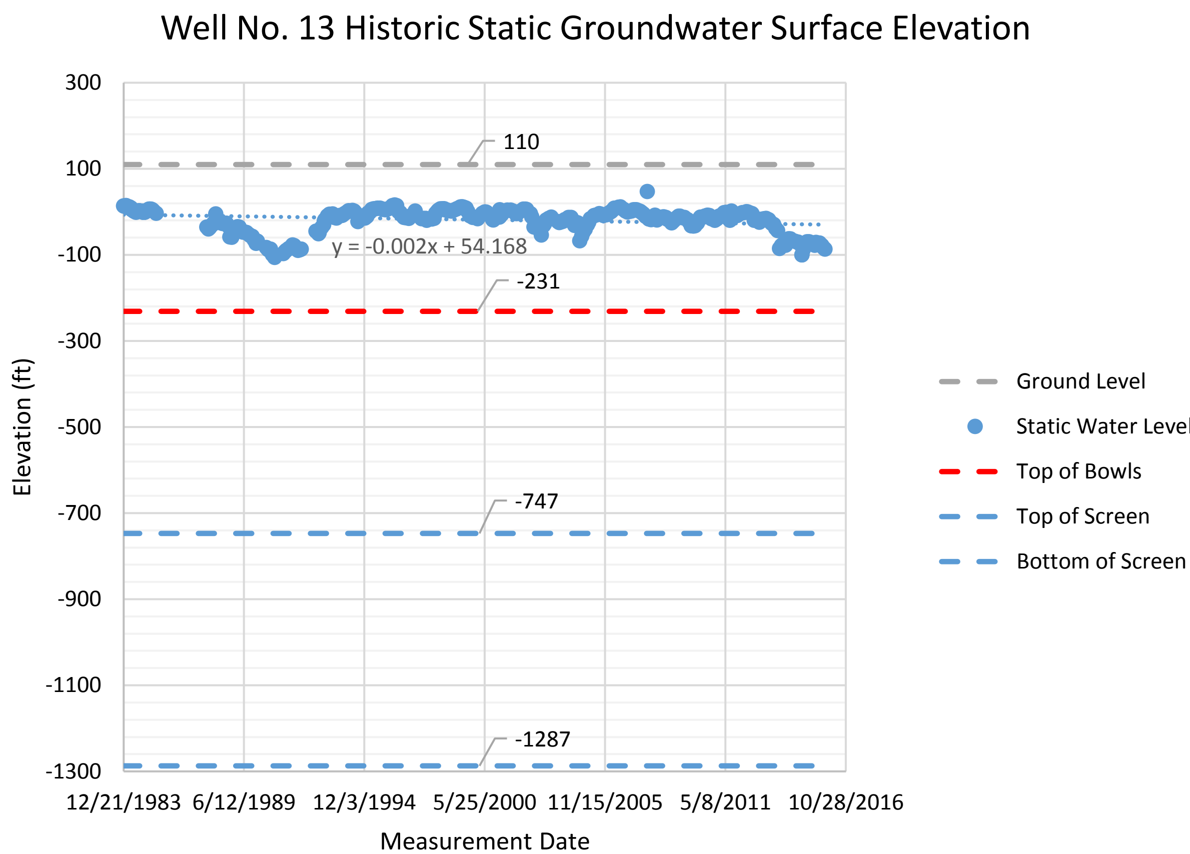
Well No. 12 Historic Static Groundwater Surface Elevation

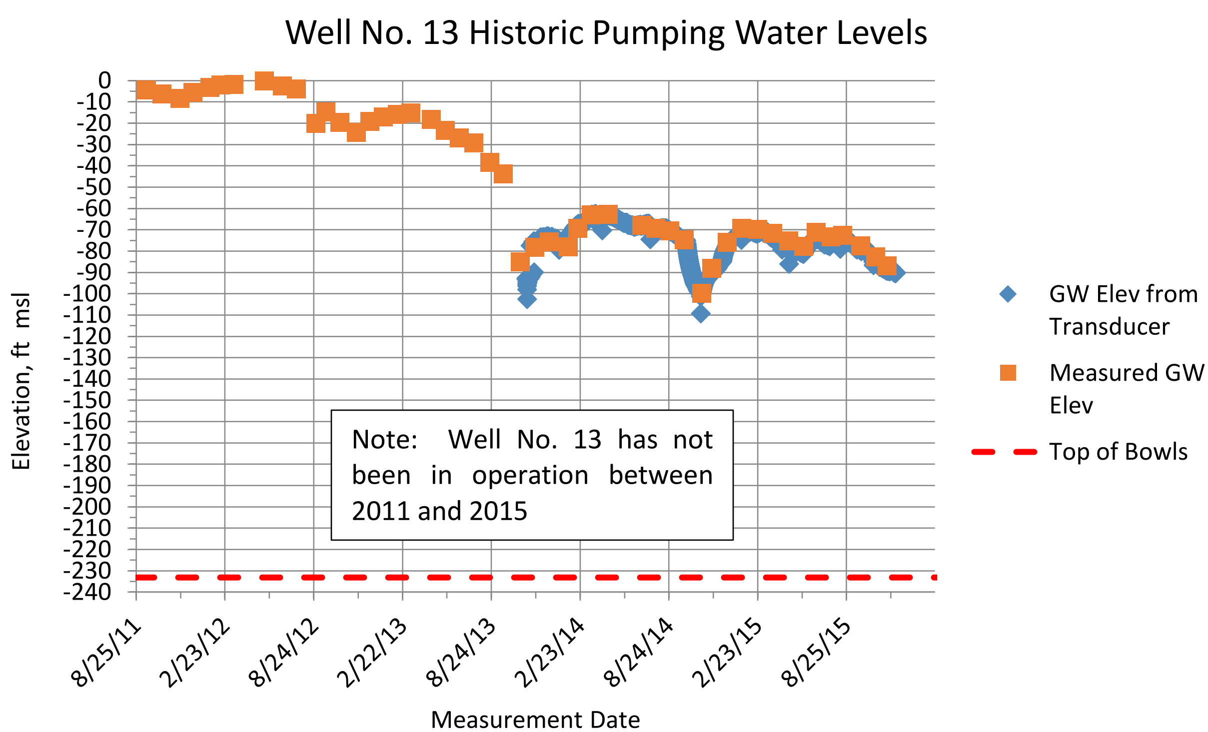



Well No. 12 Historic Pumping Groundwater Surface Elevation

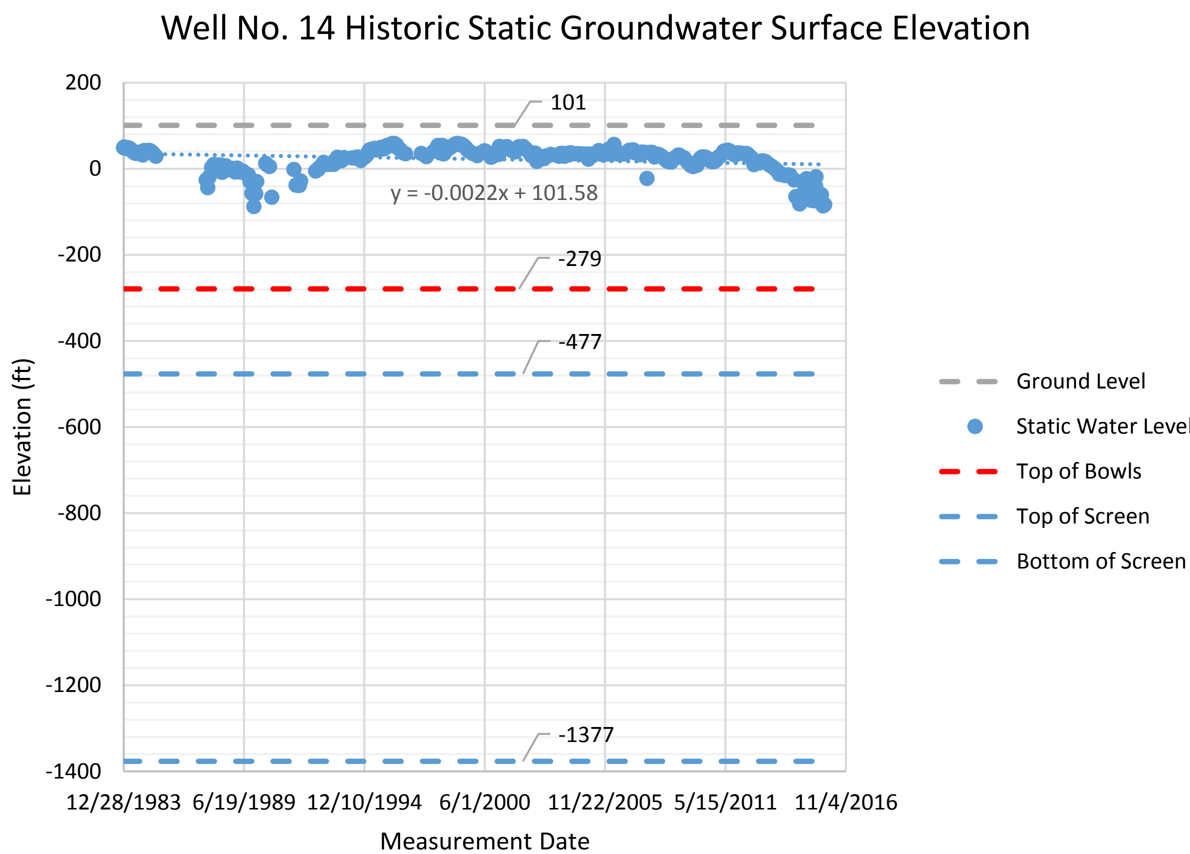


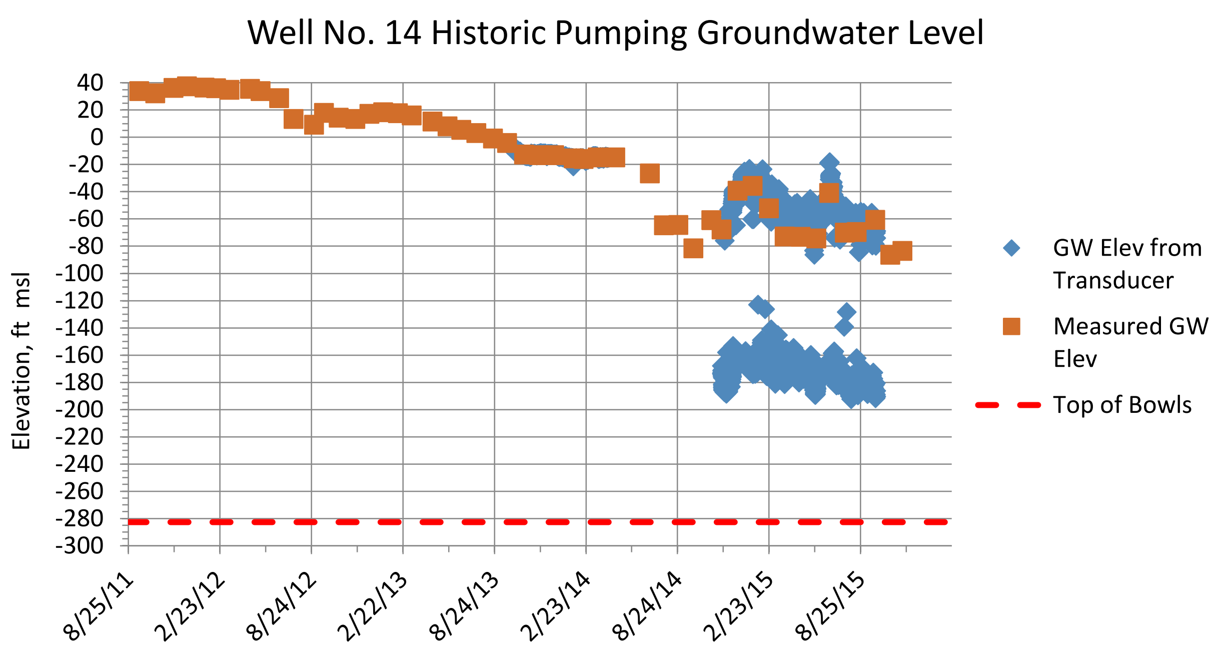
**APPENDIX 7.2 Historic Static and Pumping Water Levels at Well Nos. 12, 13 and 14**



**APPENDIX 7.2 Historic Static and Pumping Water Levels at Well Nos. 12, 13 and 14**



**APPENDIX 7.3 Lower Aquifer System Drawdown Impact Calculations**

| Parameter | Value | Units | Adjusted Value | Adjusted Units |
|---|---|---|---|---|
| Additional pumping at El Rio #12 | 1,167 | gpm | 224,584 | ft^3/d |
| Additional pumping at El Rio #13 | 1,167 | gpm | 224,584 | ft^3/d |
| Additional pumping at El Rio #14 | 1,167 | gpm | 224,584 | ft^3/d |
| Avg. Hyd. Cond | 133 | ft/d | 133 | ft/d |
| Aquifer Thickness | 70 | feet | 70 | feet |
| Storage coeff. | 0.0001 | --- | 0.0001 | --- |

| Time (days) | Additional Drawdown At El Rio #12 (ft) | Additional Drawdown At El Rio #13 (ft) | Additional Drawdown At El Rio #14 (ft) | Additional Drawdown At Center of El Rio SG (ft) | Additional Drawdown At Del Norte Bl. and US 101 (ft) |
|---|---|---|---|---|---|
| 30.00 | 76.12 | 96.38 | 87.74 | 37.38 | 23.24 |
| 365.25 | 91.66 | 114.02 | 104.87 | 51.76 | 37.62 |
| 1,826.25 | 101.66 | 125.38 | 115.90 | 61.02 | 46.87 |
| 3,652.50 | 105.97 | 130.27 | 120.65 | 65.00 | 50.86 |

Type input into yellow-highlighted cells--all other cells show results of calculations

| Drawdown Caused by El Rio #12 | | | | | |
|---|---|---|---|---|---|
| Time (days) | Drawdown At El Rio #12 (ft) | Drawdown At El Rio #13 (ft) | Drawdown At El Rio #14 (ft) | Drawdown At Center of El Rio SG (ft) | Drawdown At Del Norte Bl. and US 101 (ft) |
| --- | *1.17* | *2,270* | *6,660* | *4,000* | *11,400* |
| *30.00* | 52.99 | 13.63 | 9.50 | 11.45 | 7.44 |
| *365.25* | 58.95 | 18.42 | 14.29 | 16.25 | 12.23 |
| *1,826.25* | 62.78 | 21.50 | 17.38 | 19.33 | 15.32 |
| *3,652.50* | 64.43 | 22.83 | 18.71 | 20.66 | 16.64 |

| Drawdown Caused by El Rio #13 | | | | | |
|---|---|---|---|---|---|
| Time (days) | Drawdown At El Rio #12 (ft) | Drawdown At El Rio #13 (ft) | Drawdown At El Rio #14 (ft) | Drawdown At Center of El Rio SG (ft) | Drawdown At Del Norte Bl. and US 101 (ft) |
| --- | *2,270* | *1.17* | *4,430* | *1,900* | *10,800* |
| *30.00* | 13.63 | 71.70 | 11.06 | 14.31 | 7.64 |
| *365.25* | 18.42 | 79.75 | 15.85 | 19.10 | 12.44 |
| *1,826.25* | 21.50 | 84.94 | 18.94 | 22.19 | 15.52 |
| *3,652.50* | 22.83 | 87.17 | 20.27 | 23.52 | 16.85 |

| Drawdown Caused by El Rio #14 | | | | | |
|---|---|---|---|---|---|
| Time (days) | Drawdown At El Rio #12 (ft) | Drawdown At El Rio #13 (ft) | Drawdown At El Rio #14 (ft) | Drawdown At Center of El Rio SG (ft) | Drawdown At Del Norte Bl. and US 101 (ft) |
| --- | ***6,660*** | ***4,430*** | ***1.17*** | ***3,830*** | ***9,450*** |
| *30.00* | 9.50 | 11.06 | 67.18 | 11.62 | 8.16 |
| *365.25* | 14.29 | 15.85 | 74.73 | 16.41 | 12.95 |
| *1,826.25* | 17.38 | 18.94 | 79.59 | 19.50 | 16.04 |
| *3,652.50* | 18.71 | 20.27 | 81.68 | 20.83 | 17.36 |

## APPENDIX 7.4 Proposed Greensand Filtration Plant with Chlorine Oxidation

**Table 19 - Greensand Filtration Calculations**

| Parameter | Value | Unit | Description |
|---|---|---|---|
| Type of Operation | n/a | n/a | Catalytic oxidation using continuous regeneration (chlorine) |
| Filtration Media | n/a | n/a | Anthracite<br>Manganese dioxide coated greensand (glauconite) |
| Depth of Anthracite | 18 | inches | |
| Headloss of Anthracite Media (normal) | 0.1 | ft/ft | Approximated based on BirmFilter.com literature |
| Headloss of Anthracite Media (backwash) | 0.6 | ft/ft | Approximated based on BirmFilter.com literature |
| Headloss of Anthracite Media (normal) | 0.2 | ft | Calculated |
| Headloss of Anthracite Media (backwash) | 0.9 | ft | Calculated |
| Depth of Greensand Media | 24 | inches | |
| Headloss of Greensand Media (normal) | 1.0 | ft/ft | Approximated based on Iversand Company GreensandPlus literature @ 3 gpm/sqft |
| Headloss of Greensand Media (backwash) | 4.4 | ft/ft | Approximated based on Iversand Company GreensandPlus literature @ 12 gpm/sqft |
| Headloss of Greensand Media (normal) | 2.1 | ft | Calculated |
| Headloss of Greensand Media (backwash) | 8.8 | ft | Calculated |
| Depth of Gravel | 54 | inches | |
| Filtration Capacity | 1,000 | grains/ft^2 | As specified by Iversand Company GreensandPlus literature |
| Filtration Capacity | 64,799 | mg/ft^2 | Converted |
| Design Flow Rate | 3,500 | gpm | one well, full time operation |
| Design Flow Rate | 5.04 | mgd | Converted |
| Design Flow Rate | 5,646 | ac-ft/yr | Converted |
| Design Fe Loading Rate (daily) | 0.64 | mg/L | from water quality statistical analysis 2003-2015 |
| Design Fe Loading Rate (daily) | 2.42 | mg/gal | Converted |
| Design Mn Loading Rate (daily) | 0.2 | mg/L | from water quality statistical analysis 2003-2015 |
| Design Mn Loading Rate (daily) | 0.76 | mg/gal | Converted |
| Design Fe Loading Rate (max) | 3.8 | mg/L | from water quality statistical analysis 2003-2015 |
| Design Fe Loading Rate (max) | 14.38 | mg/gal | Converted |
| Design Mn Loading Rate (max) | 0.8 | mg/L | from water quality statistical analysis 2003-2015 |
| Design Mn Loading Rate (max) | 3.03 | mg/gal | Converted |
| Average H2S concentration | 0.00 | mg/L | non-detect |
| Average NH3 concentration | 0.00 | mg/L | non-detect |
| Estimated Chlorine Demand (avg) | 1.24 | mg/L | formula from Iversand Company GreensandPlus literature<br>(mg/L $Cl_2$) = (1*mg/L Fe) + (3*mg/L Mn) + (6*mg/L $H_2S$) + (8*mg/L $NH_3$) |

| Table 19 - Greensand Filtration Calculations | | | |
|---|---|---|---|
| **Parameter** | **Value** | **Unit** | **Description** |
| Estimated Chlorine Demand (avg daily) | 52.16 | lb/day | Converted |
| Estimated Chlorine Demand (max) | 6.2 | mg/L | formula from Iversand Company GreensandPlus literature (mg/L $Cl_2$) = (1*mg/L Fe) + (3*mg/L Mn) + (6*mg/L $H_2S$) + (8*mg/L $NH_3$) |
| Estimated Chlorine Demand (max daily) | 260.78 | lb/day | Converted |
| Design Filter Surface Loading Rate | 6 | gpm/ft^2 | 2 to 12 gpm/ft^2 recommended by Iversand Company GreensandPlus literature |
| Total Filter Surface Area | 583.3333333 | ft^2 | Calculated (gpm/ gpm/ft^2) |
| Number of Active Filters | 4 | | 4 total assumed (does not include recommended backwash and standby filters) |
| Surface Area per Filter | 146 | ft^2 | Calculated (ft^2/# of filters) |
| Horizontal Cylindrical Tank Diameter | 12 | ft | Maximum transportable by truck (wide load) |
| Horizontal Cylindrical Tank Length | 12.2 | ft | Calculated |
| Vertical Cylindrical Tank Diameter | 13.6 | ft | Calculated |
| Vertical Cylindrical Tank Length | | | Depends on depth of media |
| Treated Mass per Filter (daily) | 3.18 | mg/gal | Does not include H2S, NH3, arsenic or radium (Fe + Mn) |
| Treated Mass per Filter (maximum) | 17.41 | mg/gal | Does not include H2S, NH3, arsenic or radium (Fe + Mn) |
| Treatment Mass Capacity per Filter | 9,449,840 | mg | Calculated (filtration capacity * surface area per filter) |
| Treatment Mass Capacity per Filter | 9,450 | g | Calculated (filtration capacity * surface area per filter) |
| Treatment Mass Capacity per Filter | 9.45 | kg | Calculated (filtration capacity * surface area per filter) |
| Treatment Volume per Filter (daily) | 2,971,885 | gal | Calculated (treatment mass capacity / treatment mass per filter) |
| Treatment Volume per Filter (max) | 542,692 | gal | Calculated (treatment mass capacity / treatment mass per filter) |
| Run Time Per Filter (daily) | 3,396 | min | Calculated [treatment volume per filter/(design flow rate/no. of filters)] |
| Run Time Per Filter (daily) | 57 | hr | Calculated [treatment volume per filter/(design flow rate/no. of filters)] |
| Run Time Per Filter (daily) | 2.36 | days | Calculated [treatment volume per filter/(design flow rate/no. of filters)] |
| Run Time Per Filter (max) | 620 | min | Calculated [treatment volume per filter/(design flow rate/no. of filters)] |
| Run Time Per Filter (max) | 10 | hr | Calculated [treatment volume per filter/(design flow rate/no. of filters)] |
| Run Time Per Filter (max) | 0.43 | days | Calculated [treatment volume per filter/(design flow rate/no. of filters)] |
| Backwash Rate Per Area | 12 | gpm/ft^2 | As specified by Iversand Company GreensandPlus literature |
| Backwash Duration Per Filter | 10 | min | As specified by Iversand Company GreensandPlus literature |
| Total Backwash Volume per Run | 70,000 | gal | Calculated |
| Backwash Rate Per Filter | 175 | gpm | Calculated |
| Total Backwash Volume (daily) | 29,678 | gal/day | Calculated |
| Total Backwash Volume (daily) | 207,747 | gal/week | Calculated |

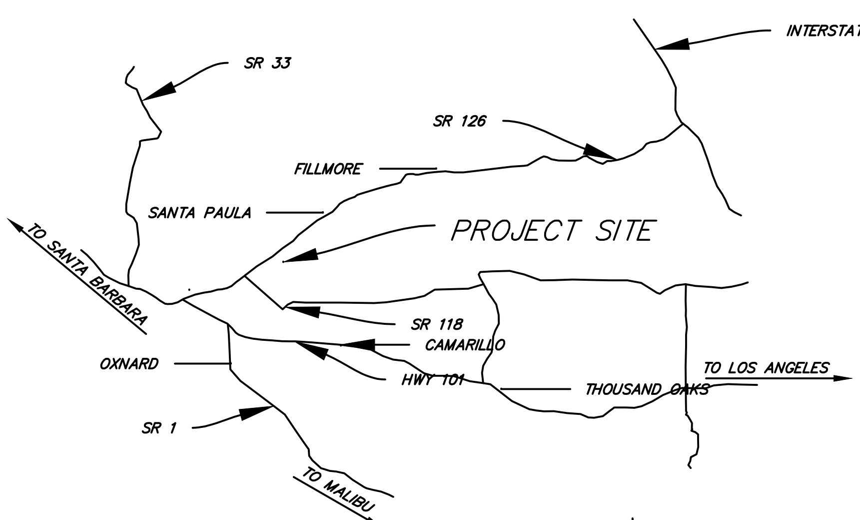
**Table 19 - Greensand Filtration Calculations**

| Parameter | Value | Unit | Description |
|---|---|---|---|
| Total Backwash Volume (daily) | 10,802,842 | gal/year | Calculated |
| Total Backwash Volume (max) | 162,523 | gal/day | Calculated |
| Total Backwash Volume (max) | 1,137,662 | gal/week | Calculated |
| Total Backwash Volume (max) | 59,158,422 | gal/year | Calculated |
| Total Mass of Sludge Generated (daily) | 16.03 | kg/day | Calculated |
| Total Mass of Sludge Generated (daily) | 35.33 | lb/day | Calculated |
| Total Mass of Sludge Generated (max) | 87.76 | kg/day | Calculated |
| Total Mass of Sludge Generated (max) | 193.48 | lb/day | Calculated |

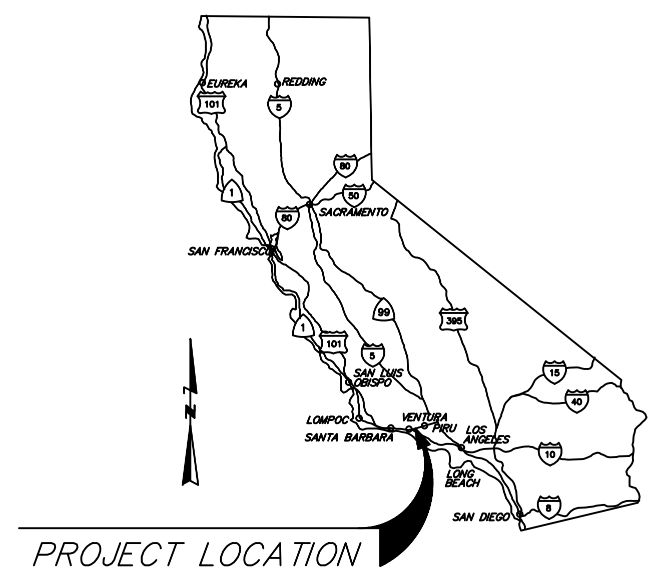
**APPENDIX 7.5 Conceptual Plans – Iron and Manganese Treatment Plant**

# UNITED WATER CONSERVATION DISTRICT
## IRON AND MANGANESE TREATMENT PLANT
## (SPECIFICATION NO. XX - XX)

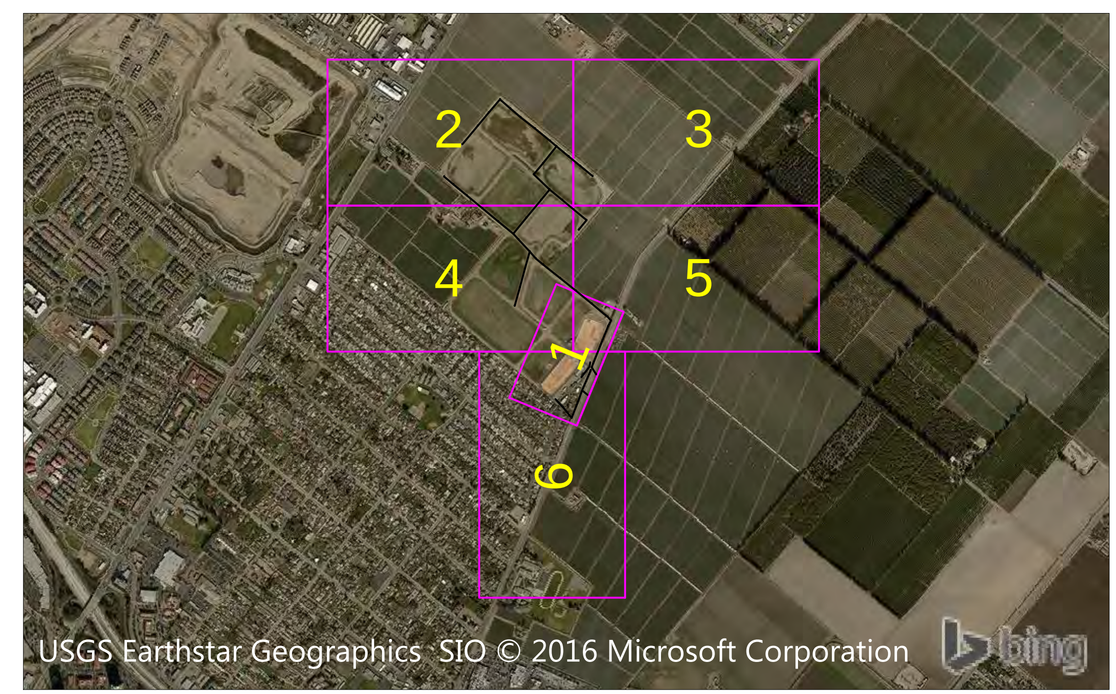
## VENTURA COUNTY, CALIFORNIA




VICINITY MAP
N.T.S.




LOCATION MAP
N.T.S.




SITE MAP
N.T.S.

| NO. | DATE | REVISION |
|---|---|---|

DESIGNED BY:
DRAWN BY: R.J.R
CHECKED BY:

UNITED WATER CONSERVATION DISTRICT
SANTA PAULA, CALIFORNIA

DESIGNED BY: PROJECT ENGINEER DATE
APPROVAL RECOMMENDED: ENGINEERING MANAGER DATE
APPROVED BY: DEPUTY GENERAL MANAGER DATE

IRON AND MANGANESE TREATMENT PLANT
TITLE SHEET

SPEC. NO. XX-XX
SHEET 1 OF 7
DWG. XX-XXX-XXX


| NO. | DATE | REVISION |
|---|---|---|
| | | |

DESIGNED BY:
DRAWN BY: R.J.R.
CHECKED BY:

UNITED WATER CONSERVATION DISTRICT
SANTA PAULA, CALIFORNIA

DESIGNED BY: PROJECT ENGINEER DATE
APPROVAL RECOMMENDED: ENGINEERING MANAGER DATE
APPROVED BY: DEPUTY GENERAL MANAGER DATE

IRON AND MANGANESE TREATMENT PLANT

PIPING LAYOUT - AREA 1

SPEC. NO. XX—XX
SHEET 2 OF 7
DWG. xxx—xxx—xxx


DWG: C:\Users\robertr\appdata\local\temp\AcPublish_7476\2015-12-11_El Rio.dwg USER: robertr
DATE: Mar 09, 2016 2:33pm XREFS: IMAGES: ER-100-18.tif ER-100-304.TIF ER-100-308.TIF ER-100-311.TIF ER-100-69.tif Topographic Index.tif

| NO. | DATE | REVISION |
|---|---|---|
| | | |

DESIGNED BY:
DRAWN BY: R.J.R.
CHECKED BY:

# UNITED WATER CONSERVATION DISTRICT

SANTA PAULA, CALIFORNIA

DESIGNED BY: PROJECT ENGINEER DATE
APPROVAL RECOMMENDED: ENGINEERING MANAGER DATE
APPROVED BY: DEPUTY GENERAL MANAGER DATE

## IRON AND MANGANESE TREATMENT PLANT

PIPING LAYOUT - AREA 2

SPEC. NO. XX-XX
SHEET 3 OF 7
DWG. xxx-xxx-xxx


| NO. | DATE | REVISION |
|---|---|---|
| | | |

DESIGNED BY:

DRAWN BY: R.J.R.

CHECKED BY:

UNITED WATER CONSERVATION DISTRICT

SANTA PAULA, CALIFORNIA

DESIGNED BY: PROJECT ENGINEER DATE

APPROVAL RECOMMENDED: ENGINEERING MANAGER DATE

APPROVED BY: DEPUTY GENERAL MANAGER DATE

IRON AND MANGANESE TREATMENT PLANT

PIPING LAYOUT - AREA 3

SPEC. NO. XX—XX

SHEET 4 OF 7

DWG. xxx—xxx—xxx


| NO. | DATE | REVISION |
|---|---|---|
| | | |

DESIGNED BY:

DRAWN BY: R.J.R.

CHECKED BY:

UNITED WATER CONSERVATION DISTRICT

SANTA PAULA, CALIFORNIA

DESIGNED BY: PROJECT ENGINEER DATE

APPROVAL RECOMMENDED: ENGINEERING MANAGER DATE

APPROVED BY: DEPUTY GENERAL MANAGER DATE

IRON AND MANGANESE TREATMENT PLANT

PIPING LAYOUT - AREA 4

SPEC. NO. XX-XX

SHEET 5 OF 7

DWG. xxx-xxx-xxx


| NO. | DATE | REVISION |
|---|---|---|

DESIGNED BY:
DRAWN BY: R.J.R.
CHECKED BY:

UNITED WATER CONSERVATION DISTRICT
SANTA PAULA, CALIFORNIA

DESIGNED BY: PROJECT ENGINEER DATE
APPROVAL RECOMMENDED: ENGINEERING MANAGER DATE
APPROVED BY: DEPUTY GENERAL MANAGER DATE

IRON AND MANGANESE TREATMENT PLANT
PIPING LAYOUT - AREA 5

SPEC. NO. XX—XX
SHEET 6 OF 7
DWG. xxx—xxx—xxx


| NO. | DATE | REVISION |
|---|---|---|

DESIGNED BY:
DRAWN BY: R.J.R.
CHECKED BY:

UNITED WATER CONSERVATION DISTRICT
SANTA PAULA, CALIFORNIA

DESIGNED BY: PROJECT ENGINEER DATE
APPROVAL RECOMMENDED: ENGINEERING MANAGER DATE
APPROVED BY: DEPUTY GENERAL MANAGER DATE

IRON AND MANGANESE TREATMENT PLANT

PIPING LAYOUT - AREA 6

SPEC. NO. XX-XX
SHEET 7 OF 7
DWG. xxx-xxx-xxx

**APPENDIX 7.6 – Headloss Calculations**

| Table 20 - Well No. 12, 13, 14 and Booster Pump Headloss Calculations | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Approximate | Diameter | Area | | Hazen Friction | Flow | | Velocity | Head Loss | |
| Line | From | To | Length | (in) | (ft^2) | Material | Factor | (gpm) | (cfs) | (ft/s) | (ft) | (ft/100ft) |
| **1** | **Well No. 12 Feeding Proposed Pressure Filter** | | | | | | | | | | | |
| 1A | Well No. 12 | "T" at Well No. 13 | 2,401 | 14 | 1.07 | ACP | 140 | 2,500 | 5.57 | 5.21 | 13.75 | 0.57 |
| 1B | "T" at Well No. 13 | "T" at Pressure Filter Manifold | 2,070 | 18 | 1.77 | ACP | 140 | 2,500 | 5.57 | 3.15 | 3.49 | 0.17 |
| 1C | "T" at Pressure Filter Manifold | Furthest Pressure Filter | 145 | 18 | 1.77 | Steel | 100 | 2,500 | 5.57 | 3.15 | 0.45 | 0.31 |
| **1D** | | **TOTAL** | **4,616** | | | | | | | **TOTAL** | **17.69** | |
| **2** | **Well No. 13 Feeding Proposed Pressure Filter** | | | | | | | | | | | |
| 2A | Well No. 13 | "T" at Well No. 13 | 66 | 14 | 1.07 | ACP | 140 | 2,250 | 5.01 | 4.69 | 0.31 | 0.47 |
| 2B | "T" at Well No. 13 | "T" at Pressure Filter Manifold | 2,070 | 18 | 1.77 | ACP | 140 | 2,250 | 5.01 | 2.84 | 2.87 | 0.14 |
| 2C | "T" at Pressure Filter Manifold | Furthest Pressure Filter | 145 | 18 | 1.77 | Steel | 100 | 2,250 | 5.01 | 2.84 | 0.37 | 0.26 |
| **2D** | | **TOTAL** | **2,281** | | | | | | | **TOTAL** | **3.55** | |
| **3** | **Well Nos. 12 and 13 in Parallel Feeding Proposed Pressure Filter** | | | | | | | | | | | |
| 3A | "T" at Well No. 13 | "T" at Pressure Filter Manifold | 2,070 | 18 | 1.77 | ACP | 140 | 4,750 | 10.58 | 5.99 | 11.43 | 0.55 |
| 3B | "T" at Pressure Filter Manifold | Furthest Pressure Filter | 145 | 18 | 1.77 | Steel | 100 | 4,750 | 10.58 | 5.99 | 1.49 | 1.03 |
| **2E** | | **TOTAL** | **2,215** | | | | | | | **TOTAL** | **12.92** | |
| **4** | **Well No. 14 Feeding Proposed Pressure Filter** | | | | | | | | | | | |
| 4A | Well No. 14 | "T" at Well No. 11 | 2,162 | 12 | 0.79 | ACP | 140 | 3,500 | 7.80 | 9.93 | 48.88 | 2.26 |
| 4B | "T" at Well No. 11 | "T" at Settling Basin | 414 | 18 | 1.77 | Steel | 100 | 3,500 | 7.80 | 4.41 | 2.42 | 0.58 |
| 4C | "T" at Settling Basin | "T" at Pressure Filter Manifold | 299 | 18 | 1.77 | Steel | 100 | 3,500 | 7.80 | 4.41 | 1.75 | 0.58 |
| 4D | "T" at Pressure Filter Manifold | Furthest Pressure Filter | 145 | 18 | 1.77 | Steel | 100 | 3,500 | 7.80 | 4.41 | 0.85 | 0.58 |
| | | **TOTAL** | **3,020** | | | | | | | **TOTAL** | **53.89** | |
| | **El Rio Booster Pumps Feeding Backwash Influent to Proposed Pressure Filter** | | | | | | | | | | | |
| 5A | Furthest Booster Pump | "T" at Discharge Manifold | 21 | 16 | 1.40 | Steel | 100 | 7,930 | 17.67 | 12.65 | 1.00 | 4.71 |
| 5B | "T" at Discharge Manifold | "T" at Backwash Influent Pipe | 91 | 30 | 4.91 | Steel | 100 | 31,720 | 70.67 | 14.40 | 2.60 | 2.87 |
| 5C | "T" at Backwash Influent Pipe | "T" at Backwash Influent Manifold | 345 | 8 | 0.35 | Steel | 100 | 350 | 0.78 | 2.23 | 1.48 | 0.43 |
| | | **TOTAL** | **457** | | | | | | | **TOTAL** | **5.08** | |

**Table 21 - Filter Feed and Backwash Analysis**

| | Construction Details | | | | 2014 SCE Test | | | Rated Capacity | | Hydraulic Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pump Name | Base (Pad) Elev (ft) | Depth to Top of Bowl (ft) | Min Submergence (ft) | Min Water Elev (ft) | Standing Water Elev (ft) | Pumping Water Elev (ft) | Δ, Pumping - Min (ft) | Capacity (gpm) | Total Head @ Capacity (ft) | HGL Elev @ Well (ft) | Pipeline Head Loss (ft) | HGL Elev @ Filter Influent (ft) | Filter Top Elev (ft) | Filter Head Loss (ft) | HGL Elev @ Filter Effluent (ft) | Margin of Safety |
| O-H Pipeline Booster Pumps | 103.6 | 16 | | 87.6 | | | | 6,700 | 109 | 196.6 | 5.1 | 191.5 | 118.0 | 9.9 | 181.6 | 54% |
| **At 2014 groundwater levels** | | | | | | | | | | | | | | | | |
| Well No. 12 | 116.9 | 470 | 20 | -333.1 | -187.3 | -283.6 | 49.5 | 2,500 | 468 | 184.4 | 17.7 | 166.7 | 118.0 | 2.3 | 164.4 | 39% |
| Well No. 13 | 109.7 | 341 | 20 | -211.3 | -100.0 | -230.6 | -19.3 | 2,500 | 360 | 129.4 | 3.6 | 125.8 | 118.0 | 2.3 | 123.5 | 5% |
| Well No. 14 | 100.7 | 380 | 20 | -259.3 | -61.1 | -183.2 | 76.1 | 3,500 | 432 | 248.8 | 53.9 | 194.9 | 118.0 | 2.3 | 192.6 | 63% |
| **At minimum pumping level** | | | | | | | | | | | | | | | | |
| Well No. 12 | 116.9 | 470 | 20 | -333.1 | | | | 2,500 | 468 | 134.9 | 17.7 | 117.2 | 118.0 | 2.3 | 114.9 | -3% |
| Well No. 13 | 109.7 | 341 | 20 | -211.3 | | | | 2,500 | 360 | 148.7 | 3.6 | 145.1 | 118.0 | 2.3 | 142.8 | 21% |
| Well No. 14 | 100.7 | 380 | 20 | -259.3 | | | | 3,500 | 432 | 172.7 | 53.9 | 118.8 | 118.0 | 2.3 | 116.5 | -1% |

**APPENDIX 7.7 – Layne Christensen Pilot Study Report**

# Pilot Study Report

LayneOx™ Iron & Manganese Removal Process


United Water Conservation District, Wells 12 and 13
Oxnard, CA
May 16th – 20th, 2016

**LAYNE** | water + mineral + energy
**1138 N. Alma School Rd, Suite 207, Mesa, AL 85201**
Office: 602-345-8600 | Fax: 602-345-8632

# TABLE OF CONTENTS

Disclosure statement……………………………………………………………………………….....i
Figures……………………………………….…………….....…..……...…………………………….…....ii
Tables….………………………………………………………………………………………………..iii
Glossary………………………………………………………………….………………………….....iv

Executive Summary………………………………………………………………………………….1
Introduction……………………………………………………………….………………………….3
Coagulation/Filtration………………………………………………………………………………..3
Treatment………………………………………………………………………………...…..3
Backwash……………………………………………………………………………….......4
Media selection…………………………………………………………………………......4
Pilot Evaluation…………………………………………………………………………………….5
Testing Objectives………………………………………………………………………....5
Site Setup…………………………………………………………………………….....….5
Equipment Operation Description - Treatment……………………………….....……...….5
Equipment Operation Description - Backwash……………………………………...….6
Chemical Injection……………………………………………………………….…….….…6
Analytical Procedures……………………………………………………………………….….....…..6
Pilot Test Results……………………………………………………………………….…...…..7
Conclusions……………………………………………………………………………………17
Full Scale Design Summary...……………………………………………………………......17

## APPENDICES

Appendix A: List of LayneOx™ installations in California……………………………………..…23
Appendix B:  LayneOx™ specifications……………………………….…………………….….25
Appendix C: Field Data…………………………………………………………………………26
Appendix D: Consolidated Lab Data……………………………………………………………37

**Disclosure Statement**

This Pilot Plant Study Report has been prepared by Layne Christensen Company - Water Treatment Group (Layne) for the purpose of presenting Technology Verification Report on Layne's LayneOx™ Iron and Manganese reduction process to the United Water Conservation District.

Contents of this document are not to be used in any manner detrimental to Layne's interests and are not to be reproduced in whole or in part other than for the purpose intended. The Recipients will take all reasonable precautions and steps to ensure that the contents of this document are maintained in confidence. The results obtained from the pilot study are not to be published without the express written consent of Layne Christensen Company.

## FIGURES

Figure 1. Hach DR/890 colorimeter…......................................................................................6

Figure 2. Hach pH Pocket Pro……………………………………………………………………6

Figure 3. Trial 1 - Hydraulic Loading Rate versus Time in Hours, Well 13.………………...…10

Figure 4. Trial 2 - Hydraulic Loading Rate versus Time in Hours, Well 13……….……….....11

Figure 5. Trial 3 - Hydraulic Loading Rate versus Time in Hours, Well 13…………….……...12

Figure 6. Trial 4 - Hydraulic Loading Rate versus Time in Hours, Well 12…………….……...13

Figure 7. Greensand Plus Percentage of Totals in Backwash Over Time…………………........15

Figure 8. Iron & Manganese in Backwash Waste as a Function of Time……………………........16

Figure 9. Iron and Manganese in Solution Over Time…………………………………………17

Figure 10. Percentage of Solids Settled over Time……………………………………………...17

# TABLES

Table 1. Summarized lab data for Greensand Plus…………………………………….....……8

Table 2. Summarized lab data for LayneOx$^{TM}$……………………………………………..9

Table 3. Greensand Plus sampling during backwash…………………………………..….14

Table 4. LayneOx$^{TM}$ sampling during backwash……………………………………….15

Table 5. Settling rate of sludge from LayneOx$^{TM}$ column at <5 seconds chlorine mixing……..17

Table 6. Settling rate of sludge from Greensand Plus column at <35 seconds chlorine mixing……………………………………………………………………………18

Table 7. Greensand Plus pilot plant process parameters………………………………..….18

Table 8. LayneOx$^{TM}$ pilot plant process parameters…………………………………….19

Table 9. Proposed full scale equipment sizes and parameters for 3500 gpm system…………...21

## Glossary

CWET – California Waste Extraction Test

FGL – Fruit Growers Laboratory

Gpm/$ft^2$ – gallons per minute per square foot

MCL – Maximum Contaminant Level

Mg/L – milligrams per liter

NRC – Nuclear Regulatory Commission

OAL – over-all length

pCi-L – picocuries per liter

POTW – Publicly Owned Treatment Works

Psid – pounds per square inch differential

RCRA – Resource Conservation and Recovery Act

RO – Reverse Osmosis

SDI – Silt Density Index

SMCL – Secondary Maximum Contaminant Level

TCLP – Toxicity Characteristic Leaching Procedure

Ug/L – micrograms per liter

UWCD – United Water Conservation District

## Executive Summary

The purpose of the iron / manganese treatment pilot for UWCD was to demonstrate, on actual well waters, the efficacy of two different treatment medias, LayneOx™ and Greensand Plus. The goal is to quantify actual flowrates and thru-puts of the two medias so as to design the most cost effective treatment system. Both medias are NSF-61 approved for potable water treatment.

Layne conducted the pilot study for 5 days, from May 16nd to the 20th, 2016. Throughout the study the two medias, Greensand Plus and LayneOx™, were piloted side-by-side. The Greensand Plus was operated at 6, 7, and 8-gpm/ft$^2$, and the LayneOx™ at 6, 8, 9, 10 and 12-gpm/ft$^2$. These loading rates were chosen to reflect normal operating rates and rates with one filter in backwash.

The pilot test equipment was set up at a discharge manifold for several wells, located at the El Rio Treatment Plant in Oxnard, California. Layne's testing protocol is described in the body of this report. The water at the outlet ran consistently throughout the 5 days of testing.

On the first four days of testing, water from Well 13 was directed through the discharge manifold. In the past, Well 13 was run only on a per need basis, and had been run infrequently. Pressure was maintained at 30 psig. During the pilot testing, a number of "Operation Critical" data points were identified for Well 13. Iron and manganese levels were found to be lower than what were previously thought and there appears to be an unusually high chlorine demand in the water. Client personnel stated that a camera had been sent down the well and irregularities were spotted. It was speculated that there may be potential biofouling in the well.

On May 18, the chlorination point was moved from immediately outside the pilot trailer to a point approximately 100 feet away, to assess the impact of additional oxidation time on manganese removal. This added approximately 30 seconds residence time to the influent.

For the next trial, Well 12 was directed through the discharge manifold and this well water was run thru the pilot trailer.

The Greensand Plus columns were able to maintain a 16 hr. run at 4 and 6-gpm/ft$^2$ with no signs of breakthrough, When the loading rate was increased to 8-gpm/ft$^2$, the columns were unable to sustain the loading rate for more than the first two hours. After the drop from the initial 8 gpm/ft$^2$, the column flow varied between 6 and 7-gpm/ft$^2$ and was able to sustain iron and manganese levels to below detection limits.

The LayneOx™ columns were able to maintain a 16 hr. run at 6, 8, and 9-gpm/ft$^2$with no signs of breakthrough, removing iron and manganese to levels below the secondary MCL. At 10-gpm/ft$^2$ under blinding conditions, the column was able to maintain manganese below the secondary MCL for only 16 hours. At 12-gpm/ft$^2$ a run of only 9 hours was achievable; the column was able to maintain iron and manganese below secondary MCL but experienced a drop in flow rate.

Also during the trials at Well #13, a backwash test was run after each filter run, after which the next set of parameters was dialed into each column. The backwash cycle was done using influent from finished plant water. The backwash rate and duration for LayneOx™ was at 20-gpm/ft$^2$ for 5 minutes and 12-gpm/ft$^2$ for 20 minutes for Greensand Plus. The backwash rate for LayneOx™ is typically at 25-gpm/ft$^2$. However, at times the flow rate from the backwash source for this pilot was sustainable only to 20-gpm/ft$^2$. Under normal backwashing conditions of 25-gpm/ft$^2$ at five minutes, the backwashing procedure should be adequate. An insufficient flow rate will lead to premature breakthrough and shortened run lengths, giving the appearance of less-than-optimal performance. Iron oxide appears to be preferentially precipitated during the settling period, with approximately 72% of particulates settled over a four hour period.

The trials began in the afternoon, and terminated the following morning. During the pilot testing, numerous influent and effluent water samples were collected and sent to Fruit Growers Laboratory, Inc. located in Santa Paula, California, for analysis. The laboratory results for the influent water showed average iron levels of 500 µg/L and manganese levels of 210 µg/L for Well 13 and iron levels of 320 µg/L and manganese levels of 145 ug/L for Well 12.

The lab results confirm that both LayneOx™ and Greensand Plus media were able to maintain iron and manganese concentration levels below the detection limits for a period of 16 hours at both Well 12 and Well 13. The primary difference, as set forth in the pilot goals, was the difference in effective flow rate through the media. The Greensand Plus performed at up to 6-gpm/ft$^2$, and the LayneOx™ performed at up to 9-gpm/ft$^2$. Therefore the LayneOx can process up to 50% more flow per unit area of filter bed design based on the current water quality produced by Wells #12 and #13. Averaged chlorine consumption over the course of the pilot for greensand was 0.73-mg/L and 1.2 mg/L for LayneOx.

## Introduction

Drinking water standards over the years have become increasingly stringent, as research has shown that health risks are associated with the presence of certain constituents in potable water. The presence of some constituents however do not necessarily pose a health risk, but still may be undesirable.

Iron and manganese do not have a Maximum Contaminant Limit (MCL) according to the EPA, but many municipalities have standardized on *secondary* MCLs (SMCLs) of 0.30 mg/L for iron and 0.050 mg/L for manganese. Iron and manganese can result in discolored water, stained plumbing fixtures, and unfavorable taste to the water, however, no known health risks are posed by high levels of iron and manganese. The SMCLs are set primarily for esthetic reasons. The goal in the pilot test was to achieve and maintain removal of iron and manganese below their respective SMCLs.

## Oxidation/Filtration

There are numerous processes capable of iron and manganese removal. Some of the more complex processes include aeration, clarification-filtration and ozonation-microfiltration. The simplest process is direct filtration on a suitable media. Historically, direct filtration of iron and manganese was done using manganese greensand. Typically, potassium permanganate or chlorine in combination with potassium permanganate is used for an oxidant. Recently there has been a trend towards selecting medias that eliminate the need for permanganate which is more expensive to use than chlorine and which further has the attendant issues related to process control to avoid the "production of pink water". Greensand Plus in a mixed bed topped with a layer of Anthracite is one such media which may be charged with a chlorinating agent instead of permanganate.

LayneOx™ exhibits superior catalytic properties to manganese greensand and has the added benefit of enabling the use of chlorine as the primary and only pre-oxidant. These properties provide the potential to operate at high surface loading rates resulting in high removal efficiency and a small equipment footprint.

### *Treatment*

LayneOx™ and Greensand Plus take advantage of the fact that iron and manganese are readily oxidized in the presence of already oxidized manganese in the media, in the form of manganese dioxide, $MnO_2$. The manganese dioxide serves as a catalyst in the oxidation reduction reaction of iron and manganese.

LayneOx™ has very high manganese dioxide content, ranging from 75-80%, and is of a somewhat porous nature which allows more surface area interactions. In contrast, Greensand Plus is comprised of a manganese dioxide coating on a silica sand core. This is significant because the manganese dioxide on the surface of the media provides sites for the adsorption and oxidation of the iron from Fe (II) to Fe (III), manganese from Mn (III) to Mn (IV). It also serves to accelerate the reaction rates. Additional surface area from a more porous particle allows for more interactions and deposition of ferric hydroxide and manganese dioxide.

Deposition of ferric hydroxide and manganese dioxide continue until the interstices between the media grains accumulate ferric hydroxide and manganese dioxide to capacity. This point is determined either by iron and/or manganese breaking through the filter bed or by high differential pressure across the bed. Backwashing is then required to abrade the excess iron and manganese oxides from the media grains, and carry these particles out of the bed to waste.

*Backwash*

As with any filtration media, LayneOx™ and Greensand Plus require backwashing after a certain period of time. The purpose of a backwash is to remove the collected particulate waste from the media bed, which in turn prevents differential pressure build up and prepares it for another cycle. Effective backwashing is essential with these media or else the filter bed will "grow" with deposited iron and manganese oxides, and the length of running time between backwashes will decline.

In a full-size Layne treatment plant, the system takes one vessel off-line at a time to backwash. Raw water is treated in the other vessels, and then sent in reverse flow through the backwashed vessel. This process continues sequentially through all pressure vessels until all vessels are backwashed, and then the system resumes normal operation. This process is completely automated, allowing the system to run autonomously without manual interference.

*Media Selection*

Manganese oxide filter medias possess a strong negative electrostatic charge, or zeta potential that can be maintained by the addition of a single oxidant such as sodium hypochlorite. A chlorine residual of 0.5-1.0 ppm is usually sufficient to pre-oxidize iron and manganese for efficient removal by the media bed. Greensand Plus was marketed as capable of 2-12 gpm/ft$^{2,}$ and LayneOx™ at loading rates of 5-15 gpm/ft$^2$, depending on the influent contaminant concentrations and the desired backwash frequency.

LayneOx™ and Greensand Plus both have advantages over traditional media:

- Highly efficient removal of iron and manganese to well below the primary and secondary MCLs.
- Media is resistant to degradation because of high particle hardness.
- Potassium permanganate is not required, eliminating the "pink water" concerns.
- Single sodium hypochlorite pre-oxidant up stream of the water treatment system provides chlorine residual for the system.
- Automated system operation and minimal operator attention required.

In addition to the above points, LayneOx™ has the additional advantages:

- Proven process (over 100 plants have been installed using LayneOx™ media).
- Highly catalytic media allows high surface loading rates within a relatively small footprint when compared to other media, resulting in capital cost savings.
- No long reaction time is required for sodium hypochlorite.

More information about LayneOx™ can be found in the Product Bulletin and the NSF Certification in the appendices of this document.

Media selection is based on several factors including site footprint, loading rate, water chemistry and cost. Although this pilot study tested LayneOx ™ media and Greensand Plus, Layne designs and builds treatment systems with a variety of filter media that are selected to best meet the customer's site-specific needs.

**Pilot Test**

*Testing Objectives*

The pilot system is a simplified version of a typical full-scale Layne coagulation/filtration treatment system. Pilot testing is used to develop and quantify the following objectives:

- Determining chlorine chemical dosing rate.
- Observe the effects of surface loading rate change on effluent water quality.
- Remove iron and manganese to levels at or below their respective SMCLs.

*Site Setup*

The pilot was set up at the UWCD treatment facility located in Oxnard, California. The source was a discharge manifold for several wells which could be isolated as needed. The influent water was drawn from a port directly off the manifold.

*Equipment Operation Description - Treatment*

Water is obtained via a ¾" hose connection providing feed water to the pilot unit. Untreated water flows into a static mixer, where a chemical injection port permits the chemical injection pump to provide metered amounts of sodium hypochlorite into the stream. The water is then sent through the filter vessels. Treated water is discharged to an on-site discharge location.

Rotameters and gate valves are used to meter and control the flow, respectively. PVC piping carries the water to a 60" high vertical column filled with a 36" bed of LayneOx™ media, or 12" 24" Greensand Plus media. The water flows into the top of the column, downward through the media bed and out through the bottom to the site's discharge point.

*Equipment Operation Description - Backwash*

Backwashing is accomplished by using the pilot's manual valves, sending the process flow in reverse through the filter columns. The process flow is directed into the piping connected to the bottom of the filter column, where it flows upward through the bed and out the top of the filter column. Backwashing is performed at a rate of 25-gpm/$ft^2$ for LayneOx™, and 12-gpm/$ft^2$ for Greensand Plus. This flux lifts the media 40% above its settled bed depth to allow the accumulated particulate sufficient space to flow out of the bed. After leaving the filter column the backwash waste flows out through a hose to an approved discharge location. The backwash process is maintained for a five minute interval for LayneOx™, and 20 minutes for Greensand Plus. The backwash process for Greensand Plus may be terminated if the waste stream becomes clear before 20 minutes.

*Chemical Injection*

Chemical injection is accomplished by utilizing a peristaltic pump capable of delivering 1-30 mL/min of metered flow. The chemical injection pump operates within a range that requires diluted chemical solutions. Household grade 7-8% sodium hypochlorite was diluted with raw water to make approximately a 0.7 % chlorine feed for the pilot.

**Analytical Procedures**

The Hach DR/890 Colorimeter was used for all field tests. Reagents are added to the sample, and the color change experienced indicates the amount of reactant in the sample. The instrument analyzes the color of the sample and returns a value in mg/L.

Figure 1. Hach DR/890 Colorimeter.

Figure 2. Hach pH Pocket Pro

Reagents/Test methods used:

- Ferrous Iron, Total (0 to 3.0 mg/L), 1, 10 Phenanthroline Method – Hach Method 8146
- Manganese, Low Range (0.0-0.7 mg/L) - Hach PAN Method 8149
- Chlorine, Free (0 to 2.00 mg/L), DPD Method – Hach Method 8021 (USEPA Method 330.5)
- pH- Hach Plus pH Meter, handheld probe – calibrated with 7.0 & 10 pH buffers

## Pilot Test Results

Table 1 and 2 summarizes the results from samples submitted to FGL Inc. Laboratory located in Santa Paula, California. These tests show that the medias consistently removed iron and manganese levels to below secondary MCL levels while processing up to 9-gpm/ft$^2$ for LayneOx$^{TM}$, and only 6-gpm/ft$^2$ for Greensand Plus during 16 hour trials without loss of flow rate. Full lab tests can be found in the appendices (ND=NonDetect, <30 ug/L for iron, and <10 ug/L for manganese). Table 5 and 6 provide a summary of the process parameters utilized during the pilot.

On May 18th, the chlorine injection point was moved approximately 100 feet upstream of the pilot at the request of the Client, thereby adding an additional approximate 30 seconds reaction time. The added reaction time caused drops in the loading rate for both the Greensand Plus and the LayneOx$^{TM}$ over the filter runs. It would suggest that the iron and manganese in the raw water were more completely oxidized before it reached the pilot, thus rendering the catalytic properties of the medias irrelevant. These types of design parameters are best suited for a mixed bed filter design with various layers of filter beds with increasing mesh sizes ran at low loading rates allowing for precipitated particulates to penetrate deep in the bed. The drop in the loading rate suggests that the medias were blinded on the surface of the bed, thereby shortening the time that the beds are functional. Under these non-ideal conditions, Greensand Plus and the LayneOx$^{TM}$ both performed equitably for both 6 and 8-gpm/ft$^2$.

Silt Density Index (SDI) testing was performed by UWCD personnel on both raw water well sources as well as each treatment media. Due to the very high pressure needed during these tests, full flow through the pilot trailer could not be achieved. In order for a media column to be tested, all flow to the other columns was stopped; this was necessary in order to achieve the required pressure for the SDI test equipment.

Typically, if the pilot was to be utilized for SDI testing, all media would have been flushed before service, and service would not be interrupted prior to testing. In addition, Layne would have provided test equipment and run the SDI testing; results could be verified by the client using separate equipment. SDI testing was not listed as a goal of the pilot, therefore, these additional steps were not incorporated into the pilot's protocols.

The procedure for the first three SDI tests was for the pressure to be increased from the water source well, and all flow was directed through the SDI test equipment. No water was supplied to the pilot trailer for approximately 15-20 minutes for the duration of the test.

The next step was to test the media. Since Greensand was in the first two columns, Greensand was tested first. Again, due to testing pressure requirements, the only flow to the pilot was through the Column being tested; this added another 20 minutes of non-operational time for the LayneOx™ columns. There was typically some 10 minutes between testing as equipment was moved, results were recorded and testing membranes were exchanged. This resulted in almost an hour of inactivity / flow to the LayneOx™ columns.

The first SDI test for LayneOx™ was performed using Column 4. Column 4 had its media replaced at the beginning of the pilot and the media had been only slightly seasoned. Column 4 proved unsatisfactory within a very short timeframe and the decision was made to use the seasoned media in Column 3. At this point, Column 3 had been sitting idle for more than 60 minutes. With no pre-flushing, although better than Column 4, results were less than desired.

The second and third SDI tests were conducted in a similar fashion; first the raw water source, then the Greensand then the LayneOx. Again, the Greensand results were satisfactory, the LayneOx, after sitting idle for almost an hour, were not.

On the fourth and final test, the testing steps were reversed; the LayneOx was tested first, then the Greensand and finally the raw water. In this sequence, the results were markedly improved, with both the LayneOx and Greensand having acceptable SDI readings.

It should be noted that the greensand passed the SDI tests, due to the fact that greensand packs more tightly than LayneOx™. Thus it stands to reason that it will pass the SDI test more easily and not release particulates when the flow rate changes abruptly. However, this same packing density also creates a faster change of differential pressure across the bed during service.

LayneOx™ oxidation-filtration systems have been used for water treatment upstream of other treatment systems such as Reverse Osmosis. References are available in the Appendices.

Table 1. Summarized lab data for Greensand Plus.

| Sample Date | Sample Description | Column | Loading Rate (gpm/ft$^2$) | Time Elapsed (hrs.) | Fe ug/L | Mn µg/L |
|---|---|---|---|---|---|---|
| 5/16/16 | Trial 1: Raw Water | | | | 470 | 210 |
| 5/16/16 | Greensand | 1 | 8 | 1 | <30 | <10 |
| 5/17/16 | Greensand | 1 | 6 | 21 | <30 | <10 |
| 5/16/16 | Greensand | 2 | 6 | 1 | <30 | 10 |
| 5/17/16 | Greensand | 2 | 6 | 21 | <30 | <10 |
| | | | | | | |
| 5/17/16 | Trial 2: Raw Water | | | | 460 | 220 |
| 5/17/16 | Greensand | 1 | 8 | 1 | <30 | <10 |
| 5/18/16 | Greensand | 1 | 7 | 16 | <30 | <10 |
| 5/17/16 | Greensand | 2 | 6 | 1 | <30 | <10 |
| 5/18/16 | Greensand | 2 | 6 | 16 | <30 | <10 |
| On 5/18/16, the chlorine injection point was moved approximately 100 feet further upstream, allowing for an additional 30 seconds reaction time. | | | | | | |
| 5/18/16 | Trial 3: Raw Water | | | | 490 | 200 |
| 5/18/16 | Greensand | 1 | 4 | 1 | <30 | <10 |
| 5/19/16 | Greensand | 1 | 3.8 | 18 | <30 | <10 |
| 5/18/16 | Greensand | 2 | 6 | 1 | <30 | <10 |
| 5/19/16 | Greensand | 2 | 5.7 | 18 | <30 | <10 |
| | | | | | | |
| 5/19/16 | Trial 4: Raw Water | | | | 330 | 145 |
| 5/19/16 | Greensand | 1 | 8 | 1 | <30 | <10 |
| 5/20/16 | Greensand | 1 | 6.5 | 16 | <30 | <10 |
| 5/19/16 | Greensand | 2 | 6 | 1 | <30 | <10 |
| 5/20/16 | Greensand | 2 | 6 | 16 | <30 | <10 |

Greensand Plus was able to remove iron and manganese to below detection levels at 6 and 8-gpm/ft$^2$. For this particular water quality, at a constant 30 psig with the chlorine feed mixing time of less than 5 seconds, it was unable to maintain loading rates above 6 and 7-gpm/ft$^2$ for 16 hours, suggesting that pressure drop across the bed may become an issue at higher loading rates.

Table 2. Summarized lab data for LayneOx™

| Sample Date | Sample Description | Column | Loading Rate (gpm/ft$^2$) | Time Elapsed (hrs.) | ΔP* | Fe ug/L | Mn µg/L |
|---|---|---|---|---|---|---|---|
| 5/16/16 | Trial 1: Raw Water | | | | | 470 | 210 |
| 5/16/16 | LayneOx™ | 3 | 6 | 1 | | <30 | <10 |
| 5/17/16 | LayneOx™ | 3 | 6 | 12 | | <30 | <10 |
| 5/16/16 | LayneOx™ | 4 | 12 | 1 | | 40 | 10 |
| 5/17/16 | LayneOx™ | 4 | 10 | 10 | | <30 | <10 |
| | | | | | | | |
| 5/17/16 | Trial 2: Raw Water | | | | | 460 | 220 |
| 5/17/16 | LayneOx™ | 3 | 6 | 1 | | <30 | <10 |
| 5/18/16 | LayneOx™ | 3 | 6 | 16 | | <30 | <10 |
| 5/17/16 | LayneOx™ | 4 | 9 | 1 | 8.8 | <30 | <10 |
| 5/18/16 | LayneOx™ | 4 | 7.5 | 16 | | <30 | <10 |
| On 5/18/16, the chlorine injection point was moved approximately 100 feet further upstream, allowing for an additional 30 seconds reaction time. | | | | | | | |
| 5/18/16 | Trial 3: Raw Water | | | | | 490 | 200 |
| 5/18/16 | LayneOx™ | 3 | 6 | 1 | | <30 | <10 |
| 5/19/16 | LayneOx™ | 3 | 5.6 | 18 | | <30 | <10 |
| 5/18/16 | LayneOx™ | 4 | 8 | 1 | 9 | <30 | <10 |
| 5/19/16 | LayneOx™ | 4 | 6.5 | 18 | | 30 | 10 |
| | | | | | | | |
| 5/19/16 | Trial 4: Raw Water | | | | | 330 | 145 |
| 5/19/16 | LayneOx™ | 3 | 6 | 1 | | <30 | <10 |
| 5/20/16 | LayneOx™ | 3 | 5.7 | 16 | | <30 | <10 |
| 5/19/16 | LayneOx™ | 4 | 10 | 1 | 7.5 | <30 | <10 |
| 5/20/16 | LayneOx™ | 4 | 7.3 | 16 | | 100 | 90 |

LayneOx™ was able to remove iron and manganese to at or below detection limit at 6, 8, and 9-gpm/ft$^2$ for a minimum of 16 hours.

For this particular water quality, at a constant 30 psig with the chlorine feed mixing time of approximately 35 seconds, it was unable to maintain 10-gpm/ft$^2$ for 16 hours, suggesting that pressure drop across the bed may become an issue.

*Estimated based on previous studies.

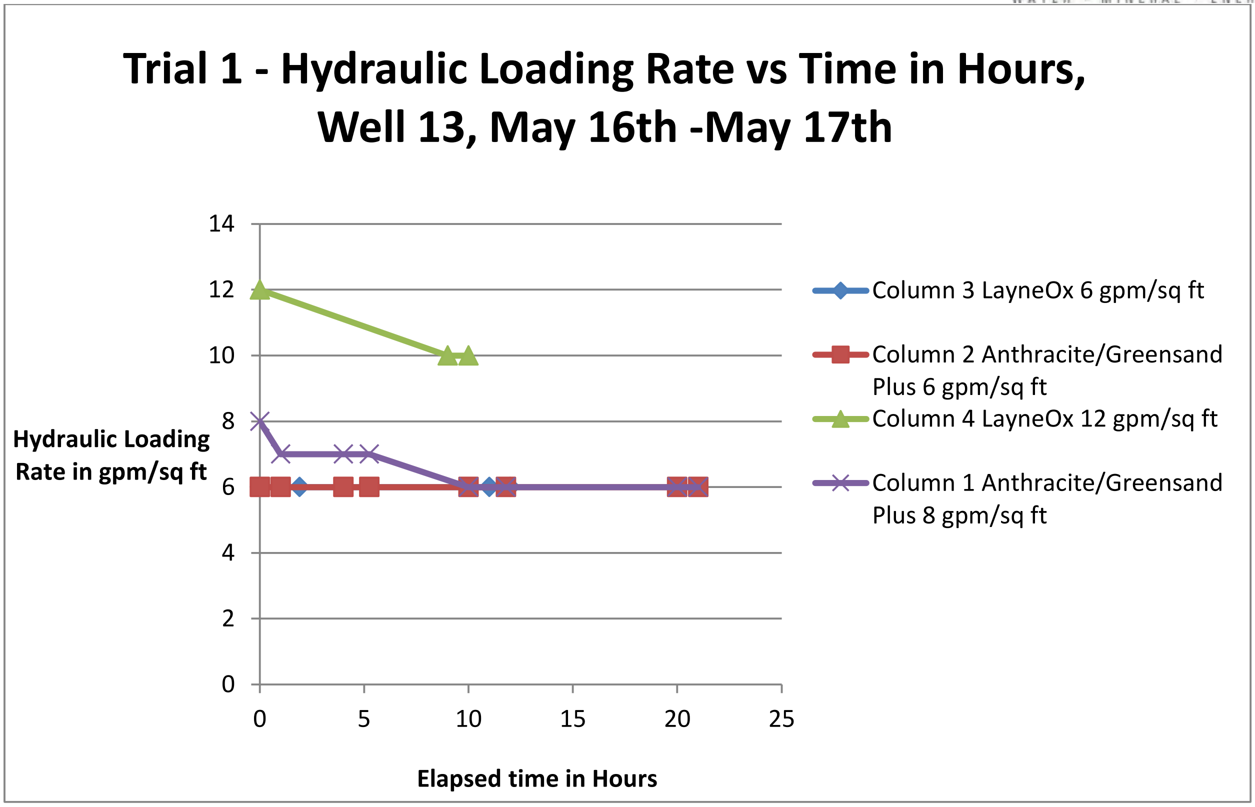



Figure 3. Trial 1 - Comparison of the hydraulic loading rates, Well 13, May 16th –May 17th. LayneOx™ columns were started later than the Greensand Plus columns, and resulted in shortened runs. At the beginning of the pilot, both Columns 3 and 4 contained previously used LayneOx™. A decision was made to exchange the contents of Column 4 for virgin LayneOx™. Both runs were terminated before 16 hours.

At 6 gpm/ft$^2$, LayneOx™ performed equitably with Greensand Plus for the length of its run. At 12 gpm/ft$^2$, LayneOx™ was unable to sustain the loading rate, but stabilized at 10-gpm/ft$^2$ at 10 hours. A 8-gpm/ft$^2$, Greensand Plus was unable to sustain the hydraulic rate for the initial 10 hours, but stabilized at 6-gpm/ft$^2$ for the remainder of the experiment.

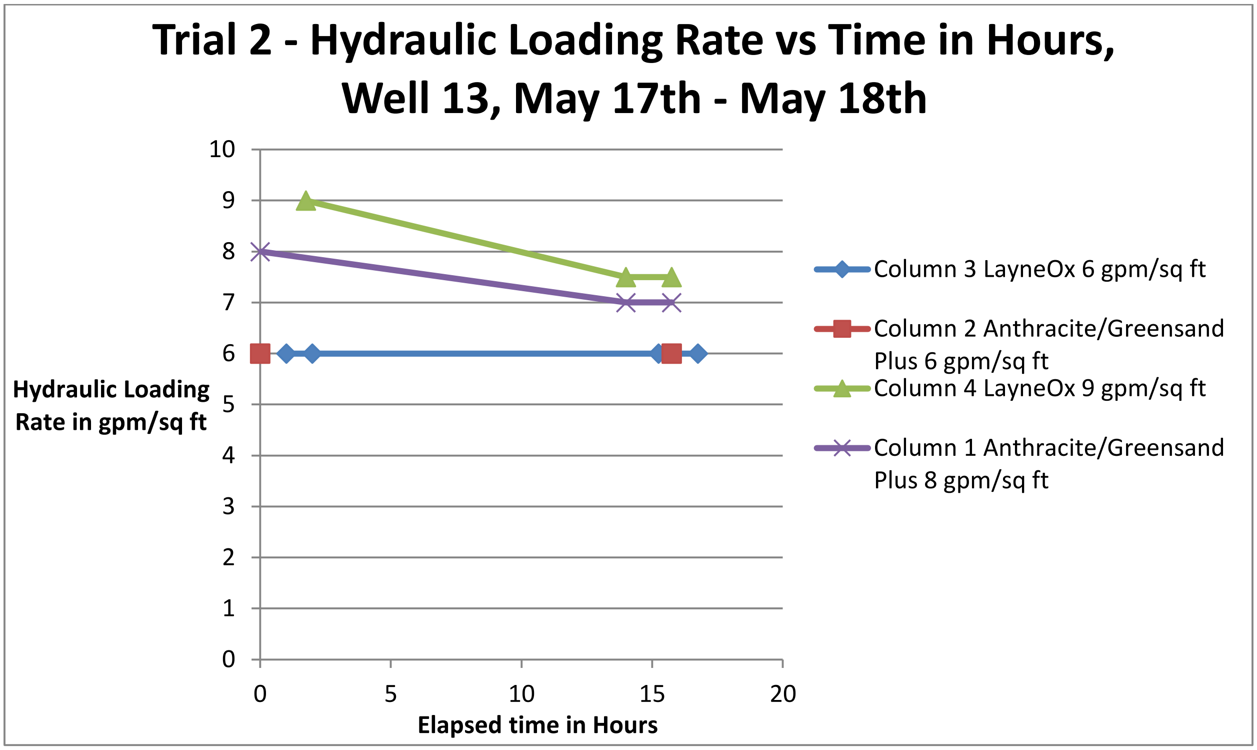



Figure 4. Trial 2 - Comparison of the hydraulic loading rates. At 6-gpm/ft$^2$, LayneOx$^{TM}$ performed the same Greensand Plus for the length of its run. At 9-gpm/ft$^2$, LayneOx$^{TM}$ was unable to sustain the loading rate, but stabilized at 7.5-gpm/ft$^2$. At 8-gpm/ft$^2$, Greensand Plus was unable to sustain the hydraulic rate for the initial 14 hours, but stabilized at 7-gpm/ft$^2$ for the remainder of the experiment.

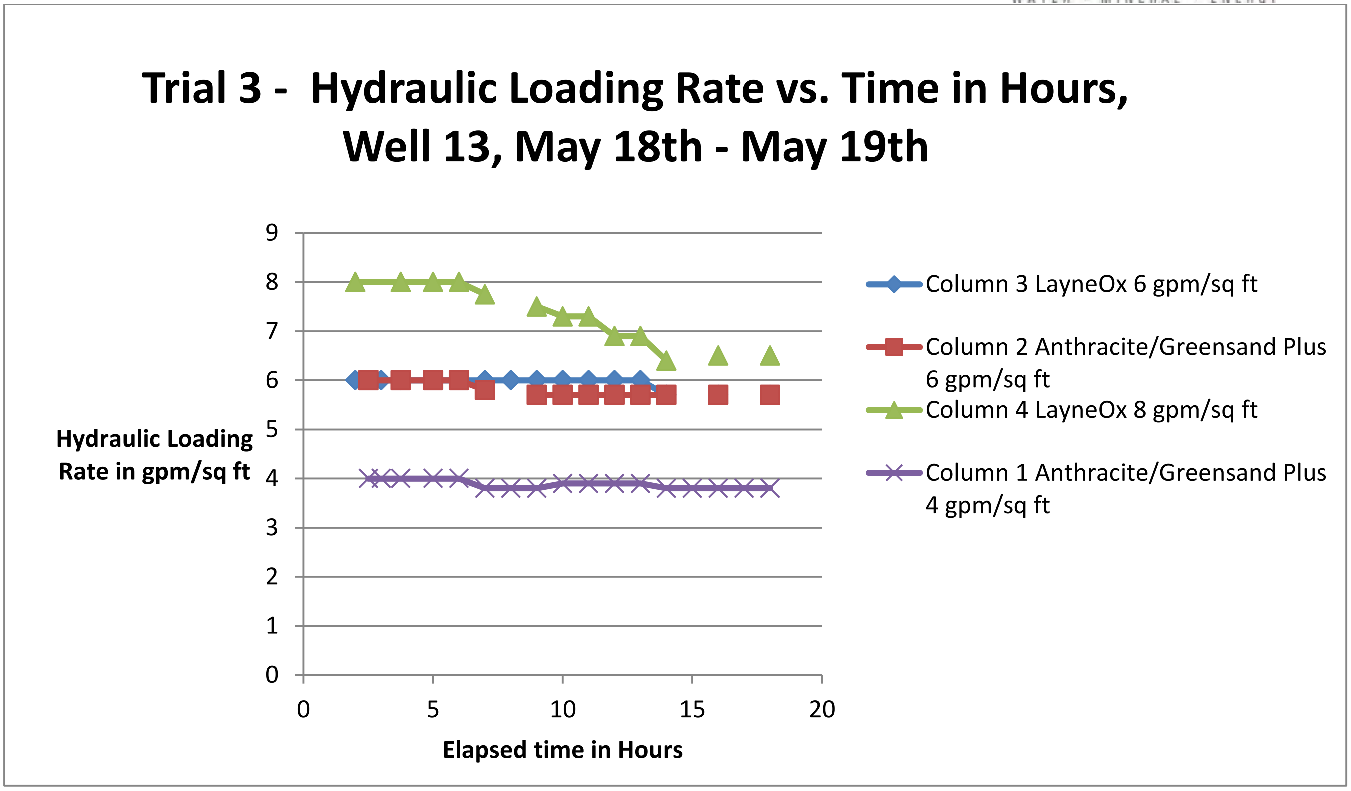



Figure 5. Trial 3 - Comparison of the hydraulic loading rates under blinding conditions. The chlorine injection point was moved 100 ft upstream, adding approximately 30 seconds reaction time. At 6-gpm/ft$^2$, LayneOx™ performed slightly better than Greensand Plus, with LayneOx™ able to sustain 6-gpm/ft$^2$ for an additional 7 hours. At 8-gpm/ft$^2$, LayneOx™ was unable to sustain the hydraulic rate for the initial 14 hours, but stabilized at 6.5-gpm/ft$^2$ for the remainder of the experiment.

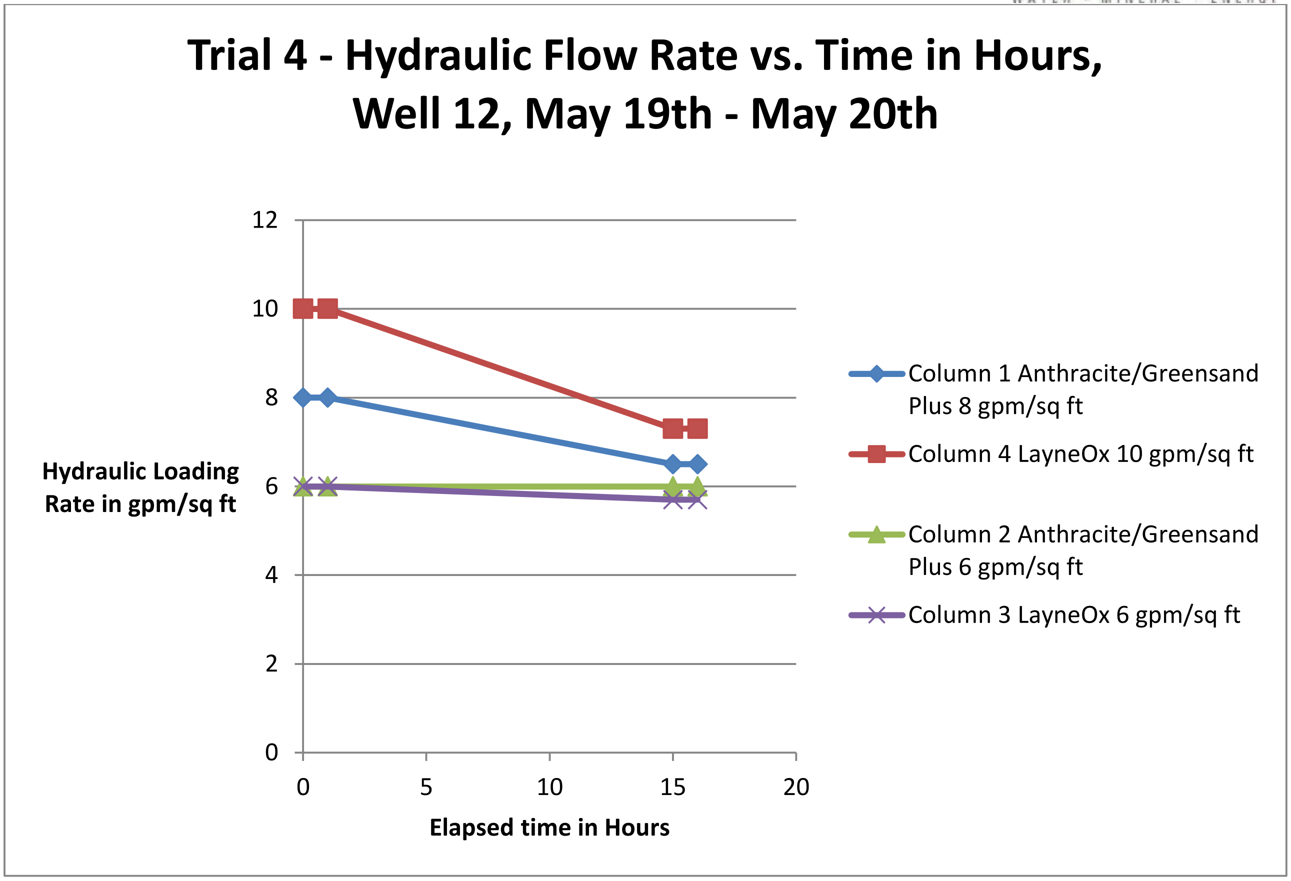



Figure 6. Trial 4 - Comparison of the hydraulic loading rates under blinding conditions. The chlorine injection point was moved 100 ft upstream, adding approximately 30 seconds reaction time. At 6-gpm/ft$^2$, Greensand Plus performed slightly better than LayneOx$^{TM}$. At 8-gpm/ft$^2$, Greensand Plus was unable to sustain the loading ate and dropped down to 6.5-gpm/ft$^2$, but was able to maintain iron and manganese levels to below secondary MCL. At 10-gpm/ft$^2$, LayneOx$^{TM}$ was unable to sustain the loading ate and dropped down to 7.3-gpm/ft$^2$, and was inable to maintain manganese levels to below secondary MCL.

A water-saving measure of the Layne's coagulation-filtration system is the ability to recycle water which had been used in the backwash process. This technology is applicable to both LayneOx$^{TM}$ and greensand. If a proactive recycling system is desired, the backwash water is sent to a settling tank, where after a predetermined amount of settling time, the decanted liquid portion is sent back through the treatment system at 10% of the influent flow rate. The somewhat liquid sludge may be sent to a disposal mechanism, or may be further dewatered, with the water being sent back to the treatment system, and the compacted sludge to be disposed. The compacted sludge typically passes Toxicity Characteristic Leaching Procedure (TCLP), but further California Waste Extraction Test (CWET) testing may be required if the raw water contains regulated contaminants.

Backwashing was conducted at 20-gpm/ft$^2$ for 5 minutes for LayneOx™, and at 12-gpm/ft$^2$ for Greensand Plus for 20 minutes. Depending on the manufacturer, the backwash cycle for greensand can range from 10 to 20 minutes. It should be noted that the backwash rate for LayneOx™ is up to 25-gpm/ft$^2$ to achieve 40% bed expansion. However, at times the flow rate from the backwash source for this pilot was sustainable only at 20-gpm/ft$^2$. Under normal backwashing conditions of 25-gpm/ft$^2$ at five minutes, the backwashing procedure should be adequate. An insufficient flow rate will result in residuals remaining on the media, thus leading to premature breakthrough and shortened run lengths, giving the appearance of less-than-optimal performance. Timed sampling was initiated for the backwashing of both medias.

Table 3. Greensand Plus backwash was sampled for 20 minutes, as a conservative measure based on manufacturers' literature. Analysis was done on the entire sample for totals. The backwash was taken after the chlorine injection point had been moved, thereby adding an additional 30 seconds of reaction time. It should be noted that there was sludge in the hoses that fed the water to the pilot, indicating some precipitating reaction had occurred. The ratio of iron to manganese in the backwash was 3.86 Iron : 1 Manganese. The influent ratio is approximately 2 Iron : 1 Manganese. The increase of iron in the iron/manganese ratio in the backwash suggests that manganese had precipitated and was not being flushed out of the media as easily as the iron. Only greensand backwash was sampled after moving the chlorination point. It is speculated that LayneOx™ and greensand sludges may behave in a similar fashion.

| **Greensand** | **0 min** | **2.5 min** | **5 min** | **7.5 min** | **10 min** | **12.5 min** | **15 min** | **17.5 min** | **20 min** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Fe (ug/L)** | 81,200 | 34,700 | 5,560 | 1,420 | 420 | 270 | 190 | 250 | 160 | 124,170 |
| **Mn (ug/L)** | 18,900 | 9,750 | 2,350 | 410 | 180 | 140 | 120 | 160 | 130 | 32,140 |
| **Settleable solids (mL/L)** | 105 | 36.8 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 142 |
| **Total solids (mg/L)** | 1,350 | 1,300 | 1,210 | 1,190 | 1,180 | 1,170 | 1,160 | 1,170 | 1,180 | 10,910 |
| **TSS (mg/L)** | 340 | 160 | 24 | 5 | 3 | 2 | 2 | 2 | 2 | 540 |

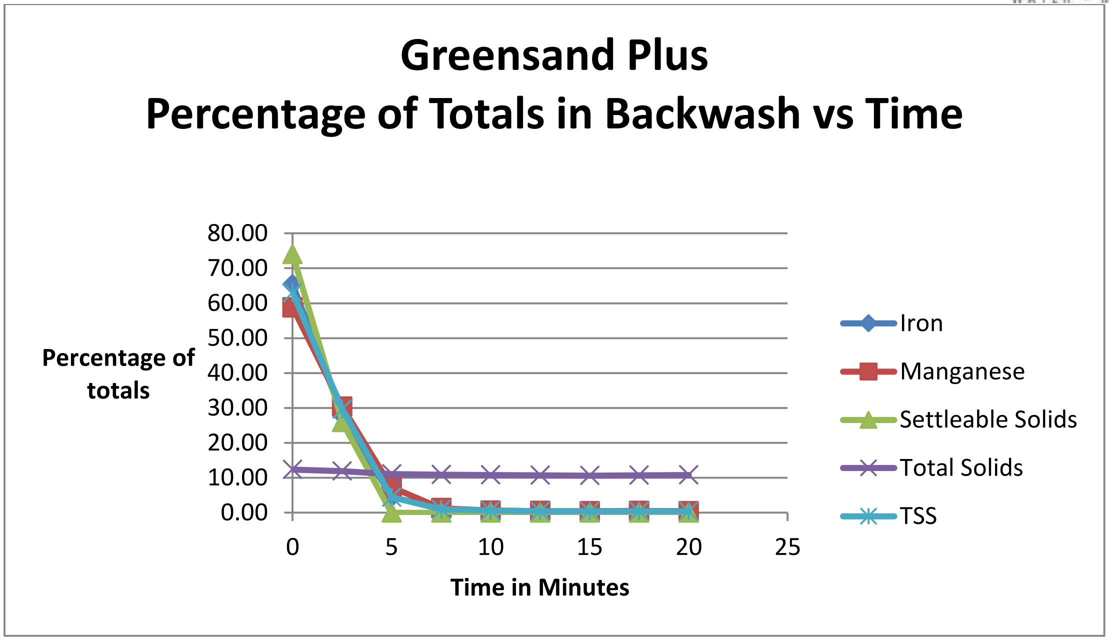



Figure 7. The percentage of the totals is plotted as a function of time. More than 97% of the residuals on the media were removed after 7.5 minutes backwash at 12-gpm/ft$^2$.

Table 4. LayneOx™ backwash was sampled for 5 minutes. The samples were analyzed for total (dissolved and particulate) iron and manganese. The backwash was taken before the chlorine injection point had been moved, with a mixing time of <5 seconds. The ratio of iron to manganese is similar to that of the influent at approximately 2:1, indicating that iron and manganese were not precipitating in the plumbing to any great extent.

| **LayneOx** | 0 min | 2.5 min | 5 min | Total |
|---|---|---|---|---|
| Fe (ug/L) | 2170 | 44000 | 58500 | 104,670 |
| Mn (ug/L) | 5830 | 24400 | 16800 | 47,030 |
| Settleable solids (mL/L) | 0 | 18.9 | 36.8 | 56 |
| Total solids (mg/L) | 1200 | 1540 | 1340 | 4,080 |
| TSS (mg/L) | 42 | 410 | 319 | 771 |

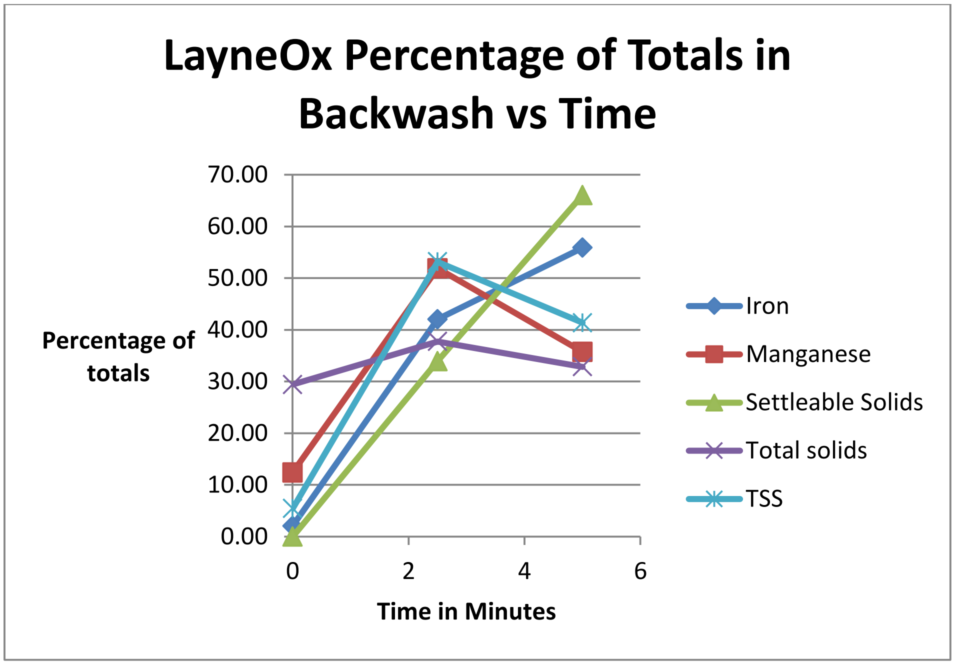



Figure 8. The percentage of the totals is plotted as a function of time. At 5 minutes backwash at 20-gpm/ft$^2$, it appears the media had not been adequately flushed because the bed was not expanded enough to allow for the contaminants and silt to be removed properly. Conditions at the pilot site allowed approximately 20-gpm/ft$^2$, but did not allow for backwashing at 25-gpm/ft$^2$. Under normal backwashing conditions of 25-gpm/ft$^2$ at five minutes, the backwashing procedure should be adequate. An insufficient flow rate will lead to premature breakthrough and shortened run lengths, giving the appearance of less-than-optimal performance. Layne recommends their maximum standard backwash rate of 25-gpm/ft$^2$ for 5 minutes for the Oxnard site. A proper backwash loading rate and bed expansion will also flush out LayneOx fines at start-up for new media allowing for acceptable SDI results exiting the filter system.

Due to the observation that fines were coming off the virgin LayneOx™ in Column 4, in combination with an inadequate flow rate for the backwash, the medias were periodically subjected to prolonged backwashes to compensate for inadequate bed expansion due to the decreased flow rate. Prolonged backwash at inadequate bed expansion did not and does not remove contaminants to the expected levels of a proper backwash and bed expansion.

Table 5. Settling rate of sludge from LayneOx™ column. This sludge was collected from the backwash process during the initial phase of the pilot, when the chlorine injection site was immediately outside the pilot trailer (mixing time <5 seconds). The sludge was placed in a container, and at selected times the liquid portion at the top was decanted and analyzed. The table illustrates the concentration of iron and manganese in the liquid portion of the sludge.

| Time Elapsed (hrs) | Iron (mg/L) | Manganese (mg/L) | Total (mg/L) | % Removed | % Remain |
|---|---|---|---|---|---|
| 0 | 18.00 | 9.06 | 27.06 | 0.0 | 100.0 |
| 3 | 2.74 | 4.83 | 7.57 | 72.0 | 28.0 |
| 5 | 1.95 | 3.63 | 5.58 | 79.4 | 20.6 |
| 7 | 1.40 | 2.92 | 4.32 | 84.0 | 16.0 |

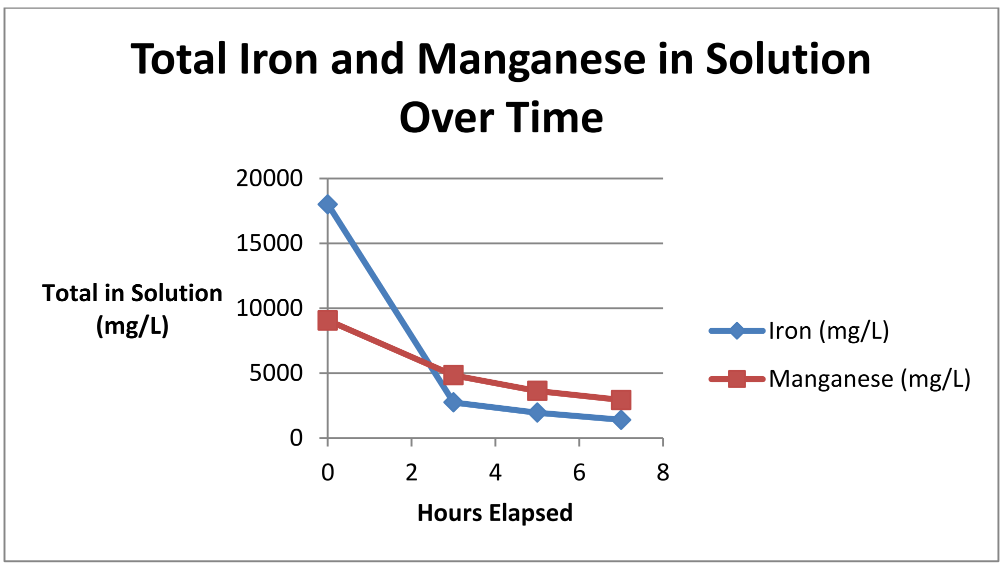



Figure 9. This figure illustrates the concentration of iron and manganese in the liquid portion of the sludge as a function of time.

In the settling tank, the majority of the sludge which precipitates over the first three hours of settling is composed of iron oxides.

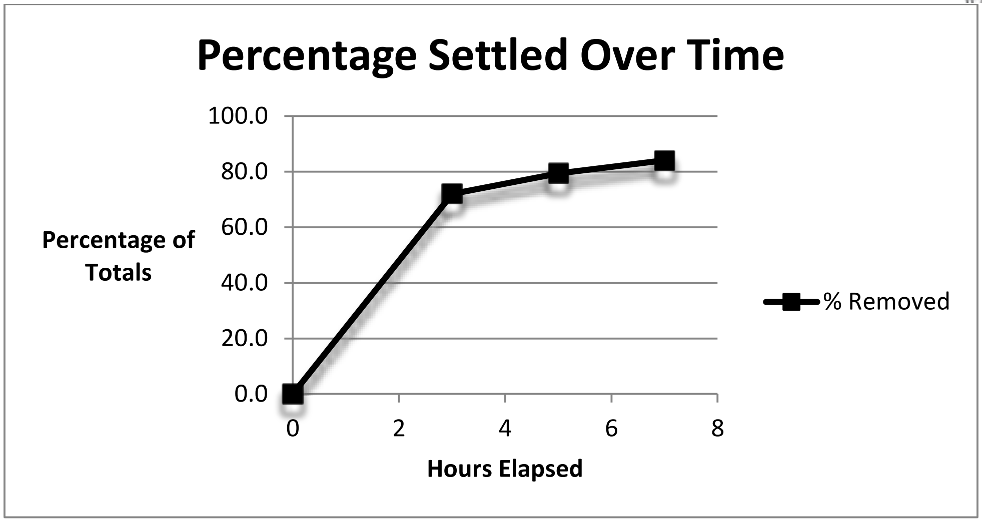



Figure 10. The bulk of the precipitates has settled by three hours, with approximately 28% still in solution. At five hours, approximately 20% is still in solution. If more expeditious settling is desired, the addition of a flocculant may aid in the process.

Table 6. Settling rate of sludge from Greensand Plus column. This sludge was collected from the backwash process during the second phase of the pilot, when the chlorine injection site was moved approximately 100 ft. from the trailer (mixing time <35 seconds). The samples were pulled from the top of the container to determine concentrations of iron and manganese which had not settled out of solution.

| Time Elapsed (hrs) | Iron (mg/L) | Manganese (mg/L) | Total (mg/L) |
|---|---|---|---|
| 0 | 13.797 | 3.571 | 17.368 |
| 4 | 2.030 | 0.460 | 2.490 |
| 20* | 5.510 | 2.190 | 7.700 |
| 24 | 0.920 | 0.260 | 1.180 |

*Sample may have been slightly agitated prior to decanting sample.

In a comparison at 4 hours settling time (averaged 3 hrs and 5 hours results) for the LayneOx sample, the liquid portion of the sludge which was collected during the run with < 5 seconds chlorine mixing time had a ratio of 1 Iron:1.8 Manganese. The liquid of the sludge which was collected for the run with <35 seconds chlorine reaction time had a ratio of 4.41 Iron: 1 Manganese. The preponderance of iron in the decanted liquid in the second sample suggests that the manganese had either had bound to the media, or been deposited in the plumbing between the injection point and the pilot. Either scenario leads to the conclusion that additional reaction time was beneficial to the oxidation and subsequent removal of manganese. However, it should be noted that with the addition of 30 seconds of reaction time, the columns appeared to suffer a blinding effect which lead to premature pressure issues.

Table 7. Greensand Plus pilot plant process parameters.

When the reaction time for the chlorine injection was less than 2 seconds, at 6-gpm/ft$^2$, Greensand Plus was able to maintain the initial process loading rate, but was unable to maintain the initial process loading rate of 8-gpm/ft$^2$. It was unable to maintain the initial process loading rates over 16 hours when the chlorine injection point was moved upstream for an additional 30 seconds reaction time.

| Parameter | Starting Value* | |
|---|---|---|
| Process Loading Rate | 6-gpm/ft$^2$ | 8-gpm/ft$^2$ |
| Flow Rate | 1.18 gpm | 1.57 gpm |
| Media Bed Dimensions | 24-inch greensand, 12-inch anthracite bed depth, 6-inch diameter | |
| Media Type | Anthracite, Greensand Plus | |
| Oxidant Chemical | Sodium Hypochlorite (NaOCl) | |
| Backwash Freeboard | 16 inches | |
| Backwash Flow Rate | 2.4 gpm (12 gpm/ft$^2$) | |
| Backwash Bed Expansion | 12 - 14 inches for the anthracite | |
| Backwash Duration | 20 minutes | |
| Backwash Source | Treated Water | |
| Backwash Destination | Approved Drainage Site | |

Table 8. LayneOx™ pilot plant process parameters.

When the reaction time for the chlorine injection was less than 3 seconds, at 6 and 9-gpm/ft$^2$, LayneOx™ was able to maintain the initial process loading rate for 16 hours, and at 12-gpm/ft$^2$ for 9 hours. It was unable to maintain the initial process loading rates over 16 hours when the chlorine injection point was moved upstream for an additional 30 seconds mixing time.

| Parameter | Starting Value* | | | | |
|---|---|---|---|---|---|
| Process Loading Rate | 6-gpm/ft$^2$ | 8-gpm/ft$^2$ | 9-gpm/ft$^2$ | 10-gpm/ft$^2$ | 12-gpm/ft$^2$ |
| Flow Rate | 1.18 gpm | 1.57 gpm | 1.78 gpm | 1.98 gpm | 2.36 gpm |
| Media Bed Dimensions | 36-inch bed depth, 6-inch diameter | | | | |
| Media Type | LayneOx™ 20x40 mesh | | | | |
| Oxidant Chemical | Sodium Hypochlorite (NaOCl) | | | | |
| Backwash Freeboard | 16 inches | | | | |
| Backwash Flow Rate | 3.95 gpm (20 gpm/ft$^2$) | | | | |
| Backwash Bed Expansion | 12 - 14 inches | | | | |
| Backwash Duration | 5 minutes | | | | |
| Backwash Source | Treated Water | | | | |
| Backwash Destination | Approved Drainage Site | | | | |

## Conclusions

Well 13's influent water contained an average of 500 ug/L iron and 210 ug/L manganese. Based on this particular water quality, Greensand Plus is capable of removing iron and manganese to below detection levels of 30 ug/L for iron, and 10 ug/L for manganese at a loading rate of 6-gpm/ft$^2$ for up to 21 hours, but was unable to maintain a higher loading rate. LayneOx$^{TM}$ was able to remove iron and manganese to the detection limit or lower, and was able to sustain the initial loading rates above 7-gpm/ft$^2$ for a minimum of 16 hours.

Given that the waters provided from UWCD to its Partners could be used as make-up water for additional treatment using reverse osmosis (RO) technologies, LayneOx$^{TM}$'s performance in similar installations did not raise any issues and, when tested per normal operating conditions, both the LayneOx$^{TM}$ and Greensand Plus did pass the SDI protocol. A list of installations using a LayneOx-RO system can be found in the Appendices.

Iron and manganese are not considered RCRA metals nor one of the parameters for TCLP and CWET testing, and discharge into the Publicly Owned Treatment Works (POTW) would be dependent on local permit regulations. Based on analyses conducted during the pilot, raw water from Well 13 has arsenic below laboratory detection limits of 2 ppb. The raw water from Well 12 has arsenic at a concentration of 3 ppb. Assuming a loading rate of 10-gpm/ft$^2$ for a 16 hour run, with a 5 minute backwash at 25-gpm/ft$^2$, the calculated arsenic content of the backwash for the worst case scenario would be 0.23 mg/L for the liquid sludge. If the sludge is de-watered to any extent, the arsenic concentration will be higher and will require further testing. The state of California stipulates the CWET level for arsenic be no higher than 5 mg/L. The mass balance for arsenic for the liquid sludge is below that of the CWET levels and therefore is subject to local permit regulations.

LayneOx$^{TM}$ in a coagulation/filtration system has been used to successfully remove radium from drinking water. Typically the backwash sludge has not posed a radioactivity disposal issue. EPA has published guidelines based on U.S. Nuclear Regulatory Commission (NRC) requirements that discharges with greater than 600 pCi/L of radium-226 and radium-228 and 3,000 pCi/L of uranium should not be discharged to the sewer. Based on analyses conducted during the pilot with a worst case scenario of radium-226 at 0.416 pCi/L and radium-228 at 0.105 pCi/L, using the same parameters as stated above, the mass balance of the total radioactivity in the liquid waste is expected to be approximately 40 pCi/L (below the 600 pCi/L threshold). Local regulations as well as requirements from the POTW which will handle the sewage discharge will be in effect. If the sludge is to be de-watered, further analyses will be needed as the waste becomes concentrated.

**Full Scale Design**

The desired additional capacity for UWCD was explained to be 3,500 gpm. Layne selected the LayneOx™ media and Greensand Plus media to demonstrate that a higher loading rate than 3-gpm/ft$^2$ is possible, thus saving UWCD significant capital expenses by requiring a smaller footprint and less equipment. Of the two medias, LayneOx™ was able to sustain higher loading rates over the duration of the pilot study at varying conditions and water quality.

Two potential vessel designs are recommended based on the pilot study results. The first design is for two horizontal, 2-cell vessel, 10' diameter by 24' over-all length (OAL), with full pressure barriers. The second option would be for a vertical 120" diameter x 60" straight side, six-vessel system comprised of two skids of three vessels each.

The proposed full scale equipment filter bed areas mirror the piloted loading rates to the closest available filter vessel size. The findings for the pilot demonstration confirmed that at the higher loading rate of 8-gpm/ft$^2$ and minimum 16 hours of filter run time, LayneOx™ was capable of reducing the manganese concentration level to less than 0.010 mg/L and the iron concentration to less than 0.030 mg/L. Actual run duration will depend on the water quality of the well.

LayneOx™ has been an industry standard for many years. Its life as a water treatment media can be upwards of 10 years. In facilities where sand is not removed from the water but pumped into the media, the media is subject to premature breakdown due to the abrasive action of the sand during the backwash cycle. If sand is suspected of being pumped into the treatment system, it is highly advised to install a particulate filter to remove the sand.

Table 9. Proposed Full Scale Equipment Sizes and Parameters for a 3500 gpm LayneOx™ system vs Greensand Plus.

| Equipment Design | Layne Horizontal 10' D x 24' OAL | Layne Vertical 120" x 60" straight side | Greensand Horizontal 10' D x 30' OAL |
|---|---|---|---|
| Number of vessels | 2 | 6 | 2 |
| Number of cells per vessel | 2 | 1 | 2 |
| Number of skids | N/A | 2 | N/A |
| Total number of cells | 4 | N/A | 4 |
| Pressure rating | 75 psig ASME Code | | |
| Vessel material | PVQ carbon steel, SA-516-70 | | |
| Lining | NSF 61 certified Epoxy | | |
| Bed area per cell or vessel | 109.5 $ft^2$ | 78.5 $ft^2$ | 150 $ft^2$ |
| System flow rate | 3500 gpm | | |
| Flow rate per cell or vessel | 875 gpm | 583 gpm | 875 gpm |
| Total bed area | 438 $ft^2$ | 471 $ft^2$ | 600 $ft^2$ |
| Loading rate | 7.99-gpm/$ft^2$ | 7.43-gpm/$ft^2$ | 5.83-gpm/$ft^2$ |
| | | | |
| Differential pressure across bed (clean) | 3-4 psig | | |
| Differential pressure across bed (terminal) | 10 psig | | |
| Total System Design head loss (max). | 15 psig | | |
| System backpressure | Atmospheric | | |
| System Design Pressure | 75 psig | | |
| | | | |
| Media | LayneOx™ 20 x 40 | | Greensand/Anthracite |
| Media depth | 36 in. | | 24"/12" |
| Media bed volume per cell/filter | 328.5 $ft^3$ | 235 $ft^3$ | 450 $ft^3$ |
| Total media volume | 1,314 $ft^3$ | 1413 $ft^3$ | 1800 $ft^3$ |
| Total media weight, shipping | 157,680 lb. | 169,560 lb. | 153,000 lb. |
| Total gravel underbed | 660 $ft^3$ | 471 $ft^3$ | 600 $ft^3$ |
| | | | |
| Backwash loading rate-max | 25-gpm/$ft^2$ at 90 deg. F | 25-gpm/$ft^2$ at 90 deg. F | 12-gpm/$ft^2$ |
| Backwash rate (per filter) | 3,000-gpm | 1,962-gpm | 1,800-gpm |
| Backwash duration | 5 minutes | 5 minutes | 10 minutes |

| | | | |
|---|---|---|---|
| Backwash volume, gal. | 15,000 gal per cell | 12,263 gal per filter | 27,000 gal per cell |
| Total backwash volume per sequence | 60,000 gal plus 7,000 (fast rinse) | 73,578 gal plus 7,000 (fast rinse) | 108,000 gal plus 7,000 (fast rinse) |

Estimated Preliminary Rough Order of Magnitude Capital Expenditures Comparison:

| Equipment Design | Layne Horizontal 10' D x 24' OAL | Layne Vertical 120" x 60" straight side | Greensand Horizontal 10' D x 30' OAL |
|---|---|---|---|
| | $875,200 | $1,100,000 | $1,010,500 |

Estimated Operational Expenditures for LayneOx™ system:

| Equipment Design | Units | Consumption per day, maximum flow at 24 hrs. (5,040 kgal per day) | Consumption per year (maximum flow 24 hrs/day) |
|---|---|---|---|
| Chlorine gas consumption* | 5.374 g (0.0118 lb) $Cl_2$ per kgal treated | 27.1 kg, or 59.7 lbs | 21,791 lbs |
| Electrical costs, Control Unit | $0.12 per kw·hr | $5.52 | $2014.80 |

*Consumption may fluctuate depending on water quality and frequency of backwashes.

**APPENDIX A**

Layne has installed successful LayneOx™ systems all over the country for iron, manganese, arsenic, and radium removal. Some of the larger systems are:

| **Location:** | **GPM** |
|---|---|
| City of Adelanto, CA | 8,100 |
| City of Plano, IL | 1,000 |
| Southern California Water Co., Roseton, CA | 1,000 |
| Arizona Water Company, Oasis, AZ | 2,500 |
| Arizona Water Company, Baseline, AZ | 4,500 |
| Arizona Water Company, Cottonwood, AZ | 5,800 |
| Arizona Water Company San Manuel, AZ | 1,500 |
| Arizona Water Company, Superior, AZ | 1,600 |
| Community Water Company, AZ, 4 wells | 1,000 – 2,500 |
| Arizona Water Company, 4 wells | 2,300 |
| Arizona Water Company, Casa Grande, AZ | 1,350 |
| Surprise, AZ | 6,000 |
| City of Minneapolis, KS, 3 wells | 1,050 |
| City of Ellis, KS, 8 wells | 1,050 |
| Newport, VT | 1,200 |
| Sonoran Vista | 3,500 |
| West Valley Water District, Riato, CA | 2,000 |
| Weatherford, OK, 2 wells | 1,4000 2,000 |
| Mason, MI | 1,736 |
| City of Rockford, IL, 10 wells | 1,200-2,100 |
| Vancouver, WA | 3,900 |
| Rural Water System #1, Sious Center, IA | 3,420 |
| City of Alliance, NE | 1,800 |
| Maywood Mutual Water Co., Maywood, CA | 1,100 |
| Sparta, MI | 1,000 |
| Rural Water Systems #1, Hospers, IA | 2,900 |
| Newburg, NY | 2,220 |
| Sunland Park, NM | 1,406 |
| Chandler, IN | 4,000 |
| Searles Valley Minerals, Trona, CA | 300-1000 |
| City of Love's Park, IL | 1,600 |
| Benkelman, NE, 2 wells | 1,000 |
| City of Merrill, WI | 1,800 |
| Twin Cities WTP, Twin City, OH | 1,560 |
| City of Fulton, IL | 1,200 |

A partial list of the larger installations completed in California alone:

| | |
|---|---|
| Maywood Mutual Water Company, Maywood, CA | 1100 gpm |
| West Valley Water District, Riato, CA | 2000 gpm |
| Southern California Water Company, Roseta, CA | 1000 gpm |
| City of Adelanto, CA | 8100 gpm |

LayneOx™ / Reverse Osmosis systems:

| | |
|---|---|
| St. Brides Water Treatment Plant, Richmond, VA | 610 gpm |
| Children's Hospital of New Orleans, LA | 135 gpm |
| Doubletree Paper Mills, Gila Bend, AZ | 310 gpm |

**APPENDIX B**

LAYNEOX™ PRODUCT SPECIFICATION

| | |
|---|---|
| Trade name | LayneOx™ |
| Color | Black |
| Form | Particulate |
| Bound Moisture Content | 2% MAX as shipped |
| Bulk Density-Loose Packed | 110-115 pounds/cu foot |
| Hardness- Ball Pan | 80 Minimum |
| Abrasion Number | 70 Minimum |
| Manganese Dioxide | 70-80% Average throughout media matrix |
| Mean Particle Diameter | 0.4-0.6MM |
| Effective Size | 0.3-0.5MM |
| Uniformity Coefficient | Less than 1.65 |
| Particle Size Range | 20x40 mesh |
| ANSI/NSF 61 | Certified without limitations for use in potable water |
| Preconditioning | Washed and Screened to size |
| Percent finer than 40 mesh | 5% max |
| Percent coarser than 20 mesh | 5% max |
| Packaging | Super sacks or 55 pound bags |

**APPENDIX C**

Field Data:

The first trial (Trial 1) of the LayneOx columns was not able to be started until much later in the day due to unforeseen circumstances.

The Hach method for free chlorine has a detection limit of 0.02 mg/L with a variance of 0.01 mg/L. The Hach method for ferrous iron analysis has a detection limit of 0.03 mg/L with a variance of 0.013 mg/L. The Hach method for manganese analysis has a detection limit of 0.02 mg/L with a variance of 0.013 mg/L. The field analyses data for manganese showed fluctuations and values above what was expected. Further examination indicated that mineral interferences were present in the water which exaggerated the true values. A chemical reagent to ameliorate the interferences was purchased and used on May 19$^{th}$ and 20$^{th}$. Results from the certified laboratory should be considered the more accurate of the analyses.

## Trial 1

**Column 1, variable gpm/ft$^3$**
**Greensand Plus**

| Date | Time | Time Elapsed (hrs) | Loading Rate (GPM/ft.$^2$) | Total Flow (Gal.) | Fe (mg/L) | Mn (mg/L) | Free Cl2 (mg/L) Influent | Free Cl2 (mg/L) Effluent | pH | Temp. (°C) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/16/16 | 1006 | 0 | 8 | 0 | | | 1.2 | 0.21 | | | Well 13 |
| 5/16/16 | 1106 | 1 | 7 | 420 | <0.03 | 0.033 | 1.1 | 0.32 | 7.57 | 20.9 | |
| 5/16/16 | 1406 | 4 | 7 | 1680 | 0.03 | 0.052 | 0.68 | 0.61 | 7.39 | 21.9 | |
| 5/16/16 | 1615 | 5.25 | 7 | 2205 | <0.03 | 0.037 | 0.60 | 0.21 | 7.38 | 21.9 | |
| 5/16/16 | 2000 | 10 | 6 | 4125 | 0.03 | 0.038 | 2.94 | 0.66 | 7.43 | 19.4 | Increased hypochlorite dosing |
| 5/16/16 | 2152 | 11.8 | 6 | 4773 | <0.03 | 0.055 | 2.32 | 0.54 | 7.53 | 18.3 | |
| 5/17/16 | 0655 | 20 | 6 | 7725 | <0.03 | 0.053 | 2.14 | 1.13 | 7.54 | 18.5 | |
| 5/17/16 | 0800 | 21 | 6 | 8085 | | | | | | | Lab sampling |

**Column 4, variable gpm/ft$^2$**
**LayneOx™**

| Date | Time | Time Elapsed (hrs) | Loading Rate (GPM/ft.$^2$) | Total Flow (Gal.) | Fe (mg/L) | Mn (mg/L) | Free Cl2 (mg/L) Influent | Free Cl2 (mg/L) Effluent | pH | Temp. (°C) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/16/16 | 2152 | 0 | 12 | 0 | 0.04 | 0.117 | 2.32 | 0.90 | 7.19 | 19.1 | Well 13 |
| 5/17/16 | 0655 | 9 | 10 | 5940 | 0.03 | 0.055 | 2.14 | 2.03 | 7.54 | 19.2 | |
| 5/17/16 | 0800 | 10 | 10 | 6540 | | | | | | | Lab sampling |

## Trial 1

**Column 2 6 gpm/ft²**
**Greensand Plus**

| Date | Time | Time Elapsed (hrs) | Loading Rate (GPM/ft.$^2$) | Total Flow (Gal.) | Fe (mg/L) | Mn (mg/L) | Free Cl2 (mg/L) Influent | Free Cl2 (mg/L) Effluent | pH | Temp. (°C) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/16/16 | 1006 | 0 | 6 | 0 | | | 1.2 | 0.21 | | | Well 13 |
| 5/16/16 | 1106 | 1 | 6 | 360 | 0.06 | 0.029 | 1.1 | 0.30 | 7.47 | 20.9 | |
| 5/16/16 | 1406 | 4 | 6 | 1440 | <0.03 | 0.049 | 0.68 | 0.57 | 7.44 | 21.8 | |
| 5/16/16 | 1615 | 5.25 | 6 | 1890 | <0.03 | 0.037 | 0.60 | 0.22 | 7.37 | 21.6 | |
| 5/16/16 | 2000 | 10 | 6 | 3600 | 0.06 | 0.029 | 2.94 | 0.80 | 7.44 | 19.4 | Increased hypochlorite dosing |
| 5/16/16 | 2152 | 11.8 | 6 | 4248 | 0.04 | 0.074 | 2.32 | 1.31 | 7.49 | 18.9 | |
| 5/17/16 | 0655 | 20 | 6 | 7200 | 0.09 | 0.056 | 2.14 | 1.24 | 7.56 | 18.9 | |
| 5/17/16 | 0800 | 21 | 6 | 7560 | | | | | | | Lab sampling |

**Column 3 6 gpm/ft²**
**LayneOx™**

| Date | Time | Time Elapsed (hrs) | Loading Rate (GPM/ft.$^2$) | Total Flow (Gal.) | Fe (mg/L) | Mn (mg/L) | Free Cl2 (mg/L) Influent | Free Cl2 (mg/L) Effluent | pH | Temp. (°C) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/16/16 | 2000 | 0 | 6 | 0 | 0.05 | 0.041 | 2.94 | 0.45 | 7.38 | 19.5 | Well 13 |
| 5/16/16 | 2152 | 1.9 | 6 | 684 | 0.04 | 0.074 | 2.32 | 0.54 | 7.42 | 19.2 | |
| 5/17/16 | 0655 | 11 | 6 | 3960 | 0.26 | 0.052 | 2.14 | 0.55 | 7.45 | 19.2 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/17/16 | 0800 | 12 | 6 | 4320 | | | | | | | Lab sampling |

**Trial 2**

| Column 1, variable rate Greensand Plus | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Time** | **Time Elapsed (hrs)** | **Loading Rate (GPM/ft.$^2$)** | **Total Flow (Gal.)** | **Fe (mg/L)** | **Mn (mg/L)** | **Free Cl2 (mg/L) Influent** | **Free Cl2 (mg/L) Effluent** | **pH** | **Temp. (°C)** | **Notes** |
| 5/17/16 | 1705 | 0 | 8 | 6300 | <0.03 | 0.135 | 1.80 | 0.95 | 7.43 | 21.3 | Well 13 |
| 5/18/16 | 0715 | 14 | 7 | 7035 | <0.03 | 0.069 | 1.38 | 0.49 | | | |
| 5/18/16 | 0842 | 15.75 | 7 | 6300 | | | | | | | Lab sampling |

| Column 4 Variable gpm/ft$^2$ LayneOx™ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Time** | **Time Elapsed (hrs)** | **Loading Rate (GPM/ft.$^2$)** | **Total Flow (Gal.)** | **Fe (mg/L)** | **Mn (mg/L)** | **Free Cl2 (mg/L) Influent** | **Free Cl2 (mg/L) Effluent** | **pH** | **Temp. (°C)** | **Notes** |
| 5/17/16 | 1600 | 1.75 | 9 | 945 | <0.03 | 0.034 | 1.80 | 0.48 | 7.37 | 21.0 | Well 13 |
| 5/18/16 | 0715 | 14 | 7.5 | 6930* | <0.03 | 0.039 | 1.38 | 0.44 | | | |
| 5/18/16 | 0842 | 15.75 | 7.5 | 7088 | | | | | | | Lab sampling |

## Trial 2

| Column 2, 6 gpm/ft² Greensand Plus | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Time** | **Time Elapsed (hrs)** | **Loading Rate (GPM/ft.$^2$)** | **Total Flow (Gal.)** | **Fe (mg/L)** | **Mn (mg/L)** | **Free Cl2 (mg/L) Influent** | **Free Cl2 (mg/L) Effluent** | **pH** | **Temp. (°C)** | **Notes** |
| 5/17/16 | 1705 | 0 | 6 | 0 | <0.03 | 0.036 | 1.80 | 0.92 | 7.38 | 21.1 | Well 13 |
| 5/18/16 | 0715 | 14.25 | 6 | 5040 | <0.03 | 0.035 | 1.38 | 0.78 | | | |
| 5/18/16 | 0842 | 15.75 | 6 | 5670 | | | | | | | Lab sampling |

| Column 3 6 gpm/ft² LayneOx™ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Time** | **Time Elapsed (hrs)** | **Loading Rate (GPM/ft.$^2$)** | **Total Flow (Gal.)** | **Fe (mg/L)** | **Mn (mg/L)** | **Free Cl2 (mg/L) Influent** | **Free Cl2 (mg/L) Effluent** | **pH** | **Temp. (°C)** | **Notes** |
| 5/17/16 | 1243 | | | | | | 1.85 | | | | |
| 5/17/16 | 1600 | 1 | 6 | 360 | <0.03 | 0.036 | | 0.29 | 7.37 | 21.0 | |
| 5/17/16 | 1626 | | | | | | 1.80 | | | | |
| 5/17/16 | 1705 | 2 | 6 | 720 | <0.03 | 0.135 | 1.80 | 0.95 | 7.43 | 21.3 | Well 13 |
| 5/18/16 | 0715 | 15.25 | 6 | 5490 | <0.03 | 0.069 | 1.38 | 0.49 | | | |
| 5/18/16 | 0842 | 16.75 | 6 | 6030 | | | | | | | Lab sampling |

## Trial 3

| Column 1, variable rate Greensand Plus | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Time | Time Elapsed (hrs) | Loading Rate (GPM/ft.$^2$) | Total Flow (Gal.) | Fe (mg/L) | Mn (mg/L) | Free Cl2 (mg/L) Influent | Free Cl2 (mg/L) Effluent | Notes |
| 5/18/16 | 1529 | 2.5 | 8 to 6.5, to 4 | 982 | <0.03 | 0.056 | 1.38 | | Well 13; moved hypochlorite injection point to 100 ft upstream, increased hypochlorite concentration |
| 5/18/16 | 1605 | 3 | 4 | 1072 | <0.03 | 0.041 | | | |
| 5/18/16 | 1645 | 3.75 | 4 | 1252 | 0.03 | 0.066 | 1.62 | 0.86 | |
| 5/18/16 | 1800 | 5 | 4 | 1552 | | 0.066 | | | |
| 5/18/16 | 1900 | 6 | 4 | 1792 | | 0.062 | | | |
| 5/18/16 | 2000 | 7 | 3.8 | 2020 | | 0.057 | | | |
| 5/18/16 | 2100 | 8 | | 2248 | | 0.062 | | | |
| 5/18/16 | 2200 | 9 | 3.8 | 2476 | | 0.051 | | | |
| 5/18/16 | 2300 | 10 | 3.9 | 2710 | | 0.052 | | | |
| 5/19/16 | 0000 | 11 | 3.9 | 2944 | | 0.048 | | | |
| 5/19/16 | 0100 | 12 | 3.9 | 3178 | | 0.057 | | | |
| 5/19/16 | 0200 | 13 | 3.9 | 3412 | | 0.053 | | | |
| 5/19/16 | 0300 | 14 | 3.8 | 3640 | | 0.059 | | | |
| 5/19/16 | 0400 | 15 | | 3868 | | 0.042 | | | |
| 5/19/16 | 0500 | 16 | 3.8 | 4096 | | 0.046 | | | |
| 5/19/16 | 0600 | 17 | | 4324 | | 0.050 | | | |
| 5/19/16 | 0700 | 18 | 3.8 | 4552 | | 0.047 | | | |
| 5/19/16 | 0704 | 18 | | 4552 | | | | | Lab sampling |

## Trial 3

| Column 4<br>Variable gpm/ft$^2$ LayneOx™ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Time | Time Elapsed (hrs) | Loading Rate (GPM/ft.$^2$) | Total Flow (Gal.) | Fe (mg/L) | Mn (mg/L) | Free Cl2 (mg/L) Influent | Free Cl2 (mg/L) Effluent | Notes |
| 5/18/16 | 1500 | 2 | 8 | 960 | <0.03 | 0.045 | 1.38 | | Well 13; moved hypochlorite injection point to 100 ft upstream, increased hypochlorite concentration |
| 5/18/16 | 1645 | 3.75 | 8 | 1800 | <0.03 | 0.049 | 1.62 | 0.62 | |
| 5/18/16 | 1800 | 5 | 8 | 2400 | | 0.042 | | | |
| 5/18/16 | 1900 | 6 | 8 | 2880 | | 0.045 | | | |
| 5/18/16 | 2000 | 7 | 7.75 | 3345 | | 0.045 | | | |
| 5/18/16 | 2100 | 8 | | 3810 | | 0.043 | | | |
| 5/18/16 | 2200 | 9 | 7.5 | 4260 | | 0.034 | | | |
| 5/18/16 | 2300 | 10 | 7.3 | 4698 | | 0.046 | | | |
| 5/19/16 | 0000 | 11 | 7.3 | 5136 | | 0.048 | | | |
| 5/19/16 | 0100 | 12 | 6.9 | 5550 | | 0.044 | | | |
| 5/19/16 | 0200 | 13 | 6.9 | 5964 | | 0.052 | | | |
| 5/19/16 | 0300 | 14 | 6.4 | 6348 | | 0.034 | | | |
| 5/19/16 | 0400 | 15 | | 6732 | | 0.042 | | | |
| 5/19/16 | 0500 | 16 | 6.5 | 7122 | | 0.044 | | | |
| 5/19/16 | 0600 | 17 | | 7512 | | 0.038 | | | |
| 5/19/16 | 0700 | 18 | 6.5 | 7902 | | 0.050 | | | |
| 5/19/16 | 0704 | 18 | | 7902 | | | | | Lab sampling |

Trial 3

| Column 2, 6 gpm/ft² Greensand Plus | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Time | Time Elapsed (hrs) | Loading Rate (GPM/ft.$^2$) | Total Flow (Gal.) | Fe (mg/L) | Mn (mg/L) | Free Cl2 (mg/L) Influent | Free Cl2 (mg/L) Effluent | Notes |
| 5/18/16 | 1529 | 2.5 | 6 | 900 | <0.03 | 0.043 | 1.38 | | Well 13; moved hypochlorite injection point to 100 ft upstream, increased hypochlorite concentration |
| 5/18/16 | 1645 | 3.75 | 6 | 1350 | < 0.03 | 0.044 | 1.62 | 0.90 | |
| 5/18/16 | 1800 | 5 | 6 | 1800 | < 0.03 | 0.0.042 | | | |
| 5/18/16 | 1900 | 6 | 6 | 2160 | | 0.039 | | | |
| 5/18/16 | 2000 | 7 | 5.8 | 2508 | | 0.046 | | | |
| 5/18/16 | 2100 | 8 | | 2856 | | 0.039 | | | |
| 5/18/16 | 2200 | 9 | 5.7 | 3195 | | 0.034 | | | |
| 5/18/16 | 2300 | 10 | 5.7 | 3450 | | 0.057 | | | |
| 5/19/16 | 0000 | 11 | 5.7 | 3882 | | 0.053 | | | |
| 5/19/16 | 0100 | 12 | 5.7 | 4224 | | 0.067 | | | |
| 5/19/16 | 0200 | 13 | 5.7 | 4566 | | 0.056 | | | |
| 5/19/16 | 0300 | 14 | 5.7 | 4908 | | 0.051 | | | |
| 5/19/16 | 0400 | 15 | | 5250 | | 0.036 | | | |
| 5/19/16 | 0500 | 16 | 5.7 | 5592 | | 0.050 | | | |
| 5/19/16 | 0600 | 17 | | 5934 | | 0.072 | | | |
| 5/19/16 | 0700 | 18 | 5.7 | 6276 | | 0.055 | | | |
| 5/19/16 | 0704 | 18 | | 6276 | | | | | Lab sampling |

## Trial 3

| Column 3<br>6 gpm/ft$^2$ LayneOx™ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Time | Time Elapsed (hrs) | Loading Rate (GPM/ft.$^2$) | Total Flow (Gal.) | Fe (mg/L) | Mn (mg/L) | Free Cl2 (mg/L) Influent | Free Cl2 (mg/L) Effluent | Notes |
| 5/18/16 | 1500 | 2 | 6 | 720 | <0.03 | 0.045 | 1.38 | | Well 13; moved hypochlorite injection point to 100 ft upstream, increased hypochlorite concentration |
| 5/18/16 | 1605 | 3 | 6 | 1080 | <0.03 | 0.041 | | | |
| 5/18/16 | 1645 | 3.75 | 6 | 1350 | <0.03 | 0.043 | 1.62 | 0.48 | |
| 5/18/16 | 1800 | 5 | 6 | 1880 | | 0.039 | | | |
| 5/18/16 | 1900 | 6 | 6 | 2160 | | 0.033 | | | |
| 5/18/16 | 2000 | 7 | 6 | 2520 | | 0.034 | | | |
| 5/18/16 | 2100 | 8 | 6 | 2880 | | 0.041 | | | |
| 5/18/16 | 2200 | 9 | 6 | 3240 | | 0.037 | | | |
| 5/18/16 | 2300 | 10 | 6 | 3600 | | 0.046 | | | |
| 5/19/16 | 0000 | 11 | 6 | 3960 | | 0.041 | | | |
| 5/19/16 | 0100 | 12 | 6 | 4320 | | 0.039 | | | |
| 5/19/16 | 0200 | 13 | 6 | 4680 | | 0.049 | | | |
| 5/19/16 | 0300 | 14 | 5.7 | 5022 | | 0.038 | | | |
| 5/19/16 | 0400 | 15 | | 5364 | | 0.040 | | | |
| 5/19/16 | 0500 | 16 | 5.7 | 5706 | | 0.037 | | | |
| 5/19/16 | 0600 | 17 | | 6048 | | 0.042 | | | |
| 5/19/16 | 0700 | 18 | 5.7 | 6390 | | 0.047 | | | |
| 5/19/16 | 0704 | 18 | | 6390 | | | | | Lab sampling |

## Trial 4

| Column 1, variable rate Greensand Plus | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Time** | **Time Elapsed (hrs)** | **Loading Rate (GPM/ft.$^2$)** | **Total Flow (Gal.)** | **Fe (mg/L)** | **Mn (mg/L)** | **Free Cl2 (mg/L) Influent** | **Free Cl2 (mg/L) Effluent** | **pH** | **Temp. (°C)** | **Notes** |
| 5/19/16 | 1558 | 0 | 8 | 0 | <0.03 | 0.027 | 3.78 | 3.3 | 7.71 | 21.7 | Water source moved to Well 12, new hypochlorite solution |
| 5/19/16 | 1700 | 1 | 8 | 480 | | | 2.28 | 1.80 | | | |
| 5/20/16 | 0701 | 15 | 6.5 | 6962 | <0.03 | 0.044 | 1.12 | 0.93 | 7.60 | 20.3 | |
| 5/20/16 | 0800 | 16 | 6.5 | 7352 | | | | | | | Lab sampling |

| Column 4 Variable gpm/ft$^2$ LayneOx™ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Time** | **Time Elapsed (hrs)** | **Loading Rate (GPM/ft.$^2$)** | **Total Flow (Gal.)** | **Fe (mg/L)** | **Mn (mg/L)** | **Free Cl2 (mg/L) Influent** | **Free Cl2 (mg/L) Effluent** | **pH** | **Temp. (°C)** | **Notes** |
| 5/19/16 | 1558 | 0 | 10 | 0 | <0.03 | 0.024 | 3.78 | 2.13 | 7.51 | 21.4 | Water source moved to Well 12, new hypochlorite solution |
| 5/19/16 | 1700 | 1 | 10 | 600 | | | 2.28 | 0.78 | | | |
| 5/20/16 | 0701 | 15 | 7 | | <0.03 | 0.028 | 1.12 | 0.42 | 7.60 | 19.7 | |
| 5/20/16 | 0800 | 16 | 7 | | | | | | | | Lab sampling |

## Trial 4

| Column 2, 6 gpm/ft² Greensand Plus | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Time | Time Elapsed (hrs) | Loading Rate (GPM/ft.$^2$) | Total Flow (Gal.) | Fe (mg/L) | Mn (mg/L) | Free Cl2 (mg/L) Influent | Free Cl2 (mg/L) Effluent | pH | Temp. (°C) | Notes |
| 5/19/16 | 1558 | 0 | 6 | 0 | <0.03 | 0.022 | 3.78 | 3.16 | 7.62 | 21.5 | Water source moved to Well 12, new hypochlorite solution |
| 5/19/16 | 1700 | | | | | | 2.28 | 1.80 | | | |
| 5/20/16 | 0701 | 15 | 6 | 5400 | <0.03 | 0.028 | 1.12 | 0.86 | 7.62 | 20.0 | |
| 5/20/16 | 0800 | 16 | 6 | 5760 | | | | | | | Lab sampling |

| Column 3 6 gpm/ft² LayneOx™ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Time | Time Elapsed (hrs) | Loading Rate (GPM/ft.$^2$) | Total Flow (Gal.) | Fe (mg/L) | Mn (mg/L) | Free Cl2 (mg/L) Influent | Free Cl2 (mg/L) Effluent | pH | Temp. (°C) | Notes |
| 5/19/16 | 1558 | 0 | 6 | 0 | <0.03 | 0.003 | 3.78 | 1.62 | 7.53 | 21.4 | Water source moved to Well 12, new hypochlorite solution |
| 5/19/16 | 1700 | 1 | 6 | 360 | | | 2.28 | 0.78 | | | |
| 5/20/16 | 0701 | 15 | 6 | 5400 | <0.03 | 0.028 | 1.12 | 0.42 | 7.60 | 19.7 | |
| 5/20/16 | 0800 | 16 | 6 | 5760 | | | | | | | Lab sampling |

**Appendix D**

Laboratory Data from FGL Inc, 853 Corporation St., Santa Paula, CA  93060

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

| | | | |
|---|---|---|---|
| **United Water Conservation Dist** | | Lab ID | : SP 1605581 |
| Attn: Mike Ellis | | Customer | : 2-200 |
| 106 N. 8th St. | | | |
| Santa Paula, CA 93060 | | | |

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 1 Greensand After Pilot | 05/16/2016 | 05/17/2016 | SP 1605581-001 | DW |
| Column 1 Greensand After Pilot | 05/16/2016 | 05/17/2016 | SP 1605581-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/18/2016:206966 All analysis quality controls are within established criteria |
| | 05/18/2016:205782 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605581-001
Customer ID : 2-200

Sampled On : May 16, 2016-13:52
Sampled By : Ruth Haldeman
Received On : May 17, 2016-15:34
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605581-002
Customer ID : 2-200

Sampled On : May 16, 2016-16:57
Sampled By : Ruth Haldeman
Received On : May 17, 2016-15:34
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 24, 2016 Lab ID : SP 1605581
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 103 % | 75-125 | |
| | | (SP 1605567-003) | MSD | ug/L | 4000 | 117 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 12.9% | ≤20.0 | |
| | 200.7 | 05/18/16:206966AC | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0038 | 0.03 | |
| | | | CCV | ppm | 5.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.0033 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 105 % | 75-125 | |
| | | (SP 1605567-003) | MSD | ug/L | 800.0 | 119 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 11.8% | ≤20.0 | |
| | 200.7 | 05/18/16:206966AC | CCV | ppm | 1.000 | 106 % | 90-110 | |
| | | | CCB | ppm | | 0.00005 | 0.01 | |
| | | | CCV | ppm | 1.000 | 106 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605690-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 17, 2016-08:00
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:54
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605690-001
Customer ID : 2-200

Sampled On : May 17, 2016-08:00
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:54
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^{2}$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |
| Manganese | ND | 10 | ug/L | $50^{2}$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605690-002
Customer ID : 2-200

Sampled On : May 17, 2016-17:35
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:54
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 24, 2016
**United Water Conservation Dist**

Lab ID : SP 1605690
Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 111 % | 75-125 | |
| | | (SP 1605686-001) | MSD | ug/L | 4000 | 109 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 1.4% | ≤20.0 | |
| | 200.7 | 05/19/16:206966AC | CCV | ppm | 5.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.0032 | 0.03 | |
| | | | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0032 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 113 % | 75-125 | |
| | | (SP 1605686-001) | MSD | ug/L | 800.0 | 112 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 1.7% | ≤20.0 | |
| | 200.7 | 05/19/16:206966AC | CCV | ppm | 1.000 | 105 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |
| | | | CCV | ppm | 1.000 | 105 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |

| **Definition** | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605713
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 1 Greensand After Pilot | 05/18/2016 | 05/19/2016 | SP 1605713-001 | DW |
| Column 1 Greensand After Pilot | 05/18/2016 | 05/19/2016 | SP 1605713-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/20/2016:206891 All analysis quality controls are within established criteria |
| | 05/19/2016:205849 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



**Corporate Offices & Laboratory** 853 Corporation Street Santa Paula, CA 93060 TEL: (805)392-2000 Env FAX: (805)525-4172 / Ag FAX: (805)392-2063 CA ELAP Certification No. 1573

**Office & Laboratory** 2500 Stagecoach Road Stockton, CA 95215 TEL: (209)942-0182 FAX: (209)942-0423 CA ELAP Certification No. 1563

**Office & Laboratory** 563 E. Lindo Avenue Chico, CA 95926 TEL: (530)343-5818 FAX: (530)343-3807 CA ELAP Certification No. 2670

**Office & Laboratory** 3442 Empresa Drive, Suite D San Luis Obispo, CA 93401 TEL: (805)783-2940 FAX: (805)783-2912 CA ELAP Certification No. 2775

**Office & Laboratory** 9415 W. Goshen Avenue Visalia, CA 93291 TEL: (559)734-9473 FAX: (559)734-8435 CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605713-001
Customer ID : 2-200

Sampled On : May 18, 2016-08:42
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605713-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 18, 2016-15:46
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**P:1'5 | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 24, 2016
**United Water Conservation Dist**

Lab ID : SP 1605713
Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 103 % | 75-125 | |
| | | (SP 1605711-001) | MSD | ug/L | 4000 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.7% | ≤20.0 | |
| | 200.7 | 05/20/16:206891AC | CCV | ppm | 5.000 | 98.2 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.03 | |
| | | | CCV | ppm | 5.000 | 100 % | 90-110 | |
| | | | CCB | ppm | | -0.0002 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 107 % | 75-125 | |
| | | (SP 1605711-001) | MSD | ug/L | 800.0 | 105 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 2.7% | ≤20.0 | |
| | 200.7 | 05/20/16:206891AC | CCV | ppm | 1.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |
| | | | CCV | ppm | 1.000 | 99.6 % | 90-110 | |
| | | | CCB | ppm | | 0.0002 | 0.01 | |

| Definition | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605781
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 1 Greensand After Pilot | 05/19/2016 | 05/20/2016 | SP 1605781-001 | DW |
| Column 1 Greensand After Pilot | 05/20/2016 | 05/20/2016 | SP 1605781-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/23/2016:207249 All analysis quality controls are within established criteria |
| | 05/23/2016:206004 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016

Lab ID : SP 1605781-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-16:15
Sampled By : R.M./N.S.
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605781-002
Customer ID : 2-200

Sampled On : May 20, 2016-08:00
Sampled By : R.M./N.S.
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016 Lab ID : SP 1605781
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 105 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 4000 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 1.7% | ≤20.0 | |
| | | | MS | ug/L | 4000 | 108 % | 75-125 | |
| | | (SP 1605785-006) | MSD | ug/L | 4000 | 104 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 3.0% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 5.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | -0.0006 | 0.03 | |
| | | | CCV | ppm | 5.000 | 99.6 % | 90-110 | |
| | | | CCB | ppm | | -0.0003 | 0.03 | |
| | | | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | -0.0003 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 103 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 800.0 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.6% | ≤20.0 | |
| | | | MS | ug/L | 800.0 | 107 % | 75-125 | |
| | | (SP 1605785-006) | MSD | ug/L | 800.0 | 101 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 5.0% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 1.000 | 94.1 % | 90-110 | |
| | | | CCB | ppm | | -0.00001 | 0.01 | |
| | | | CCV | ppm | 1.000 | 96.5 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |
| | | | CCV | ppm | 1.000 | 100 % | 90-110 | |
| | | | CCB | ppm | | -0.00002 | 0.01 | |

| **Definition** | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605707
Customer : 2-200

**Laboratory Report**

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

**Case Narrative**

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 1 Greensand After Pilot | 05/19/2016 | 05/19/2016 | SP 1605707-001 | DW |
| Column 1 Greensand After Pilot | 05/19/2016 | 05/19/2016 | SP 1605707-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

**Inorganic - Metals QC**

| | |
|---|---|
| 200.7 | 05/19/2016:206891 All analysis quality controls are within established criteria |
| | 05/19/2016:205849 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL
ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605707-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-03:00
Sampled By : Ruth Haldeman / Norm
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: () , (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605707-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-07:04
Sampled By : Ruth Haldeman / Norm
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Silica | 26 | 1 | mg/L | | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: () , (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016 Lab ID : SP 1605707
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 4000 | 98.1 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.2% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 5.000 | 96.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00005 | 0.03 | |
| | | | CCV | ppm | 5.000 | 98.2 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 800.0 | 96.2 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 2.1% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 1.000 | 99.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00009 | 0.01 | |
| | | | CCV | ppm | 1.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |
| Silicon | 200.7 | | MS | mg/L | 2.400 | 67.4 % | <¼ | |
| | | (SP 1605706-001) | MSD | mg/L | 2.400 | 63.0 % | <¼ | |
| | | | MSRPD | mg/L | 800.0 | 0.7% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 5.000 | 97.6 % | 90-110 | |
| | | | CCB | ppm | | 0.07 | 1 | |
| | | | CCV | ppm | 5.000 | 95.6 % | 90-110 | |
| | | | CCB | ppm | | 0.07 | 1 | |

| **Definition** | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| <¼ | : High Sample Background - Spike concentration was less than one forth of the sample concentration. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605581
Customer : 2-200

**Laboratory Report**

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

**Case Narrative**

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 1 Greensand After Pilot | 05/16/2016 | 05/17/2016 | SP 1605581-001 | DW |
| Column 1 Greensand After Pilot | 05/16/2016 | 05/17/2016 | SP 1605581-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

**Inorganic - Metals QC**

| | |
|---|---|
| 200.7 | 05/18/2016:206966 All analysis quality controls are within established criteria |
| | 05/18/2016:205782 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



**Corporate Offices & Laboratory** 853 Corporation Street Santa Paula, CA 93060 TEL: (805)392-2000 Env FAX: (805)525-4172 / Ag FAX: (805)392-2063 CA ELAP Certification No. 1573

**Office & Laboratory** 2500 Stagecoach Road Stockton, CA 95215 TEL: (209)942-0182 FAX: (209)942-0423 CA ELAP Certification No. 1563

**Office & Laboratory** 563 E. Lindo Avenue Chico, CA 95926 TEL: (530)343-5818 FAX: (530)343-3807 CA ELAP Certification No. 2670

**Office & Laboratory** 3442 Empresa Drive, Suite D San Luis Obispo, CA 93401 TEL: (805)783-2940 FAX: (805)783-2912 CA ELAP Certification No. 2775

**Office & Laboratory** 9415 W. Goshen Avenue Visalia, CA 93291 TEL: (559)734-9473 FAX: (559)734-8435 CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605581-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 16, 2016-13:52
Sampled By : Ruth Haldeman
Received On : May 17, 2016-15:34
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605581-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 16, 2016-16:57
Sampled By : Ruth Haldeman
Received On : May 17, 2016-15:34
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016 Lab ID : SP 1605581
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 103 % | 75-125 | |
| | | (SP 1605567-003) | MSD | ug/L | 4000 | 117 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 12.9% | ≤20.0 | |
| | 200.7 | 05/18/16:206966AC | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0038 | 0.03 | |
| | | | CCV | ppm | 5.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.0033 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 105 % | 75-125 | |
| | | (SP 1605567-003) | MSD | ug/L | 800.0 | 119 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 11.8% | ≤20.0 | |
| | 200.7 | 05/18/16:206966AC | CCV | ppm | 1.000 | 106 % | 90-110 | |
| | | | CCB | ppm | | 0.00005 | 0.01 | |
| | | | CCV | ppm | 1.000 | 106 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |

| Definition | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605690
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 1 Greensand After Pilot | 05/17/2016 | 05/18/2016 | SP 1605690-001 | DW |
| Column 1 Greensand After Pilot | 05/17/2016 | 05/18/2016 | SP 1605690-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/19/2016:206966 All analysis quality controls are within established criteria |
| | 05/18/2016:205789 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.**
Digitally signed by Kelly A. Dunnahoo, B.S
Title: Laboratory Director
Date: 2016-05-25



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

Layne
WATER · MINERAL · ENERGY

FGL
ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605690-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 17, 2016-08:00
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:54
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation Method | Sample Preparation Date/ID | Sample Analysis Method | Sample Analysis Date/ID |
|---|---|---|---|---|---|---|---|---|
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605690-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 17, 2016-17:35
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:54
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**P:1'5 | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016 Lab ID : SP 1605690
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 111 % | 75-125 | |
| | | (SP 1605686-001) | MSD | ug/L | 4000 | 109 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 1.4% | ≤20.0 | |
| | 200.7 | 05/19/16:206966AC | CCV | ppm | 5.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.0032 | 0.03 | |
| | | | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0032 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 113 % | 75-125 | |
| | | (SP 1605686-001) | MSD | ug/L | 800.0 | 112 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 1.7% | ≤20.0 | |
| | 200.7 | 05/19/16:206966AC | CCV | ppm | 1.000 | 105 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |
| | | | CCV | ppm | 1.000 | 105 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605713
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 1 Greensand After Pilot | 05/18/2016 | 05/19/2016 | SP 1605713-001 | DW |
| Column 1 Greensand After Pilot | 05/18/2016 | 05/19/2016 | SP 1605713-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/20/2016:206891 All analysis quality controls are within established criteria |
| | 05/19/2016:205849 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.**
Digitally signed by Kelly A. Dunnahoo, B.S
Title: Laboratory Director
Date: 2016-05-25



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER • MINERAL • ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605713-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 18, 2016-08:42
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL
ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605713-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 18, 2016-15:46
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:T5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016 Lab ID : SP 1605713
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 103 % | 75-125 | |
| | | (SP 1605711-001) | MSD | ug/L | 4000 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.7% | ≤20.0 | |
| | 200.7 | 05/20/16:206891AC | CCV | ppm | 5.000 | 98.2 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.03 | |
| | | | CCV | ppm | 5.000 | 100 % | 90-110 | |
| | | | CCB | ppm | | -0.0002 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 107 % | 75-125 | |
| | | (SP 1605711-001) | MSD | ug/L | 800.0 | 105 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 2.7% | ≤20.0 | |
| | 200.7 | 05/20/16:206891AC | CCV | ppm | 1.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |
| | | | CCV | ppm | 1.000 | 99.6 % | 90-110 | |
| | | | CCB | ppm | | 0.0002 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

FGL ENVIRONMENTAL AGRICULTURAL Analytical Chemists

May 25, 2016

| | | |
|---|---|---|
| **United Water Conservation Dist** | Lab ID | : SP 1605781 |
| Attn: Mike Ellis | Customer | : 2-200 |
| 106 N. 8th St. | | |
| Santa Paula, CA 93060 | | |

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 1 Greensand After Pilot | 05/19/2016 | 05/20/2016 | SP 1605781-001 | DW |
| Column 1 Greensand After Pilot | 05/20/2016 | 05/20/2016 | SP 1605781-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/23/2016:207249 All analysis quality controls are within established criteria |
| | 05/23/2016:206004 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25

KD:DMB



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605781-001
Customer ID : 2-200

Sampled On : May 19, 2016-16:15
Sampled By : R.M./N.S.
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**P:1'5 | | | | | | | | |
| Iron | ND | 30 | ug/L | 300$^2$ | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | ND | 10 | ug/L | 50$^2$ | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605781-002
Customer ID : 2-200

Sampled On : May 20, 2016-08:00
Sampled By : R.M./N.S.
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

Layne

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL

Analytical Chemists

May 25, 2016 | Lab ID : SP 1605781

**United Water Conservation Dist** | Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 105 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 4000 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 1.7% | ≤20.0 | |
| | | | MS | ug/L | 4000 | 108 % | 75-125 | |
| | | (SP 1605785-006) | MSD | ug/L | 4000 | 104 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 3.0% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 5.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | -0.0006 | 0.03 | |
| | | | CCV | ppm | 5.000 | 99.6 % | 90-110 | |
| | | | CCB | ppm | | -0.0003 | 0.03 | |
| | | | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | -0.0003 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 103 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 800.0 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.6% | ≤20.0 | |
| | | | MS | ug/L | 800.0 | 107 % | 75-125 | |
| | | (SP 1605785-006) | MSD | ug/L | 800.0 | 101 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 5.0% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 1.000 | 94.1 % | 90-110 | |
| | | | CCB | ppm | | -0.00001 | 0.01 | |
| | | | CCV | ppm | 1.000 | 96.5 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |
| | | | CCV | ppm | 1.000 | 100 % | 90-110 | |
| | | | CCB | ppm | | -0.00002 | 0.01 | |

| **Definition** | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605707
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 1 Greensand After Pilot | 05/19/2016 | 05/19/2016 | SP 1605707-001 | DW |
| Column 1 Greensand After Pilot | 05/19/2016 | 05/19/2016 | SP 1605707-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/19/2016:206891 All analysis quality controls are within established criteria |
| | 05/19/2016:205849 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



**Corporate Offices & Laboratory** 853 Corporation Street Santa Paula, CA 93060 TEL: (805)392-2000 Env FAX: (805)525-4172 / Ag FAX: (805)392-2063 CA ELAP Certification No. 1573

**Office & Laboratory** 2500 Stagecoach Road Stockton, CA 95215 TEL: (209)942-0182 FAX: (209)942-0423 CA ELAP Certification No. 1563

**Office & Laboratory** 563 E. Lindo Avenue Chico, CA 95926 TEL: (530)343-5818 FAX: (530)343-3807 CA ELAP Certification No. 2670

**Office & Laboratory** 3442 Empresa Drive, Suite D San Luis Obispo, CA 93401 TEL: (805)783-2940 FAX: (805)783-2912 CA ELAP Certification No. 2775

**Office & Laboratory** 9415 W. Goshen Avenue Visalia, CA 93291 TEL: (559)734-9473 FAX: (559)734-8435 CA ELAP Certification No. 2810

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605707-001
Customer ID : 2-200

Sampled On : May 19, 2016-03:00
Sampled By : Ruth Haldeman / Norm
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

### Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: () , (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

FGL
ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605707-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-07:04
Sampled By : Ruth Haldeman / Norm
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 1 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Silica | 26 | 1 | mg/L | | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: () , (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016 Lab ID : SP 1605707
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 4000 | 98.1 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.2% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 5.000 | 96.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00005 | 0.03 | |
| | | | CCV | ppm | 5.000 | 98.2 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 800.0 | 96.2 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 2.1% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 1.000 | 99.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00009 | 0.01 | |
| | | | CCV | ppm | 1.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |
| Silicon | 200.7 | | MS | mg/L | 2.400 | 67.4 % | <¼ | |
| | | (SP 1605706-001) | MSD | mg/L | 2.400 | 63.0 % | <¼ | |
| | | | MSRPD | mg/L | 800.0 | 0.7% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 5.000 | 97.6 % | 90-110 | |
| | | | CCB | ppm | | 0.07 | 1 | |
| | | | CCV | ppm | 5.000 | 95.6 % | 90-110 | |
| | | | CCB | ppm | | 0.07 | 1 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| <¼ | : High Sample Background - Spike concentration was less than one forth of the sample concentration. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

June 1, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605582
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 2 Greensand After Pilot | 05/16/2016 | 05/17/2016 | SP 1605582-001 | DW |
| Column 2 Greensand After Pilot | 05/16/2016 | 05/17/2016 | SP 1605582-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/18/2016:206966 All analysis quality controls are within established criteria |
| | 05/18/2016:205782 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-06-01



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

June 1, 2016

Lab ID : SP 1605582-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 16, 2016-13:55
Sampled By : Ruth Haldeman
Received On : May 17, 2016-15:34
Matrix : Drinking Water

Description : Column 2 Greensand After Pilot
Project : Pilot Study-Column 2 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total** P:1'5 | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |
| Manganese | 10 | 10 | ug/L | $50^2$ | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

June 1, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605582-002
Customer ID : 2-200

Sampled On : May 16, 2016-16:56
Sampled By : Ruth Haldeman
Received On : May 17, 2016-15:34
Matrix : Drinking Water

Description : Column 2 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1,5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/18/16:205782 | 200.7 | 05/18/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

June 1, 2016
**United Water Conservation Dist**

Lab ID : SP 1605582
Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 103 % | 75-125 | |
| | | (SP 1605567-003) | MSD | ug/L | 4000 | 117 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 12.9% | ≤20.0 | |
| | 200.7 | 05/18/16:206966AC | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0038 | 0.03 | |
| | | | CCV | ppm | 5.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.0033 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 105 % | 75-125 | |
| | | (SP 1605567-003) | MSD | ug/L | 800.0 | 119 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 11.8% | ≤20.0 | |
| | 200.7 | 05/18/16:206966AC | CCV | ppm | 1.000 | 106 % | 90-110 | |
| | | | CCB | ppm | | 0.00005 | 0.01 | |
| | | | CCV | ppm | 1.000 | 106 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605686
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 2 Greensand After Pilot | 05/17/2016 | 05/18/2016 | SP 1605686-001 | DW |
| Column 2 Greensand After Pilot | 05/17/2016 | 05/18/2016 | SP 1605686-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/19/2016:206966 All analysis quality controls are within established criteria |
| | 05/18/2016:205789 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25

KD:DMB



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

| | |
|---|---|
| May 24, 2016 | Lab ID : SP 1605686-001 |
| | Customer ID : 2-200 |
| **United Water Conservation Dist** | |
| Attn: Mike Ellis | Sampled On : May 17, 2016-08:00 |
| 106 N. 8th St. | Sampled By : Ruth Haldeman |
| Santa Paula, CA 93060 | Received On : May 18, 2016-15:55 |
| | Matrix : Drinking Water |

Description : Column 2 Greensand After Pilot
Project : Pilot Study-Column 2 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation Method | Sample Preparation Date/ID | Sample Analysis Method | Sample Analysis Date/ID |
|---|---|---|---|---|---|---|---|---|
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605686-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 17, 2016-17:45
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:55
Matrix : Drinking Water

Description : Column 2 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1‡5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 24, 2016 Lab ID : SP 1605686
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 111 % | 75-125 | |
| | | (SP 1605686-001) | MSD | ug/L | 4000 | 109 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 1.4% | ≤20.0 | |
| | 200.7 | 05/19/16:206966AC | CCV | ppm | 5.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.0032 | 0.03 | |
| | | | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0032 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 113 % | 75-125 | |
| | | (SP 1605686-001) | MSD | ug/L | 800.0 | 112 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 1.7% | ≤20.0 | |
| | 200.7 | 05/19/16:206966AC | CCV | ppm | 1.000 | 105 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |
| | | | CCV | ppm | 1.000 | 105 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605710
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 2 Greensand After Pilot | 05/18/2016 | 05/19/2016 | SP 1605710-001 | DW |
| Column 2 Greensand After Pilot | 05/18/2016 | 05/19/2016 | SP 1605710-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/19/2016:206891 All analysis quality controls are within established criteria |
| | 05/19/2016:205849 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25

KD:DMB



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605710-001
Customer ID : 2-200

Sampled On : May 18, 2016-08:42
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 2 Greensand After Pilot
Project : Pilot Study-Column 2 Greensand

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605710-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 18, 2016-15:46
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 2 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

### Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER • MINERAL • ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016 Lab ID : SP 1605710
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 4000 | 98.1 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.2% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 5.000 | 96.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00005 | 0.03 | |
| | | | CCV | ppm | 5.000 | 98.2 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 800.0 | 96.2 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 2.1% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 1.000 | 99.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00009 | 0.01 | |
| | | | CCV | ppm | 1.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605706
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 2 Greensand After Pilot | 05/19/2016 | 05/19/2016 | SP 1605706-001 | DW |
| Column 2 Greensand After Pilot | 05/19/2016 | 05/19/2016 | SP 1605706-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/19/2016:206891 All analysis quality controls are within established criteria |
| | 05/19/2016:205849 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



**Corporate Offices & Laboratory** 853 Corporation Street Santa Paula, CA 93060 TEL: (805)392-2000 Env FAX: (805)525-4172 / Ag FAX: (805)392-2063 CA ELAP Certification No. 1573
**Office & Laboratory** 2500 Stagecoach Road Stockton, CA 95215 TEL: (209)942-0182 FAX: (209)942-0423 CA ELAP Certification No. 1563
**Office & Laboratory** 563 E. Lindo Avenue Chico, CA 95926 TEL: (530)343-5818 FAX: (530)343-3807 CA ELAP Certification No. 2670
**Office & Laboratory** 3442 Empresa Drive, Suite D San Luis Obispo, CA 93401 TEL: (805)783-2940 FAX: (805)783-2912 CA ELAP Certification No. 2775
**Office & Laboratory** 9415 W. Goshen Avenue Visalia, CA 93291 TEL: (559)734-9473 FAX: (559)734-8435 CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605706-001
Customer ID : 2-200

Sampled On : May 19, 2016-03:00
Sampled By : Ruth Haldeman / Norm
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 2 Greensand After Pilot
Project : Pilot Study-Column 2 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: () , (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Description : Column 2 Greensand After Pilot
Project : Pilot Study-Column 1 Greensand

Lab ID : SP 1605706-002
Customer ID : 2-200

Sampled On : May 19, 2016-07:04
Sampled By : Ruth Haldeman / Norm
Received On : May 19, 2016-10:19
Matrix : Drinking Water

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Silica | 26 | 1 | mg/L | | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: () , (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016
**United Water Conservation Dist**

Lab ID : SP 1605706
Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 4000 | 98.1 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.2% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 5.000 | 96.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00005 | 0.03 | |
| | | | CCV | ppm | 5.000 | 98.2 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 800.0 | 96.2 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 2.1% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 1.000 | 99.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00009 | 0.01 | |
| | | | CCV | ppm | 1.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |
| Silicon | 200.7 | | MS | mg/L | 2.400 | 67.4 % | <¼ | |
| | | (SP 1605706-001) | MSD | mg/L | 2.400 | 63.0 % | <¼ | |
| | | | MSRPD | mg/L | 800.0 | 0.7% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 5.000 | 97.6 % | 90-110 | |
| | | | CCB | ppm | | 0.07 | 1 | |
| | | | CCV | ppm | 5.000 | 95.6 % | 90-110 | |
| | | | CCB | ppm | | 0.07 | 1 | |

| **Definition** | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| <¼ | : High Sample Background - Spike concentration was less than one forth of the sample concentration. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605783
Customer : 2-200

**Laboratory Report**

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

**Case Narrative**

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 2 Greensand After Pilot | 05/19/2016 | 05/20/2016 | SP 1605783-001 | DW |
| Column 2 Greensand After Pilot | 05/20/2016 | 05/20/2016 | SP 1605783-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

**Inorganic - Metals QC**

| | |
|---|---|
| 200.7 | 05/23/2016:207249 All analysis quality controls are within established criteria |
| | 05/23/2016:206004 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605783-001
Customer ID : 2-200

Sampled On : May 19, 2016-16:15
Sampled By : R.M./N.S.
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Column 2 Greensand After Pilot
Project : Pilot Study-Column 2 Greensand

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605783-002
Customer ID : 2-200

Sampled On : May 20, 2016-08:00
Sampled By : R.M./N.S.
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Column 2 Greensand After Pilot
Project : Pilot Study-Column 2 Greensand

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation Method | Sample Preparation Date/ID | Sample Analysis Method | Sample Analysis Date/ID |
|---|---|---|---|---|---|---|---|---|
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016 Lab ID : SP 1605783
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 105 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 4000 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 1.7% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 5.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | -0.0006 | 0.03 | |
| | | | CCV | ppm | 5.000 | 99.6 % | 90-110 | |
| | | | CCB | ppm | | -0.0003 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 103 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 800.0 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.6% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 1.000 | 94.1 % | 90-110 | |
| | | | CCB | ppm | | -0.00001 | 0.01 | |
| | | | CCV | ppm | 1.000 | 96.5 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605688
Customer : 2-200

**Laboratory Report**

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

**Case Narrative**

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 3 LayneOx After Pilot | 05/17/2016 | 05/18/2016 | SP 1605688-001 | DW |
| Column 3 LayneOx After Pilot | 05/17/2016 | 05/18/2016 | SP 1605688-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

**Inorganic - Metals QC**

| | |
|---|---|
| 200.7 | 05/19/2016:206966 All analysis quality controls are within established criteria |
| | 05/18/2016:205789 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605688-001
Customer ID : 2-200

Sampled On : May 17, 2016-08:00
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:55
Matrix : Drinking Water

Description : Column 3 LayneOx After Pilot
Project : Pilot Study-Column 3 LayneOx

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605688-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 17, 2016-16:44
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:55
Matrix : Drinking Water

Description : Column 3 LayneOx After Pilot
Project : Pilot Study-Column 3 LayneOx

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016 | Lab ID : SP 1605688
**United Water Conservation Dist** | Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 111 % | 75-125 | |
| | | (SP 1605686-001) | MSD | ug/L | 4000 | 109 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 1.4% | ≤20.0 | |
| | 200.7 | 05/19/16:206966AC | CCV | ppm | 5.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.0032 | 0.03 | |
| | | | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0032 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 113 % | 75-125 | |
| | | (SP 1605686-001) | MSD | ug/L | 800.0 | 112 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 1.7% | ≤20.0 | |
| | 200.7 | 05/19/16:206966AC | CCV | ppm | 1.000 | 105 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |
| | | | CCV | ppm | 1.000 | 105 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605712
Customer : 2-200

**Laboratory Report**

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

**Case Narrative**

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 3 LayneOx After Pilot | 05/18/2016 | 05/19/2016 | SP 1605712-001 | DW |
| Column 3 LayneOx After Pilot | 05/18/2016 | 05/19/2016 | SP 1605712-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

**Inorganic - Metals QC**

| | |
|---|---|
| 200.7 | 05/20/2016:206891 All analysis quality controls are within established criteria |
| | 05/19/2016:205849 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25

KD:DMB



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

| | |
|---|---|
| May 24, 2016 | Lab ID : SP 1605712-001 |
| | Customer ID : 2-200 |
| **United Water Conservation Dist** | |
| Attn: Mike Ellis | Sampled On : May 18, 2016-08:42 |
| 106 N. 8th St. | Sampled By : Ruth Haldeman |
| Santa Paula, CA 93060 | Received On : May 19, 2016-10:19 |
| | Matrix : Drinking Water |

Description : Column 3 LayneOx After Pilot
Project : Pilot Study-Column 3 LayneOx

### Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 40 | 30 | ug/L | $300^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |
| Manganese | 10 | 10 | ug/L | $50^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 24, 2016

Lab ID : SP 1605712-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 18, 2016-15:46
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 3 LayneOx After Pilot
Project : Pilot Study-Column 3 LayneOx

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation Method | Sample Preparation Date/ID | Sample Analysis Method | Sample Analysis Date/ID |
|---|---|---|---|---|---|---|---|---|
| **Metals, Total**[P:T5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 24, 2016
**United Water Conservation Dist**

Lab ID : SP 1605712
Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 103 % | 75-125 | |
| | | (SP 1605711-001) | MSD | ug/L | 4000 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.7% | ≤20.0 | |
| | 200.7 | 05/20/16:206891AC | CCV | ppm | 5.000 | 98.2 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.03 | |
| | | | CCV | ppm | 5.000 | 100 % | 90-110 | |
| | | | CCB | ppm | | -0.0002 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 107 % | 75-125 | |
| | | (SP 1605711-001) | MSD | ug/L | 800.0 | 105 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 2.7% | ≤20.0 | |
| | 200.7 | 05/20/16:206891AC | CCV | ppm | 1.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |
| | | | CCV | ppm | 1.000 | 99.6 % | 90-110 | |
| | | | CCB | ppm | | 0.0002 | 0.01 | |

**Definition**

CCV : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria.
CCB : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria.
MS : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery.
MSD : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery.
MSRPD : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis.
DQO : Data Quality Objective - This is the criteria against which the quality control data is compared.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

| | | |
|---|---|---|
| **United Water Conservation Dist** | Lab ID | : SP 1605708 |
| Attn: Mike Ellis | Customer | : 2-200 |
| 106 N. 8th St. | | |
| Santa Paula, CA 93060 | | |

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 3 LayneOx After Pilot | 05/19/2016 | 05/19/2016 | SP 1605708-001 | DW |
| Column 3 LayneOx After Pilot | 05/19/2016 | 05/19/2016 | SP 1605708-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/19/2016:206891 All analysis quality controls are within established criteria |
| | 05/19/2016:205849 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25

KD:DMB



**Corporate Offices & Laboratory** 853 Corporation Street Santa Paula, CA 93060 TEL: (805)392-2000 Env FAX: (805)525-4172 / Ag FAX: (805)392-2063 CA ELAP Certification No. 1573
**Office & Laboratory** 2500 Stagecoach Road Stockton, CA 95215 TEL: (209)942-0182 FAX: (209)942-0423 CA ELAP Certification No. 1563
**Office & Laboratory** 563 E. Lindo Avenue Chico, CA 95926 TEL: (530)343-5818 FAX: (530)343-3807 CA ELAP Certification No. 2670
**Office & Laboratory** 3442 Empresa Drive, Suite D San Luis Obispo, CA 93401 TEL: (805)783-2940 FAX: (805)783-2912 CA ELAP Certification No. 2775
**Office & Laboratory** 9415 W. Goshen Avenue Visalia, CA 93291 TEL: (559)734-9473 FAX: (559)734-8435 CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605708-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-03:01
Sampled By : Ruth Haldeman / Norm
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 3 LayneOx After Pilot
Project : Pilot Study-Column 3 LayneOx

### Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: () , (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL
ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605708-002
Customer ID : 2-200

Sampled On : May 19, 2016-07:04
Sampled By : Ruth Haldeman / Norm
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 3 LayneOx After Pilot
Project : Pilot Study-Column 3 LayneOx

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Silica | 27 | 1 | mg/L | | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: () , (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 24, 2016 Lab ID : SP 1605708
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 4000 | 98.1 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.2% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 5.000 | 96.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00005 | 0.03 | |
| | | | CCV | ppm | 5.000 | 98.2 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 800.0 | 96.2 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 2.1% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 1.000 | 99.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00009 | 0.01 | |
| | | | CCV | ppm | 1.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |
| Silicon | 200.7 | | MS | mg/L | 2.400 | 67.4 % | <¼ | |
| | | (SP 1605706-001) | MSD | mg/L | 2.400 | 63.0 % | <¼ | |
| | | | MSRPD | mg/L | 800.0 | 0.7% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 5.000 | 97.6 % | 90-110 | |
| | | | CCB | ppm | | 0.07 | 1 | |
| | | | CCV | ppm | 5.000 | 95.6 % | 90-110 | |
| | | | CCB | ppm | | 0.07 | 1 | |

| **Definition** | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| <¼ | : High Sample Background - Spike concentration was less than one forth of the sample concentration. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605780
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 3 LayneOx After Pilot | 05/19/2016 | 05/20/2016 | SP 1605780-001 | DW |
| Column 3 LayneOx After Pilot | 05/20/2016 | 05/20/2016 | SP 1605780-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/23/2016:207249 All analysis quality controls are within established criteria |
| | 05/23/2016:206004 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25

KD:DMB



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL
ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605780-001
Customer ID : 2-200

Sampled On : May 19, 2016-16:00
Sampled By : Ruth Maldeman
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Column 3 LayneOx After Pilot
Project : Pilot Study-Column 3 LayneOx

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL
ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605780-002
Customer ID : 2-200

Sampled On : May 20, 2016-08:00
Sampled By : Ruth Maldeman
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Column 3 LayneOx After Pilot
Project : Pilot Study-Column 3 LayneOx

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 25, 2016
**United Water Conservation Dist**

Lab ID : SP 1605780
Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 113 % | 75-125 | |
| | | (STK1636155-010) | MSD | ug/L | 4000 | 120 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 6.6% | ≤20.0 | |
| | | | MS | ug/L | 4000 | 105 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 4000 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 1.7% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 5.000 | 101 % | 90-110 | |
| | | | CCB | ppm | | -0.0005 | 0.03 | |
| | | | CCV | ppm | 5.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | -0.0006 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 113 % | 75-125 | |
| | | (STK1636155-010) | MSD | ug/L | 800.0 | 119 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 5.2% | ≤20.0 | |
| | | | MS | ug/L | 800.0 | 103 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 800.0 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.6% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 1.000 | 99.9 % | 90-110 | |
| | | | CCB | ppm | | -0.00009 | 0.01 | |
| | | | CCV | ppm | 1.000 | 94.1 % | 90-110 | |
| | | | CCB | ppm | | -0.00001 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

**ENVIRONMENTAL FGL AGRICULTURAL**
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605689
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 4 LayneOx After Pilot | 05/17/2016 | 05/18/2016 | SP 1605689-001 | DW |
| Column 4 LayneOx After Pilot | 05/17/2016 | 05/18/2016 | SP 1605689-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/19/2016:206966 All analysis quality controls are within established criteria |
| | 05/18/2016:205789 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



**Corporate Offices & Laboratory** 853 Corporation Street Santa Paula, CA 93060 TEL: (805)392-2000 Env FAX: (805)525-4172 / Ag FAX: (805)392-2063 CA ELAP Certification No. 1573
**Office & Laboratory** 2500 Stagecoach Road Stockton, CA 95215 TEL: (209)942-0182 FAX: (209)942-0423 CA ELAP Certification No. 1563
**Office & Laboratory** 563 E. Lindo Avenue Chico, CA 95926 TEL: (530)343-5818 FAX: (530)343-3807 CA ELAP Certification No. 2670
**Office & Laboratory** 3442 Empresa Drive, Suite D San Luis Obispo, CA 93401 TEL: (805)783-2940 FAX: (805)783-2912 CA ELAP Certification No. 2775
**Office & Laboratory** 9415 W. Goshen Avenue Visalia, CA 93291 TEL: (559)734-9473 FAX: (559)734-8435 CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605689-001
Customer ID : 2-200

Sampled On : May 17, 2016-08:00
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:55
Matrix : Drinking Water

Description : Column 4 LayneOx After Pilot
Project : Pilot Study-Column 4 LayneOx

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1‡5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

Lab ID : SP 1605689-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 17, 2016-16:44
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:55
Matrix : Drinking Water

Description : Column 4 LayneOx After Pilot
Project : Pilot Study-Column 4 LayneOx

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:T5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/18/16:205789 | 200.7 | 05/19/16:206966 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016 Lab ID : SP 1605689
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 111 % | 75-125 | |
| | | (SP 1605686-001) | MSD | ug/L | 4000 | 109 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 1.4% | ≤20.0 | |
| | 200.7 | 05/19/16:206966AC | CCV | ppm | 5.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.0032 | 0.03 | |
| | | | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0032 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 113 % | 75-125 | |
| | | (SP 1605686-001) | MSD | ug/L | 800.0 | 112 % | 75-125 | |
| | | | MSRPD | ug/L | 4000 | 1.7% | ≤20.0 | |
| | 200.7 | 05/19/16:206966AC | CCV | ppm | 1.000 | 105 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |
| | | | CCV | ppm | 1.000 | 105 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |

| **Definition** | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605711
Customer : 2-200

**Laboratory Report**

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

**Case Narrative**

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 4 LayneOx After Pilot | 05/18/2016 | 05/19/2016 | SP 1605711-001 | DW |
| Column 4 LayneOx After Pilot | 05/18/2016 | 05/19/2016 | SP 1605711-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

**Inorganic - Metals QC**

| | |
|---|---|
| 200.7 | 05/20/2016:206891 All analysis quality controls are within established criteria |
| | 05/19/2016:205849 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



**Corporate Offices & Laboratory** 853 Corporation Street Santa Paula, CA 93060 TEL: (805)392-2000 Env FAX: (805)525-4172 / Ag FAX: (805)392-2063 CA ELAP Certification No. 1573

**Office & Laboratory** 2500 Stagecoach Road Stockton, CA 95215 TEL: (209)942-0182 FAX: (209)942-0423 CA ELAP Certification No. 1563

**Office & Laboratory** 563 E. Lindo Avenue Chico, CA 95926 TEL: (530)343-5818 FAX: (530)343-3807 CA ELAP Certification No. 2670

**Office & Laboratory** 3442 Empresa Drive, Suite D San Luis Obispo, CA 93401 TEL: (805)783-2940 FAX: (805)783-2912 CA ELAP Certification No. 2775

**Office & Laboratory** 9415 W. Goshen Avenue Visalia, CA 93291 TEL: (559)734-9473 FAX: (559)734-8435 CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605711-001
Customer ID : 2-200

Sampled On : May 18, 2016-08:42
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 4 LayneOx After Pilot
Project : Pilot Study-Column 4 LayneOx

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605711-002
Customer ID : 2-200

Sampled On : May 18, 2016-15:46
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 4 LayneOx After Pilot
Project : Pilot Study-Column 4 LayneOx

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/19/16:205849 | 200.7 | 05/20/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 24, 2016 | Lab ID : SP 1605711
**United Water Conservation Dist** | Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 103 % | 75-125 | |
| | | (SP 1605711-001) | MSD | ug/L | 4000 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.7% | ≤20.0 | |
| | 200.7 | 05/20/16:206891AC | CCV | ppm | 5.000 | 98.2 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.03 | |
| | | | CCV | ppm | 5.000 | 100 % | 90-110 | |
| | | | CCB | ppm | | -0.0002 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 107 % | 75-125 | |
| | | (SP 1605711-001) | MSD | ug/L | 800.0 | 105 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 2.7% | ≤20.0 | |
| | 200.7 | 05/20/16:206891AC | CCV | ppm | 1.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |
| | | | CCV | ppm | 1.000 | 99.6 % | 90-110 | |
| | | | CCB | ppm | | 0.0002 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605709
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 4 LayneOx After Pilot | 05/19/2016 | 05/19/2016 | SP 1605709-001 | DW |
| Column 4 LayneOx After Pilot | 05/19/2016 | 05/19/2016 | SP 1605709-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/19/2016:206891 All analysis quality controls are within established criteria |
| | 05/19/2016:205849 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S Title: Laboratory Director Date: 2016-05-25



**Corporate Offices & Laboratory** 853 Corporation Street Santa Paula, CA 93060 TEL: (805)392-2000 Env FAX: (805)525-4172 / Ag FAX: (805)392-2063 CA ELAP Certification No. 1573
**Office & Laboratory** 2500 Stagecoach Road Stockton, CA 95215 TEL: (209)942-0182 FAX: (209)942-0423 CA ELAP Certification No. 1563
**Office & Laboratory** 563 E. Lindo Avenue Chico, CA 95926 TEL: (530)343-5818 FAX: (530)343-3807 CA ELAP Certification No. 2670
**Office & Laboratory** 3442 Empresa Drive, Suite D San Luis Obispo, CA 93401 TEL: (805)783-2940 FAX: (805)783-2912 CA ELAP Certification No. 2775
**Office & Laboratory** 9415 W. Goshen Avenue Visalia, CA 93291 TEL: (559)734-9473 FAX: (559)734-8435 CA ELAP Certification No. 2810

May 24, 2016

Lab ID : SP 1605709-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-03:02
Sampled By : Ruth Haldeman / Norm
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Column 4 LayneOx After Pilot
Project : Pilot Study-Column 4 LayneOx

### Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | $300^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | ND | 10 | ug/L | $50^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: () , (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 24, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Description : Column 4 LayneOx After Pilot
Project : Pilot Study-Column 4 LayneOx

Lab ID : SP 1605709-002
Customer ID : 2-200

Sampled On : May 19, 2016-07:04
Sampled By : Ruth Haldeman / Norm
Received On : May 19, 2016-10:19
Matrix : Drinking Water

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 30 | 30 | ug/L | $300^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Manganese | 10 | 10 | ug/L | $50^2$ | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |
| Silica | 27 | 1 | mg/L | | 200.7 | 05/19/16:205849 | 200.7 | 05/19/16:206891 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: () , (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 24, 2016
**United Water Conservation Dist**

Lab ID : SP 1605709
Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 4000 | 98.1 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.2% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 5.000 | 96.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00005 | 0.03 | |
| | | | CCV | ppm | 5.000 | 98.2 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 98.3 % | 75-125 | |
| | | (SP 1605706-001) | MSD | ug/L | 800.0 | 96.2 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 2.1% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 1.000 | 99.0 % | 90-110 | |
| | | | CCB | ppm | | 0.00009 | 0.01 | |
| | | | CCV | ppm | 1.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |
| Silicon | 200.7 | | MS | mg/L | 2.400 | 67.4 % | <¼ | |
| | | (SP 1605706-001) | MSD | mg/L | 2.400 | 63.0 % | <¼ | |
| | | | MSRPD | mg/L | 800.0 | 0.7% | ≤20.0 | |
| | 200.7 | 05/19/16:206891AC | CCV | ppm | 5.000 | 97.6 % | 90-110 | |
| | | | CCB | ppm | | 0.07 | 1 | |
| | | | CCV | ppm | 5.000 | 95.6 % | 90-110 | |
| | | | CCB | ppm | | 0.07 | 1 | |

| **Definition** | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| <¼ | : High Sample Background - Spike concentration was less than one forth of the sample concentration. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605782
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 4 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (2 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Column 4 LayneOx After Pilot | 05/19/2016 | 05/20/2016 | SP 1605782-001 | DW |
| Column 4 LayneOx After Pilot | 05/20/2016 | 05/20/2016 | SP 1605782-002 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.7 | 05/23/2016:207249 All analysis quality controls are within established criteria |
| | 05/23/2016:206004 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.**

Digitally signed by Kelly A. Dunnahoo, B.S
Title: Laboratory Director
Date: 2016-05-25



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016

Lab ID : SP 1605782-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-15:58
Sampled By : R.M./N.S.
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Column 4 LayneOx After Pilot
Project : Pilot Study-Column 4 LayneOx

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | ND | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | ND | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605782-002
Customer ID : 2-200

Sampled On : May 20, 2016-08:05
Sampled By : R.M./N.S.
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Column 4 LayneOx After Pilot
Project : Pilot Study-Column 4 LayneOx

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 100 | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | 90 | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016 Lab ID : SP 1605782
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.7 | | MS | ug/L | 4000 | 105 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 4000 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 1.7% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 5.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | -0.0006 | 0.03 | |
| | | | CCV | ppm | 5.000 | 99.6 % | 90-110 | |
| | | | CCB | ppm | | -0.0003 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 103 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 800.0 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.6% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 1.000 | 94.1 % | 90-110 | |
| | | | CCB | ppm | | -0.00001 | 0.01 | |
| | | | CCV | ppm | 1.000 | 96.5 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

June 10, 2016

| | | | |
|---|---|---|---|
| **United Water Conservation Dist** | | Lab ID | : SP 1605692 |
| Attn: Mike Ellis | | Customer | : 2-200 |
| 106 N. 8th St. | | | |
| Santa Paula, CA 93060 | | | |

## Laboratory Report

**Introduction:** This report package contains total of 6 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (2 pages) | : An overview of the work performed at FGL. |
| Sample Results | (3 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Backwash Water | 05/18/2016 | 05/18/2016 | SP 1605692-001 | DW |
| Backwash Water | 05/18/2016 | 05/18/2016 | SP 1605692-002 | DW |
| Backwash Water | 05/18/2016 | 05/18/2016 | SP 1605692-003 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.1 | 05/24/2016:206062 All preparation quality controls are within established criteria |
| 200.7 | 05/24/2016:207318 All analysis quality controls are within established criteria |
| | 05/26/2016:207414 All analysis quality controls are within established criteria |

### Inorganic - Wet Chemistry QC

| | |
|---|---|
| 2540D | 05/23/2016:206003 All preparation quality controls are within established criteria |
| EPA 160 | 05/20/2016:205929 All preparation quality controls are within established criteria |



**Corporate Offices & Laboratory** 853 Corporation Street Santa Paula, CA 93060 TEL: (805)392-2000 Env FAX: (805)525-4172 / Ag FAX: (805)392-2063 CA ELAP Certification No. 1573

**Office & Laboratory** 2500 Stagecoach Road Stockton, CA 95215 TEL: (209)942-0182 FAX: (209)942-0423 CA ELAP Certification No. 1563

**Office & Laboratory** 563 E. Lindo Avenue Chico, CA 95926 TEL: (530)343-5818 FAX: (530)343-3807 CA ELAP Certification No. 2670

**Office & Laboratory** 3442 Empresa Drive, Suite D San Luis Obispo, CA 93401 TEL: (805)783-2940 FAX: (805)783-2912 CA ELAP Certification No. 2775

**Office & Laboratory** 9415 W. Goshen Avenue Visalia, CA 93291 TEL: (559)734-9473 FAX: (559)734-8435 CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

| | | | |
|---|---|---|---|
| June 10, 2016 | | Lab ID | : SP 1605692 |
| **United Water Conservation Dist** | | Customer | : 2-200 |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S.
Title: Laboratory Director
Date: 2016-06-10

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

June 10, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605692-001
Customer ID : 2-200

Sampled On : May 18, 2016-09:45
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:53
Matrix : Drinking Water

Description : Backwash Water
Project : Pilot Study-Backwash Water

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 2170 | 30 | ug/L | 300[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| Manganese | 5830 | 10 | ug/L | 50[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| **Wet Chemistry**[P:1] | | | | | | | | |
| Solids, Settleable | ND | 0.1 | ml/L | | 2540F | 05/19/16:205880 | 2540F | 05/19/16:207061 |
| Solids, Total | 1200 | 40 | mg/L | | EPA 160 | 05/20/16:205929 | 2540B | 05/23/16:207211 |
| Solids, Total Suspended (TSS) | 42 | 3* | mg/L | | 2540D | 05/23/16:206003 | 2540D | 05/24/16:207265 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

June 10, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605692-002
Customer ID : 2-200

Sampled On : May 18, 2016-09:47
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:53
Matrix : Drinking Water

Description : Backwash Water
Project : Pilot Study-Backwash Water

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total** P:1'5 | | | | | | | | |
| Iron | 44000 | 30 | ug/L | 300[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| Manganese | 24400 | 50* | ug/L | 50[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/26/16:207414 |
| **Wet Chemistry** P:1 | | | | | | | | |
| Solids, Settleable | 18.9 | 0.1 | ml/L | | 2540F | 05/19/16:205880 | 2540F | 05/19/16:207061 |
| Solids, Total | 1540 | 40 | mg/L | | EPA 160 | 05/20/16:205929 | 2540B | 05/23/16:207211 |
| Solids, Total Suspended (TSS) | 410 | 40* | mg/L | | 2540D | 05/23/16:206003 | 2540D | 05/24/16:207265 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

June 10, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605692-003
Customer ID : 2-200

Sampled On : May 18, 2016-09:49
Sampled By : Ruth Haldeman
Received On : May 18, 2016-15:53
Matrix : Drinking Water

Description : Backwash Water
Project : Pilot Study-Backwash Water

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation Method | Sample Preparation Date/ID | Sample Analysis Method | Sample Analysis Date/ID |
|---|---|---|---|---|---|---|---|---|
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 58500 | 150* | ug/L | $300^2$ | 200.1 | 05/24/16:206062 | 200.7 | 05/26/16:207414 |
| Manganese | 16800 | 50* | ug/L | $50^2$ | 200.1 | 05/24/16:206062 | 200.7 | 05/26/16:207414 |
| **Wet Chemistry**[P:1] | | | | | | | | |
| Solids, Settleable | 36.8 | 0.1 | ml/L | | 2540F | 05/19/16:205880 | 2540F | 05/19/16:207061 |
| Solids, Total | 1340 | 40 | mg/L | | EPA 160 | 05/20/16:205929 | 2540B | 05/23/16:207211 |
| Solids, Total Suspended (TSS) | 319 | 29* | mg/L | | 2540D | 05/23/16:206003 | 2540D | 05/24/16:207265 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

June 10, 2016
**United Water Conservation Dist**

Lab ID : SP 1605692
Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.1 | 05/24/16:206062AMB | Blank | mg/L | | ND | <0.03 | |
| | | | LCS | mg/L | 4.000 | 98.6 % | 85-115 | |
| | | | MS | mg/L | 4.000 | 112 % | 75-125 | |
| | | (SP 1605692-001) | MSD | mg/L | 4.000 | 97.5 % | 75-125 | |
| | | | MSRPD | mg/L | 0.8000 | 9.1% | ≤20 | |
| Manganese | 200.1 | 05/24/16:206062AMB | Blank | mg/L | | ND | <0.01 | |
| | | | LCS | mg/L | 0.8000 | 98.5 % | 85-115 | |
| | | | MS | mg/L | 0.8000 | 166 % | <¼ | |
| | | (SP 1605692-001) | MSD | mg/L | 0.8000 | 102 % | 75-125 | |
| | | | MSRPD | mg/L | 0.8000 | 7.4% | ≤20.0 | |
| Iron | 200.7 | 05/24/16:207318AC | CCV | ppm | 5.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.0069 | 0.03 | |
| | | | CCV | ppm | 5.000 | 98.5 % | 90-110 | |
| | | | CCB | ppm | | 0.0041 | 0.03 | |
| | 200.7 | 05/26/16:207414AC | CCV | ppm | 5.000 | 100 % | 90-110 | |
| | | | CCB | ppm | | 0.0019 | 0.03 | |
| | | | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0049 | 0.03 | |
| Manganese | 200.7 | 05/24/16:207318AC | CCV | ppm | 1.000 | 101 % | 90-110 | |
| | | | CCB | ppm | | 0.00002 | 0.01 | |
| | | | CCV | ppm | 1.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0003 | 0.01 | |
| | 200.7 | 05/26/16:207414AC | CCV | ppm | 1.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |
| | | | CCV | ppm | 1.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.00002 | 0.01 | |
| **Wet Chem** | | | | | | | | |
| Solids, Suspended | 2540D | 05/23/16:206003JBA | Blank | mg/L | | ND | <1 | |
| | | | LCS | mg/L | 50.05 | 92.9 % | 38-138 | |
| | | | LCS | mg/L | 50.05 | 93.9 % | 38-138 | |
| | | (SP 1605738-001) | Dup | mg/L | | 2.8% | 28.7 | |
| Solids, Total | EPA 160 | 05/20/16:205929CTL | Blank | mg/L | | ND | <40 | |
| | | | LCS | mg/L | 1000 | 100 % | 90-110 | |
| | | | LCS | mg/L | 1000 | 97.3 % | 90-110 | |
| | | (SP 1605461-001) | Dup | mg/L | | 0.6% | 10.0 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| Blank | : Method Blank - Prepared to verify that the preparation process is not contributing contamination to the samples. |
| LCS | : Laboratory Control Standard/Sample - Prepared to verify that the preparation process is not affecting analyte recovery. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| Dup | : Duplicate Sample - A random sample with each batch is prepared and analyzed in duplicate. The relative percent difference is an indication of precision for the preparation and analysis. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| ND | : Non-detect - Result was below the DQO listed for the analyte. |
| <¼ | : High Sample Background - Spike concentration was less than one forth of the sample concentration. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

June 7, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605785
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 13 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (2 pages) | : An overview of the work performed at FGL. |
| Sample Results | (9 pages) | : Results for each sample submitted. |
| Quality Control | (2 pages) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Backwash Water BW0 | 05/19/2016 | 05/20/2016 | SP 1605785-001 | DW |
| Backwash Water BW2.5 | 05/19/2016 | 05/20/2016 | SP 1605785-002 | DW |
| Backwash Water BW5 | 05/19/2016 | 05/20/2016 | SP 1605785-003 | DW |
| Backwash Water BW7.5 | 05/19/2016 | 05/20/2016 | SP 1605785-004 | DW |
| Backwash Water BW10 | 05/19/2016 | 05/20/2016 | SP 1605785-005 | DW |
| Backwash Water BW12.5 | 05/19/2016 | 05/20/2016 | SP 1605785-006 | DW |
| Backwash Water BW15 | 05/19/2016 | 05/20/2016 | SP 1605785-007 | DW |
| Backwash Water BW17.5 | 05/19/2016 | 05/20/2016 | SP 1605785-008 | DW |
| Backwash Water BW20 | 05/19/2016 | 05/20/2016 | SP 1605785-009 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.1 | 05/24/2016:206062 All preparation quality controls are within established criteria |
| 200.7 | 05/23/2016:207249 All analysis quality controls are within established criteria |
| | 05/24/2016:207318 All analysis quality controls are within established criteria |
| | 05/26/2016:207414 All analysis quality controls are within established criteria |



**Corporate Offices & Laboratory** 853 Corporation Street Santa Paula, CA 93060 TEL: (805)392-2000 Env FAX: (805)525-4172 / Ag FAX: (805)392-2063 CA ELAP Certification No. 1573

**Office & Laboratory** 2500 Stagecoach Road Stockton, CA 95215 TEL: (209)942-0182 FAX: (209)942-0423 CA ELAP Certification No. 1563

**Office & Laboratory** 563 E. Lindo Avenue Chico, CA 95926 TEL: (530)343-5818 FAX: (530)343-3807 CA ELAP Certification No. 2670

**Office & Laboratory** 3442 Empresa Drive, Suite D San Luis Obispo, CA 93401 TEL: (805)783-2940 FAX: (805)783-2912 CA ELAP Certification No. 2775

**Office & Laboratory** 9415 W. Goshen Avenue Visalia, CA 93291 TEL: (559)734-9473 FAX: (559)734-8435 CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

| | | |
|---|---|---|
| June 7, 2016 | Lab ID | : SP 1605785 |
| **United Water Conservation Dist** | Customer | : 2-200 |

**Inorganic - Metals QC**

| | |
|---|---|
| 200.7 | 05/23/2016:206004 All preparation quality controls are within established criteria |

**Inorganic - Wet Chemistry QC**

| | |
|---|---|
| 2540D | 05/25/2016:206100 All preparation quality controls are within established criteria |
| EPA 160 | 05/24/2016:206086 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.**

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

June 7, 2016

Lab ID : SP 1605785-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-13:00
Sampled By : Ruth Haldeman
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Backwash Water BW0
Project : Pilot Study-Backwash Water

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 81200 | 150* | ug/L | 300[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/26/16:207414 |
| Manganese | 18900 | 50* | ug/L | 50[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/26/16:207414 |
| **Wet Chemistry**[P:1] | | | | | | | | |
| Solids, Settleable | 105 | 0.1 | ml/L | | 2540F | 05/20/16:205988 | 2540F | 05/20/16:207183 |
| Solids, Total | 1350 | 40 | mg/L | | EPA 160 | 05/24/16:206086 | 2540B | 05/26/16:207321 |
| Solids, Total Suspended (TSS) | 340 | 40* | mg/L | | 2540D | 05/25/16:206100 | 2540D | 05/26/16:207437 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

June 7, 2016

Lab ID : SP 1605785-002
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-13:02
Sampled By : Ruth Haldeman
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Backwash Water BW2.5
Project : Pilot Study-Backwash Water

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation Method | Sample Preparation Date/ID | Sample Analysis Method | Sample Analysis Date/ID |
|---|---|---|---|---|---|---|---|---|
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 34700 | 30 | ug/L | $300^2$ | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| Manganese | 9750 | 10 | ug/L | $50^2$ | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| **Wet Chemistry**[P:1] | | | | | | | | |
| Solids, Settleable | 36.8 | 0.1 | ml/L | | 2540F | 05/20/16:205988 | 2540F | 05/20/16:207183 |
| Solids, Total | 1300 | 40 | mg/L | | EPA 160 | 05/24/16:206086 | 2540B | 05/26/16:207321 |
| Solids, Total Suspended (TSS) | 160 | 20* | mg/L | | 2540D | 05/25/16:206100 | 2540D | 05/26/16:207437 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

June 7, 2016

Lab ID : SP 1605785-003
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-13:05
Sampled By : Ruth Haldeman
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Backwash Water BW5
Project : Pilot Study-Backwash Water

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 5560 | 30 | ug/L | 300[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| Manganese | 2350 | 10 | ug/L | 50[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| **Wet Chemistry**[P:1] | | | | | | | | |
| Solids, Settleable | ND | 0.1 | ml/L | | 2540F | 05/20/16:205988 | 2540F | 05/20/16:207183 |
| Solids, Total | 1210 | 40 | mg/L | | EPA 160 | 05/24/16:206086 | 2540B | 05/26/16:207321 |
| Solids, Total Suspended (TSS) | 24 | 3* | mg/L | | 2540D | 05/25/16:206100 | 2540D | 05/26/16:207437 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

June 7, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605785-004
Customer ID : 2-200

Sampled On : May 19, 2016-13:07
Sampled By : Ruth Haldeman
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Backwash Water BW7.5
Project : Pilot Study-Backwash Water

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation Method | Sample Preparation Date/ID | Sample Analysis Method | Sample Analysis Date/ID |
|---|---|---|---|---|---|---|---|---|
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 1420 | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | 410 | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| **Wet Chemistry**[P:1] | | | | | | | | |
| Solids, Settleable | ND | 0.1 | ml/L | | 2540F | 05/20/16:205988 | 2540F | 05/20/16:207183 |
| Solids, Total | 1190 | 40 | mg/L | | EPA 160 | 05/24/16:206086 | 2540B | 05/26/16:207321 |
| Solids, Total Suspended (TSS) | 5 | 1 | mg/L | | 2540D | 05/25/16:206100 | 2540D | 05/26/16:207437 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

June 7, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605785-005
Customer ID : 2-200

Sampled On : May 19, 2016-13:10
Sampled By : Ruth Haldeman
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Backwash Water BW10
Project : Pilot Study-Backwash Water

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 420 | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | 180 | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| **Wet Chemistry**[P:1] | | | | | | | | |
| Solids, Settleable | ND | 0.1 | ml/L | | 2540F | 05/20/16:205988 | 2540F | 05/20/16:207183 |
| Solids, Total | 1180 | 40 | mg/L | | EPA 160 | 05/24/16:206086 | 2540B | 05/26/16:207321 |
| Solids, Total Suspended (TSS) | 3 | 1 | mg/L | | 2540D | 05/25/16:206100 | 2540D | 05/26/16:207437 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

June 7, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605785-006
Customer ID : 2-200

Sampled On : May 19, 2016-13:12
Sampled By : Ruth Haldeman
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Backwash Water BW12.5
Project : Pilot Study-Backwash Water

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total** P:1'5 | | | | | | | | |
| Iron | 270 | 30 | ug/L | $300^2$ | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | 140 | 10 | ug/L | $50^2$ | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| **Wet Chemistry** P:1 | | | | | | | | |
| Solids, Settleable | ND | 0.1 | ml/L | | 2540F | 05/21/16:205990 | 2540F | 05/21/16:207188 |
| Solids, Total | 1170 | 40 | mg/L | | EPA 160 | 05/24/16:206086 | 2540B | 05/26/16:207321 |
| Solids, Total Suspended (TSS) | 2 | 1 | mg/L | | 2540D | 05/25/16:206100 | 2540D | 05/26/16:207437 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

June 7, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605785-007
Customer ID : 2-200

Sampled On : May 19, 2016-13:15
Sampled By : Ruth Haldeman
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Backwash Water BW15
Project : Pilot Study-Backwash Water

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 190 | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | 120 | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| **Wet Chemistry**[P:1] | | | | | | | | |
| Solids, Settleable | ND | 0.1 | ml/L | | 2540F | 05/21/16:205990 | 2540F | 05/21/16:207188 |
| Solids, Total | 1160 | 40 | mg/L | | EPA 160 | 05/24/16:206086 | 2540B | 05/26/16:207321 |
| Solids, Total Suspended (TSS) | 2 | 1 | mg/L | | 2540D | 05/25/16:206100 | 2540D | 05/26/16:207437 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

June 7, 2016

Lab ID : SP 1605785-008
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-13:17
Sampled By : Ruth Haldeman
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Backwash Water BW17.5
Project : Pilot Study-Backwash Water

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation Method | Sample Preparation Date/ID | Sample Analysis Method | Sample Analysis Date/ID |
|---|---|---|---|---|---|---|---|---|
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 250 | 30 | ug/L | $300^2$ | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | 160 | 10 | ug/L | $50^2$ | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| **Wet Chemistry**[P:1] | | | | | | | | |
| Solids, Settleable | ND | 0.1 | ml/L | | 2540F | 05/21/16:205990 | 2540F | 05/21/16:207188 |
| Solids, Total | 1170 | 40 | mg/L | | EPA 160 | 05/24/16:206086 | 2540B | 05/26/16:207321 |
| Solids, Total Suspended (TSS) | 2 | 1 | mg/L | | 2540D | 05/25/16:206100 | 2540D | 05/26/16:207437 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

June 7, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605785-009
Customer ID : 2-200

Sampled On : May 19, 2016-13:20
Sampled By : Ruth Haldeman
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Backwash Water BW20
Project : Pilot Study-Backwash Water

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 160 | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | 130 | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| **Wet Chemistry**[P:1] | | | | | | | | |
| Solids, Settleable | ND | 0.1 | ml/L | | 2540F | 05/21/16:205990 | 2540F | 05/21/16:207188 |
| Solids, Total | 1180 | 40 | mg/L | | EPA 160 | 05/24/16:206086 | 2540B | 05/26/16:207321 |
| Solids, Total Suspended (TSS) | 2 | 1 | mg/L | | 2540D | 05/25/16:206100 | 2540D | 05/26/16:207437 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

June 7, 2016
**United Water Conservation Dist**

Lab ID : SP 1605785
Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.1 | 05/24/16:206062AMB | Blank | mg/L | | ND | <0.03 | |
| | | | LCS | mg/L | 4.000 | 98.6 % | 85-115 | |
| | | | MS | mg/L | 4.000 | 112 % | 75-125 | |
| | | (SP 1605692-001) | MSD | mg/L | 4.000 | 97.5 % | 75-125 | |
| | | | MSRPD | mg/L | 0.8000 | 9.1% | ≤20 | |
| Manganese | 200.1 | 05/24/16:206062AMB | Blank | mg/L | | ND | <0.01 | |
| | | | LCS | mg/L | 0.8000 | 98.5 % | 85-115 | |
| | | | MS | mg/L | 0.8000 | 166 % | <¼ | |
| | | (SP 1605692-001) | MSD | mg/L | 0.8000 | 102 % | 75-125 | |
| | | | MSRPD | mg/L | 0.8000 | 7.4% | ≤20.0 | |
| Iron | 200.7 | | MS | ug/L | 4000 | 105 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 4000 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 1.7% | ≤20.0 | |
| | | | MS | ug/L | 4000 | 108 % | 75-125 | |
| | | (SP 1605785-006) | MSD | ug/L | 4000 | 104 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 3.0% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 5.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | -0.0006 | 0.03 | |
| | | | CCV | ppm | 5.000 | 99.6 % | 90-110 | |
| | | | CCB | ppm | | -0.0003 | 0.03 | |
| | | | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | -0.0003 | 0.03 | |
| | 200.7 | 05/24/16:207318AC | CCV | ppm | 5.000 | 98.5 % | 90-110 | |
| | | | CCB | ppm | | 0.0041 | 0.03 | |
| | | | CCV | ppm | 5.000 | 98.5 % | 90-110 | |
| | | | CCB | ppm | | 0.0008 | 0.03 | |
| | 200.7 | 05/26/16:207414AC | CCV | ppm | 5.000 | 100 % | 90-110 | |
| | | | CCB | ppm | | 0.0019 | 0.03 | |
| | | | CCV | ppm | 5.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0049 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 103 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 800.0 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.6% | ≤20.0 | |
| | | | MS | ug/L | 800.0 | 107 % | 75-125 | |
| | | (SP 1605785-006) | MSD | ug/L | 800.0 | 101 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 5.0% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 1.000 | 94.1 % | 90-110 | |
| | | | CCB | ppm | | -0.00001 | 0.01 | |
| | | | CCV | ppm | 1.000 | 96.5 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |
| | | | CCV | ppm | 1.000 | 100 % | 90-110 | |
| | | | CCB | ppm | | -0.00002 | 0.01 | |
| | 200.7 | 05/24/16:207318AC | CCV | ppm | 1.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0003 | 0.01 | |
| | | | CCV | ppm | 1.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0005 | 0.01 | |
| | 200.7 | 05/26/16:207414AC | CCV | ppm | 1.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.00003 | 0.01 | |
| | | | CCV | ppm | 1.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.00002 | 0.01 | |
| **Wet Chem** | | | | | | | | |
| Solids, Suspended | 2540D | 05/25/16:206100jba | Blank | mg/L | | ND | <1 | |
| | | | LCS | mg/L | 50.05 | 81.9 % | 38-138 | |
| | | | LCS | mg/L | 50.05 | 82.9 % | 38-138 | |
| | | (SP 1605791-001) | Dup | mg/L | | 2.5% | 28.7 | |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

June 7, 2016
**United Water Conservation Dist**

Lab ID : SP 1605785
Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Wet Chem** | | | | | | | | |
| Solids, Total | EPA 160 | 05/24/16:206086CTL | Blank | mg/L | | ND | <40 | |
| | | | LCS | mg/L | 1000 | 99.7 % | 90-110 | |
| | | | LCS | mg/L | 1000 | 99.0 % | 90-110 | |
| | | (SP 1605784-001) | Dup | mg/L | | 0.4% | 10.0 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| Blank | : Method Blank - Prepared to verify that the preparation process is not contributing contamination to the samples. |
| LCS | : Laboratory Control Standard/Sample - Prepared to verify that the preparation process is not affecting analyte recovery. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| Dup | : Duplicate Sample - A random sample with each batch is prepared and analyzed in duplicate. The relative percent difference is an indication of precision for the preparation and analysis. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| ND | : Non-detect - Result was below the DQO listed for the analyte. |
| <¼ | : High Sample Background - Spike concentration was less than one forth of the sample concentration. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

June 9, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605786
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 3 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (1 page) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Backwash Water Composite | 05/19/2016 | 05/20/2016 | SP 1605786-001 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.1 | 05/24/2016:206062 All preparation quality controls are within established criteria |
| 200.7 | 05/24/2016:207318 All analysis quality controls are within established criteria |
| 200.8 | 06/07/2016:208040 All analysis quality controls are within established criteria |
| | 06/07/2016:206624 All preparation quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:CEA

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S. Title: Laboratory Director Date: 2016-06-09



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL
ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 26, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605705
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 6 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (1 pages) | : An overview of the work performed at FGL. |
| Sample Results | (4 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Settling Samples | 05/18/2016 | 05/19/2016 | SP 1605705-001 | DW |
| Settling Samples | 05/18/2016 | 05/19/2016 | SP 1605705-002 | DW |
| Settling Samples | 05/18/2016 | 05/19/2016 | SP 1605705-003 | DW |
| Settling Samples | 05/18/2016 | 05/19/2016 | SP 1605705-004 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.1 | 05/24/2016:206062 All preparation quality controls are within established criteria |
| 200.7 | 05/24/2016:207318 All analysis quality controls are within established criteria |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S. Title: Laboratory Director Date: 2016-05-26



**Corporate Offices & Laboratory** 853 Corporation Street Santa Paula, CA 93060 TEL: (805)392-2000 Env FAX: (805)525-4172 / Ag FAX: (805)392-2063 CA ELAP Certification No. 1573

**Office & Laboratory** 2500 Stagecoach Road Stockton, CA 95215 TEL: (209)942-0182 FAX: (209)942-0423 CA ELAP Certification No. 1563

**Office & Laboratory** 563 E. Lindo Avenue Chico, CA 95926 TEL: (530)343-5818 FAX: (530)343-3807 CA ELAP Certification No. 2670

**Office & Laboratory** 3442 Empresa Drive, Suite D San Luis Obispo, CA 93401 TEL: (805)783-2940 FAX: (805)783-2912 CA ELAP Certification No. 2775

**Office & Laboratory** 9415 W. Goshen Avenue Visalia, CA 93291 TEL: (559)734-9473 FAX: (559)734-8435 CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL
ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 26, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605705-001
Customer ID : 2-200

Sampled On : May 18, 2016-10:00
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Settling Samples
Project : Pilot Study-Settling Samples

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 18000 | 30 | ug/L | 300[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| Manganese | 9060 | 10 | ug/L | 50[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 26, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605705-002
Customer ID : 2-200

Sampled On : May 18, 2016-13:00
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Settling Samples
Project : Pilot Study-Settling Samples

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 2740 | 30 | ug/L | 300[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| Manganese | 4830 | 10 | ug/L | 50[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

Layne
WATER · MINERAL · ENERGY

FGL
ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 26, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605705-003
Customer ID : 2-200

Sampled On : May 18, 2016-15:00
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Settling Samples
Project : Pilot Study-Settling Samples

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 1950 | 30 | ug/L | 300[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| Manganese | 3630 | 10 | ug/L | 50[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 26, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605705-004
Customer ID : 2-200

Sampled On : May 18, 2016-17:00
Sampled By : Ruth Haldeman
Received On : May 19, 2016-10:19
Matrix : Drinking Water

Description : Settling Samples
Project : Pilot Study-Settling Samples

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation Method | Sample Preparation Date/ID | Sample Analysis Method | Sample Analysis Date/ID |
|---|---|---|---|---|---|---|---|---|
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 1400 | 30 | ug/L | 300[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| Manganese | 2920 | 10 | ug/L | 50[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 26, 2016 Lab ID : SP 1605705
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.1 | 05/24/16:206062AMB | Blank | mg/L | | ND | <0.03 | |
| | | | LCS | mg/L | 4.000 | 98.6 % | 85-115 | |
| | | | MS | mg/L | 4.000 | 112 % | 75-125 | |
| | | (SP 1605692-001) | MSD | mg/L | 4.000 | 97.5 % | 75-125 | |
| | | | MSRPD | mg/L | 0.8000 | 9.1% | ≤20 | |
| Manganese | 200.1 | 05/24/16:206062AMB | Blank | mg/L | | ND | <0.01 | |
| | | | LCS | mg/L | 0.8000 | 98.5 % | 85-115 | |
| | | | MS | mg/L | 0.8000 | 166 % | <¼ | |
| | | (SP 1605692-001) | MSD | mg/L | 0.8000 | 102 % | 75-125 | |
| | | | MSRPD | mg/L | 0.8000 | 7.4% | ≤20.0 | |
| Iron | 200.7 | 05/24/16:207318AC | CCV | ppm | 5.000 | 103 % | 90-110 | |
| | | | CCB | ppm | | 0.0069 | 0.03 | |
| | | | CCV | ppm | 5.000 | 98.5 % | 90-110 | |
| | | | CCB | ppm | | 0.0041 | 0.03 | |
| | | | CCV | ppm | 5.000 | 98.5 % | 90-110 | |
| | | | CCB | ppm | | 0.0008 | 0.03 | |
| Manganese | 200.7 | 05/24/16:207318AC | CCV | ppm | 1.000 | 101 % | 90-110 | |
| | | | CCB | ppm | | 0.00002 | 0.01 | |
| | | | CCV | ppm | 1.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0003 | 0.01 | |
| | | | CCV | ppm | 1.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0005 | 0.01 | |

| **Definition** | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| Blank | : Method Blank - Prepared to verify that the preparation process is not contributing contamination to the samples. |
| LCS | : Laboratory Control Standard/Sample - Prepared to verify that the preparation process is not affecting analyte recovery. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| ND | : Non-detect - Result was below the DQO listed for the analyte. |
| <¼ | : High Sample Background - Spike concentration was less than one forth of the sample concentration. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Lab ID : SP 1605787
Customer : 2-200

## Laboratory Report

**Introduction:** This report package contains total of 6 pages divided into 3 sections:

| | | |
|---|---|---|
| Case Narrative | (2 pages) | : An overview of the work performed at FGL. |
| Sample Results | (3 pages) | : Results for each sample submitted. |
| Quality Control | (1 page) | : Supporting Quality Control (QC) results. |

## Case Narrative

This Case Narrative pertains to the following samples:

| Sample Description | Date Sampled | Date Received | FGL Lab ID # | Matrix |
|---|---|---|---|---|
| Settling Samples | 05/19/2016 | 05/20/2016 | SP 1605787-001 | DW |
| Settling Samples | 05/20/2016 | 05/20/2016 | SP 1605787-002 | DW |
| Settling Samples | 05/20/2016 | 05/20/2016 | SP 1605787-003 | DW |

**Sampling and Receipt Information:** All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

**Quality Control:** All samples were prepared and analyzed according to the following tables:

### Inorganic - Metals QC

| | |
|---|---|
| 200.1 | 05/24/2016:206062 All preparation quality controls are within established criteria |
| 200.7 | 05/23/2016:207249 All analysis quality controls are within established criteria |
| | 05/24/2016:207318 All analysis quality controls are within established criteria |
| | 05/23/2016:206004 All preparation quality controls are within established criteria |



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

| | | | |
|---|---|---|---|
| May 25, 2016 | | Lab ID | : SP 1605787 |
| **United Water Conservation Dist** | | Customer | : 2-200 |

**Certification::** I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.**

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016

Lab ID : SP 1605787-001
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 19, 2016-17:00
Sampled By : R.H./M.E.
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Settling Samples
Project : Pilot Study-Settling Samples

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 2030 | 30 | ug/L | $300^2$ | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | 460 | 10 | ug/L | $50^2$ | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Description : Settling Samples
Project : Pilot Study-Settling Samples

Lab ID : SP 1605787-002
Customer ID : 2-200

Sampled On : May 20, 2016-13:00
Sampled By : R.H./M.E.
Received On : May 20, 2016-13:26
Matrix : Drinking Water

**Sample Result - Inorganic**

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 920 | 30 | ug/L | 300[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |
| Manganese | 260 | 10 | ug/L | 50[2] | 200.7 | 05/23/16:206004 | 200.7 | 05/23/16:207249 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

May 25, 2016

Lab ID : SP 1605787-003
Customer ID : 2-200

**United Water Conservation Dist**
Attn: Mike Ellis
106 N. 8th St.
Santa Paula, CA 93060

Sampled On : May 20, 2016-08:30
Sampled By : R.H./M.E.
Received On : May 20, 2016-13:26
Matrix : Drinking Water

Description : Settling Samples
Project : Pilot Study-Settling Samples

## Sample Result - Inorganic

| Constituent | Result | PQL | Units | MCL/AL | Sample Preparation | | Sample Analysis | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Method | Date/ID | Method | Date/ID |
| **Metals, Total**[P:1'5] | | | | | | | | |
| Iron | 5510 | 30 | ug/L | 300[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |
| Manganese | 2190 | 10 | ug/L | 50[2] | 200.1 | 05/24/16:206062 | 200.7 | 05/24/16:207318 |

ND=Non-Detected. PQL=Practical Quantitation Limit. Containers: (P) Plastic Preservatives: HNO3 pH < 2 ‡Surrogate. * PQL adjusted for dilution.
MCL = Maximum Contamination Level. 2 - Secondary Standard. 3 - CDPH Notification Level. AL = Regulatory Action Level.



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WATER · MINERAL · ENERGY

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

May 25, 2016 Lab ID : SP 1605787
**United Water Conservation Dist** Customer : 2-200

## Quality Control - Inorganic

| Constituent | Method | Date/ID | Type | Units | Conc. | QC Data | DQO | Note |
|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | |
| Iron | 200.1 | 05/24/16:206062AMB | Blank | mg/L | | ND | <0.03 | |
| | | | LCS | mg/L | 4.000 | 104 % | 85-115 | |
| | | | MS | mg/L | 4.000 | 85.4 % | 75-125 | |
| | | (CH 1673305-001) | MSD | mg/L | 4.000 | 81.3 % | 75-125 | |
| | | | MSRPD | mg/L | 0.8000 | 1.8% | ≤20 | |
| Manganese | 200.1 | 05/24/16:206062AMB | Blank | mg/L | | ND | <0.01 | |
| | | | LCS | mg/L | 0.8000 | 106 % | 85-115 | |
| | | | MS | mg/L | 0.8000 | 100 % | 75-125 | |
| | | (CH 1673305-001) | MSD | mg/L | 0.8000 | 104 % | 75-125 | |
| | | | MSRPD | mg/L | 0.8000 | 3.9% | ≤20.0 | |
| Iron | 200.7 | | MS | ug/L | 4000 | 105 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 4000 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 1.7% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 5.000 | 97.3 % | 90-110 | |
| | | | CCB | ppm | | -0.0006 | 0.03 | |
| | | | CCV | ppm | 5.000 | 99.6 % | 90-110 | |
| | | | CCB | ppm | | -0.0003 | 0.03 | |
| | 200.7 | 05/24/16:207318AC | CCV | ppm | 5.000 | 98.5 % | 90-110 | |
| | | | CCB | ppm | | 0.0008 | 0.03 | |
| | | | CCV | ppm | 5.000 | 98.6 % | 90-110 | |
| | | | CCB | ppm | | 0.0047 | 0.03 | |
| Manganese | 200.7 | | MS | ug/L | 800.0 | 103 % | 75-125 | |
| | | (SP 1605780-002) | MSD | ug/L | 800.0 | 103 % | 75-125 | |
| | | | MSRPD | ug/L | 800.0 | 0.6% | ≤20.0 | |
| | 200.7 | 05/23/16:207249AC | CCV | ppm | 1.000 | 94.1 % | 90-110 | |
| | | | CCB | ppm | | -0.00001 | 0.01 | |
| | | | CCV | ppm | 1.000 | 96.5 % | 90-110 | |
| | | | CCB | ppm | | 0.00004 | 0.01 | |
| | 200.7 | 05/24/16:207318AC | CCV | ppm | 1.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0005 | 0.01 | |
| | | | CCV | ppm | 1.000 | 102 % | 90-110 | |
| | | | CCB | ppm | | 0.0005 | 0.01 | |

**Definition**

| | |
|---|---|
| CCV | : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria. |
| CCB | : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria. |
| Blank | : Method Blank - Prepared to verify that the preparation process is not contributing contamination to the samples. |
| LCS | : Laboratory Control Standard/Sample - Prepared to verify that the preparation process is not affecting analyte recovery. |
| MS | : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSD | : Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery. |
| MSRPD | : MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis. |
| ND | : Non-detect - Result was below the DQO listed for the analyte. |
| DQO | : Data Quality Objective - This is the criteria against which the quality control data is compared. |



**Corporate Offices & Laboratory**
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

**Office & Laboratory**
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

**Office & Laboratory**
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

**Office & Laboratory**
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

**Office & Laboratory**
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

**APPENDIX 7.8 – Silt Density Index (SDI) Test Data**

| Table 22 - Summary of SDI Test Values | | | | |
|---|---|---|---|---|
| | Filter Feed (Raw Water) | | Filter Effluent | |
| Date | Well No. 13 | Well No. 12 | Greensand Plus | LayneOx |
| 5/17/2016 | 2.3 – pre-chlorine | | 1.6 | 3.8 – initially<br>1.6 – backwashed |
| 5/18/2016 | 1.0 – pre-chlorine<br>4.52 – post-chlorine | | 1.0 | 4.6 |
| 5/19/2016 | Not recorded | | 0.9 | 5.2 (x2) |
| 5/19/2016 | | 2.6 – pre-chlorine<br>6.3 – post-chlorine | 3.4 | 4.2 |
| 5/20/2016 | | 0.3 – pre-chlorine<br>6.3 – post-chlorine | 1.7 | 1.1 |

Note: Merck Millipore "EZ-Pak" membrane filters used (47 mm dia, 0.45µm).

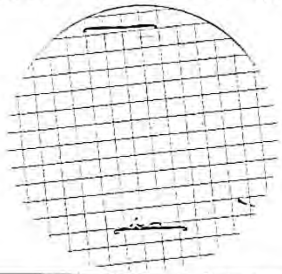
**Figure 28 - Ruben Sanchez (UWCD) performs SDI testing**

TUES 5/17 WELL#13

## SDI Daily Log

Pre/Post Bag
Date: 5/17/16 Time: 0830 T1= 11.7 T2= 18.1

INLET SOURCE WELL#13

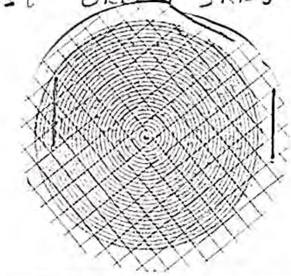


$11.7 \div 18.1 = 0.65$
$1 - 0.65 = 0.35$
$0.35 \div 15 = 0.23$
$0.23 \times 100$

SDI Value= 2.3

Pre/Post Bag
Date: 5/17/16 Time: 0918 T1= 14 T2= 18.7

POST GR[illegible] SAND WELL#13

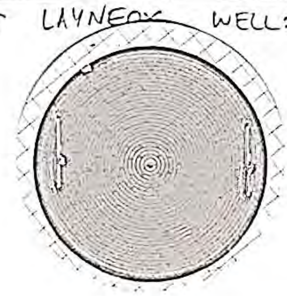


$14.0 \div 18.7 = 0.75$
$1 - .75 = 0.25$
$0.25 \div 15 = 0.0.16$
$0.016 \times 100 = 1.6$

SDI Value= 1.6

Pre/Post Bag
Date: 5/17/16 Time: 1105 T1= 14.1 T2= 32.8

POST LAYNEOX WELL#13

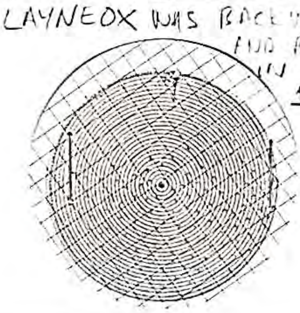


$14.1 \div 32.8 = 0.43$
$1 - 0.43 = 0.57$
$0.57 \div 15 = 0.038$
$0.038 \times 100 = 3.8$

SDI Value= 3.8

Pre/Post Bag
Date: 5/17/16 Time: 1322 T1= 14.9 T2= 19.7

POST LAYNEOX WAS BACKWASHED WELL #13 AND BACK IN SERVICE 1 HR.



$14.9 \div 19.7 = 0.76$
$1 - 0.76 = 0.24$
$0.24 \div 15 = 0.016$
$0.016 \times 100 = 1.6$

SDI Value= 1.6

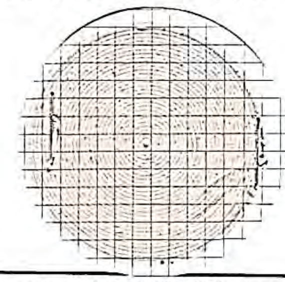
Formula: 1-(T1/T2) /15x100=SDI Value

WED 5/18 WELL # 13

## SDI Daily Log

Pre/Post Bag
Date: 5/18/16 Time: 1318 T1= 161 T2= 500

PRE FILTER, POST Cl2 WELL #13

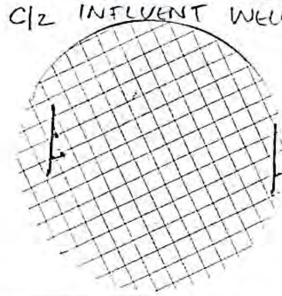


161 ÷ 500 = 0.322
1 - .322 = 0.678
0.678 ÷ 15 = 0.452
0.452 x 100 = 4.52

SDI Value= 4.52

Pre/Post Bag
Date: 5/18/16 Time: 1340 T1= 11.4 T2= 13.4

PRE Cl2 INFLUENT WELL # 13

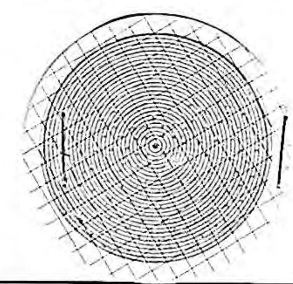


11.4 ÷ 13.4 = 0.85
1 - 0.85 = 0.15
0.15 ÷ 15 = 0.01
0.01 x 100 = 1

SDI Value= 1

Pre/Post Bag
Date: 5/18/16 Time: 1425 T1= 11.8 T2= 15.2

POST GREENSAND FILTER #1 WELL #13

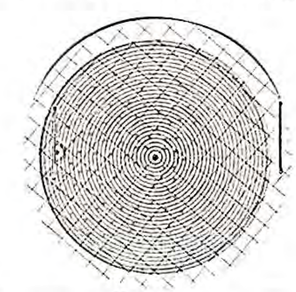


11.8 ÷ 15.2 = 0.77
1 - 0.77 = 0.23
0.23 ÷ 15 = 0.01
0.01 x 100 = 1

SDI Value= 1

Pre/Post Bag
Date: 5/18/16 Time: 1500 T1= 13.6 T2= 44.0

POST LAYNOEX FILTER # 3 WELL # 13



13.6 ÷ 44.0 = 0.31
1 - 0.31 = 0.69
0.69 ÷ 15 = 0.046
0.046 x 100 = 4.6

SDI Value= 4.6

Formula: 1-(T1/T2) /15x100=SDI Value

THUR 5/19 WELL # 13

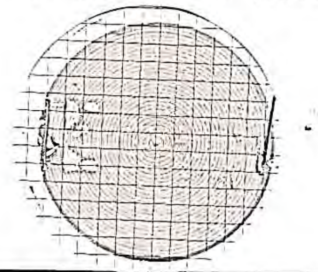
## SDI Daily Log

Pre/Post Bag
Date: 5/19/16 Time: 0840 T1= 115 T2= 520

115 ÷ 520 = 0.22
1 - 0.22 = 0.78
0.78 ÷ 15 = 0.052
0.052 × 100 = 5.2

SDI Value= 5.2

POST LAYNDEX #4 WELL #13

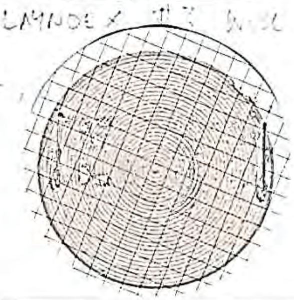


Pre/Post Bag
Date: 5/19/16 Time: 0915 T1= 50 T2= 220

50 ÷ 220 = 0.22
1 - 0.22 = 0.78
0.78 ÷ 15 = 0.052
0.052 × 100 = 5.2

SDI Value= 5.2

POST LAYNDEX #3 WELL #13
26#

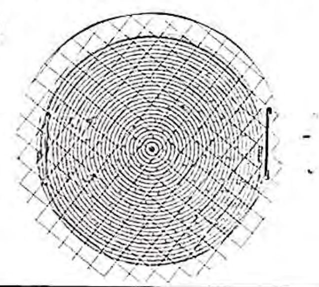


Pre/Post Bag
Date: 5/19/16 Time: 0955 T1= 16 T2= 18.6

16 ÷ 18.6 = 0.86
1 - 0.86 = 0.14
0.14 ÷ 15 = .009
.009 × 100 = 0.9

SDI Value= 0.9

POST GREENSAND #2 WELL #13
26#



Pre/Post Bag
Date: Time: T1= T2=

SDI Value=

Attach Filter Here

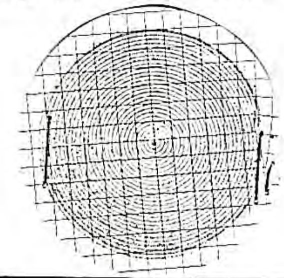
Formula: 1-(T1/T2) /15x100=SDI Value

THURS 5/19 WELL #12

## SDI Daily Log

Pre/Post Bag
Date: 5/19/16 Time: 1350 T1= 12.5 T2= 20.5

PRE Cl2 INFLUENT WELL #12

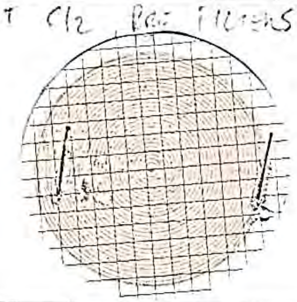


12.5 ÷ 20.5 = 0.61
1 - .61 = 0.39
0.39 ÷ 15 = 0.026
0.026 x 100 =

SDI Value= 2.6

Pre/Post Bag
Date: 5/19/16 Time: 1415 T1= 17.3 T2= 320

POST Cl2 PRE FILTERS WELL # 12

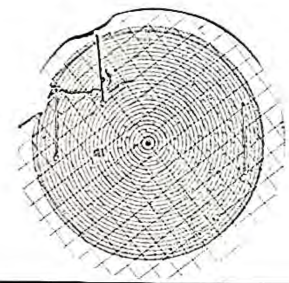


17.3 ÷ 320 = 0.054
1 - 0.054 = 0.946
0.946 ÷ 15 = 0.063
0.063 x 100 = 6.3

SDI Value= 6.3

Pre/Post Bag
Date: 5/19/16 Time: 1440 T1= 12.9 T2= 26.3

POST GREENSAND #2 WELL #12

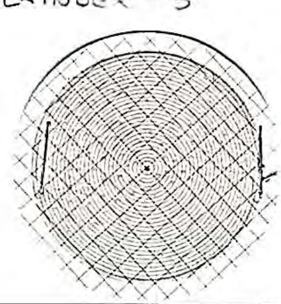


12.9 ÷ 26.3 = 0.49
1 - 0.49 = 0.51
0.51 ÷ 15 = 0.034
0.034 x 100 = 3.4

SDI Value= 3.4

Pre/Post Bag
Date: 5/19/16 Time: 1505 T1= 11.8 T2= 32.1

POST LAYNOEX #3



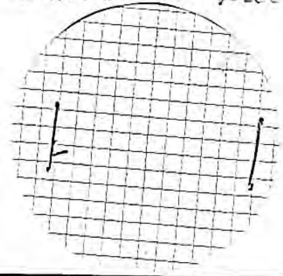
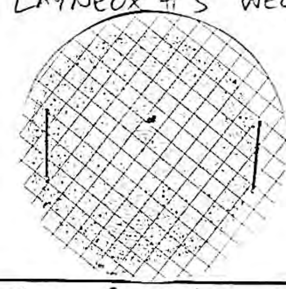
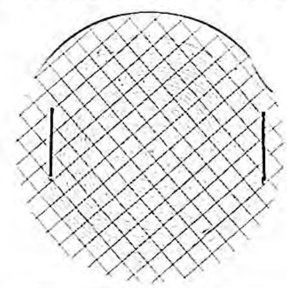
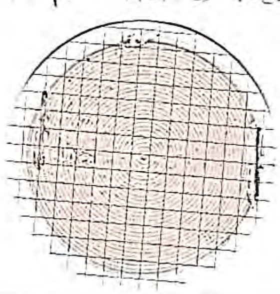
11.8 ÷ 32.1 = 0.37
1 - 0.37 = 0.63
0.63 ÷ 15 = 0.042
0.042 x 100 = 4.2

SDI Value= 4.2

Formula: 1-(T1/T2) /15x100=SDI Value

FRI 5/20 WELL #12

## SDI Daily Log

| Pre/Post Bag | |
|---|---|
| Date: 5/20/16 Time: 0750 T1= 13.5 T2= 14.1 | PRE $Cl_2$ INFLUENT WELL #12 |
| $13.5 \div 14.1 = 0.96$<br>$1 - 0.96 = 0.04$<br>$0.04 \div 15 = 0.003$<br>$0.003 \times 100 = 0.3$<br>SDI Value= 0.3 |  |
| Pre/Post Bag<br>Date: 5/20/16 Time: 0820 T1= 14.6 T2= 17.6 | POST LAYNEOX #3 WELL #12 |
| $14.6 \div 17.6 = 0.83$<br>$1 - 0.83 = 0.17$<br>$0.17 \div 15 = 0.11$<br>$0.11 \times 100 = 1.1$<br>SDI Value= 1.1 |  |
| Pre/Post Bag<br>Date: 5/20/16 Time: 0850 T1= 12.0 T2= 16.2 | POST GREEN SAND #2 WELL #12 |
| $12.0 \div 16.2 = 0.74$<br>$1 - 0.74 = 0.26$<br>$0.26 \div 15 = 0.17$<br>$0.17 \times 100 = 1.7$<br>SDI Value= 1.7 |  |
| Pre/Post Bag<br>Date: 5/20/16 Time: 0915 T1= 17.8 T2= 360 | POST $Cl_2$, PRE FILTERS WELL #12 |
| $17.8 \div 360 = 0.049$<br>$1 - 0.049 = 0.951$<br>$0.951 \div 15 = 0.063$<br>$0.063 \times 100 = 6.3$<br>SDI Value= 6.3 |  |

Formula: 1-(T1/T2) /15x100=SDI Value

**APPENDIX 7.9 – SWRCB Letter in Response to Proposition 1 Groundwater Grant Funding Pre-Application**

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board

RECEIVED

JUL 23 2016

United Water
Conservation District

JUL 20 2016

Mr. Robert Richardson
United Water Conservation District
106 N. 8th Street
Santa Paula, CA 93060

PROPOSITION 1 GROUNDWATER GRANT FUNDING PRE-APPLICATION; UNITED WATER CONSERVATION DISTRICT (DISTRICT); IRON AND MANGANESE DEEP WELL TREATMENT AT UWCD EL RIO FACILITY IN OXNARD (FAAST #34474)

Dear Mr. Richardson:

Thank you for submitting a pre-application on January 8, 2016, for the District's (FAAST #34474) project, for consideration of funding through the Groundwater Grant Program (GWGP). The GWGP Funding Guidelines were adopted by the State Water Resources Control Board (State Water Board) on May 18, 2016. We regret to inform you that your project does not qualify for GWGP funding. However, if you are still interested in State Water Board funding for your project, your project may qualify for funding through the Drinking Water State Revolving Fund (DWSRF) program.

Per the adopted GWGP Funding Guidelines, projects that treat groundwater for direct potable use, with no cleanup or remediation of the aquifer, are considered "drinking water treatment projects". Drinking water treatment projects generally address regional contamination that is not conducive to aquifer cleanup due to the extent of the contamination, ongoing discharge, or naturally elevated levels of the contaminant (e.g., regional nitrate plumes, hexavalent chromium, etc). Your project appears to be a drinking water treatment project.

Based on State Water Board staff's discussion with you over the phone, as well as in reviewing the Pre-application, your project would remove nitrate, iron, and manganese to serve potable drinking water to your customers, but would not clean up the aquifer. Your project meets the definition of "a drinking water treatment project". Only drinking water treatment projects that benefit a disadvantaged community or economically distressed area can qualify for GWGP funding. Your drinking water treatment project does not appear to benefit a disadvantaged community or economically distressed area, and, therefore, does not qualify for these funds.

To apply to the DWSRF Program, please use the Financial Assistance Application Submittal Tool (FAAST) and select the appropriate funding avenue (Planning or Construction) for your proposed project. For information on how and where to apply to the DWSRF Program, please see their webpage here:
http://www.waterboards.ca.gov/drinking_water/services/funding/SRF.shtml.

If you have any questions or for further information, please contact Erin Crandall at (916) 319-8263, or Erin.Crandall@waterboards.ca.gov for Proposition 1 Groundwater Program information.

Sincerely,

Joe Karkoski, P.E., MPAA
Chief, Bond Section
Division of Financial Assistance