



Pilot Study Report

on

WRT/Loprest Div. Filtration System for Iron and Manganese Removal



conducted by

**Loprest, a division of WRT
Westminster, Colorado**

for the

**Town of Lakeview, Oregon
Proposed Water Treatment Plant
Job # L33695**

**July 14, 2023
Rev. 0**

TABLE OF CONTENTS

- 1.0 EXECUTIVE SUMMARY/CONCLUSIONS..... 3**
- 2.0 THE WRT/LOPREST FILTRATION SYSTEM AND STUDY OVERVIEW 5**
 - 2.1 Iron and Manganese Removal..... 5**
- 3.0 TEST EQUIPMENT DESCRIPTION..... 5**
 - 3.1 Pilot Study Equipment and Process Flow Diagram 8**
 - 3.2 WRT/Loprest Pilot Study Equipment Photos..... 9**
- 4.0 RAW WATER ANALYTICAL DATA 10**
 - 4.1 Statement of Purpose 10**
- 5.0 PILOT TEST PROTOCOL 11**
 - 5.1 Operating Procedures and Performance Testing 11**
 - 5.1.1 Preparation of Chemical Solutions 11**
 - 5.1.2 Operating Procedure..... 12**
 - 5.1.3 Sampling Protocol..... 13**
 - 5.1.4 Sample Tests..... 13**
 - 5.1.5 Onsite Test Equipment, Procedures, and Methods 13**
- 6.0 TREATMENT PERFORMANCE EVALUATION 14**
 - 6.2 Filter Headloss 14**
 - 6.3 Iron and Manganese Treatment..... 14**
 - 6.4 Water Treatment Residuals Quantitative Analysis..... 19**
- 7.0 PERFORMANCE EVALUATION NOTES 21**
 - 7.1 Summary of Test Results 23**
- APPENDIX A 24**
- APPENDIX B 32**
- APPENDIX C 44**

1.0 EXECUTIVE SUMMARY/CONCLUSIONS

The Town of Lakeview, Oregon is planning installation of iron and manganese treatment for local groundwater well sources. Well water is pumped from multiple well sources, chlorinated at each well location and collected in two elevated water storage tanks. The proposed iron and manganese treatment facility will treat combined well water from these sources. Well water supplies from the Town of Lakeview has tested above state of Oregon secondary MCL levels for manganese. In addition, measurable iron levels are also present. WRT LLC Loprest division agreed to provide well water treatment testing of an oxidation filtration and treatment process to remove iron and manganese to comply with state of Oregon drinking water standards and eliminate iron and manganese precipitation and color. Design for the oxidation-filtration pilot test system is in accordance with the Anderson Perry and Associates engineering project documents and RFQ dated February 22, 2023 and subsequent agreements and discussions contained in associated email communications. A final Loprest Filtration System Pilot Study Description dated May 3, 2023 is the basis to the pilot testing plan. The filtration testing is to provide operational performance simulating conditions of a full-scale installation and evaluate final design parameters for treatment equipment. This proof pilot installation and testing was conducted on-site over two one-week periods using WRT/ Loprest Division pilot testing personnel and equipment.

The Town of Lakeview chlorinated combined well water from the elevated storage tanks is the source water for pilot testing. The proof pilot testing included five separate 10-hour filtration service intervals with simulated full-scale backwash cleaning cycles. Filtration rates based on hydraulic loading rate (HLR) were constant over all filtration runs. To confirm final operating conditions and the changes made in oxidant used after the first two filtrations runs, two additional filtration runs were conducted at a later testing week to provide three consecutive filtration runs repeatability demonstrating complete iron and manganese removal meeting test objectives. Field analytical testing for raw treatment system inlet and test unit effluent contaminants including iron, manganese, turbidity, and ammonia, among other water quality parameters was completed. Two water quality samples were drawn each filtration run to verify field analytical results.

The iron and manganese concentration in the raw water averaged 0.11 mg/L and 320 micrograms per liter ($\mu\text{g/L}$) respectively. The project specifications require that the finished water from the proposed treatment system shall not exceed 0.3 mg/L iron and 0.05 mg/L (50 $\mu\text{g/L}$) manganese, to comply with State of Oregon drinking water standards. The pilot test conditions were set to achieve these directives.

A raw well water supply to the water storage tanks and provided to the pilot test equipment was operated at normal full-scale well withdrawals representative of standard treatment operation.

The media system was tested in a single filtration column containing Mag-Ox[®] granular media at specified service flow conditions. This media system was initially operated using sodium hypochlorite as a pretreatment oxidant. To assist in the oxidative precipitation process, chlorine oxidant is added to the raw water as sodium hypochlorite reagent in the service filtration phase of the treatment. Free chlorine oxidant addition rates were adjusted to maintain between 0.8 and 1.0 ppm residual in the finished water. Water quality produced from the filtration treatment process columns did remove some oxidized iron levels and manganese consistently below 100 µg/L but not to treatment objectives. The oxidant material was changed to potassium permanganate to improve the metal oxidation removal efficiency. Filter run no. 3 was conducted using the revised oxidant addition. Manganese and iron removal was dramatically improved, meeting iron and manganese removal objectives to below detection limits never exceeding 0.004 mg/L total iron and manganese to less than the 10 µg/L limits in laboratory samples from the raw water stream. Testing was suspended for approximately 4 weeks and two additional filter runs were performed the week of June 12, 2023. These test filtration runs RUN #4 and #5 were to confirm the iron and manganese removal results obtained during Run #3. The results of these test runs demonstrated the much-improved iron and manganese removal using permanganate as the primary oxidant. Although iron removal showed less than detectable concentrations in the treated effluent, manganese results were slightly higher as the effluent manganese concentration averaged 0.03 mg/L. A minimum filtration run of 10 hours as guaranteed in our proposal was met in all test filter runs. All contaminants tested below project specifications for effluent water quality in the finished treated water exiting the filtration media column in the final three filter runs in effluent field and laboratory samples. Pressure loss results through each filter run never exceeded recommended backwash initiation points through the service cycles and were uniformly predictable to extrapolate to expected service runs of more than 10 hours before recommended filter backwash cleaning. In this instance, service run time and not pressure loss through the filter will determine the end of the service cycle.

The testing conducted here demonstrates that the filtration media selected along with the revised permanganate pretreatment chemical addition at prescribed dose rates can provide effluent water quality meeting the project specifications.

Final Design Recommendations

1. The first recommendation is a nominal service filtration HLR of 7.4 gpm/sq.ft. for this filtration media type and filtration system. This will provide extended service run times of 10 hours or more and reduced chance of iron and manganese contaminant leakage from the filtration media bed.
2. The second recommendation is to include a revised pretreatment oxidant addition using permanganate at a 0.5 to 0.8 mg/L to fully oxidize and removal iron and manganese from this water supply.
3. A pre-filtration reaction/detention tank is not required as demonstrated in the pilot work.

2.0 THE WRT/LOPREST FILTRATION SYSTEM AND STUDY OVERVIEW

The WRT/Loprest filtration system removes iron and manganese contaminants from drinking water in a downflow filtration media process using chemical oxidation and co-precipitation. Solid phase metal oxide contaminants are physically separated from the water stream and collected within a packed media bed and safely removed during a backwash operation. The backwash wastewater from the filter is directed to an on-site collection tank for disposal. The process has been designed for simplicity of operation, minimal maintenance, and reliable operation. The filtration system is designed to meet the water production requirements of a specific treatment facility.

Several media types have demonstrated effective catalytic oxidation properties and can be used to facilitate the oxidation process. Depending upon the specific water conditions and corresponding water quality, oxidative media types will perform differently. This pilot study was conducted using one selected media type and that is the basis of design for installation in the full-scale treatment system. The media was tested for proof of treatment concept for iron and manganese removal performance for this raw ground water source. The media is a formulated product from Noble House Group trademarked Mang-Ox[®] in downflow filtration of oxidized particulates.

2.1 Iron and Manganese Removal

The most common method of removing iron and manganese from water involves the oxidation of soluble iron (Fe^{+2} , or ferrous ion) and manganese (Mn^{+2} , or manganous ion) to insoluble forms (Fe^{+3} , ferric ion, and Mn^{+4} , tetravalent manganese ion), and subsequent removal of the precipitates formed by filtration.

Mang-Ox[®] is a high-capacity granular filter media consisting of 80 percent manganese dioxide. Refer to Appendix A for specific product information. It requires oxidant addition prior to media contact. Chlorine is the most used oxidant; however as has been demonstrated with this pilot test results, other oxidants are effective. The manganese dioxide material acts as a catalyst in the oxidation process of both iron and manganese. The media is evaluated in a test filter column containing Mang-Ox[®] media and a specified underdrain gravel subfill.

3.0 TEST EQUIPMENT DESCRIPTION

WRT/Loprest division's filter pilot test equipment is installed in a 16 ft. x 8 ft. trailer. The pilot test components are installed and pre-plumbed in the trailer for single-point supply and discharge connection at the test site. The filtration equipment includes three test media filtration columns available for individual media testing, chlorination and chemical feed addition, and all automated filtration backwash piping valves and

instrumentation and process control equipment. Refer to Figure 1 for the pilot equipment general process flow diagram. Installed trailer equipment may or may not be used in part in this pilot test. The following equipment is installed in the trailer unit:

- Three (3) Pulsafeeder metering pumps, with a maximum injection flow rate of 3.0 GPD, each with a dedicated solution tank and a 100 mL calibration cylinder. One pump will be used to inject sodium hypochlorite oxidizing reagent. A second and third reagent pumping systems are included to inject additional pretreatment reagents or revised oxidizing agent. A second chemical injection pumping systems was used in this pilot test.
- One (1) vertical detention reaction pressure vessel constructed of Sch 40 PVC pipe, nominal 6-inch outside diameter (6.03 inches inside diameter) by 65-1/2 inches straight side height, cross sectional area of 0.1963 sq. ft. including flow distribution internal piping, manual valves as follows:
 - Vessel-mounted air release valve
 - Outlet valve sample ports

The detention reaction pressure vessel was not required or used in this pilot testing.

- A pH control system is included to adjust raw water pH using a dilute sulfuric acid injection. The pH control system is self-contained and monitors the treated water stream and a feedback control function to adjust acid injection to maintain a pH setpoint at the monitoring point. pH adjustment was not required or used in this testing.
- Three (3) vertical pressure filter vessels constructed of Sch 40 PVC pipe, nominal 6-inch outside diameter (6.03 inches inside diameter) by 65-1/2 inches straight side height, cross sectional area of 0.1963 sq. ft. including flow distribution internal piping, manual and automatically controlled valves, instrumentation and controls, and filtration media bed as follows:
 - Slotted stainless steel strainer underdrain laterals
 - Upper surface wash header/distributor
 - 30 to 36 inches of 20 x 60 mesh prewashed filtration media
 - 6 inches of 1/8-inch x 1/4-inch washed gravel subfill
 - Automatic and separate manually operated valves to control filtration, rinse to waste, surface wash and backwash flow sequences
 - Pressure indicators on inlet and outlet flow piping
 - Vessel-mounted air release valve
 - Inlet and outlet valve sample ports
 - Rate of flow indicators for the service inlet, backwash, and surface wash flow streams

One (1) pressure filter vessel was used in this pilot test containing of 30-inches of Mang-Ox[®] catalytic oxidizing media.

- A simulated backwash method for the Loprest[®] Syncrocleanse[®] system using a combined air and water scour followed by a low flow water backwash is included. This system is used in the backwash sequence for this test.

- A 200-gallon polyethylene storage tank and backwash pump. The storage tank is used to store filtered water for filter backwash operations.
- PLC-based control panel, which automatically controls the filter control valves, surface wash and backwash pump during filter cleaning sequences. Filter cleaning sequence initiation can be controlled using elapsed service time, filter differential pressure, or manually. It is anticipated that pressure filter differential pressure will be used as the primary filter cleaning sequence initiation followed by elapsed service time initiation during this pilot testing.
- Additional portable test equipment as follows:
 - Hach DR 900 Portable Colorimeter and accompanying reagent packs for free chlorine measurement, as well as iron and manganese, ammonia, and apparent color measurements.
 - LaMott DC1500 free chlorine test kit for free chlorine analysis.
 - Portable handheld probe and analyzer for pH.
 - Turbidity testing using a LaMott 2020we turbidity meter.

The source water enters the pilot test unit from a connection to the raw water pressurized supply line through a hose connection to the WRT/Loprest filtration system trailer. Raw water sampling occurs at this location referred to as SP1 on the process flow diagram. The water is first directed to the inline mixing unit where oxidant pretreatment addition and other pretreatment reagents, if used, are added to the raw water as specified by the test protocol. A sample valve is included to allow full sampling of the pretreated raw water prior to filtration. The pretreated water then enters the top of each media treatment column. The treated water exits the bottom of each treatment column where it is directed to the main discharge piping and out through the outlet connection on the trailer. Each treatment column is equipped with a valved effluent sample connection labeled SP2. Effluent filtered water is then directed discharge through a final treated water exit bulkhead connection and can be sampled using sample valve connection SP3. Two pretreatment oxidizing reagents of sodium hypochlorite and potassium permanganate were used in this pilot testing.

The media filter columns are backwashed automatically using one of several backwash trigger points set at the PLC controller. Set points for filter backwash can be initiated manually, by operating time interval, by filter differential pressure loss or by filtered water discharge conditions. Based upon the filter run requirements and the testing protocol for the test(s) a filter backwash frequency is selected. Backwashing of the filter units is accomplished by directing treated and finished water from the integrated treated water collection tank. Backwash water supply is directed automatically to each filter column sequentially upflow through the media column to expand the media bed and release the collected solids to exit the out of the top of the filter media column. In addition, an air supply provides compressed air to the backwash water inlet line to simulate an air scour sequence. The backwashed liquid and solids are sent to the wastewater discharge connection on the trailer.

Note: Not all components or pretreatment reagent additions are included and in operation in this pilot study. Flow diagram depicts full pilot test equipment available for use in the test trailer.

3.1 Pilot Study Equipment and Process Flow Diagram

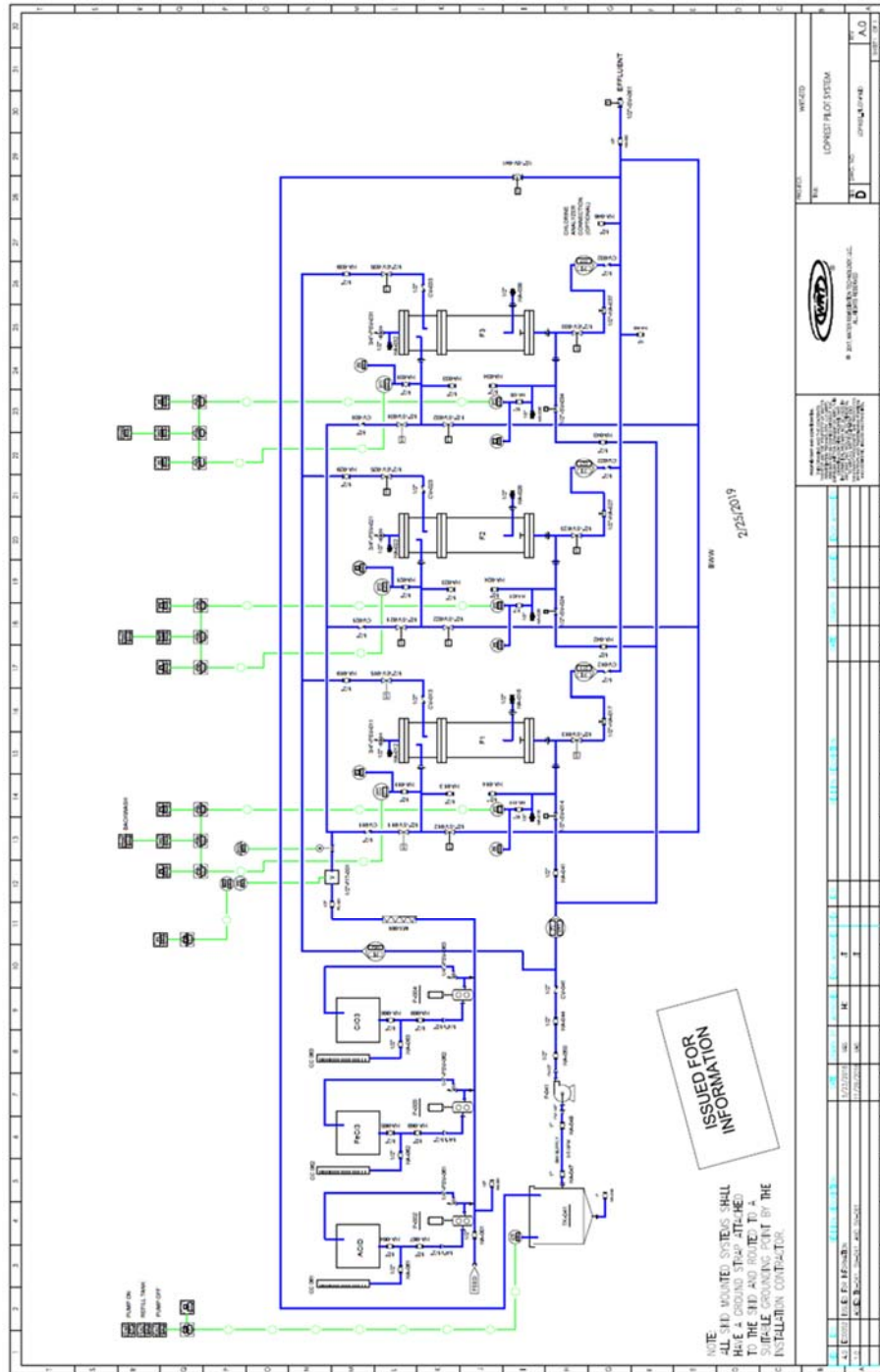


Figure 1. Pilot Study Equipment Process Flow Diagram

3.2 WRT/Loprest Pilot Study Equipment Photos



4.0 RAW WATER ANALYTICAL DATA

A comparison of the raw water constituent levels presented in the project specifications vs. those measured onsite are summarized below. All analytical results can be found in Appendix A of this report.

**TABLE 1
RAW FEED WATER CHARACTERISTICS**

Constituent	Raw Well Water Supply	Owner's Recent Historical Data (avg.)
Iron, total, mg/L	0.05 - 0.28	0.14 - 0.75
Manganese, mg/L	0.28 - 0.79	0.043 - 2.030

4.1 Statement of Purpose

The iron and manganese levels in water obtained from the Town of Lakeview well water sources are elevated and exceed the USEPA and state of Oregon Drinking Water secondary drinking water MCL manganese concentration of 0.050 mg/L. The pilot test average raw water iron and manganese levels are consistent with that reported from the historical raw water quality provided in the RFP document. A treatment system designed for iron and manganese metals removal is the primary demonstration objective of this test.

The purpose of this study was to determine chemical requirements for treatment, their dosage rates, optimum filtration rate in gpm/sf and expected service run times. Based on a review of the water chemistry and full-scale plant experience in the area, expectations were that only chlorine would be required as an oxidant and no other chemical treatment would be needed. This was modified to include an alternate oxidizer based upon the first two filtration test run results. Service run times are always a variable of inlet contaminate concentrations and treatment HLR. A service run time of 10 hours minimum was desired and to be confirmed through pilot testing.

A proof-of-concept study for the selected treatment media type to remove iron and manganese from the raw water supply to specified effluent quality of less than 300 µg/L iron and manganese levels consistently below 50 µg/L at the specified HLR was run. Effluent performance data is used for extrapolating expected treatment results for the full-scale treatment system.

5.0 PILOT TEST PROTOCOL

The Town of Lakeview well water storage system was operated at the proposed normal treatment flow during the pilot study to supply raw water to the filter testing system. Apart from chlorine addition at the well head the water is consistent with the well water supply to the proposed treatment facility. The pilot test consisted of five separate filter test runs, one per day for the selected filtration media conducted continually over a 10-hour service run time. Separate runs were conducted using the directly obtained supply water consisting of water supply from the storage tank source. The hydraulic loading filtration rate of 7.4 gpm/sq.ft HLR was used. Following the second test run and unsatisfactory test results, a change in the pretreatment oxidant used was initiated for the third filtration run. Based upon the iron and manganese removal and the filter pressure loss performance results for the third filter test run, two additional filter runs were scheduled and completed at a return testing session to provide verification and comparable data for the changes made to ascertain performance repeatability.

**TABLE 2
FILTRATION RUN TEST CONDITIONS**

Test Run No.	Filtration Hydraulic Loading Rate (HLR, gpm/sq. ft.)	Pretreatment Oxidant Type Used
1	7.4	Sodium Hypochlorite
2	7.4	Sodium Hypochlorite
3	7.4	Potassium Permanganate
4	7.4	Potassium Permanganate
5	7.4	Potassium Permanganate

5.1 Operating Procedures and Performance Testing

This section describes the steps and procedures that were followed during the onsite pilot study. One of the first steps was the preparation of chemical feed stock solutions.

5.1.1 Preparation of Chemical Solutions

Sodium hypochlorite (10.0 percent) was used to prepare the chlorine solution. The dilution factors for the chlorine solution are 0.5 liters of 10 percent sodium hypochlorite into 10 gals of water.

Potassium permanganate solid hydrate of 20 grams into 3 gallons water to create a 1,761 mg/L reagent for injection.

pH adjustment is not required or recommended for this treatment and hence, pH adjustment reagent is not used.

5.1.2 Operating Procedure

Fresh unused Mag-Ox[®] filter media was installed in the test filter column and initially backwashed at the WRT/Loprest facility. The source of water for the first backwash is potable water from the local potable water distribution system at WRT's facility. After the first backwash, the filtered water from the pilot unit was used for backwashing. Media fines are removed at this point. A recommended chlorine pretreatment conditioning consisting of direct media contact with 0.3 percent sodium hypochlorite solution for 12 hours is then completed in preparation for service.

Following reagent feed determination, the first of 5 test runs were conducted to demonstrate iron and manganese removal capability. Chemical feed rates were noted in the attached data log. A backwash cleaning step is performed at the conclusion of each filter run.

The backwash cycle was completed in a three step process: 1) a full bed air scour and water backwash for 4 minutes at a flow rate of 5 gpm/sq.ft. (1 gpm) and 2 cfm/sq.ft. (0.4 cfm), 2) a full bed water only backwash for 4 minutes using 5 gpm/sq.ft. (1 gpm) and 3) a final 4 minute downflow rinse at service flow rate of 7.4 gpm/sq.ft. (1.4 gpm) as recommended by the treatment media manufacturer for full media expansion and fluidization of entrapped metal oxide particulate. Effluent water was accumulated for use as backwash supply water. These same values would be recommended for full scale treatment.

During each filter run, the following parameters are measured and recorded at the indicated intervals for each run:

1. Filter HLR of flow, gpm
2. Filter column pressure loss, psid
3. Filter inlet and effluent free chlorine, mg/L
4. Iron in filter influent, mg/L
5. Iron in filter effluent, mg/L
6. Manganese in raw water, mg/L
7. Manganese in filter effluents, mg/L
8. Ammonia in raw water, mg/L
9. Ammonia in filter effluent, mg/L
10. Color, true and apparent
11. Chemical feed pump speed strokes per minute

The above data was recorded on pilot test log sheets, which are included in the Appendix B of this report.

5.1.3 Sampling Protocol

All inorganic water analyses were performed an external laboratory certified by the National Environmental Laboratory Accreditation Program. All samples are drawn into clean sample containers and preserved for metal analysis twice per filter run. Chain of custody documentation is completed, and samples transported to the laboratory for immediate analysis. Laboratory test samples were analyzed by the Edge Analytical in Portland, Oregon certified by NELAP located using USEPA and state of Oregon recognized testing methods for drinking water.

Methods for analysis are:

Total Manganese	EPA 200.7
Total Iron	EPA 200.8
Hydrogen Sulfide	SM 4500 -S ² F
Ammonia nitrogen	EPA 350.1 Rev. 2.0
Color, True and Apparent	EPA 110.2 / SM 2120 C
Odor	SM 2150 B
Total Suspended Solids (TSS)	I-3765-85

5.1.4 Sample Tests

Onsite tests for free chlorine, manganese, iron, pH, ammonia, and color were tested onsite using the instruments and procedures described in the following section. Each filter influent and effluent sample was taken in enough volume to provide the required sample volume for each parameter to be tested. Sample volumes were sufficient to provide a sample for offsite testing. The two collected samples for the off-site independent lab analysis were drawn twice per filter run approximately midway through the filter service run.

5.1.5 Onsite Test Equipment, Procedures, and Methods

Field testing for iron, and manganese are performed with a Hach DR 900. With this instrument, packets of reagents specific for each constituent are added to a pair of sample cylinders, which are then inserted into the test instrument in two steps. One sample is called the blank, which is inserted into the DR 900 first, and the instrument is zeroed. The DR 900 measures the amount of light passing through the blank sample and electronically stores the result. Next, the second prepared sample is inserted, and the value is read by the DR 900. The instrument compares the stored value for the blank to the value for the prepared sample and displays the results for the constituent being tested.

For manganese, the blank is prepared with deionized water. The iron test blanks are prepared with water from the filter effluent. The test results are displayed on the digital readout. For iron, the Total Iron, FerroVer test Method 8008 is used. For manganese, Method 8149 is used.

For ammonia test included Method 10200.

Chlorine analysis is performed on a Lamotte DC1500 using the DPD Method. This test is equivalent to Standard Method 4500-C1 G.

pH is measured using an Oakton pH Acorn Series Pocket pH Tester with a range of 0.0 – 10.0 pH. The probe was calibrated daily using a 7.0 pH buffer solution.

Color testing is performed using a Hach 900 colorimetric/spectrophotometry test using true and apparent alpha platinum-cobalt standard method 8025.

6.0 TREATMENT PERFORMANCE EVALUATION

This section provides a performance summary of the equipment and filtration media type evaluated during the pilot test. Refer to Section 3.0 for a complete description and specification of the pilot test equipment and field analysis test equipment.

6.2 Filter Headloss

The pressure differential across the filter during each filter run increased uniformly in a predictable manner when operated at each of the specified filter media HLR. Filter test RUN #1, at a filtration HLR of 7.4 gpm/sq.ft. provided the lowest initial clean head loss of 1.6 psid. Over the 10-hour run period the filter head loss increased gradually to 1.9 psid. Filter RUN #2, a repeat of filter RUN #1 at a nominal 7.4 gpm/sq.ft. started at a measured differential pressure of 1.9 psid and increased to 2.4 psid at the 10-hour close of the test. RUN #3 with the change in oxidant pretreatment began measuring 2.1 psid and finished at 4.5 psid over the 10-hour service run period. The last two filtration tests, filter RUN #4 and RUN #5 were conducted using this filtration HLR and verified similar pressure loss as observed in filter RUN #3. A clean pressure loss for the filter column is nominally 1.5 to 2.0 psid. Precise measurements of filter headloss given the pilot test instrumentation and variations in flow conditions is not possible, however the general increase in pressure loss over the course of each filter run is expected and iron precipitate removal is not a limiting factor in the expected filter service run cycle times given the relatively limited iron precipitate loading in the media. In testing, the normally observed regular effluent leakage of iron late in the filter runs did not occur and excessive differential pressure loss was not shown. It is expected that over the course of a filter run differential pressure loss will be an indication of the filter service run termination.

6.3 Iron and Manganese Treatment

A summary of the influent and filtered water values for iron, manganese, and ammonia is

presented in Tables 4 through 8. The test results noted “field” are test results from the Hach DR 900 and field test kits, and those noted Lab are from Edge Analytical in Portland, Oregon Laboratory off-site analysis.

TABLE 4
IRON AND MANGANESE TEST RESULTS
Well Water, MEDIA #F1 RUN #1
Sodium hypochlorite oxidant
May 16, 2023

ANALYTE	Hours of Service						
	0	2	3	4	7	9	10
Raw Fe, mg/L, field		0.21		0.21	0.28	0.21	
Raw Fe, mg/L, Lab				0.37			
Treated Fe filter out, mg/L, field		0.16		0.14	0.15	0.11	
Treated Fe final, mg/L, Lab				0.20			0.12
Raw Mn, mg/L, field		0.629		0.798	0.685	0.616	
Raw Mn, mg/L, Lab				0.548			
Treated Mn, mg/L, field		0.050		0.074	0.045	0.053	
Treated Mn, mg/L, Lab				0.0420			0.0421
Raw Ammonia, mg/L, field		0.02			0.06	0.07	
Raw Ammonia, mg/L, Lab				0.030			
Treated Ammonia, mg/L, field		ND			ND	0.01	
Treated Ammonia, mg/L, Lab				0.012			<0.010
Raw Sulfide as S, mg/L, Lab				<0.05			
Treated Sulfide as S, mg/L, Lab				<0.05			<0.05
Raw Color, units, field			39	59	65	57	
Treated Color, units, field			21	35	50	29	
Raw Tot. Susp. Solids, mg/L, Lab				2.5 NN			
Treated Tot. Susp. Solids, mg/L				ND NN			ND NN
Raw Water Odor, TON, Lab				1			
Treated Water Odor, TON, Lab				ND			ND
DP, psid	1.7	1.7	1.7	1.7	1.7	1.9	1.9

NOTES: Media = F1 Media Mag-Ox[®]

Flow = 1.6 GPM (7.4 gpm/sq.ft.)

**TABLE 5
IRON AND MANGANESE TEST RESULTS
Well Water, MEDIA #F1 RUN #2
Sodium hypochlorite oxidant
May 17, 2023**

ANALYTE	Hours of Service						
	0	2	3	4	5	8	10
Raw Fe, mg/L, field	0.14				0.16	0.13	
Raw Fe, mg/L, Lab				0.18			
Treated Fe filter out, mg/L, field	0.10				0.09	0.04	
Treated Fe final, mg/L, Lab				0.094		0.075	
Raw Mn, mg/L, field	0.474				0.451	0.448	
Raw Mn, mg/L, Lab				0.368			
Treated Mn, mg/L, field	0.093				0.074	0.081	
Treated Mn, mg/L, Lab				0.0599		0.0526	
Raw Ammonia, mg/L, field	0.14				0.08	0.03	
Raw Ammonia, mg/L, Lab				0.018			
Treated Ammonia, mg/L, field	0.02				ND	0.03	
Treated Ammonia, mg/L, Lab				<0.01		<0.010	
Raw Sulfide as S, mg/L, Lab				<0.05			
Treated Sulfide as S, mg/L Lab				<0.05		<0.05	
Raw Color, units, field	59				67	51	
Treated Color, units, field	41				36	24	
Raw Tot. Susp. Solids, mg/L, Lab				ND NN			
Treated Suspended Solids, mg/L				ND NN		16 NN	
Raw Water Odor, TON, Lab				ND			
Treated Odor, TON, Lab				ND		1.5	
DP, psid	1.8	1.9	1.9	2.0	2.0	2.3	2.4

NOTES: Media = F1 Media Mag-Ox[®] Flow = 1.6 GPM (7.4 gpm/sq.ft.)

**TABLE 6
IRON AND MANGANESE TEST RESULTS
Well Water, MEDIA #F1 RUN #3
Potassium Permanganate oxidant
May 18, 2023**

ANALYTE	Hours of Service					
	0	2	3	6	8	10
Raw Fe, mg/L, field	0.13	0.11		0.10		0.09
Raw Fe, mg/L, Lab				0.15		
Treated Fe filter out, mg/L, field	0.02	ND		ND		ND
Treated Fe final, mg/L, Lab				<0.05		<0.05
Raw Mn, mg/L, field	0.410	0.403		0.397	0.393	0.372
Raw Mn, mg/L, Lab				0.324		
Treated Mn, mg/L, field	0.021	0.014	0.013	0.009	0.011	ND
Treated Mn, mg/L, Lab				0.0032		0.0026
Raw Ammonia, mg/L, field		0.08		0.11		
Raw Ammonia, mg/L, Lab				<0.010		
Treated Ammonia, mg/L, field		ND		0.02		
Treated Ammonia, mg/L, Lab				<0.010		0.010
Raw Sulfide as S, mg/L, Lab				<0.05		
Treated Sulfide as S, mg/L, Lab				<0.05		<0.05
Raw Color, units, field		60		70		77
Treated Color, units, field		8		9		12
Raw Tot. Susp. Solids, mg/L, Lab				<2 NN		
Treated Tot. Susp. Solids, mg/L				<2 NN		<2 NN
Raw Water Odor, TON, Lab				ND		
Treated Odor, TON, Lab				ND		1.2
DP, psid	2.1	2.6	3.1	3.4	3.8	4.5

NOTES: Media = F1 Media Mang-Ox[®] Flow = 1.6 GPM (7.4 gpm/sq.ft.)

TABLE 7
IRON AND MANGANESE TEST RESULTS
Well Water, MEDIA #F1 RUN #4
Potassium Permanganate oxidant
June 13, 2023

ANALYTE	Hours of Service						
	0	2	3	4	7	9	10
Raw Fe, mg/L, field		0.09	0.08	0.09	0.07	0.08	
Raw Fe, mg/L, Lab				0.15			
Treated Fe filter out, mg/L, field		ND	ND	ND	ND	ND	
Treated Fe final, mg/L, Lab				<0.05		<0.05	
Raw Mn, mg/L, field		0.386	0.376	0.359	0.321	0.331	
Raw Mn, mg/L, Lab				0.278			
Treated Mn, mg/L, field		0.069	0.054	0.041	0.032	0.023	
Treated Mn, mg/L, Lab				0.0350		0.0275	
Raw Ammonia, mg/L, field			0.03	0.04	0.02	0.03	
Raw Ammonia, mg/L, Lab				0.023			
Treated Ammonia, mg/L, field			ND	ND	ND	ND	
Treated Ammonia, mg/L, Lab				<0.010		0.010	
Raw Sulfide as S, mg/L, Lab				<0.05			
Treated Sulfide as S, mg/L, Lab				<0.05		<0.05	
Raw Color, units, field		47	33	52	61	60	
Treated Color, units, field		16	5	8	22	14	
Raw Tot. Susp. Solids, mg/L, Lab				<2 NN			
Treated Tot. Susp. Solids, mg/L				<2 NN		<2 NN	
DP, psid	1.6	1.8	1.9	2.1	2.4	2.7	2.9

NOTES: Media = F1 Media Mang-Ox[®] Flow = 1.6 GPM (7.4 gpm/sq.ft.)

**TABLE 8
IRON AND MANGANESE TEST RESULTS
Well Water, MEDIA #F1 RUN #5
Potassium Permanganate oxidant
June 14, 2023**

ANALYTE	Hours of Service						
	1	2	4	6	8	9	10
Raw Fe, mg/L, field		0.09	0.06	0.03	0.04	0.04	
Raw Fe, mg/L, Lab				0.12			
Treated Fe filter out, mg/L, field		ND	ND	ND	ND	ND	
Treated Fe final, mg/L, Lab				<0.05			<0.05
Raw Mn, mg/L, field	0.283	0.292	0.279	0.283	0.285	0.342	
Raw Mn, mg/L, Lab				0.230			
Treated Mn, mg/L, field	0.059	0.042	0.056	0.044	0.036	0.029	
Treated Mn, mg/L, Lab				0.0394			0.0330
Raw Ammonia, mg/L, field			0.04	0.01	0.02		
Raw Ammonia, mg/L, Lab				<0.010			
Treated Ammonia, mg/L, field			ND	ND	ND		
Treated Ammonia, mg/L, Lab				<0.010			<0.010
Raw Sulfide as S, mg/L, Lab				<0.05			
Treated Sulfide as S, mg/L, Lab				<0.05			<0.05
Raw Color, units, field	64	71	65	65	65	61	
Treated Color, units, field	31	29	30	29	26	23	
Raw Tot. Susp. Solids, mg/L, Lab				<2 NN			
Treated Tot. Susp. Solids, mg/L				<2 NN			<2 NN
DP, psid	2.5	2.6	2.8	3.0	3.3	3.6	3.9

NOTES: Media = F1 Media Mang-Ox[®] Flow = 1.6 GPM (7.4 gpm/sq.ft.)

6.4 Water Treatment Residuals Quantitative Analysis

The complete backwash volume of filter RUN Nos. 3, 4 and 5 were collected into a holding tank and allowed to settle to concentrate the backwash solids. Approximately 10 gallons of backwash water for each backwash operation was collected. The supernatant was decanted to consolidate the final collected solids to a single one-gallon volume and shipped to the WRT LLC laboratory in Westminster, Colorado. A simple settling test was performed on the solids sample from backwash of Run No. 3. Quantitative analysis of the samples for each of the collected backwash solids samples for Run Nos. 3, 4 and 5 are tabulated below.

Backwash solids residual materials were tested in two phases. Some on-site analysis involved solids content characterization of the collected backwash water immediately following the backwashing operation in succeeding settling periods. Here a sample of decanted supernatant settled backwash water was sampled for total suspended solids

content. The results are tabulated below.

Run No.	Collected Backwash Water Settling Time (hrs.)	Total Suspended Solids Content (mg/L)
1	7	5 NN
2	3	13.3 NN
2	7	12 NN
3	14	11 NN
4	11	6 NN
5	12	7 NN

The laboratory test results provide some data regarding the expected solids loading to the filtrations system in the should backwash water be returned to the raw water supply as a water conservation measure.

A second phase of testing involved off-site laboratory testing. The solids settling test included diluting the collected backwash solids sample to a total volume of 2 liters in a graduated cylinder. Settling gradients were observed over incremental time to a final time of 14 hours. Refer to the test photographs for the observational results of this testing.



0 Hour

1 Hours

5 Hours

20 Hours

Photos of graduated cylinder settling test for backwash of Run No. 3.

The test is not dispositive of measured settling behavior for the backwash solids immediately following a backwash sequence because of the elapsed time between collection and analysis. However, the test does confirm that the solids do rapidly settle over a relatively short quiescent period consisting of a few hours. We can conclude that reinjection of decanted supernatant backwash water is feasible in this case and can be recommended to conserve and economize water use.

Quantitative analysis

Each collected backwash sample was allowed to settle over 8 hours at which time the clear supernatant was decanted from the solids. The remaining material was then filtered through a 25 micron filter paper and the wet cake collected was weighed. The wet cake was then dried in a 225 deg. F laboratory drying oven for 12 hours and weighed again to obtain a total dry solids weight. The results are tabulated below.

Run No.	Representative treated water volume (gal.)	Settled Volume of sludge Collected (mL)	Filtered Wet Cake Solids Weight (gms)	Filtered Dry Cake Solids Weight (gms)
3	875	325	150	125
4	877	94.0	21.7	13.7
5	875	9.2	2.8	1.6

The large disparity between the volume and final weight of the backwash solids does not allow definitive conclusion of the expected quantity of solids expected for a given treated water volume. Calculations show that at 1,750 gpm for a 10 hour filter service run and concentrations of 0.15 mg/L iron including 0.4 mg/L manganese that 8 lbs. of combined iron and manganese oxide material is formed.

7.0 PERFORMANCE EVALUATION NOTES

For the first two filter test runs, sodium hypochlorite was fed at a rate of 1.5 mg/L NaOCl (calculated) to maintain a chlorine residual in the treated effluent water from 0.75 to 1.0 ppm as free chlorine. This free chlorine measurement includes the residual chlorine content as received in the raw water stream. The effluent free chlorine content varied between 0.60 and 1.2 mg/L through each of these filter runs. Field measurements indicate nearly complete oxidation and removal of ammonia from the raw water in the initial minutes of the service run through the 10-hour test. However, complete iron and manganese removal was not to the test objective standards. The oxidant was then changed to potassium permanganate for filter runs Nos. 3, 4 and 5. Permanganate addition rate was 0.53 mg/L as calculated. The finished water quality results indicated much improved iron and manganese removal from the water stream. Each filter run duration was 10 hours. A concluding backwash sequence was commenced at the end of each filter run conclusion. The filtration capacity for iron and manganese precipitate of the media bed was never exceeded in any of the filter test runs.

Filter Run No. 1

RUN #1 was conducted at 7.4 gpm/sq.ft. with a nominal 4.5 mL/min addition rate or 3.0 mg/L NaOCl dosage for a final measured free chlorine content of 1.5 ppm at the column input. Measured ammonia values in the treated water effluent confirm full oxidation at these chlorine oxidant addition levels. The run consisted of regular field sampling for effluent iron and manganese from the filter column four times through the course of the

10-hour service run. Two laboratory sample sets were drawn to confirm field analytical data at run hours 4 and 10. The laboratory sample analysis showed relatively minor iron and manganese removal to 0.12 mg/L and 0.042 mg/L respectively. Nearly full ammonia oxidation is apparent as very little ammonia remains in the treated water. The limited reduction in color units reveals incomplete filtration of the oxidized metal solids through the treatment media.

Removal efficiencies averaged less than 25 percent for iron and manganese. Offsite laboratory analysis data confirm very inefficient removal of both iron and manganese contaminants, measuring slightly less than equivalent field test measurements. The absence of a measurable increase in pressure loss over the course of the 10-hour service run also indicates very low solids loading in the filter media. Leakage of iron from the filtration column was not significantly improved and remained above the filter removal objectives from the start of the filter run. The run was terminated at 10 hours and the filter column was placed into a backwash sequence.

Filter Run No. 2

Following the filter backwash sequence, RUN #2 was conducted at the same filter treatment HLR of approximately 7.4 gpm/sq.ft. and a similar chlorine oxidant addition rate. Sodium hypochlorite addition was adjusted accordingly to maintain an effluent free chlorine residual of around 0.8 ppm. The filter column is operated identically to RUN #1 with regular field sampling for iron and manganese in the effluent treated water. Three full field analysis sample sets and two single laboratory sample set were drawn. A higher than RUN #1 starting pressure loss through the filter column was seen increasing by 0.5 psid over the 10-hour run period. Effluent iron or manganese field measurements show marginally better iron and manganese removal for each constituent. Reduction of color units did not improve sufficiently to presume that filtration results of the oxidized metal constituents improved. Some improvement of manganese removal did occur but removal objectives below the 0.050 mg/L limit were not attained. Per the assigned testing protocol, the filter test run was terminated after 10 hours of service and the column backwashed in preparation for the third test run.

Filter Run No. 3

The third filter test run conditions for RUN #3 was modified to use a permanganate oxidant and the same filtration HLR of 7.4 gpm/sq.ft. The permanganate oxidant feed rate was adjusted to 0.53 mg/L potassium permanganate prior to entering the media treatment column. Four sets of field analysis and two laboratory analysis samples were made through the 10-hour service run. Much improved removal of both iron and manganese were observed from the first set of samples throughout the filter run. Both field analysis and the confirming laboratory analysis show consistent iron and manganese removal to well below the removal objectives. Iron removal results show complete removal below detection limits of the analytical test minimums and manganese removal to well below 0.050 mg/L MCL limits. The filter column pressure loss was noticeably higher initially at 2.1 psid increasing to 4.5 psid at the termination of the filter test run. Field sampling revealed no leakage of iron and manganese in the treated filter effluent in all four sets of

field samples. The two laboratory samples reported iron removal to <0.05 mg/L and manganese removal to 0.0032 mg/L, representing >50 percent and 99 percent removal respectively. The laboratory analysis results confirm field test measurements. In addition, effluent ammonia and color were also improved to indicate full oxidation much better solids filtration and treated water results. Treated water iron and manganese remained well below the objective values for all samplings. A filter column backwash was completed at the 10-hour service mark.

Filter Runs No. 4 and No. 5

The last two filter runs, RUN #4 and #5 were conducted during a return testing session to confirm the results obtained using the test conditions of filter RUN #3 with a filtration HLR of 7.4 gpm/sq.ft. and potassium permanganate as the primary oxidant. Results indicate excellent iron and manganese removal performance to non-detectable levels in the case of iron and below the performance objectives of 0.05 mg/L for manganese. The laboratory samples drawn confirm manganese removal exceeding 83 percent in all analytical results. As expected, pressure loss performance for both filter runs was also similar to that reported in RUN #3 gradually increasing 1.4 psid over the filter service run time in both filter test runs, RUN #4 and #5 was terminated after 10 hours of filter service showing high iron and manganese removal rates and similar pressure loss increases for the allotted service period. In both filter runs, effluent ammonia values measured non-detect at <0.010 mg/L as N.

7.1 Summary of Test Results

The 7.4 gpm/sq.ft. filtration basis of design has been confirmed as an appropriate treatment filtration HLR based upon effluent water quality and filter run times. At the guaranteed run time of greater than 10 hours, the filter differential pressure should still be less than the recommended differential pressure backwash setpoint of 8 to 10 psid. As stated earlier, filter differential pressure will also be the most likely initiation point for backwash.

The settling characteristics of the wastewater will allow the waste to be collected, settled and the supernatant returned to the filter inlet for water recovery and reclamation. The sludge calculations shown earlier provide a total sludge material weight of less than 2,000 lbs. collected in the waste settling tank per yearly quarter at full water production. This falls within our normal guidelines recommending the waste tank be cleaned and evacuate of sludge approximately every 3 months of operation or once a yearly quarter.

Data contained herein and Loprest field experience of pilot testing confirms all facets of our basis of design for the Water Treatment Equipment Package Proposal – Quote No. 23-023 and no revisions of this initially published design basis is requested by WRT Loprest Division at this time. Chemical feed systems were not included in our original proposal and the additional requirement for permanganate pretreatment is therefore presumed to be provided by others.

APPENDIX A

Mang-Ox™ Media Data and Operating Information
Page 24 - 31

Mang-Ox™

Product features

Mang-Ox is a high capacity, granular filter media used for removing hydrogen sulfide, iron and manganese compounds from water supplies. **Mang-Ox** operates both as a classical filter working with an oxidant and as a catalytic media due to its ability to accelerate the reaction between the oxidizing agent and any prevalent dissolved oxygen with sulfide, iron and manganese present. Dissolved iron, manganese and hydrogen sulfide will stay in solution unless the equilibrium is changed. Iron and manganese that is not oxidized become catalytically precipitated and then adsorbed directly on the media. **Mang-Ox** is a very dense media that stops oxidized (precipitated) forms of iron, manganese and hydrogen sulfide from passing through the bed. Most of the manganous manganese is rapidly removed in the first few inches of the media where it is further oxidized to manganese dioxide.

The adsorbed manganese, iron and precipitated sulfur are expelled during backwash. Any insoluble ferric hydroxide particulate growths are also expelled during backwash. The media must be properly backwashed to break loose and remove the filtered contaminants and precipitated iron, manganese and hydrogen sulfide. System sizing of the control valve and tank are necessary to sustain media performance.

A continuous reaction occurs with the addition of an oxidant, regenerating the media surface and replenishing the **Mang-Ox**. For difficult applications, **Mang-Ox** filters can be enhanced with aeration, chlorination, and ozone. Because of **Mang-Ox**'s naturally high manganese dioxide content, it provides a higher adsorption capacity than other media. A **Mang-Ox** filter is recommended before softeners to protect the ion exchange resin from fouling.

Advantages

- Efficient reduction of manganese, iron and hydrogen sulfide
- Long service life
- Only regular backwashing is necessary
- Ability to process high flow rates with low pressure drop
- Continuous regeneration
- Ability to be utilized with common oxidants including:
 - Cl_2 (gas)
 - Sodium hypochlorite
 - Potassium Permanganate
- 10 – 30 second reaction time with oxidant additive
- Converts ferrous iron to ferric iron
- Converts H_2S to sulfur
- Converts Manganese to MnO_2
- No chemical regeneration is required but may reduce service life
- Allows for adequate reaction time to permit for the formation of ferric hydroxide
- Allows for physical straining of the ferric hydroxide floc and sulfur until media requires backwashing
- Allows for adsorption of MnO_2
- NSF/ANSI Standard 61-2002 Certified

Applications

- Removal of Iron up to 10 ppm
- Removal of Manganese up to 5 ppm
- Removal of Hydrogen Sulfide (rotten egg smell) up to 3 ppm
- Not recommended for Iron and Manganese bacteria removal
- Not recommended for tannin and organics removal

Specifications:

Physical Properties

Color	Black
Purity	> 85 %
C.A.S No.	1313-13-9
Physical Form	Granular particles
Moisture content	< 0.5 % as shipped
Bulk density	125 lbs/cu.ft (2.00 g / cm^3)
Mesh size (US-Unit)	8 x 20 / 20 x 40
Mesh size (mm)	0.85 – 2.36 / 0.425 – 0.85
Uniformity Coefficient	1.77
Specific Gravity	3.8

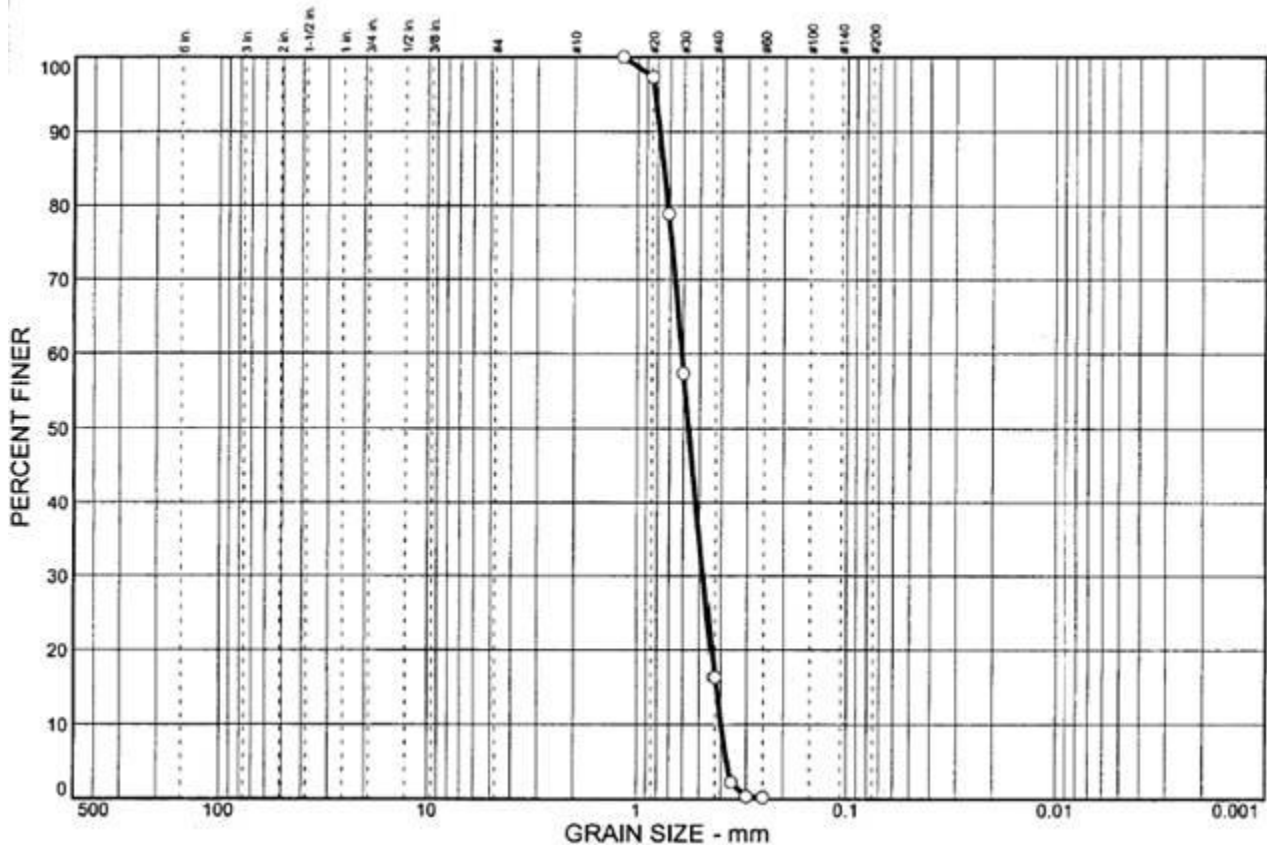
Operating Conditions

pH	6 – 9
Bed depth	36 – 48 inches (900 – 1200 mm)
Service flow rate	5 – 10 gpm / sq ft. (12 – 20 m/h)
Back wash flow rate	22-30 gpm / Sq ft (50 - 72 m/h)
Back wash expansion	15 – 30 %
Freeboard	70 % of bed depth
Oxidant type	Chlorine
Oxidant Form	12.5 % Sodium Hypochlorite
Oxidant contact time	10 – 30 seconds
Typical oxidant dosage	0.5 – 2 ppm
Regeneration	Continuous w / oxidant addition
Removal efficiency	95 – 99 % for Iron 99 % for Manganese
Back wash efficiency	Every 24 hours (typical)

Shipping Information

Packaging	25 kg bags, 1 Metric Ton Big Bag
Bags per pallet (25 kg bags)	40
NPFA Rating	Health: 2 Flammability: 0 Reactivity: 1

Particle Distribution Chart:



Particle Distribution:

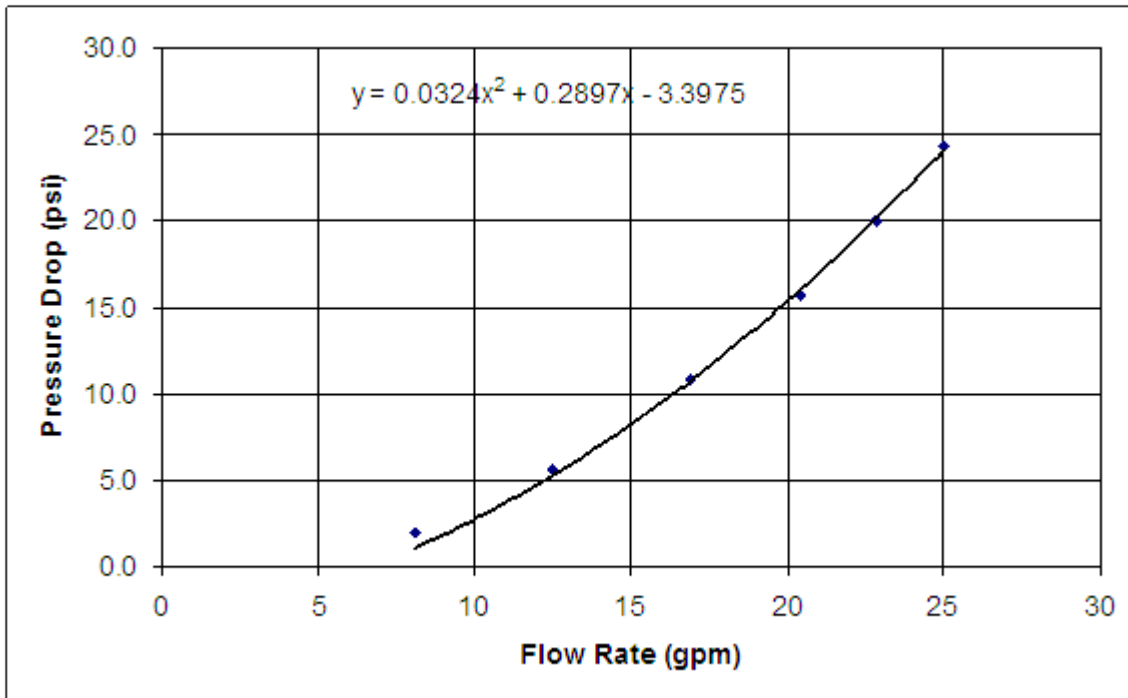
Sieve Size	Percent Fines
#16	100
#20	97.3
#25	78.9
#30	57.4
#40	16.3
#45	2.2
#50	0.3
#60	0.2

Service Flow Rate:

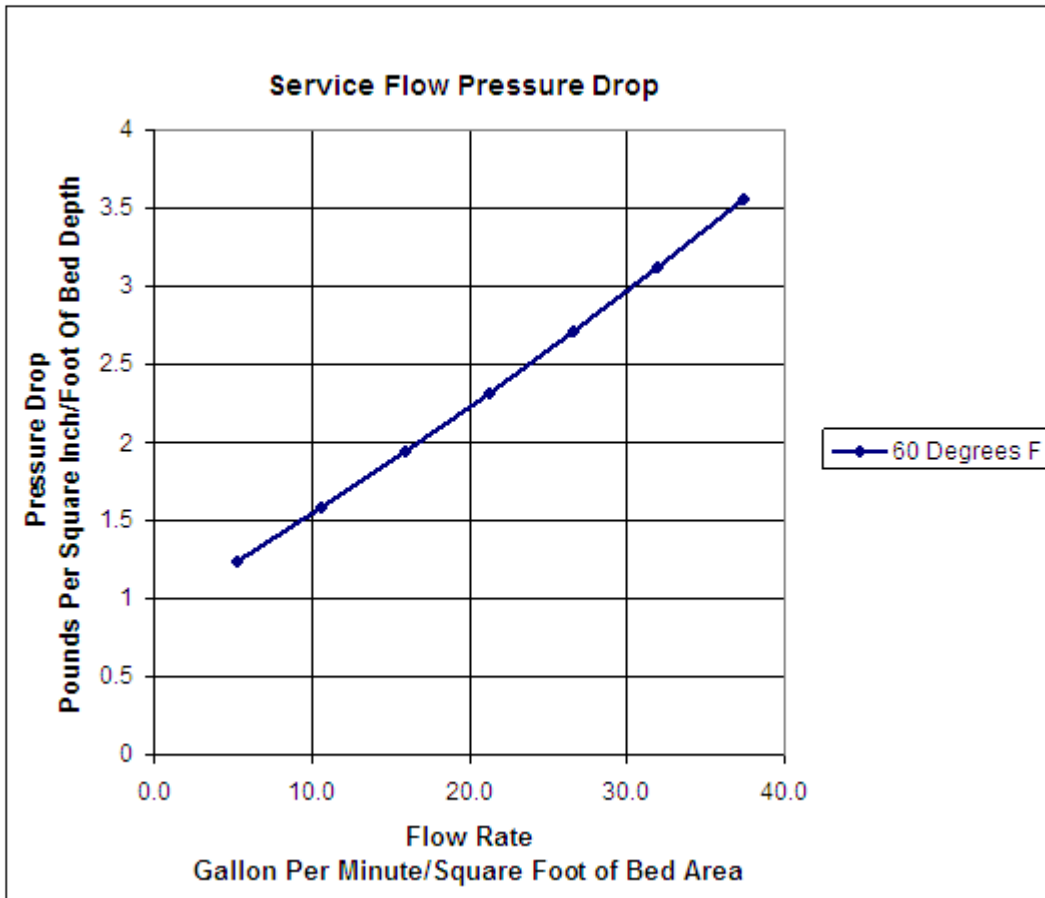
Flow Rate (gpm)	Water Temp. (deg. F)	Temperature Correction Factor:	Differential Pressure (psid)	Differential Pressure Corrected (psid)	Cv
8	60	1	2.00	2.00	5.73
13	60	1	5.60	5.60	5.28
17	60	1	10.80	10.80	5.14
20	60	1	15.70	15.70	5.15
23	60	1	20.00	20.00	5.10
25	60	1	24.30	24.30	5.07
				0.00	#DIV/0!

Flow Rating @ 15 psid (gpm): 20.85 per ANSI/NSF Standard 44 - 2001 Section 6.6

Test Item Cv: 5.38



Flow Rate (gpm)	Flow Rate (gpm/sq ft)	Empty Tank (psi)	System (psi)	Media Alone (psi)	Media Alone (psi/ft of bed)
1	5.3	-3.0754	-0.5737	2.5017	1.238848654
2	10.7	-2.6885	0.5008	3.1893	1.579350046
3	16.0	-2.2368	1.6771	3.9139	1.938173940
4	21.3	-1.7203	2.9552	4.6755	2.315320334
5	26.6	-1.139	4.3351	5.4741	2.710789229
6	32.0	-0.4929	5.8168	6.3097	3.124580625
7	37.3	0.218	7.4003	7.1823	3.556694522



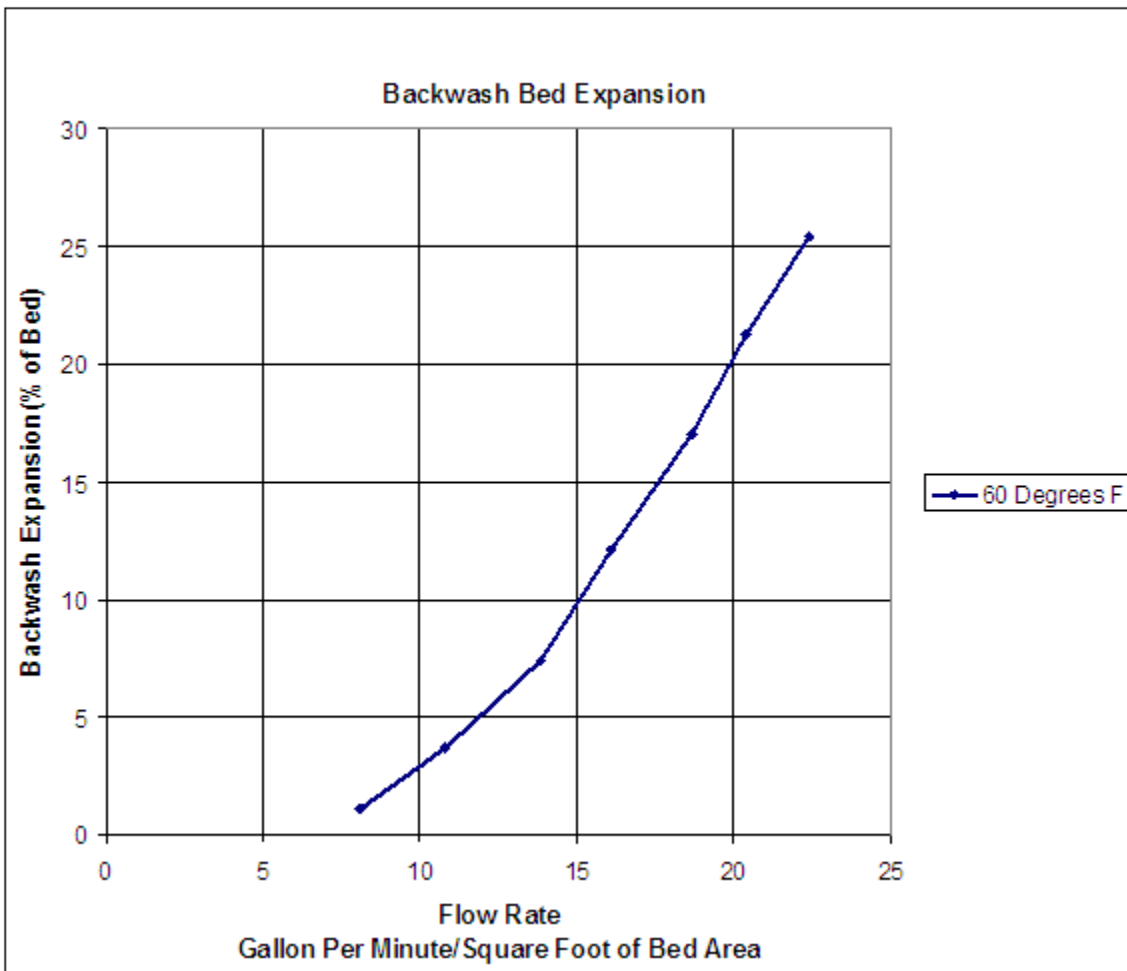
Bed Expansion:

Bed Depth 25.3125 in
 Tank Diameter 5.96 in
 Dist Tube Diameter 1.05 in
 Available Area 27.033 sq in
 Available Area 0.188 sq ft

Temperature 60 Degrees F

60 Degrees F

Flow Rate (gpm)	Tape Position	expansion (in)	Expansion (%)	Flow Rate (gpm/sq ft)
1.52	D	0.281	1	8
2.03	E	0.938	4	11
2.60	C	1.875	7	14
3.02	F	3.063	12	16
3.50	J	4.313	17	19
3.83	G	5.375	21	20
4.20	H	6.438	25	22



Composition Analysis:

Characteristic	Unit	Chemical Specification		Analysis	Physical Specification		Analysis
		Mín.	Máx.		Mín.	Máx.	
Purity as MnO ₂	%	80.0		82.31			
Mn content	%	50.6		52.10			
SiO ₂ content	%		2.0	1.10			
Fe ₂ O ₃ content	%		5.0	4.06			
Al ₂ O ₃ content	%		5.0	3.52			
CaO content	%		1.0	0.27			
MgO content	%		1.0	0.24			
Arsenic content				Non detectable			
+ 0.85 mm	%				5		2.7
- 0.35 mm	%				5		2.8
Uniformity coefficient							1.45
Contents of organic matter	N/Y			No content			
Bulk density	g/ml						1.90
Oxidation capacity		500		1750			
Pin ball hardness	%						97

Updated 10/03

The information and recommendations in this product data sheet are based on data we believe to be reliable. They are offered in good faith, but do not imply any warranty or performance guarantee, as conditions and methods of use of our products are beyond our control. As such, NHG International, LLC makes no express or implied warranties of any kind with respect to this product, including but not limited to any implied warranty of merchantability or fitness for a particular purpose.

We recommend that the user determine whether the products and the information given are appropriate, and that the suitability and performance of our products are appropriate by testing with its own equipment. Specifications are subject to change without notice.

The information and recommendations given in this product data sheet should not be understood as a recommendation for the use of our products in violation of any patent or as a license to use any patents of NHG International, LLC

The filter medias listed in this brochure do not remove or kill bacteria. Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system. NHG International, LLC will not be liable under any circumstance for consequential or incidental damages, including but not limited to, lost profits resulting from the use of our products.

APPENDIX B

Analytical Test Results
Page 32 - 43



Burlington, WA Corporate Laboratory (a)
1620 S Walnut St - Burlington, WA 98233 - 800.755.9295 • 360.757.1400

Bellingham, WA Microbiology (b)
805 Orchard Dr Ste 4 - Bellingham, WA 98225 - 360.715.1212

Portland, OR Microbiology/Chemistry (c)
9725 SW Commerce Cr Ste A2 - Wilsonville, OR 97070 - 503.682.7802

Corvallis, OR Microbiology/Chemistry (d)
1100 NE Circle Blvd, Ste 130 - Corvallis, OR 97330 - 541.753.4946

Bend, OR Microbiology (e)
20332 Empire Blvd Ste 4 - Bend, OR 97701 - 541.639.8425

Data Report

Client Name: Water Remediation Technology LLC
901 W 116th Ave. Ste. 400
Westminster, CO 80234

Reference Number: **23-14249**
Project: Lakeview, OR

Report Date: 5/23/23

Date Received: 5/17/23

Approved by: pdk

Authorized by:

Thanh B Phan
Lab Manager, Portland

Sample Description: Raw Lakeview, OR								Matrix DW	Sample Date: 5/16/23 10:00 am			
Lab Number: 28755		Sample Comment:						Collected By: Marc Malone				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

E-11734	ODOR	1			TON	1.0	SM2150	5/17/23	PAP	codor_230517	
---------	------	---	--	--	-----	-----	--------	---------	-----	--------------	--

Sample Description: Pretreated Lakeview, OR								Matrix DW	Sample Date: 5/16/23 10:00 am			
Lab Number: 28756		Sample Comment:						Collected By: Marc Malone				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

E-11734	ODOR	ND			TON	1.0	SM2150	5/17/23	PAP	codor_230517	
---------	------	----	--	--	-----	-----	--------	---------	-----	--------------	--

Sample Description: Treated Lakeview, OR								Matrix DW	Sample Date: 5/16/23 10:00 am			
Lab Number: 28757		Sample Comment:						Collected By: Marc Malone				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

E-11734	ODOR	ND			TON	1.0	SM2150	5/17/23	PAP	codor_230517	
---------	------	----	--	--	-----	-----	--------	---------	-----	--------------	--

Notes:

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.
PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
D.F. - Dilution Factor

If you have any questions concerning this report contact us at the above phone number.



Burlington, WA Corporate Laboratory (a)
1620 S Walnut St - Burlington, WA 98233 - 800.755.9295 • 360.757.1400

Bellingham, WA Microbiology (b)
805 Orchard Dr Ste 4 - Bellingham, WA 98225 - 360.715.1212

Portland, OR Microbiology/Chemistry (c)
9725 SW Commerce Cr Ste A2 - Wilsonville, OR 97070 - 503.682.7802

Corvallis, OR Microbiology/Chemistry (d)
1100 NE Circle Blvd, Ste 130 - Corvallis, OR 97330 - 541.753.4946

Bend, OR Microbiology (e)
20332 Empire Blvd Ste 4 - Bend, OR 97701 - 541.639.8425



Data Report

Client Name: Water Remediation Technology LLC
901 W 116th Ave Ste. 400
Westminster, CO 80234

Reference Number: **23-14409**
Project: Lakeview

Report Date: 5/31/23

Date Received: 5/18/23

Approved by: anl,anp,bj,pap,tjb

Authorized by:

Thanh B Phan
Lab Manager, Portland

Sample Description: Raw		Matrix	DW	Sample Date: 5/16/23 10:00 am								
Lab Number: 29178		Sample Comment:		Collected By: Marc Malone								
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab Prepped	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	0.37	0.05	0.001	mg/L	1.0	200.7	a	5/30/23	BJ	200.7_230530A	
7439-96-5	MANGANESE	0.548	0.001	0.00018	mg/L	1.0	200.8	a	5/25/23	TJB	200.8_230525B	
7664-41-7	*AMMONIA-N	0.030	0.010	0.0088	mg/L	1.0	350.1	a	5/30/23	MSO	350.1_230530	
E-10162	*TOTAL SUSPENDED SOLIDS	2.5 NN	2		mg/L	1.0	I-3765-85	c	5/22/23 10:20	5/22/23	PDK	ctss_230522
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	5/26/23	KLP	H2S_230526A	

Sample Description: Pretreated		Matrix	DW	Sample Date: 5/16/23 10:00 am								
Lab Number: 29179		Sample Comment:		Collected By: Marc Malone								
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab Prepped	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	0.40	0.05	0.001	mg/L	1.0	200.7	a	5/30/23	BJ	200.7_230530A	
7439-96-5	MANGANESE	0.519	0.001	0.00018	mg/L	1.0	200.8	a	5/25/23	TJB	200.8_230525B	
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a	5/30/23	MSO	350.1_230530	
E-10162	*TOTAL SUSPENDED SOLIDS	4.5 NN	2		mg/L	1.0	I-3765-85	c	5/22/23 10:20	5/22/23	PDK	ctss_230522
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	5/26/23	KLP	H2S_230526A	

Sample Description: Treated		Matrix	DW	Sample Date: 5/16/23 10:00 am								
Lab Number: 29180		Sample Comment:		Collected By: Marc Malone								
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab Prepped	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	0.20	0.05	0.001	mg/L	1.0	200.7	a	5/30/23	BJ	200.7_230530A	
7439-96-5	MANGANESE	0.0420	0.001	0.00018	mg/L	1.0	200.8	a	5/25/23	TJB	200.8_230525B	
7664-41-7	*AMMONIA-N	0.012	0.010	0.0088	mg/L	1.0	350.1	a	5/30/23	MSO	350.1_230530	
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	5/22/23 10:20	5/22/23	PDK	ctss_230522
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	5/26/23	KLP	H2S_230526A	

Notes:

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.
PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

D.F. - Dilution Factor

An * in front of the parameter name indicates it is not NELAP accredited but it is accredited through WSDOH or USEPA Region 10.

These test results meet all the requirements of NELAP, unless otherwise stated in writing, and relate only to these samples. Estimates of uncertainty are not included in this report. If this information is required please contact us at the phone number listed in the report header.

If you have any questions concerning this report contact us at the above phone number.

Data Report

Sample Description: Treated								Matrix	DW	Sample Date: 5/16/23 3:30 pm			
Lab Number: 29181		Sample Comment:						Collected By: Marc Malone					
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Prepped	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	0.12	0.05	0.001	mg/L	1.0	200.7	a		5/30/23	BJ	200.7_230530A	
7439-96-5	MANGANESE	0.0421	0.001	0.00018	mg/L	1.0	200.8	a		5/25/23	TJB	200.8_230525B	
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a		5/30/23	MSO	350.1_230530	
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	5/22/23 10:20	5/22/23	PDK	ctss_230522	
E-11734	*ODOR	ND			TON	1.0	SM2150		5/18/23 12:30	5/18/23	PDK	codor_230518	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a		5/26/23	KLP	H2S_230526A	

Sample Description: Raw								Matrix	DW	Sample Date: 5/17/23 12:15 pm			
Lab Number: 29182		Sample Comment:						Collected By: Marc Malone					
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Prepped	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	0.18	0.05	0.001	mg/L	1.0	200.7	a		5/30/23	BJ	200.7_230530A	
7439-96-5	MANGANESE	0.368	0.001	0.00018	mg/L	1.0	200.8	a		5/26/23	BJ	200.8_230526A2	
7664-41-7	*AMMONIA-N	0.018	0.010	0.0088	mg/L	1.0	350.1	a		5/30/23	MSO	350.1_230530	
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	5/22/23 10:20	5/22/23	PDK	ctss_230522	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a		5/26/23	KLP	H2S_230526A	

Sample Description: Pretreated								Matrix	DW	Sample Date: 5/17/23 12:15 pm			
Lab Number: 29183		Sample Comment:						Collected By: Marc Malone					
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Prepped	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	0.17	0.05	0.001	mg/L	1.0	200.7	a		5/30/23	BJ	200.7_230530A	
7439-96-5	MANGANESE	0.360	0.001	0.00018	mg/L	1.0	200.8	a		5/26/23	BJ	200.8_230526A2	
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a		5/30/23	MSO	350.1_230530	
E-10162	*TOTAL SUSPENDED SOLIDS	3.5 NN	2		mg/L	1.0	I-3765-85	c	5/22/23 10:20	5/22/23	PDK	ctss_230522	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a		5/26/23	KLP	H2S_230526A	

Sample Description: Treated								Matrix	DW	Sample Date: 5/17/23 12:15 pm			
Lab Number: 29184		Sample Comment:						Collected By: Marc Malone					
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Prepped	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	0.094	0.05	0.001	mg/L	1.0	200.7	a		5/30/23	BJ	200.7_230530A	
7439-96-5	MANGANESE	0.0599	0.001	0.00018	mg/L	1.0	200.8	a		5/26/23	BJ	200.8_230526A2	
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a		5/30/23	MSO	350.1_230530	
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	5/22/23 10:20	5/22/23	PDK	ctss_230522	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a		5/26/23	KLP	H2S_230526A	

Notes:

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.

PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

D.F. - Dilution Factor

An * in front of the parameter name indicates it is not NELAP accredited but it is accredited through WSDOH or USEPA Region 10.

These test results meet all the requirements of NELAP, unless otherwise stated in writing, and relate only to these samples. Estimates of uncertainty are not included in this report. If this information is required please contact us at the phone number listed in the report header.



Burlington, WA Corporate Laboratory (a)
1620 S Walnut St - Burlington, WA 98233 - 800.755.9295 • 360.757.1400

Bellingham, WA Microbiology (b)
805 Orchard Dr Ste 4 - Bellingham, WA 98225 - 360.715.1212

Portland, OR Microbiology/Chemistry (c)
9725 SW Commerce Cr Ste A2 - Wilsonville, OR 97070 - 503.682.7802

Corvallis, OR Microbiology/Chemistry (d)
1100 NE Circle Blvd, Ste 130 - Corvallis, OR 97330 - 541.753.4946

Bend, OR Microbiology (e)
20332 Empire Blvd Ste 4 - Bend, OR 97701 - 541.639.8425

Data Report

Client Name: Water remediation Technology LLC
901 W 116th Ave Ste. 400
Westminster, CO 80234

Reference Number: **23-14378**
Project: WRT Odor

Report Date: 5/25/23

Date Received: 5/18/23

Approved by: anl

Authorized by:

Thanh B Phan
Lab Manager, Portland

Sample Description: Raw										Matrix DW	Sample Date: 5/17/23 12:15 pm		
Lab Number: 29131		Sample Comment:								Collected By: Marc Malone			
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment	

E-11734	ODOR	ND			TON	1.0	SM2150	5/18/23	PDK	codor_230518		
---------	------	----	--	--	-----	-----	--------	---------	-----	--------------	--	--

Sample Description: Pretreated										Matrix DW	Sample Date: 5/17/23 12:15 pm		
Lab Number: 29132		Sample Comment:								Collected By: Marc Malone			
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment	

E-11734	ODOR	3			TON	1.0	SM2150	5/18/23	PDK	codor_230518		
---------	------	---	--	--	-----	-----	--------	---------	-----	--------------	--	--

Sample Description: Treated										Matrix DW	Sample Date: 5/17/23 12:15 pm		
Lab Number: 29133		Sample Comment:								Collected By: Marc Malone			
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment	

E-11734	ODOR	ND			TON	1.0	SM2150	5/18/23	PDK	codor_230518		
---------	------	----	--	--	-----	-----	--------	---------	-----	--------------	--	--

Notes:

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.
PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
D.F. - Dilution Factor

If you have any questions concerning this report contact us at the above phone number.



Burlington, WA Corporate Laboratory (a)
1620 S Walnut St - Burlington, WA 98233 - 800.755.9295 • 360.757.1400

Bellingham, WA Microbiology (b)
805 Orchard Dr Ste 4 - Bellingham, WA 98225 - 360.715.1212

Portland, OR Microbiology/Chemistry (c)
9150 SW Pioneer Ct Ste W - Wilsonville, OR 97070 - 503.682.7802

Corvallis, OR Microbiology/Chemistry (d)
1100 NE Circle Blvd, Ste 130 - Corvallis, OR 97330 - 541.753.4946
Bend, OR Microbiology (e)
20332 Empire Blvd Ste 4 - Bend, OR 97701 - 541.639.8425



Data Report

Client Name: Water Remediation Technology LLC
901 W 116th Ave. Ste. 400
Westminster, CO 80234

Reference Number: **23-14533**
Project: Lakeview

Report Date: 6/2/23

Date Received: 5/19/23

Approved by: anl,anp,pap,tjb

Authorized by:

Thanh B Phan
Lab Manager, Portland

Sample Description: Raw										Sample Date: 5/18/23 11:30 am			
Lab Number: 29398		Sample Comment:								Collected By: Marc Malone			
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment	
7439-89-6	IRON	0.15	0.05	0.001	mg/L	1.0	200.7	a	5/30/23	BJ	200.7_230530A		
7439-96-5	MANGANESE	0.324	0.001	0.00018	mg/L	1.0	200.8	a	5/26/23	BJ	200.8_230526A2		
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a	6/1/23	MSO	350.1_230601		
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	5/22/23	PDK	ctss_230522		
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	5/26/23	KLP	H2S_230526A		

Sample Description: Pretreated										Sample Date: 5/18/23 11:30 am			
Lab Number: 29399		Sample Comment:								Collected By: Marc Malone			
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment	
7439-89-6	IRON	0.13	0.05	0.001	mg/L	1.0	200.7	a	5/30/23	BJ	200.7_230530A		
7439-96-5	MANGANESE	0.393	0.001	0.00018	mg/L	1.0	200.8	a	5/26/23	BJ	200.8_230526A2		
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a	6/1/23	MSO	350.1_230601		
E-10162	*TOTAL SUSPENDED SOLIDS	3 NN	2		mg/L	1.0	I-3765-85	c	5/22/23	PDK	ctss_230522		
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	5/26/23	KLP	H2S_230526A		

Sample Description: Treated										Sample Date: 5/18/23 11:30 am			
Lab Number: 29400		Sample Comment:								Collected By: Marc Malone			
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment	
7439-89-6	IRON	ND	0.05	0.001	mg/L	1.0	200.7	a	5/30/23	BJ	200.7_230530A		
7439-96-5	MANGANESE	0.0032	0.001	0.00018	mg/L	1.0	200.8	a	5/26/23	BJ	200.8_230526A2		
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a	6/1/23	MSO	350.1_230601		
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	5/22/23	PDK	ctss_230522		
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	5/26/23	KLP	H2S_230526A		

Notes:

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.

PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

D.F. - Dilution Factor

An "*" indicates it is not NELAP accredited though method requirements have been met unless noted in cover letter or case narrative.

These test results meet all the requirements of NELAC, unless otherwise stated in writing, and relate only to these samples. Estimates of uncertainty are not included in this report. If this information is required please contact us at the phone number listed in the report header.

If you have any questions concerning this report contact us at the above phone number.

Data Report

Sample Description: Treated										Sample Date: 5/17/23 5:30 pm		
Lab Number: 29401		Sample Comment:							Collected By: Marc Malone			
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	0.075	0.05	0.001	mg/L	1.0	200.7	a	5/30/23	BJ	200.7_230530A	
7439-96-5	MANGANESE	0.0526	0.001	0.00018	mg/L	1.0	200.8	a	5/26/23	BJ	200.8_230526A2	
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a	6/1/23	MSO	350.1_230601	
E-10162	*TOTAL SUSPENDED SOLIDS	16 NN	2		mg/L	1.0	I-3765-85	c	5/22/23	PDK	ctss_230522	
E-11734	*ODOR	1.5			TON	1.0	SM2150		5/22/23	PDK	codor_230519	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	5/26/23	KLP	H2S_230526A	

Sample Description: BW #1 - 7 Hr										Sample Date: 5/17/23 5:30 pm		
Lab Number: 29402		Sample Comment:							Collected By: Marc Malone			
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment
E-10162	TOTAL SUSPENDED SOLIDS	5 NN	2		mg/L	1.0	I-3765-85	c	5/22/23	PDK	ctss_230522	

Sample Description: BW #2 - 3 Hr										Sample Date: 5/18/23 11:00 am		
Lab Number: 29403		Sample Comment:							Collected By: Marc Malone			
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment
E-10162	TOTAL SUSPENDED SOLIDS	13.3 NN	2.67		mg/L	1.0	I-3765-85	c	5/22/23	PDK	ctss_230522	

Notes:

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.

PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

D.F. - Dilution Factor

An "*" indicates it is not NELAP accredited though method requirements have been met unless noted in cover letter or case narrative.

These test results meet all the requirements of NELAC, unless otherwise stated in writing, and relate only to these samples. Estimates of uncertainty are not included in this report. If this information is required please contact us at the phone number listed in the report header.



Burlington, WA Corporate Laboratory (a)
1620 S Walnut St - Burlington, WA 98233 - 800.755.9295 • 360.757.1400

Bellingham, WA Microbiology (b)
805 Orchard Dr Ste 4 - Bellingham, WA 98225 - 360.715.1212

Portland, OR Microbiology/Chemistry (c)
9725 SW Commerce Cr Ste A2 - Wilsonville, OR 97070 - 503.682.7802

Corvallis, OR Microbiology/Chemistry (d)
1100 NE Circle Blvd, Ste 130 - Corvallis, OR 97330 - 541.753.4946

Bend, OR Microbiology (e)
20332 Empire Blvd Ste 4 - Bend, OR 97701 - 541.639.8425



Data Report

Client Name: Water Remediation Technology LLC
901 W 116th Ave. Ste. 400
Westminster, CO 80234

Reference Number: **23-14531**
Project:

Report Date: 5/31/23

Date Received: 5/19/23

Approved by: anl,anp,bj,tjb

Authorized by:

Michelle R England
Lab Manager, Bend

Sample Description: Treated		Matrix DW		Sample Date: 5/18/23 3:47 pm								
Lab Number: 29394	Sample Comment:	Collected By: Marc Malone										
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	ND	0.05	0.001	mg/L	1.0	200.7	a	5/30/23	BJ	200.7_230530A	
7439-96-5	MANGANESE	0.0026	0.001	0.0002	mg/L	1.0	200.7	a	5/30/23	BJ	200.7_230530A	
7664-41-7	*AMMONIA-N	0.010	0.010	0.0088	mg/L	1.0	350.1	a	5/30/23	MSO	350.1_230530	
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	5/24/23	PDK	ctss_230524	
E-11734	ODOR	1.20	1		TON	1.0	SM2150	a	5/25/23	KLP	ODOR_230525	Temperature: 40.3
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	5/26/23	KLP	H2S_230526A	

Sample Description: BW #2- 7 Hour		Matrix W		Sample Date: 5/18/23 3:00 pm								
Lab Number: 29395	Sample Comment:	Collected By: Marc Malone										
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment
E-10162	TOTAL SUSPENDED SOLIDS	12 NN	2.67		mg/L	1.0	I-3765-85	c	5/24/23	PDK	ctss_230524	

Sample Description: BW #3-14 Hour		Matrix W		Sample Date: 5/19/23 6:30 am								
Lab Number: 29396	Sample Comment:	Collected By: Marc Malone										
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment
E-10162	TOTAL SUSPENDED SOLIDS	11 NN	4		mg/L	1.0	I-3765-85	c	5/24/23	PDK	ctss_230524	

Notes:

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.

PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

D.F. - Dilution Factor

An * in front of the parameter name indicates it is not NELAP accredited but it is accredited through WSDOH or USEPA Region 10.

These test results meet all the requirements of NELAP, unless otherwise stated in writing, and relate only to these samples. Estimates of uncertainty are not included in this report. If this information is required please contact us at the phone number listed in the report header.

If you have any questions concerning this report contact us at the above phone number.



Burlington, WA Corporate Laboratory (a)
1620 S Walnut St - Burlington, WA 98233 - 800.755.9295 • 360.757.1400

Bellingham, WA Microbiology (b)
805 Orchard Dr Ste 4 - Bellingham, WA 98225 - 360.715.1212

Portland, OR Microbiology/Chemistry (c)
9725 SW Commerce Cr Ste A2 - Wilsonville, OR 97070 - 503.682.7802

Corvallis, OR Microbiology/Chemistry (d)
1100 NE Circle Blvd, Ste 130 - Corvallis, OR 97330 - 541.753.4946

Bend, OR Microbiology (e)
20332 Empire Blvd Ste 4 - Bend, OR 97701 - 541.639.8425

Data Report

Client Name: Water Remediation Technology LLC
901 W 116th Ave Ste. 400
Westminster, CO 80234

Reference Number: **23-14517**
Project: Lakeview

Report Date: 5/25/23

Date Received: 5/19/23

Approved by: anl

Authorized by:

Thanh B Phan
Lab Manager, Portland

Sample Description: Raw								Matrix DW	Sample Date: 5/18/23 11:30 am			
Lab Number: 29360		Sample Comment:						Collected By: Marc Malone				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

E-11734	ODOR	ND			TON	1.0	SM2150	5/22/23	PDK	codor_230519	
---------	------	----	--	--	-----	-----	--------	---------	-----	--------------	--

Sample Description: Pretreated								Matrix DW	Sample Date: 5/18/23 11:30 am			
Lab Number: 29361		Sample Comment:						Collected By: Marc Malone				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

E-11734	ODOR	1.33			TON	1.0	SM2150	5/22/23	PDK	codor_230519	
---------	------	------	--	--	-----	-----	--------	---------	-----	--------------	--

Sample Description: Treated								Matrix DW	Sample Date: 5/18/23 11:30 am			
Lab Number: 29362		Sample Comment:						Collected By: Marc Malone				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

E-11734	ODOR	ND			TON	1.0	SM2150	5/22/23	PDK	codor_230519	
---------	------	----	--	--	-----	-----	--------	---------	-----	--------------	--

Notes:

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.
PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
D.F. - Dilution Factor

If you have any questions concerning this report contact us at the above phone number.



Burlington, WA Corporate Laboratory (a)
1620 S Walnut St - Burlington, WA 98233 - 800.755.9295 • 360.757.1400

Bellingham, WA Microbiology (b)
805 Orchard Dr Ste 4 - Bellingham, WA 98225 - 360.715.1212

Portland, OR Microbiology/Chemistry (c)
9725 SW Commerce Cr Ste A2 - Wilsonville, OR 97070 - 503.682.7802

Corvallis, OR Microbiology/Chemistry (d)
1100 NE Circle Blvd, Ste 130 - Corvallis, OR 97330 - 541.753.4946

Bend, OR Microbiology (e)
20332 Empire Blvd Ste 4 - Bend, OR 97701 - 541.639.8425



Data Report

Client Name: Water Remediation Technology LLC
901 W 116th Ave. Ste. 400
Westminster, CO 80234

Reference Number: **23-17625**
Project: Lakeview OR

Report Date: 7/6/23

Date Received: 6/15/23
Approved by: anp,bj,pap,tjb
Authorized by:

Michelle R England
Michelle R England
Lab Manager, Bend

Sample Description: Lakeview Raw								Matrix DW	Sample Date: 6/13/23 11:40 am			
Lab Number: 34892		Sample Comment:						Collected By: David Jones				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	0.15	0.05	0.0007	mg/L	1.0	200.7	a	6/23/23	BJ	200.7_230623A5	
7439-96-5	MANGANESE	0.278	0.001	0.00018	mg/L	1.0	200.8	a	6/26/23	TJB	200.8_230626A	
7664-41-7	*AMMONIA-N	0.023	0.010	0.0088	mg/L	1.0	350.1	a	6/28/23	MSO	350.1_230628	
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	6/19/23	PDK	ctss_230619	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	6/20/23	KLP	H2S_230620A	

Sample Description: Lakeview Pretreated								Matrix DW	Sample Date: 6/13/23 11:40 am			
Lab Number: 34893		Sample Comment:						Collected By: David Jones				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	0.11	0.05	0.0007	mg/L	1.0	200.7	a	6/23/23	BJ	200.7_230623A5	
7439-96-5	MANGANESE	0.363	0.001	0.00018	mg/L	1.0	200.8	a	6/26/23	TJB	200.8_230626A	
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a	6/28/23	MSO	350.1_230628	
E-10162	*TOTAL SUSPENDED SOLIDS	4 NN	2		mg/L	1.0	I-3765-85	c	6/19/23	PDK	ctss_230619	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	6/20/23	KLP	H2S_230620A	

Sample Description: Lakeview Treated								Matrix DW	Sample Date: 6/13/23 11:40 am			
Lab Number: 34894		Sample Comment:						Collected By: David Jones				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment
7439-89-6	IRON	ND	0.05	0.0007	mg/L	1.0	200.7	a	6/23/23	BJ	200.7_230623A5	
7439-96-5	MANGANESE	0.0350	0.001	0.00018	mg/L	1.0	200.8	a	6/26/23	TJB	200.8_230626A	
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a	6/28/23	MSO	350.1_230628	
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	6/19/23	PDK	ctss_230619	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	6/20/23	KLP	H2S_230620A	

Notes:

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.
PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

D.F. - Dilution Factor

An * in front of the parameter name indicates it is not NELAP accredited but it is accredited through WSDOH or USEPA Region 10.

These test results meet all the requirements of NELAP, unless otherwise stated in writing, and relate only to these samples. Estimates of uncertainty are not included in this report. If this information is required please contact us at the phone number listed in the report header.

If you have any questions concerning this report contact us at the above phone number.

Data Report

Sample Description: Lakeview Treated								Matrix DW	Sample Date: 6/13/23 4:30 pm			
Lab Number: 34895		Sample Comment:						Collected By: David Jones				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

7439-89-6	IRON	ND	0.05	0.0007	mg/L	1.0	200.7	a	6/23/23	BJ	200.7_230623A5	
7439-96-5	MANGANESE	0.0275	0.001	0.00018	mg/L	1.0	200.8	a	6/26/23	TJB	200.8_230626A	
7664-41-7	*AMMONIA-N	0.010	0.010	0.0088	mg/L	1.0	350.1	a	6/28/23	MSO	350.1_230628	
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	6/19/23	PDK	ctss_230619	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	6/20/23	KLP	H2S_230620A	

Sample Description: Lakeview Raw								Matrix DW	Sample Date: 6/14/23 12:00 pm			
Lab Number: 34896		Sample Comment:						Collected By: David Jones				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

7439-89-6	IRON	0.12	0.05	0.0007	mg/L	1.0	200.7	a	6/23/23	BJ	200.7_230623A5	
7439-96-5	MANGANESE	0.230	0.001	0.00018	mg/L	1.0	200.8	a	6/30/23	TJB	200.8_230630A2	
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a	6/28/23	MSO	350.1_230628	
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	6/19/23	PDK	ctss_230619	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	6/20/23	KLP	H2S_230620A	

Sample Description: Lakeview Pretreated								Matrix DW	Sample Date: 6/14/23 12:00 pm			
Lab Number: 34897		Sample Comment:						Collected By: David Jones				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

7439-89-6	IRON	0.10	0.05	0.0007	mg/L	1.0	200.7	a	6/23/23	BJ	200.7_230623A5	
7439-96-5	MANGANESE	0.446	0.001	0.00018	mg/L	1.0	200.8	a	6/30/23	TJB	200.8_230630A2	
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a	6/28/23	MSO	350.1_230628	
E-10162	*TOTAL SUSPENDED SOLIDS	3 NN	2		mg/L	1.0	I-3765-85	c	6/19/23	PDK	ctss_230619	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	6/20/23	KLP	H2S_230620A	

Sample Description: Lakeview Treated								Matrix DW	Sample Date: 6/14/23 12:00 pm			
Lab Number: 34898		Sample Comment:						Collected By: David Jones				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

7439-89-6	IRON	ND	0.05	0.0007	mg/L	1.0	200.7	a	6/23/23	BJ	200.7_230623A5	
7439-96-5	MANGANESE	0.0394	0.001	0.00018	mg/L	1.0	200.8	a	6/30/23	TJB	200.8_230630A2	
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a	6/28/23	MSO	350.1_230628	
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	6/19/23	PDK	ctss_230619	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	6/20/23	KLP	H2S_230620A	

Notes:

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.
 PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
 D.F. - Dilution Factor
 An * in front of the parameter name indicates it is not NELAP accredited but it is accredited through WSDOH or USEPA Region 10.
 These test results meet all the requirements of NELAP, unless otherwise stated in writing, and relate only to these samples. Estimates of uncertainty are not included in this report. If this information is required please contact us at the phone number listed in the report header.

Data Report

Sample Description: Lakeview Treated								Matrix DW	Sample Date: 6/14/23 4:00 pm			
Lab Number: 34899		Sample Comment:						Collected By: David Jones				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

7439-89-6	IRON	ND	0.05	0.0007	mg/L	1.0	200.7	a	6/23/23	BJ	200.7_230623A5	
7439-96-5	MANGANESE	0.0330	0.001	0.00018	mg/L	1.0	200.8	a	6/30/23	TJB	200.8_230630A2	
7664-41-7	*AMMONIA-N	ND	0.010	0.0088	mg/L	1.0	350.1	a	6/28/23	MSO	350.1_230628	
E-10162	*TOTAL SUSPENDED SOLIDS	ND NN	2		mg/L	1.0	I-3765-85	c	6/19/23	PDK	ctss_230619	
18496-25-8	*SULFIDE AS S	ND	0.05	0.044	mg/L	1.0	SM4500-S2 F	a	6/20/23	KLP	H2S_230620A	

Sample Description: Lakeview 11 Hr Decant								Matrix W	Sample Date: 6/14/23 6:00 am			
Lab Number: 34900		Sample Comment:						Collected By: David Jones				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

E-10162	TOTAL SUSPENDED SOLIDS	6 NN	2		mg/L	1.0	I-3765-85	c	6/19/23	PDK	ctss_230619	
---------	-------------------------------	------	---	--	------	-----	-----------	---	---------	-----	-------------	--

Sample Description: Lakeview 12 Hr Decant								Matrix W	Sample Date: 6/15/23 5:00 am			
Lab Number: 34901		Sample Comment:						Collected By: David Jones				
CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Lab	Analyzed	Analyst	Batch	Comment

E-10162	TOTAL SUSPENDED SOLIDS	7 NN	2		mg/L	1.0	I-3765-85	c	6/19/23	PDK	ctss_230619	
---------	-------------------------------	------	---	--	------	-----	-----------	---	---------	-----	-------------	--

Notes:

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.

PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

D.F. - Dilution Factor

An * in front of the parameter name indicates it is not NELAP accredited but it is accredited through WSDOH or USEPA Region 10.

These test results meet all the requirements of NELAP, unless otherwise stated in writing, and relate only to these samples. Estimates of uncertainty are not included in this report. If this information is required please contact us at the phone number listed in the report header.

APPENDIX C

Pilot Test Daily Operations Log
Page 44 – 49

Line #	Date (2023)	Time	Initials	Flow Rate digital gpm	Flow Filter 1 rotameter gpm	Cl Rate cal colim mL/min	Pressure In Fil 1 gauge psi	Pressure Out Fil 1 gauge psi	Dif Pres psid	Mn In mg/l	Mn Out mg/l	Fe In mg/l	Fe Out mg/l	pH In mg/l	pH Out mg/l	Temp In °F	Temp Out °F	Cl Free In mg/l	Cl Free Out mg/l	Cl Total In mg/l	Cl Total Out mg/l	NH3-N In mg/l	NH3-N Out mg/l	Color In mg/l	Color Out mg/l	Turbidity In NTU	Turbidity Out NTU	Current RunTime hours	Total Treated Gallons gal	Pull Lab Samples? yes/no	Notes		
1	5/16	5:27	MM	1.45	1.6	5.5	18.5	16.8	1.7									1.64	1.19	1.85	1.22										Cl pump @ 86%, 31%		
2	5/16	5:45	MM	1.45	1.6	4.8	18.7	17.1	1.6									2.06	1.25	2.12	1.43										Cl pump @ 75%, 27%		
3	5/16	6:08	MM	1.45	1.6	4.2	18.7	17.1	1.6									1.89	1.08	2.14	1.37										Cl pump @ 75%, 23%		
4		6:21	MM	1.45	1.6	3.8	18.7	17.1	1.6									2.01	1.12	2.07	1.16										Cl pump @ 75%, 20%		
		6:54																													Added 2 gallons DI. to chlorine tank.		
5	5/16	7:13	MM	1.45	1.6	^{Diluted} 4.7	18.7	17.1	1.6									1.70	0.80	1.85	1.17										Cl pump @ 75%, 25%		
6	5/16	7:19	MM	1.45	1.6	4.5	18.7	17.0	1.7	0.629	0.050	0.21	0.16	6.93	6.87	65	65	1.42	0.78	2.02	0.99	0.02	0.00			0.76	0.53	1.9	158	N			
7		7:53	MM																0.85														
8		8:42	MM																0.75														
9		8:55	MM																					39	21								
10		10:00	MM	1.45	1.6	4.5	18.7	17.0	1.7	0.798	0.074	0.21	0.14	6.89	6.92	66	66	2.22	0.49	2.50	0.65			59	35	0.73	0.58	4.5	386	Y			
11		11:15	DI	1.45	1.6		17.9	16.2	1.7									1.15	0.68												5.8	499	
12		12:00	DI	1.45	1.6	4.5	17.9	16.2	1.7	0.685	0.045	0.28	0.15	6.93	7.02	66	66	0.98	0.58	1.30	0.91	0.06	0.00	65	50	0.62	0.47	6.6	576				
13		14:40	DI	1.45	1.6		18.0	16.1	1.9	0.616	0.053	0.21	0.11	6.92	7.02	66	66	1.58	0.59	1.82	0.79	0.07	0.01	57	29	0.68	0.53	9.2	792				
14	5/16	15:45	MM	1.45	1.6		19.0	17.1	1.9																						Y	Initiate backwash	

Notes:

Initial Chlorine : $\frac{1000 \text{ mL of } 6.4\% \text{ Chlorine}}{5.22 \text{ gallons}} = 3,220 \text{ ppm}$
 6:54 am Chlorine : $\frac{940 \text{ mL of } 6.4\% \text{ Chlorine}}{6.9 \text{ gallons}} = 2,304 \text{ ppm}$

Measuring apparent color (not filtering)

↓
At 7:45 AM 5/17

Line #	Date	Time	Initials	Flow Rate digital gpm	Flow Filter rotameter gpm	Cl Rate cal colm mL/min	Pressure In Fit 1 gauge psi	Pressure Out Fit 1 gauge psi	Dif Pres psid	Mn In mg/l	Mn Out mg/l	Fe In mg/l	Fe Out mg/l	pH In mg/l	pH Out mg/l	Temp In °F	Temp Out °F	Cl Free In mg/l	Cl Free Out mg/l	Cl Total In mg/l	Cl Total Out mg/l	NH3-N In mg/l	NH3-N Out mg/l	Color In mg/l	Color Out mg/l	Turbidity In NTU	Turbidity Out NTU	Current RunTime hours	Total Treated Gallons gal	Pull Lab Samples? yes/no	Notes		
15	5/17	0818	DJ	1.45	1.6		18.0	16.2	1.8																				0		START		
16	5/17	0835	MM	1.45	1.6	4.3	18.0	16.2	1.8	0.474	0.093	0.14	0.10	7.40	7.38	63	63	1.65	0.80	1.78	0.89	0.14	0.02	59	41	0.71	0.54	0.3	24		Cl Pump @ 25%		
17	5/17	10:06	MM	1.40	1.6													1.90	1.12														
18		10:28	MM	1.40	1.6	4.0	18.4	16.5	1.9	0.454	0.080							2.39	0.96														Reduced cl pump to 22% @ 10:13
19		1120	DJ	1.45			18.4	16.5	1.9									1.45	0.87	1.58	1.03								260				
20		1215	MM	1.45	1.6	3.8	18.4	16.4	2.0									1.76	0.93	2.37	1.04									Y			
21		1250	DJ	1.45	1.6	3.8	18.3	16.3	2.0	0.451	0.074	0.16	0.09	6.91	6.96	64	64	1.37	0.85	1.52	1.00	0.08		67	36	0.50	0.32	4.5	388				
22		1450	DJ	1.45	1.6	3.8	18.4	16.1	2.3	0.462	0.073							1.36	0.83	1.46	0.94								578				
23		1640	DJ	1.45	1.60		18.4	16.1	2.3	0.448	0.081	0.13	0.04	6.85	6.91	64	64	1.62	0.65	1.72	0.94	0.03	0.03	51	24	0.68	0.44	8.4	700	Y			
24		1818	MM	1.45	1.6	3.5	18.2	15.8	2.4										0.97		1.00							10	864			Indiate BW @ 1840	

Notes:

Loprest Pilot
Loprest Trailer
Pilot Test Data Log

Job Name: Lakeview, OR
Job Number: 33695
Well # 2, 6, 7, and 9
Sheet # 3

Media Type F1: Mang-Ox
Media Type F2: Not Used
Media Type F3: Not Used

Hydraulic Loading Rate: 7.4 gpm/sf (1.4 gpm)
Backwash Rate: 5 gpm/sf (1 gpm)
Air Scour Rate: 2 cfm/sf (0.4 CFM)

Backwash sequence:
4 minutes air + water
4 minutes water only
4 minutes rinse

Line #	Date	Time	Initials	Flow Rate digital gpm	Flow Filter rotameter gpm	Cl Rate cal colm mL/min	Pressure In Flt 1 gauge psi	Pressure Out Flt 1 gauge psi	Dif Pres psid	Mn In mg/l	Mn Out mg/l	Fe In mg/l	Fe Out mg/l	pH In mg/l	pH Out mg/l	Temp In °F	Temp Out °F	Cl Free In mg/l	Cl Free Out mg/l	Cl Total In mg/l	Cl Total Out mg/l	NH3-N In mg/l	NH3-N Out mg/l	Color In mg/l	Color Out mg/l	Turbidity In NTU	Turbidity Out NTU	Current RunTime hours	Total Treated Gallons gal	Pull Lab Samples? (1/day) yes/no	Notes	
25	5/18	5:47	MM	1.45	1.6		17.1	15.0	2.1										0.72													Cl Pump @ 20%
26		0638	MM	1.45	1.6	3.35				0.410	0.037	0.13	0.02																			KMnO4 Pump @ 20% (0.53 ppm)
27		0703	MM	1.45	1.6		17.1	14.8	2.3		0.021								0.75													At 0725 adjusted dosing
28		0737	MM	1.45	1.6	3.0													0.66													Cl pump @ 18% KMnO4 @ 23% (0.82 ppm)
29	5/18	0800	MM	1.45	1.6	3.0	17.4	14.8	2.6	0.403	0.014	0.11	0.00	6.96	7.01	63	63	2.02	0.65	2.14	0.71	0.08	0.00	60	8	0.42	0.03	2.2	204			
30		0945	MM	1.50	1.6	3.0	17.6	14.5	3.1		0.013								0.77													
31	5/18	1130	MM	1.50	1.6	2.9	18.2	14.8	3.4	0.397	0.009	0.10	0.00	7.21	7.12	63	63	2.07	0.61	2.14	0.72	0.11	0.02	70	9	0.35	0.05	5.7	500	Y		
32	5/18	1310	MM	1.45	1.6		18.4	14.6	3.8	0.393	0.011								0.72													
33		1504	MM	1.45	1.6		18.6	14.4	4.2										0.63													
34	5/18	1547	MM	1.45	1.6	2.6	19.2	14.7	4.5	0.372	0.000	0.09	0.00	7.17	7.03	64	64	2.09	0.64	2.22	0.69			77	12	0.42	0.04	10	875	Y	Initiate BWe 1640	

Notes:

0547 Adding KMnO4 at 0.53ppm
 $\frac{20g}{3 \text{ gallons}} = 1,761 \text{ ppm stock solution, dosing at } 1.6 \text{ mL/min into } 1.4 \text{ gal/min}$

Flow rate test with stopwatch
and graduated cylinder at 1547
 $\frac{4L}{42.9s} = 1.48 \text{ GPM (7.55 GPM/SF)}$
 (Agrees with digital flow meter)

No effluent samples
showed any pink
coloration

After backwash
DP= 1.9 psid
@ 1.45 GPM

Loprest Pilot
Loprest Trailer
Pilot Test Data Log

Job Name: Lakeview, OR
Job Number: 33695
Well # 2, 6, 7, and 9
Sheet # 4

Media Type F1: Mang-Ox
Media Type F2: Not Used
Media Type F3: Not Used

Hydraulic Loading Rate: 7.4 gpm/sf (1.4 gpm)
Backwash Rate: 5 gpm/sf (1 gpm)
Air Scour Rate: 2 cfm/sf (0.4 CFM)

Backwash sequence:
4 minutes air + water
4 minutes water only
4 minutes rinse

Line #	Date	Time	Initials	Flow Rate digital gpm	Flow Filter rolameter gpm	Cl Rate cal colm mL/min	Pressure In Fit 1 gauge psi	Pressure Out Fit 1 gauge psi	Dif Pres psid	Mn In mg/l	Mn Out mg/l	Fe In mg/l	Fe Out mg/l	pH In mg/l	pH Out mg/l	Temp In °F	Temp Out °F	Cl Free In mg/l	Cl Free Out mg/l	Cl Total In mg/l	Cl Total Out mg/l	NH3-N In mg/l	NH3-N Out mg/l	Color In mg/l	Color Out mg/l	Turbidity In NTU	Turbidity Out NTU	Current RunTime hours	Total Treated Gallons gal	Pull Lab Samples? (1/day) yes/no	Notes
	6/13	0730	DS	1.45	1.6		17.4	15.8	1.6							65	65	RAW 0.23													0% KMnO4 START 27 2.16 20 2.14
		0805		1.45	1.6	2.5	17.4	15.7	1.7	0.379	0.075							2.26	0.72									59		23/30	
		0850		1.45	1.6	2.5	17.4	15.6	1.8	0.386	0.069	0.09			65	65	2.99	0.86					47	16	0.31	0.09		124		30% 3.0	
		1000		1.45	1.6	2.5	17.4	15.5	1.9	0.376	0.054	0.08		7.12	7.07	65	65	2.51	0.93	2.67	1.13	0.03		33	5	0.33	0.13		218		KMnO4 20% → Agallan 30% 3.3
		1140		1.45	1.6	2.5	17.4	15.3	2.1	0.359	0.041	0.09		7.02	6.98	65	65	3.51	0.94	3.70	1.06	0.04		52	8	0.38	0.11		372	Y	30% 3.3
		1250		1.45	1.6	2.5	18.1	15.9	2.2																			480		30% 3.5	
		1415		1.45	1.6	2.5/2.3	18.0	15.6	2.4	0.321	0.032	0.07		7.06	7.01	65	65	2.78	1.10	3.06	1.20	0.02		61	22	0.24	0.02		596		3.5
		1630		1.45	1.6	2.3	17.7	15.0	2.7	0.331	0.023	0.08		6.98	7.02	65	65	2.39	0.80	2.57	0.91	0.03		60	14	0.30	0.05		799	Y	
		1730		1.45	1.6		18.9	16.0	2.9																			877		STOP START BW	

Notes:
Chlorine
1500 ml + 5 gallons DI Water

KMnO4 20g → 4 gallons

Line #	Date (2023)	Time 24:00	Initials	Flow Rate digital gpm	Flow Filter 1 rotameter gpm	Cl Rate cal colm mL/min	Pressure In Filt 1 gauge psi	Pressure Out Filt 1 gauge psi	Dif Pres psid	Mn In mg/l	Mn Out mg/l	Fe In mg/l	Fe Out mg/l	pH In mg/l	pH Out mg/l	Temp In °F	Temp Out °F	Cl Free In mg/l	Cl Free Out mg/l	Cl Total In mg/l	Cl Total Out mg/l	NH3-N In mg/l	NH3-N Out mg/l	Color In mg/l	Color Out mg/l	Turbidity In NTU	Turbidity Out NTU	Current RunTime hours	Total Treated Gallons gal	Pull Lab Samples? (1/day) yes/no	Notes % KMnO4	
	6/14	0600	DT	1.45	1.6	2.5	19.0	16.7	2.3									RAW 0.17										0		START	30% 35	2.8 3.0
		0700		1.45	1.6	2.5	18.3	15.8	2.5	0.283	0.059							2.6	1.06	2.79	1.12			64	31	0.31	0.12		97		35/37	3.2/3.5
		0805		1.45	1.6	2.5	18.3	15.7	2.6	0.292	0.042	0.09	0	7.10	7.12	65	65	1.97	1.01	2.12	1.15			71	29	0.33	0.13		181		37	3.5
		0940		1.45	1.6	2.5	18.4	15.6	2.8	0.279	0.056	0.06	0	7.05	7.01	65	65	2.81	1.00	3.00	1.13	0.04	0	65	30	0.33	0.14		318		37	3.5
		1200		1.45	1.6	2.5	19.1	16.1	3.0	0.283	0.044	0.03	0	6.97	6.93	65	65	2.47	1.03	2.73	1.24	0.01	0	65	29	0.32	0.04		518	Y	37	3.5
		1400		1.45	1.6		19.3	16.0	3.3	0.285	0.036	0.04	0	7.04	6.97	65	65	2.27	0.96	2.42	1.07	0.02	0	65	26	0.33	0.12		691			
		1530		1.45	1.6	2.5	19.3	15.7	3.6	0.342	0.029	0.04	0			65	65	2.34	0.96	2.51	1.05			61	23	0.33	0.12		825		37	3.5
		1605		1.45			20.0	16.1	3.9																			815	Y	STOP START BW		