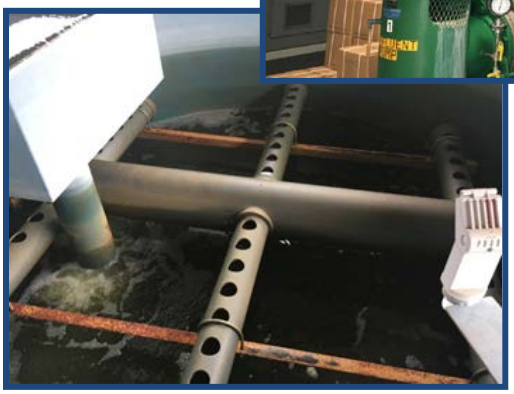
City of Molalla
Clackamas County, Oregon

RECYCLED WATER USE PLAN

SEPTEMBER 2018

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Project No. 100.31

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Recycled Water Use Plan

September 2018

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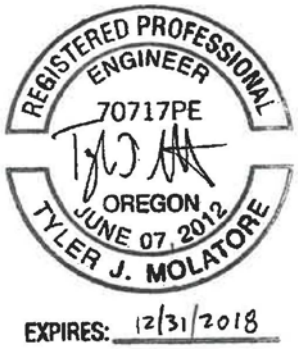

For
NPDES Permit No. 101514
File No. 57613

Facility:
City of Molalla WWTP

Physical Address:
City of Molalla WWTP
12424 South Toliver Road
Molalla, OR 97038

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SECTION 1:

INTRODUCTION

SECTION 1: **INTRODUCTION**

The City of Molalla, Oregon (City) operates a Wastewater Treatment Plant (WWTP) located at 12424 South Toliver Road, Molalla, Oregon. Discharge of treated effluent from the WWTP is regulated under National Pollution Discharge Elimination System (NPDES) Permit Number 101514, issued by the Oregon Department of Environmental Quality (DEQ). A copy of the current NPDES Permit is provided in Appendix A. Outfall 002 of the current permit is for the use of recycled water.

This Recycled Water Use Plan (RWUP) is provided to describe the City's recycled Water Use Program and supersedes all previous recycled water use plans. Content within this RWUP restates information contained in the previously approved *Consolidated Recycled Water Use Plan* prepared by Brown and Caldwell (July, 2015).

In accordance with the current NPDES Permit, municipal wastewater will be treated and effluent will be discharged through Outfall 001 during the winter months to the Molalla River. Unless approved by a permit modification, during the summer months (May 1st through October 31st) no discharge to waters of the state is allowed. Recycled water will either be land applied or stored in the facultative/storage lagoons during the summer months.

The City land applies recycled water onto the sites listed below. A vicinity map depicting the site locations is provided in Figure 1.1.1, on the following page. The NPDES Permit requires that the effluent be treated in accordance with Class A, B, or C requirements, depending on the beneficial use. All land application sites addressed within this RWUP will use Class C recycled water.

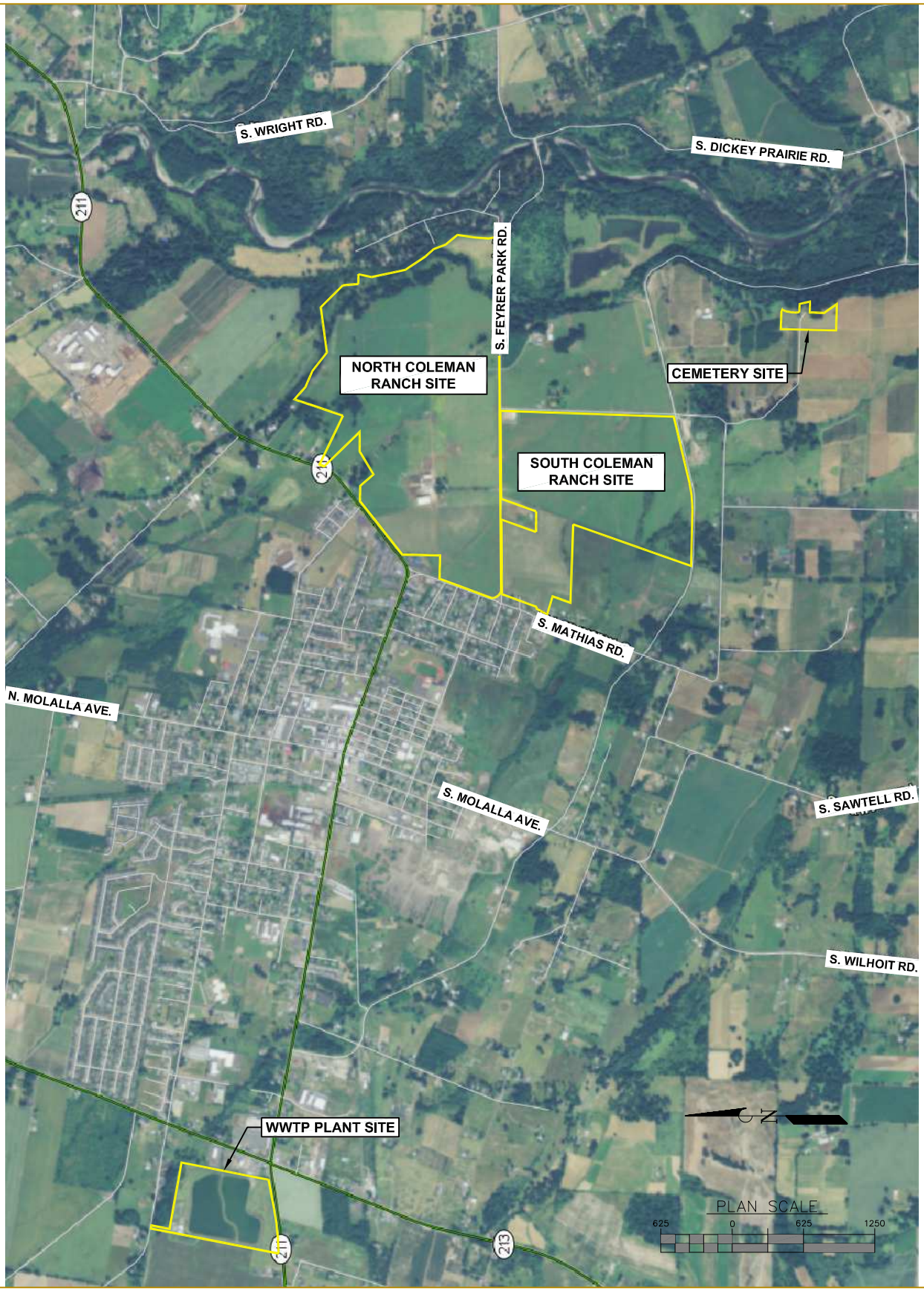
- North Coleman Ranch Site
- South Coleman Ranch Site
- Cemetery Site
- WWTP Site

The City of Molalla's Recycled Water Use Program is governed by Oregon Administrative Rule (OAR) 340-055 and guided by the DEQs Internal Management Directive (IMD): Implementing Oregon's Recycled Water Use Rules. This Recycled Water Use Plan has been prepared to address the requirements of OAR 340-055 and also provide a single comprehensive document that can be used and understood by the City employees responsible for implementing the plan, regulators, owners and operators of the recycled water land application sites and the general public.

Contact information for City Staff responsible for the Recycled Water Use Plan is presented in Table 1.1.1.

TABLE 1.1.1
CITY STAFF CONTACT INFORMATION

Name	Position	Phone	Email address
Dan Huff	City Manager	(503) 829-6855	dhuff@cityofmolalla.com
Gerald Fisher	Public Works Director	(503) 829-6855	gfisher@cityofmolalla.com
Andy Peters	Public Works Operations Supervisor	(503) 793-0507	apeters@cityofmolalla.com
Jake Ehredt	WWTP Operator Lead	(503) 829-5407	jehredt@cityofmolalla.com
James Clifton	WWTP Operator 1	(503) 829-5407	jclifton@cityofmolalla.com
Public Works Emergency	On-Call Staff	(503) 829-4160	-



THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	*CITY OF MOLALLA* *RECYCLED WATER USE PLAN*	FIGURE NO. ***1.1.1***
DATE: NOV. 2017 PROJECT NO.: 100.31	***VICINITY MAP***	

SECTION 2:

BENEFICIAL PURPOSES

SECTION 2: **BENEFICIAL PURPOSES**

The recycled water will be beneficially used for the purpose of irrigating pastures and grass lands. This will reduce or eliminate the need for recycled water users to irrigate with local ground water or surface water. Use of recycled water also eliminates discharge of treated effluent to surface water during the summer months.

Contact information for recycled water users that are involved with the City's recycled water use program is summarized in Table 2.1.1.

TABLE 2.1.1
RECYCLED WATER USERS

Name	Site	Location	Contact
Steve Coleman	Coleman Ranch (North and South) Sites	15151 South Feyrer Park Road, Molalla, Oregon 97038	(503) 970-2502
Dennis Kyllo	Cemetery Site	Termination of South Adams Cemetery Road, Molalla, Oregon 97038	(971) 221-5650
Jake Ehredt	WWTP Operator Lead	12424 South Tolliver Road, Molalla, Oregon 97038	(503) 829-5407
James Clifton	WWTP Operator 1	12424 South Tolliver Road, Molalla, Oregon 97038	(503) 829-5407

Table 2.1.2 summarizes the proposed beneficial end uses of the City's recycled water, as required by OAR 340-055-0025(1)(c). The total recycled water capacity of the land application sites is 201.4 Million Gallons (MG). All sites have filed Registration of Recycled Water Use forms with the Water Resource Department (ORS 537.132(2)). These completed forms are included in Appendix E. The recycled water capacity for each site is based upon amended land application plans as originally presented in the *Consolidated Recycled Water Use Plan* prepared by Brown and Caldwell (July, 2015). This RWUP adjusts setback distances based upon Class C recycled water, as set forth in OAR 340-055-0012(5)(e).

TABLE 2.1.2
SUMMARY OF BENEFICIAL PURPOSES

Site	Beneficial Purpose	Class of Water	Recycled Water Capacity (MG)	Frequency[1]
Coleman Ranch (North & South) Sites	Pasture (with some hay production) Irrigation	C	196.4	May - October
Cemetery Site	Grass Irrigation	C	1.5	May - October
WWTP Site	Pasture Irrigation	C	3.5	May - October

1. City is usually unable to irrigate in May and October due to rainfall. If no irrigation occurs in May and October the total recycled water capacity of all sites is reduced to 182.3 MG.

SECTION 3:

WASTEWATER TREATMENT

SECTION 3: **WASTEWATER TREATMENT**

In accordance with OAR 340-055-0025(1)(a), Section 3 describes the wastewater treatment system operating at the City's WWTP including information on the quantity of recycled water, quality of the recycled water, and the permitted use of recycled water.

3.1 Wastewater Treatment System

The City of Molalla's current average dry weather flow (May to October) is 1.11 Million Gallons per Day (MGD). The City accepts and processes domestic wastewater from residential and commercial users. The City currently has 2,700 services (water meters) inside the City Limits that also receive sewer service. Based on a Single Family Residence (SFR) usage rate, the City has 3,272 Equivalent Dwelling Units (EDUs). An analysis of historical billing records for the fiscal year 2015-2016, shows that 94.0 percent of all accounts are single family residential, and 5.5 percent are large multifamily residential, light commercial. The remaining 0.5 percent of the City of Molalla population is classified as industrial.

Wastewater is treated and disposed of in accordance with the National Pollution Discharge Elimination Permit (NPDES) No. 101514 (provided in Appendix A). There are currently two permitted effluent Outfall 001 and Outfall 002. Outfall 001 is for discharge of disinfected final effluent during the winter months to the Molalla River. Outfall 002 is for the irrigation of recycled water onto the Oregon DEQ approved land application sites.

Wastewater Treatment Process

The City's existing wastewater treatment plant was constructed in 1980 and is located in the west end of the City, immediately south of Toliver Road. The wastewater treatment facility includes the following major unit processes:

- Influent fine screen
- Parshall flume flow meter
- Aerated lagoon
- Transfer pump station
- Two facultative/storage lagoons
- Tertiary treatment by Dissolved Air Flotation (DAF) and sand/anthracite gravity filters
- Calcium hypochlorite disinfection
- Chlorine contact basin
- Effluent pump station
- Dechlorination

Raw wastewater flows by gravity to a headworks system consisting of an automated fine screen, mechanical bar screen, and Parshall flume for flow measurement. The fine screen is an in-channel, perforated plate type screen (1/4-inch) with a design capacity of 9.25 MGD. The principle role of influent screening is to remove coarse materials from the waste stream.

Screened raw sewage flows by gravity to a 1.3 Million Gallon (MG) asphalt-concrete lined aerated lagoon designed with six aspirating aerators. Treatment in the aerated lagoon is provided by both biological and physical processes. A transfer pump station conveys wastewater from the aerated lagoon to the first of two facultative lagoons installed in series. The lagoons provide additional treatment, flow equalization, storage, and long-term solids retention and digestion. The lagoons are lined with native clay. Lagoon #1 is 11.4 acres and has a maximum volume of 45 MG at a 12 ft water level. Lagoon #2 is approximately 13.6 acres and has a total volume of 53 MG at a 12 ft water level. The total liquid capacity of Lagoons #1 and #2 is 98 MG.

Tertiary treatment is provided by DAF units and gravity sand filters. Effluent from Lagoon #2 is conveyed to two DAF units; one installed in 1980 and another installed in 2007. The DAF unit (DAF #1) installed in 1980 is 31 feet in diameter. The DAF unit (DAF #2) installed in 2007 is 38 feet diameter. The DAF units were originally designed for a total hydraulic capacity of 4 MGD. Each DAF unit consists of a circular clarifier, a saturation tank, two recycle pumps (or pressurization pumps), and an influent flow meter. The primary purpose of the DAF units is to remove algae from the waste stream.

Effluent from the DAF units is conveyed by gravity to a splitter box and then to four gravity filters, all installed in 2007. The primary purpose of the gravity filters is to provide additional solids removal. The filters are rated for a total capacity of 4 MGD. The filters have a total surface area of 573 square feet, and a maximum loading rate of 4.85 gpm/ft^2. The filters contain a 12-inch layer of silica sand and a 24-inch layer of anthracite coal. It should be noted that tertiary treatment is required due to the mass load limitations of the City's NPDES Permit and not for the class limitations of the recycled water.

After gravity filtration, calcium hypochlorite is used for disinfection, immediately prior to entering the chlorine contact basin. The tablet chlorination system is manufactured by Accu-Tab. The tablets are dissolved in feed water, enter a solution tank, and then are introduced to the waste stream. Effluent from the tablet chlorination system flows by gravity to the chlorine contact basin. The chlorine contact basin is 67,500 gallons. The contact time in the basin at 2017 average irrigation season flow is approximately 1.4 hours. This has shown to be acceptable because the operators dose at a high rate between 5 and 12 mg/L and maintain a chlorine residual in the 0.3 to 8.8 mg/L range.

Disinfected effluent flows by gravity to the effluent pump station, where it is either land applied or discharged to the Molalla River, depending upon the time of year. The pump station houses two vertical turbine pumps with a total capacity between 500 and 7,000 gallons per minute (gpm). The pumps are Variable Frequency Drive (VFD) controlled. The effluent pump station is designed with provisions to add a third pump in the future. The wet well is a precast reinforced concrete 12-foot inner diameter manhole. A level transducer is included for liquid level measurement.

The existing WWTP site plan is depicted in Figure 3.1.1. The WWTP process schematic is illustrated in Figure 3.1.2. Existing WWTP drawings and specifications are included in Appendix B.

Recycled Water Quantity

In 2015, from May through October, the total WWTP influent flow was 158 MG, and a total of 111 MG of recycled water was land applied. In 2016, from May through October, the total WWTP influent flow was approximately 197.5 MG, and a total of 110 MG of recycled water was land applied. The difference between the total influent dry weather flow and the recycled water land applied, is typically stored in the lagoons and eventually discharged, after tertiary treatment and disinfection, to the Molalla River outfall during the winter months. For more information about the quantity of recycled water, refer to Section 4.

Recycled Water Quality

The WWTP will generate Class C recycled water. Class C standards, as specified in Table A3 of the NPDES Permit, are summarized in Table 3.1.1.

TABLE 3.1.1
QUALITY OF RECYCLED WATER

Parameter	Class C
Oxidized	Yes
Disinfected	Yes
Total Coliform (organisms/100 mL)	
7-day median	23
Maximum in any sample	-
Maximum in 2-consecutive samples	240
Monitoring frequency	1/week

The permittee is authorized to distribute recycled water if it is:

1. Treated and used according to the criteria listed in Table A3 of the NPDES Permit.

2. Managed in accordance with its DEQ approved Recycled Water Use Plan unless exempt as provided in Schedule D, Condition 3, of the NPDES Permit.

3. Used in a manner and applied at a rate that does not have the potential to adversely impact groundwater quality.

4. Applied at a rate and in accordance with site management practices that ensure continued agricultural, horticultural, or silvicultural production and does not reduce the productivity of the site.

5. Irrigated using sound irrigation practices to prevent:

   A. Offsite surface runoff or subsurface drainage through drainage tile;

   B. Creation of odors, fly and mosquito breeding, or other nuisance conditions; and

   C. Overloading of land with nutrients, organics, or other pollutants.

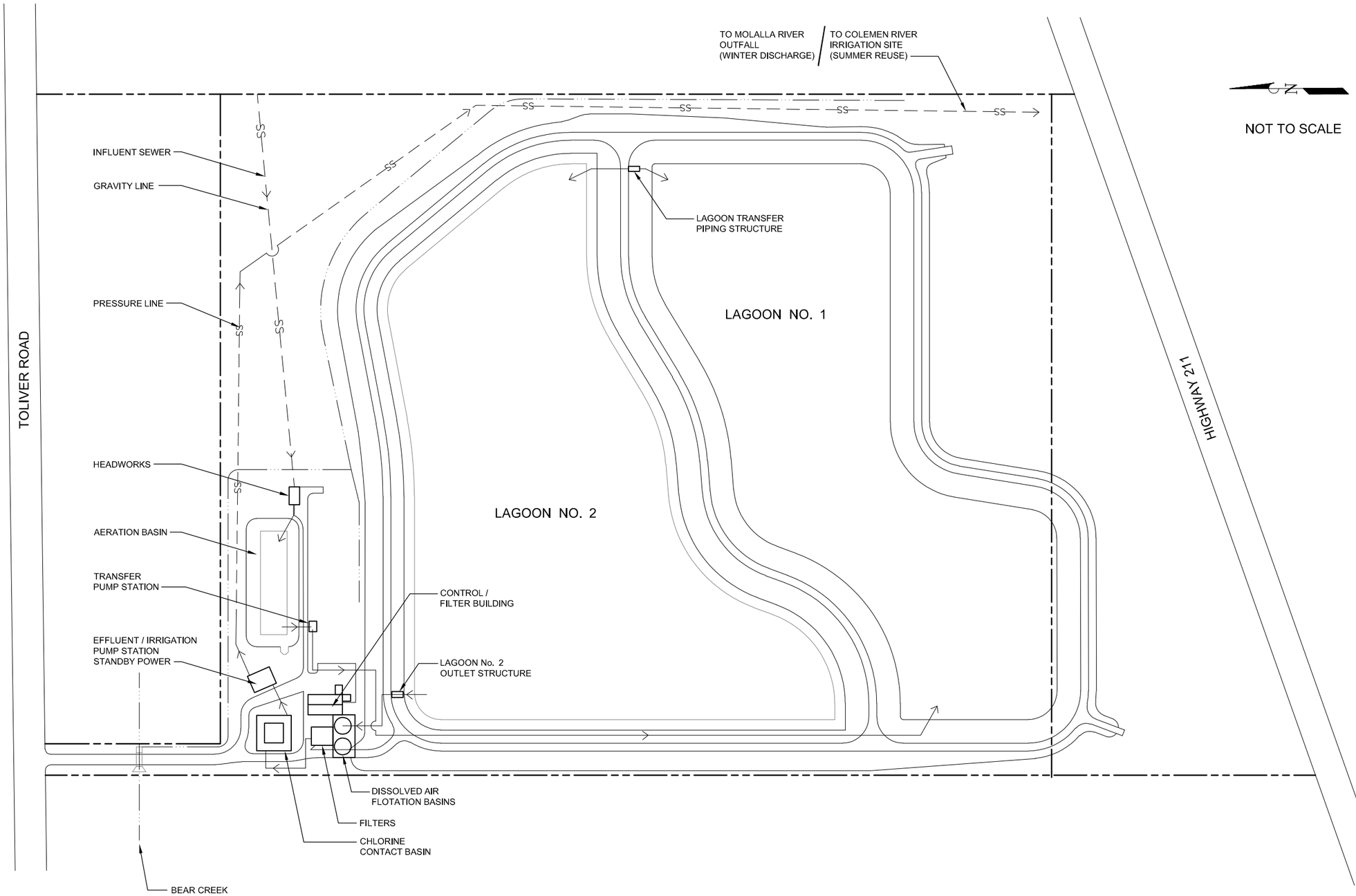


FIGURE NO. 3.1.1

CITY OF MOLALLA
RECYCLED WATER USE PLAN

WWTP SITE PLAN

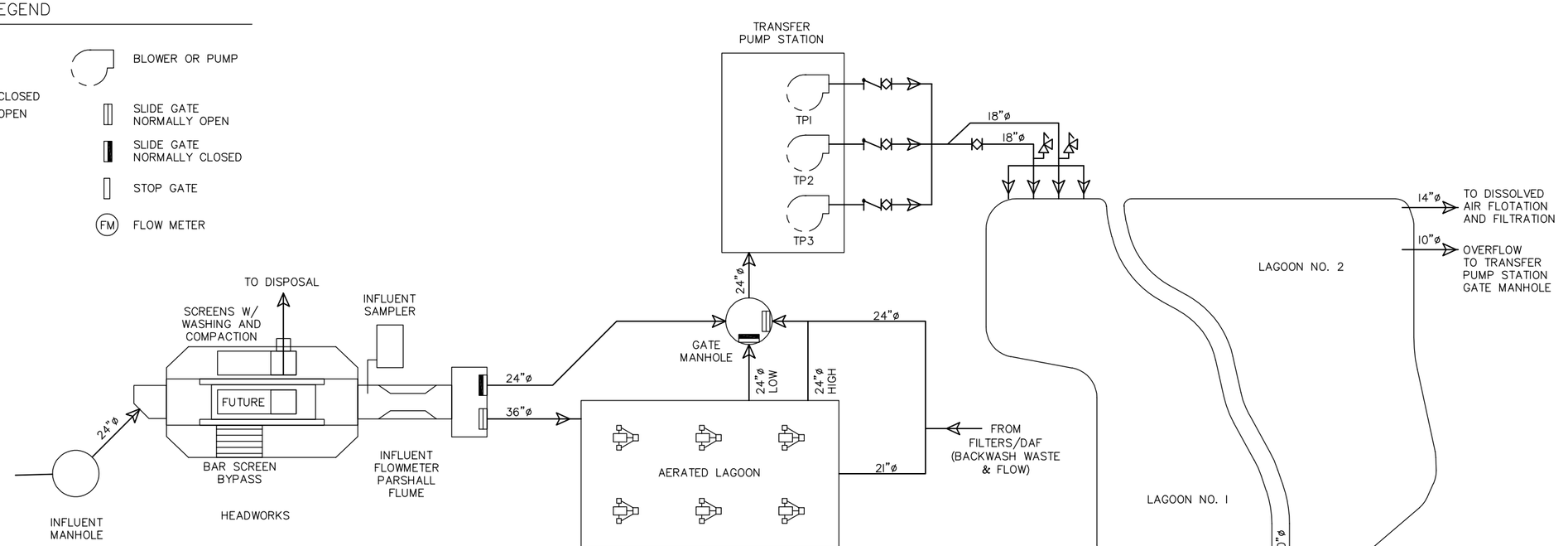
THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: OCTOBER 2017

PROJECT NO.: 100.31

LEGEND

- AIR RELIEF VALVE
- CHECK VALVE
- PLUG VALVE, NORMALLY CLOSED
- PLUG VALVE, NORMALLY OPEN
- BALL VALVE
- GATE VALVE
- VALVE MOTOR OPERATOR
- WAS PIPING
- PROCESS PIPING
- AIR, OTHER PIPING
- OPEN / CLOSE VALVE
- EXISTING FACILITIES
- BLOWER OR PUMP
- SLIDE GATE NORMALLY OPEN
- SLIDE GATE NORMALLY CLOSED
- STOP GATE
- FLOW METER (FM)



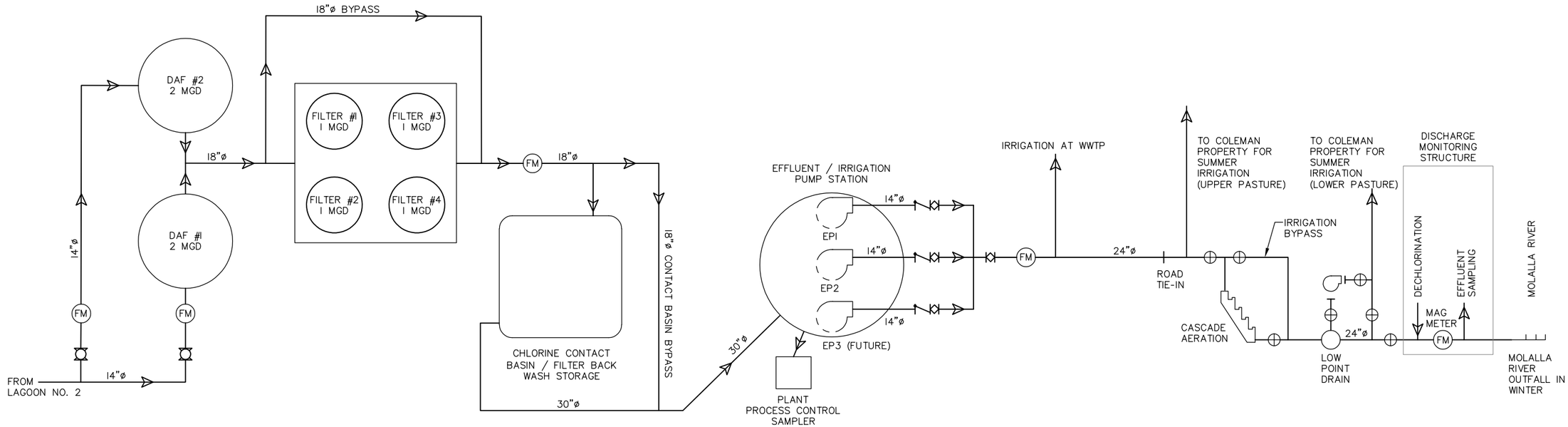


FIGURE NO. 3.1.2

CITY OF MOLALLA
RECYCLED WATER USE PLAN

WASTEWATER TREATMENT PROCESS FLOW SCHEMATIC

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: OCTOBER 2017

PROJECT NO.: 100.31

SECTION 4:

RECYCLED WATER MONITORING & SAMPLING

SECTION 4: **RECYCLED WATER MONITORING AND SAMPLING**

Section 4 describes the recycled water monitoring and sampling procedures for the Recycled Water Reuse Program per OAR 340-055-0025(1)(e). The City's WWTP will produce Class C recycled water, in accordance with their NPDES Permit.

4.1 Recycled Water Quantity

Class C recycled water will be produced at the WWTP during the recycled water irrigation season. Land application of recycled water will typically commence in June and continue through September. During unseasonably dry years, and based upon actual land application site conditions, irrigation may also occur in May and October.

Current Quantity of Recycled Water

Based upon an analysis of the City's Discharge Monitoring Reports (DMRs) between January 2014 and August 2017, the current average dry weather flow is 1.11 MGD. Monthly WWTP influent wastewater flows and the quantity of recycled water generated from May to October in 2016 is listed in Table 4.1.1.

TABLE 4.1.1
QUANTITY OF RECYCLED WATER (2016)

Month	Influent Flow (MG)	Recycled Water Quantity (MG)
May	34	0
June	30	18.7
July	26.5	32.5
August	24	34.5
September	24	23
October	59	1.6
Total	197.5	110.3

As reported in the City's 2016 Recycled Water Use Summary, Table 4.1.2 summarizes the quantity of recycled water that was applied to each land application site during the 2016 irrigation season, as well as the individual site capacities, all based on the land application plans presented in Section 9.

TABLE 4.1.2
QUANTITY AND CAPACITY OF RECYCLED WATER BY SITE (2016)

Parameter	North Coleman Ranch Site	South Coleman Ranch Site	Cemetery Site	WWTP Site
Total Million Gallons Irrigated (MG)	55.6	52.1	0	2.3
Site Capacity (MG)	121.7	74.7	1.5	3.5
% of Capacity	45.7%	69.7%	0%	65.7%

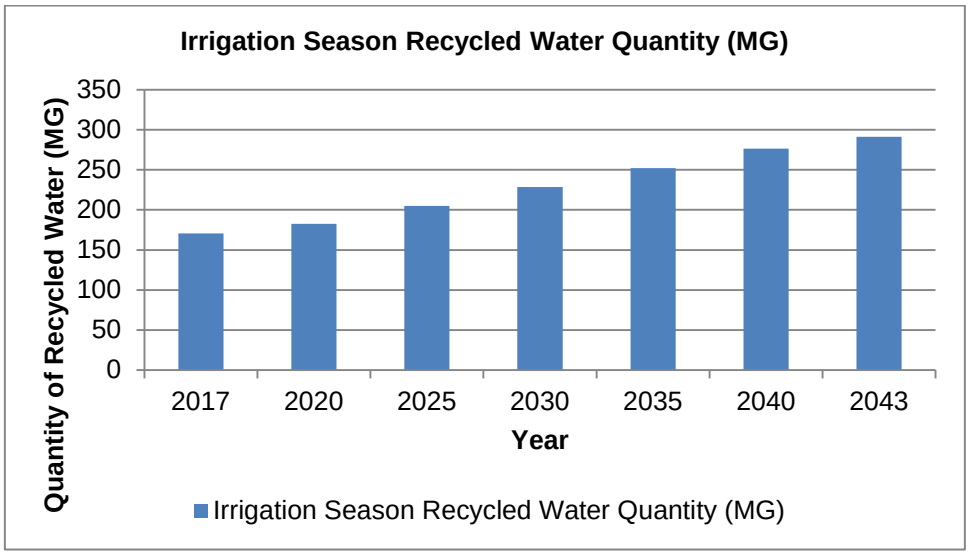
The City is not allowed to discharge to waters of the state in May through October. Due to precipitation, usually the City cannot land apply recycled water in May or October. In May, wastewater is stored in the lagoons. After treatment and disinfection, the City mainly land applies recycled water in June through September. In October, partially treated wastewater is stored in the lagoons. The stored

wastewater is further treated and disinfected prior to being discharged to the Molalla River outfall during the winter months. In general, the difference between the influent dry weather flows and the actual quantity of recycled water irrigated is stored in the lagoons and eventually discharged to the Molalla River outfall during the winter, to satisfy water balance requirements.

Future Quantity of Recycled Water

As the City's population grows, the City's Recycled Water Use Plan will need to be kept current to address new circumstances in recycled water production, treatment processes, monitoring, the addition of new reuse sites, or changing/expanding uses. The scope of the RWUP pertains to existing flows, but some information concerning future dry weather flows and impacts to the City's Recycled Water Use Plan is summarized herein. In 2043, average dry weather flows are projected to be approximately 1.9 MGD. Future land area requirements for application of recycled water are a function of the future mass load allocations associated with the Molalla River outfall, new reuse site characteristics, and several other factors. In the next 20 years, the amount of land required may need to increase by approximately 50 percent or more. Figure 4.1.1 shows the future quantity of recycled water, assuming that all influent flows in October are stored in the facultative/storage lagoons and eventually discharged to the Molalla River during the winter months. Based on the total capacity (201.5 MG) of the existing land application sites, the City currently has adequate land area to apply Class C recycled water until approximately 2025.

FIGURE 4.1.1
FUTURE QUANTITY OF RECYCLED WATER[1]



1. Total quantity of recycled water generated from May 1st to September 31st; assumes partially treated wastewater is stored in lagoons in October and discharged to the Molalla River after further treatment during the winter months.

Recycled Water Flow Measurement

Total recycled water flows are measured using transit time/doppler meters on the effluent force main at the WWTP. At the WWTP, daily flows are recorded in the Supervisory Control and Data Acquisition (SCADA) system. Recycled water flows directed to the Cemetery and WWTP sites are measured

manually by operational staff with mechanical flow meters located at each site. Recycled water flow for the Coleman Ranch sites are calculated by subtracting flow diverted to the other sites (Cemetery and WWTP). All flows are recorded in the City's discharge monitoring reports.

4.2 Recycled Water Quality

Recycled water permit limits, as set forth in the NPDES Permit, are presented in Table 4.2.1. The City intends to irrigate oxidized and disinfected Class C recycled water onto the North and South Coleman Ranch sites, WWTP site, and Cemetery site.

TABLE 4.2.1
NPDES PERMIT (101514) RECYCLED WATER LIMITS
OUTFALL 002 (MAY 1 – OCT 31)

Class	Level of Treatment	Beneficial Uses
C	Oxidized and disinfected. Total coliform may not exceed: • A median of 23 total coliform organisms per 100 mL, based on results of the last 7 days that analyses have been completed. • 240 total coliform organisms per 100 mL in any two consecutive samples.	• Class D and non-disinfected uses. • Irrigation of processed food crops; irrigation of orchards or vineyards if an irrigation method is used to apply recycled water directly to the soil. • Landscape irrigation of golf courses, cemeteries, highway medians, or industrial or business campuses. • Industrial, commercial, or construction uses limited to: industrial cooling, rock crushing, aggregate washing, mixing concrete, dust control, nonstructural fire-fighting using aircraft, street sweeping, or sanitary sewer flushing.

In accordance with the NPDES Permit, Table 4.2.2 summarizes the monitoring requirements that are required for Class C recycled water.

TABLE 4.2.2
RECYCLED WATER MONITORING REQUIREMENTS
OUTFALL 002 (MAY 1 – OCT 31)

Item or Parameter	Minimum Frequency	Sample Type
Flow (MGD) or quantity irrigated (inches/acre)	Daily	Measurement
Flow meter calibration	Annually	Verification
Quantity chlorine used (lbs)	Daily	Measurement
Chlorine, total residual (mg/L)	Daily	Grab
pH (standard units)	2/week	Grab
Total Coliform (MPN[1] per 100 mL)	1/week	Grab
Nutrients (TKN[2], NO_2-N+NO_3-N, NH_3-N, Total Phosphorus)	Quarterly	Grab

1. MPN = Most Probable Number.
2. TKN = Total Kjeldahl Nitrogen.

The wastewater treatment facility is designed to produce effluent consistent with Class C requirements. Effluent Biochemical Oxygen Demand (BOD_5) and Total Suspended Solids (TSS) sampling for the recycled water outfall is not required as part of the NPDES Permit. However, the recycled water must be

oxidized and disinfected. The recycled water will be fully oxidized with a BOD_5 and TSS of less than 30 mg/L, non-putrescible, and contain dissolved oxygen. Figure 4.2.3 shows the WWTP effluent as reported in the City's 2016 Recycled Water Use Summary.

TABLE 4.2.3
WWTP EFFLUENT QUALITY OUTFALL 002 (2016)

Parameter	Average	Number of Tests
Total Coliform (organisms per 100 mL)	8.26	97
pH	7.12	2/week
Chlorine Residual (mg/L)	5.09	When irrigating
NO_2-N + NO_3-N (mg/L)	7.95	2 (June, Sept)
TKN (mg/L)	7.54	2 (June, Sept)

For the purpose of demonstrating that the WWTP can produce effluent that is oxidized, effluent BOD_5 and TSS data from the winter time is summarized herein. A summary of the City of Molalla's WWTP effluent performance, with respect to effluent BOD_5 and TSS, is provided in Figures 4.2.1 and 4.2.2, respectively. From the time period of January 2015 to June 2017, the average monthly effluent BOD_5 concentration was less than 5 mg/L. For the same time period, the average monthly effluent TSS was less than 7.1 mg/L.

FIGURE 4.2.1
HISTORICAL WWTP EFFLUENT BOD_5 PERFORMANCE

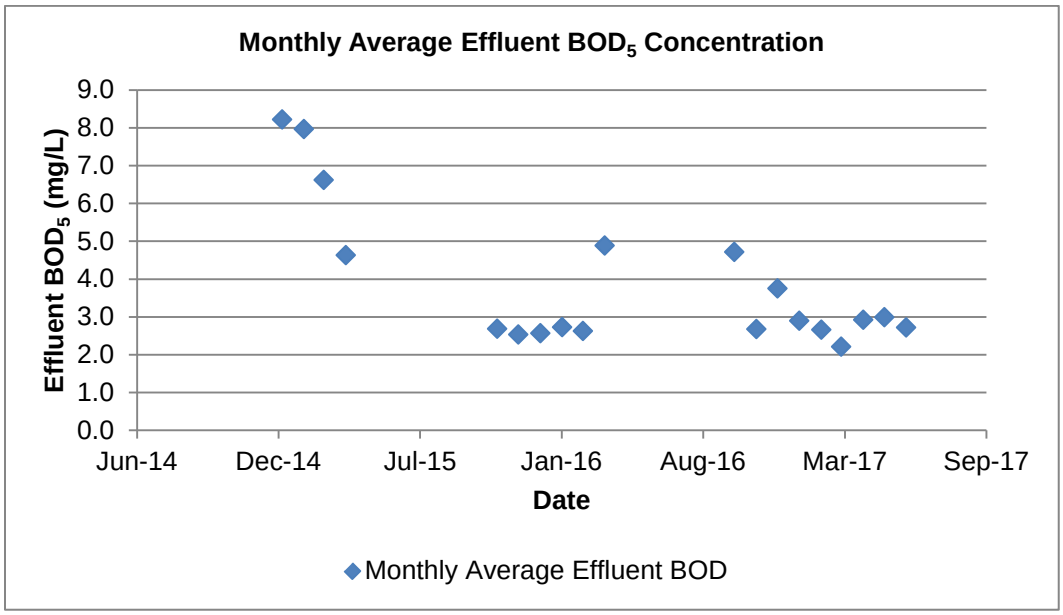
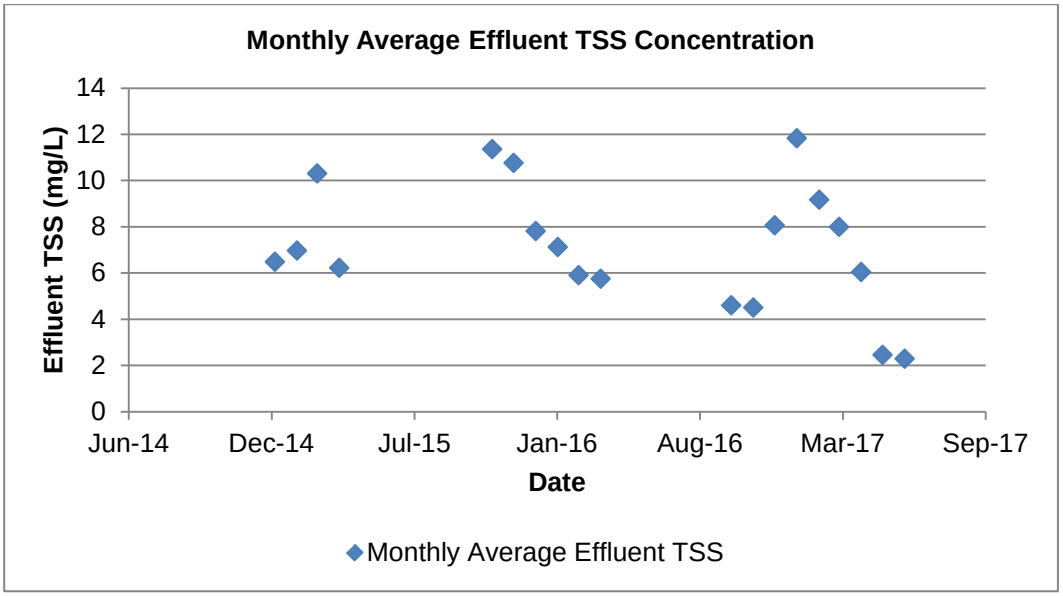


FIGURE 4.2.2
HISTORICAL WWTP EFFLUENT TSS PERFORMANCE



Sampling Methods

Recycled water is sampled prior to land application at the farthest point in the irrigation system at each site. In accordance with Class C sampling requirements, chlorine residual is sampled daily (when irrigating), and total coliform samples are pulled once per week. Testing for total coliform, pH, and chlorine residual are conducted at the City's own laboratory. Coliform testing is performed using membrane filtration (US Environmental Protection Agency Method 10029 M-Coliblue 24 or IDEXX Quanti-Tray/2000 , or other DEQ approved methods for testing Coliform. The City uses a HACH Spectrophotometer, or other DEQ approved methods for testing, to test for TKN, Nitrite-N, Nitrate-N, Ammonia-N, and Total Phosphorus. Irrigation of recycled water is suspended if effluent quality is not in compliance with NPDES Permit limits.

SECTION 5:

SYSTEM MAINTENANCE & CONTINGENCY PROCEDURES

SECTION 5: **SYSTEM MAINTENANCE AND CONTINGENCY PROCEDURES**

5.1 Maintenance and Contingency

Section 5 describes how the WWTP equipment and processes will be maintained per OAR 340-055-0025(1)(f), as well as a description of contingency procedures per OAR 340-055-0025(1)(d).

NPDES Permit requirements for Class C recycled water require that the effluent is fully oxidized, non-putrescible, and contains dissolved oxygen. The existing wastewater treatment facility is capable of producing higher quality effluent than Class C requirements. As evidence of the WWTPs capabilities, from the time period of January 2015 to June 2017, the monthly average effluent BOD_5 and TSS was less than 5 mg/L and less than 7.1 mg/L, respectively.

Operation and Maintenance Manual

The wastewater treatment plant is operated and maintained in accordance with the City of Molalla's "*Wastewater Treatment Facilities Operation and Maintenance Manual*" as prepared by The Dyer Partnership in May 2017. Operators at the WWTP use the manufacturer suggested maintenance intervals and operational procedures for the equipment in operation at the WWTP. There are times, typically in May and October, when the WWTP is not allowed to discharge to waters of the state and rainfall prevents land application of recycled water. During these downtimes, the required maintenance at the WWTP is completed.

Reliability and Redundancy

The recycled water system has a sufficient level of redundant treatment components and monitoring equipment to prevent inadequately treated recycled water from being used. The design of the wastewater treatment facility process equipment allows for flexibility of operation that enables permit compliance under varying circumstances.

Short term storage of wastewater is provided in the facultative/storage lagoons for the retention of wastewater under adverse weather conditions or at other times when recycled water irrigation is precluded. The mechanical aspirators in the aeration basin, the transfer pump station, the Dissolved Air Flow (DAF) units, the gravity filters, and the effluent pump station are all designed for redundancy.

In the event of a transfer or effluent pump failure, operational staff is automatically notified of the alarm condition through the Supervisory Control and Data Acquisition (SCADA) system. With only one pump operational, the transfer and effluent pump stations are capable of processing average dry weather flows. The DAF units and gravity filters were designed with similar redundant and alarm notification systems.

Disinfection is the primary mechanism used for the destruction of pathogenic organisms to prevent the spread of waterborne diseases. Effluent from the gravity filters is disinfected with a tablet chlorination system and a 67,500 gallon chlorine contact basin. The chlorine dose is applied to achieve disinfection targets, and alarms are activated if the chlorine residual is outside specified limits. Irrigation of recycled water is also suspended if effluent quality is not in compliance with NPDES Permit limits.

In the event of an equipment or system failure, a generous inventory of spare motors, pneumatic valve actuators, and other common parts, is stocked at the WWTP, expediting repair or replacement procedures.

Alarms, Controls, and Standby Power

The WWTP includes a SCADA system. Alarm devices are established in accordance with OAR 340-055-0030(2). The SCADA system is manufactured by CIMPLICITY and the hardware is manufactured by General Electric. The alarm dialer is manufactured by Antx Dialog Elite. In the event of an alarm condition, the alarm dialer proceeds to notify operational staff of the alarm condition(s). The following conditions will activate the alarm dialer:

- Headworks general alarm
- Aerated lagoon aeration systems general alarm
- Transfer pump station general alarm
- DAF units general alarm
- Gravity filters general alarm
- Operations building general alarm
- Chlorine contact basin general alarm
- Effluent pump station alarm
- Effluent pump station facility alarm
- Generator alarm
- WWTP intrusion alarm
- Chlorine residual is too high or too low alarm
- Power failure alarm

The alarm system will autodial a list of user defined phone numbers until the phone call is answered. If no one answers, the alarm system will re-call the list. City employees rotate on-call shifts. If there is no response by one of the on-call employees, the system will autodial other City Staff. When an alarm call is answered, the Antx Dialog Elite system informs the recipient of the active alarm condition. The alarm dialer system also has the capability of answering incoming calls. Upon receipt of a call, the system reports the alarm condition to the caller.

A 750-kW generator located at the WWTP is capable of powering all essential treatment processes. The generator starts automatically and runs when power from the grid is lost. With this generator running, the WWTP can operate normally. Only one effluent pump is connected to the standby generator.

The generator runs a weekly test cycle to ensure that it will start up and work properly in the event of a power loss. An alarm device is incorporated into the WWTP controls to provide warning of power loss. In accordance with the procedures set forth in the City's WWTP Operation and Maintenance Manual, following a transfer of power to the standby generator, critical wastewater treatment process components are visually inspected to verify functionality and operation.

SECTION 6:

RECYCLED WATER STORAGE, TRANSMISSION, & DISTRIBUTION

SECTION 6: **RECYCLED WATER STORAGE, TRANSMISSION, AND DISTRIBUTION**

Section 6 describes the recycled water transmission, storage, and distribution systems.

6.1 Recycled Water Storage

Recycled water storage is necessary to balance differences that occur in the generation and use of recycled water. The two lagoons at the WWTP total 25 acres and have a maximum operating depth of 12 feet. They are clay-lined and have a total capacity of approximately 98 Million Gallons (MG). This provides the City with water storage for irrigation purposes during the summer, as well as the ability to store some wastewater for eventual discharge, after treatment and disinfection, to the Molalla River outfall during the winter, all based upon current flows.

Three major variables impact the water balance for storage of wastewater. First, sludge depths in the lagoons should allow liquid depths in the facultative/storage lagoons to be drawn down to achieve equalization objectives. Second, the current NPDES Permit prohibits discharge to the Molalla River from May through October, even if river flows are high enough in the border months to achieve NPDES Permit dilution, temperature, and other water quality requirements. Third, the current NPDES Permit is based on an average wet weather flow of 1.92 MGD and is not representative of current flows. This ultimately restricts the City's ability to discharge flows at rates necessary to satisfy a water balance.

A water balance for the facultative/storage lagoons was prepared based upon:

- Current average dry weather flows.
- Precipitation data derived from the City of Molalla's National Oceanic and Atmospheric Administration (NOAA) station.
- Evaporation data based on historical means for Corvallis in the Climatology Handbook (1969).
- No recycled water irrigation occurs in May and October.
- October flows are typically stored in the facultative/storage Lagoons #1 and #2 and eventually discharged to the Molalla River during the winter months.
- Leakage through the native clay lined facultative/storage Lagoons #1 and #2 based upon a lagoon leakage test performed by The Dyer Partnership in 2017.

The water balance assumes that the City can draw down the lagoons while maintaining the biological capacity and performance of the facultative lagoons and tertiary systems, and operationally adjust the liquid levels to a maximum liquid level of up to 12 feet.

Since the City typically cannot irrigate in May and October, the maximum equalization (i.e. surge volume) requirements are primarily a function of the monthly influent flow in May and October. The most extreme design condition typically occurs when there is a high amount of precipitation in May or October. When there is a high amount of rainfall in May or October, rain induced Inflow and Infiltration (I/I) creates high wastewater flows, and wet conditions prevent land application of recycled

water. Under these conditions, all of the influent wastewater received in May or October must be stored in the lagoons. For reference, historical monthly flows for October and May, from 2014 through 2016, are summarized in Table 6.1.1.

TABLE 6.1.1
HISTORICAL INFLUENT FLOWS – MAY AND OCTOBER

Year	Monthly Flow – May (MG)	Monthly Flow – October (MG)
2014	38	35
2015	47	21
2016	34	59
Average	40	38
Maximum	47	59

The total available equalization volume, or surge volume, of Lagoons #1 and #2 is established by the liquid level of Lagoons #1 and #2 at the beginning of May or October. Table 6.1.2 lists the equalization volume associated with various lagoon liquid depths, and the corresponding allowable influent flow for May or October, assuming that no irrigation occurs in May or October.

TABLE 6.1.2
ALLOWABLE MAY OR OCTOBER INFLUENT FLOW

Lagoon #1 and #2 Liquid Depth (feet)[1]	Equalization (feet)	Equalization Volume (acre-feet)	Allowable Influent Flow – May or October (MG)
9	3	75	24
8	4	100	33
7	5	125	41
6	6	150	49
5	7	175	57

1. Liquid depth of lagoons at beginning of May and October. Facultative lagoon performance deteriorates when the liquid level drops below seven to eight feet.

Based on an analysis of the 2014 through 2016 discharge monitoring reports, on average, the City can satisfy a water balance by lowering the Lagoons #1 and #2 to a liquid depth between seven and eight feet. This provides up to 125 acre-feet of equalization storage.

During wet months, more equalization is required because rain induced infiltration and inflow produce high flows, and rainfall prevents significant irrigation of recycled water. However, the lagoons operate optimally (biologically) at liquid levels greater than 7 feet. Lowering the lagoon liquid depths below optimum biological levels offers more storage, but biological treatment isn't optimized. Consequently, under the current permit and during a wet May or October, the City is sometimes forced to discharge to the Molalla River outfall, in violation of the NPDES Permit.

6.2 Recycled Water Transmission, Distribution and Plumbing

Effluent from the chlorine contact basin flows by gravity to an effluent pump station, constructed in 2006. The pump station houses two vertical turbine pumps with a total capacity between 500 and 7,000 gpm. The effluent pump station is designed with provisions to add a third pump in the future. The wet well is a precast reinforced concrete 12-foot inner diameter manhole. The pumps are Variable Frequency

Drive (VFD) controlled. An ultrasonic level controller is included for liquid level measurement. Summertime operation of the transfer pumps is based upon a pressure set point, typically between 100 to 104 psi.

The main irrigation line is the same force main that is used to discharge effluent to the Molalla River from November to April. It is constructed of 24-inch high-density polyethylene pipe and is 27,000 feet in length. The design capacity of the force main is 10.1 MGD. There are several irrigation risers throughout the Coleman Ranch sites. There is a separate valve for each line that allows one section to be isolated for repairs without having to shut down the entire system. The pipeline is a different size and color than the City's water lines and it was routed as much as possible through areas devoid of City water lines to prevent accidental water hookups. Future expansion of the irrigation transmission system will be colored purple following the uniform color code of the American Public Works Association.

Currently, there are three areas where there is a potential for cross connection; Highway 211 (Hwy 213 to Molalla Forest Road), Molalla Forest Road (MRM Entrance and Ona Way intersection), and Mathias Road (South City Limits to 8th Street). The City has a procedure in place for review of connections to the water system, including a plan review. There is separation on Hwy 211 with the water line on the north side of the street and the force main on the south side of the street. There is separation on Molalla Forest Road at the crossing. There is separation on Mathias Road with the water line on the west side of the road and the force main on the east side.

Figure 6.2.1, on the following page, is a schematic drawing of the recycled water distribution system. Irrigation submain layout, valve locations, moisture block locations, piezometer locations, and irrigation plans are included in Appendix J.

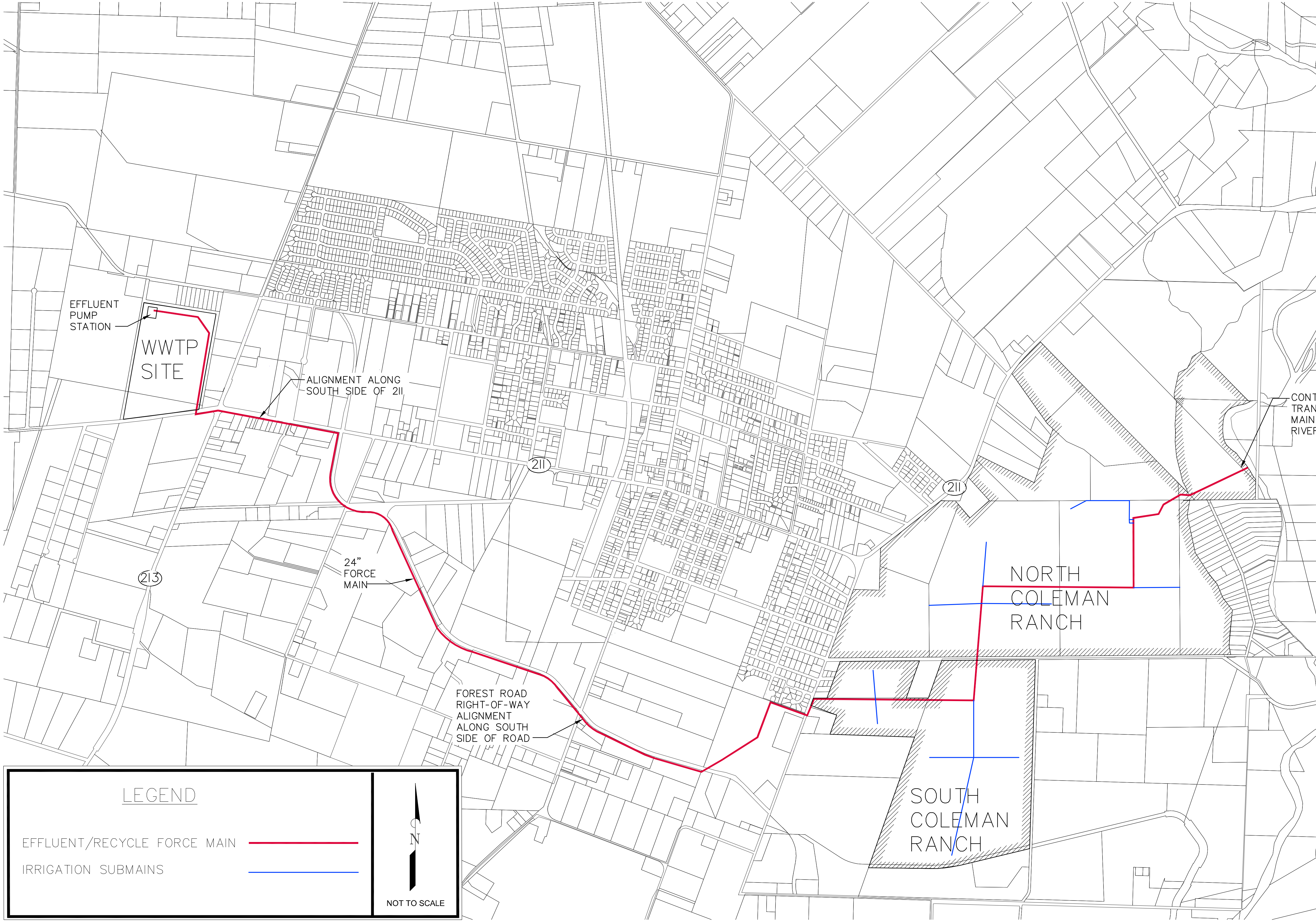


FIGURE NO. 6.2.1

CITY OF MOLALLA
EFFLUENT/RECYCLED WATER USE PLAN

EFFLUENT/RECYCLE FORCE-MAIN

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: OCTOBER 2017

PROJECT NO.: 100.31

SECTION 7:

PUBLIC HEALTH & ENVIRONMENTAL CONTROLS

SECTION 7: **PUBLIC HEALTH AND ENVIRONMENTAL CONTROLS**

Section 7 discusses potential public health and environmental concerns associated with Class C beneficial use of recycled water; including measures taken to control adverse effects on public health and the environment.

Multiple barriers are integrated into the Recycled Water Use Plan to prevent, to the extent practicable, the transmission of pathogens and harmful organic and inorganic contaminants contained in the recycled water disseminated to the public and environment. A combination of secondary and tertiary treatment processes, as well as disinfection systems, reduce pathogen and contaminant concentrations.

Environmental controls, such as setbacks, access and exposure control, and site management practices are incorporated into the RWUP to protect the public and environment.

7.1 Signs

All irrigation equipment and recycled water pipes will be labeled with signs that state "NON-POTABLE WATER." Additionally, signs will be posted in both English and Spanish stating:

- "RECYCLED WATER USED – NOT SAFE FOR DRINKING"
- "AGUS DE REUSO - NO SALUDABLE BEBER"
- "IN ORDER TO CONSERVE WATER … RECYCLED WATER IN USE … DO NOT DRINK"
- "NO TOME EL AGUA"
- "WASH HANDS AFTER CONTACT"
- "LAVESE LAS MANOS DESPUES DE TOCAR"

Size lettering will be readable from an appropriate distance. A universal symbol for do not drink will be used. Signs will be posted around the perimeter at locations visible to the public and employees as well as access points to the sites. The signs will be durable and withstand the outdoor environment. All signs will be routinely inspected to ensure their purpose is maintained.

7.2 Setbacks

Setback distances will be maintained in accordance with OAR 340-055-0012(5)(e). The following setbacks, based on Class C recycled water, are established, and used for determining usable acreage for each site.

- A minimum of 70 feet from the edge of the site used for irrigation and the site property line.
- A minimum of 100 feet from the edge of an irrigation site to a water supply source used for human consumption.
- Recycled water will not be sprayed within 70 feet of an area where food is being prepared or served, or where a drinking fountain is located.

Land application site plans that identify features that setbacks apply, as originally developed in the *Consolidated Recycled Water Use Plan* prepared by Brown and Caldwell (2015), are included in Appendix C. Amended land application site plans, based on Class C setback distances, are provided in Figures C.1 through C.4, also in Appendix C.

7.3 Groundwater and Surface Water Protection

The recycled water will be land applied at rates that minimize the movement of contaminants to groundwater and do not adversely impact groundwater quality (OAR 340-055-0020). Irrigation systems have been designed to apply recycled water below agronomic and consumptive rates, and thus should not adversely affect groundwater.

Piezometers that measure groundwater depth are installed at the North Coleman Ranch site and South Coleman Ranch site, as shown in Appendix M. If the depth to groundwater is less than one foot, recycled water irrigation operations will be terminated.

Schedule A of the permit contains language prohibiting surface runoff or discharges to surface waters. To prevent surface water contamination, a setback distance of 70 feet was applied to all seasonal and permanent drainages. Additionally, this plan assumes that the soil moisture will be maintained at or below 90 percent of the AWC. Soil becomes saturated only when soil moisture exceeds 100 percent of the AWC, when all of the soil void space is displaced by water. When soil becomes completely saturated (i.e. moisture exceeds 100 percent of the AWC), surface run-off or movement of recycled water to groundwater could ensue. Soil moisture monitoring will be used as a site management tool for preventing and managing environmental impacts to surface water and groundwater. Soil moisture block locations for the South and North Coleman Ranch are provided in Appendix M.

7.4 Aerosol Mitigation

The transmission of pathogens via aerosols is a concern with recycled water use. The definition of an aerosol, as used by the National Institute for Occupational Safety and Health (NIOSH), is a suspension of tiny particles or droplets in the air, such as dusts, mists, or fumes. These particles may be inhaled or absorbed by the skin, and can sometimes cause adverse health effects for workers (NIOSH Division of Applied Research and Technology 2008).

Setbacks, access and exposure controls, and site management practices are incorporated into this plan to protect public health from aerosol exposure. To incorporate another level of protection, irrigation operations will be suspended if wind velocities exceed ten (10) mph.

For determining wind velocity, the City of Molalla uses a Davis Vantage Pro weather station, located at the Water Treatment Plant, which provides 24 HR precipitation, wind direction, and wind speed. Additionally, for redundancy and data validation, a hand held Ambient Weather WM-2 is used. The hand held unit will be used to measure wind speed, temperature, and wind chill at the Coleman Ranch site, typically at the big guns.

The operational approach is to first, at the beginning of each day, evaluate the wind speed and direction using the Davis Vantage Pro Weather Station. If conditions appear suitable for application of recycled water, in accordance with the RWUP, operational staff would proceed to the Coleman Ranch irrigation site. At the Coleman Ranch site, actual weather conditions will be obtained. If weather conditions, based on both the Davis Vantage Pro Weather Station and hand held unit are appropriate for irrigation, land application of recycled water will commence.

Weather data will be recorded and logged from the Davis Vantage Pro Weather Station, as well as the hand-held unit. Instruments will be used in accordance with manufacturer recommendations.

7.5 Special Site Management Restrictions

Site management restrictions for Class C recycled water at agricultural sites include:

Public Access Restrictions (Class C)

- Grazing Livestock. Grazing animals are allowed without restriction on fields irrigating with Class A-D recycled water except if the animals are used for milk production [OAR 340-055-0012(4)(f)(A).
- In coordination with the property owners, irrigate will occur during off hours or during periods of low public contact.
- In accordance with OAR 340-055-0012(5)(f), when irrigating the cemetery, the public will be restricted from direct contact with the recycled water.
- Irrigate only when conditions preclude the offsite migration of recycled water via transport by wind or surface water runoff.
- Install barriers such as fencing, tall vegetation, a cable, or other material strung around the perimeter of the application area.
- Post signage. For the North Coleman and South Coleman Ranch sites, signs are posted around the perimeter of the property and the site is completely fenced. Signs are posted strategically around the Cemetery site.
- Maintain setbacks. Setbacks are maintained at the North and South Coleman Ranch, and Cemetery sites in accordance with OARs.
- If harvesting hay occurs on the North of South Coleman Ranch, irrigation is prohibited for three days prior to swathing and harvesting.

SECTION 8:

RECORDS AND REPORTS

SECTION 8: **RECORDS AND REPORTS**

The City maintains records of the following information at the Wastewater Treatment Plant office for a minimum of three years:

- Effluent quality monitoring;
- Recycled water system performance;
- Ongoing system maintenance records;
- Inspection records; and
- Monthly quantity of recycled water irrigated at each site.

According to the NPDES Permit, the City is required to submit monthly monitoring reports to DEQ, which include any monitoring related to recycled water irrigation. In addition, the City submits an annual recycled water report that summarizes recycled water quantity and quality data, and operations and maintenance information for the irrigation season, by no later than January 15th of each year. The annual report must describe the effectiveness of the system in complying with the approved Recycled Water Use Plan, the rules included in OAR 340-055, the permit limits, and conditions for recycled water. The annual report must include monitoring data for the previous year. Information in the annual report may include, but is not limited to:

- Description of changes to treatment facilities;
- Description of changes to processes specific to production of recycled water;
- Weather data;
- Results of site inspection reports;
- Description of any operational problems (e.g., system upsets, overflows, etc.) and the corrective actions taken;
- Description of changes in the beneficial purpose (e.g., crop changes, water delivery times, supplemental water sources, etc.);
- Location and amount of recycled water used for each beneficial purpose;
- Recycled water volume produced;
- Recycled water characteristics including bacteria and other required monitoring results;
- Results from any site monitoring (e.g., soil monitoring);
- Any planned or anticipated changes to the treatment facility equipment or operations during the next calendar year; and
- Description of any proposed or anticipated changes in water reuse operations, including major changes in agricultural practices, such as crops.

SECTION 9:

LAND APPLICATION PLAN

SECTION 9: **LAND APPLICATION PLAN**

Management approaches for land application of recycled water are directed to ensure irrigation water is used in a responsible manner and protects the public and environment. Section 9 summarizes soil information, water balance calculations, nitrogen loading rate calculations, irrigation system descriptions and management procedures, soil moisture block plans, and startup and shut down procedures for all of the land application sites.

Climate

The Molalla area has a temperate maritime climate with dry, moderately warm summers and wet, mild winters. The temperature ranges from an average high of 81°F in July to an average low of 33°F in January. The average annual rainfall is 47 inches, over 75percent of which falls from November to April, on average.

9.1 North Coleman Ranch Site

The North Coleman Ranch site is located immediately east of the Molalla Urban Growth Boundary (UGB). Mathias Road runs along the west edge of the site and Feyrer Park Road runs along the south edge. Feyrer Road separates the North Coleman Ranch site from the South Coleman Ranch site.

The North Coleman Ranch site is owned by Coleman Corrals, Incorporated and includes several tax lots, as shown in Appendix D. Appendix D also includes a table that lists the legal descriptions for each tax lot. All tax lots are zoned for exclusive farm use. The site is primarily used for cattle grazing (pasture) with some hay production. As depicted in Figure C.1 in Appendix C, useable land for irrigation was estimated to be 270 acres. Signs are posted around the perimeter of the property and the site is completely fenced.

Water Right Registration

In accordance with ORS 537.132(2), any person using or intending to use recycled water must file a Registration of Recycled Water Use with the Oregon Water Resources Department (WRD). A registration of recycled water use for the North Coleman Ranch site is included in Appendix E.

Soils

The predominant soil is Sawtell silt loam, which comprises 88 percent of the site. The Natural Resources and Conservation Service (NRCS) soil report for the North Coleman Ranch site is presented in Appendix F. The most limiting Ksat value (0.03 inch per hour) is found at a depth of 15 inches in the Dayton silt loam soil that comprises eight percent of the site. The average Available Water Capacity (AWC), as specified in the Consolidated Recycled Water Use Plan (2015) and provided in Appendix G, was calculated to be 7.4 inches.

Water Balance

Water balances were developed in the Consolidated Recycled Water Use Plan (2015) and are included in Appendix H. The water balances are based upon net irrigation data as set forth in Oregon State University Extension publication 8530, “Oregon Crop Water Use and Irrigation Requirements.” Net evapotranspiration (Net ET) data was used for pasture crop and based upon a five out of ten year probability (50 percent probability), the most conservative values.

The irrigation management plan ensures that crops receive suitable water while safeguarding against runoff due to saturated soil conditions. Soil becomes saturated only when soil moisture exceeds 100 percent of the AWC, when all of the soils void space is displaced by water. This plan assumes that the soil moisture will be maintained at or below 90 percent of the AWC. The 90 percent AWC for the North Coleman Ranch site is 6.66 inches. The water balances take into account historic climate data, vegetation/crops, agricultural practices, and the soil AWC. During the irrigation season, including May and October, the total gross irrigation capacity of the North Coleman Ranch site is 16.60 inches. Table 9.1.1 summarizes the monthly gross irrigation allowances for the North Coleman Ranch site.

TABLE 9.1.1
NORTH COLEMAN RANCH SITE WATER BALANCE SUMMARY

Component	Units	May	June	July	Aug.	Sept.	Oct.	Total
Net ET	inches	1.65	2.56	5	3.98	1.3	0.16	14.85
Soil Moisture	inches	5.55	6.66	6.66	6.66	6.66	6.66	
Net Irrigation[1]	inches	1.11	2.56	5	3.98	1.3	0.16	
Gross Irrigation[2]	inches	1.31	3.01	5.88	4.68	1.53	0.19	16.60

1. Net irrigation required to maintain 90% AWC.
2. Gross irrigation required to maintain 90% AWC; assumes 85% irrigation efficiency factor for spray irrigation systems.

Nitrogen Loading

Nutrients are applied below agronomic rates and will not result in public health or environmental impacts. Nutrient loading accounts for the nitrogen and phosphorus needs of the crop and that supplied in the recycled water. Ammonia and nitrate nitrogen are readily available to plants and provide immediate fertilizer value. Phosphorus concentrations are generally not a concern, and irrigation rates will not result in surface water runoff or erosion that may carry phosphorus-laden soils or water to surface waters.

Recycled water characteristics were derived from the City's 2016 Recycled Water Use Summary. According to the 2016 Recycled Water Use Summary, the average WWTP effluent Total Kjeldahl Nitrogen (TKN) was approximately 7.5 mg/L. The average WWTP effluent nitrite and nitrate (NO_2-N + NO_3-N) was approximately 7.95 mg/L. The required nitrogen (lb-N/acre) agronomic uptake rate for pasture hay, as defined in the OSU Fertilizer Guide (FG 63), is 100 to 120 lb-N/acre. At a gross irrigation rate of 16.6 inches/acre, and assuming a recycled water total nitrogen (TN) of 15 mg/L, the nitrogen loading rate is approximately 56 lb-N/acre. As such, the hydraulic loading rate controls the application of recycled water, not the Nitrogen loading rate. Nitrogen loading calculations are presented in Appendix I.

Irrigation System

The effluent pump station, located at the WWTP, is used to pump recycled water from the WWTP to the North Coleman Ranch site. There are 23 risers at the North Coleman Ranch site and there are isolation valves at each sub main. A diagram of the force main and sub mains is presented in Appendix J. The effluent force main at the WWTP is maintained at a pressure between 100 and 110 pounds per square inch (psi); which correlates to 40 to 60 psi at the North Coleman Ranch site. Irrigation at the North Coleman Ranch site is accomplished using hand-set aluminum pipe with Rain Bird sprinklers, three large hard hose reel systems (i.e. traveling guns), and one small traveling gun. The three SR150 Big Guns are fitted with 150T Taper Boar Nozzles (one nozzle is 1.1-inch, and the other two are 1.2 inch) manufactured by Nelson Irrigation. The Big Guns are operated, via booster pumps, at 90 to 100 psi, and a 24 degree trajectory. The spray height is approximately 20 to 30 ft. The spray diameter is approximately 400 feet or less for the 1.1-

inch nozzle, and 420 feet or less for the 1.2-inch nozzle. Additional information pertaining to the performance of the Big Guns is provided in Appendix M. Hand-set aluminum systems are generally operated at 40 to 60 psi, and use Rain Bird sprinklers (model numbers vary).

Irrigation Rates and Scheduling

Hand lines and traveling guns are used to irrigate the North Coleman Ranch site. The gross irrigation rate is 3.6 in/ac for the hand lines and 1.9 in/ac for the traveling guns. The application rate assumes a 12 hour set for the hand lines. For the traveling gun, the application rate assumes a gun retrieval velocity of one foot per minute. Application rate calculations for traveling guns and hand lines are included in Appendix K.

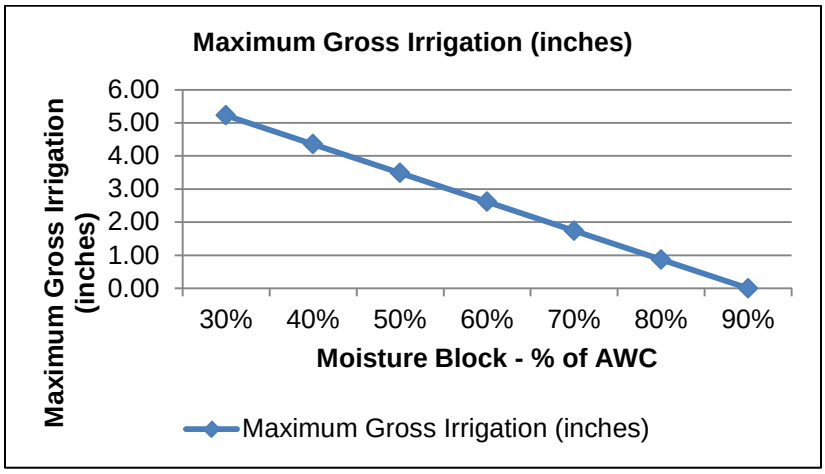
During months where the allowable gross irrigation capacity is considerably less than the gross irrigation rate for the hand lines, only the traveling guns will be used to irrigate. In May and September, the traveling gun retrieval rate must increase from one to two feet per minute, to not exceed the allowable gross irrigation capacity. In June, also to maintain the allowable AWC, the hand lines will operate at less than ten hours per day.

Soil Moisture Blocks

OAR 340-055 does not specify requirements for site monitoring at agricultural irrigation sites. However, DEQ recommends soil monitoring before application of recycled water begins. Soil moisture monitoring is a useful site management tool for preventing and managing environmental impacts to surface water and groundwater. The City will periodically conduct soil monitoring as a tool to guide irrigation operations.

The North Coleman Ranch site has soil moisture blocks installed, typically at 6-inch to 12-inch, throughout the various irrigation zones. The limits of each irrigation zone are provided in Appendix M. The North Coleman Ranch site is divided into five irrigation sections (1 through 5). As a guide for determining recycled water application rates, the soil moisture blocks will be read periodically during the irrigation season. The average AWC will be determined for a particular section, and then Figure 9.1.1 will be used as a reference to determine the approximate and allowable gross irrigation rate. Irrigation is allowed until the soil moisture block reaches 90 percent of the AWC, for the particular site. Typically, the soil moisture blocks will be read following rain events. The owner's manual for the Delmhorst (KS-D1 gypsum) moisture blocks is also included in Appendix M.

FIGURE 9.1.1
MAXIMUM GROSS IRRIGATION[1] VS. SOIL MOISTURE BLOCK PERCENTAGE OF AWC
NORTH COLEMAN RANCH SITE



1. Gross irrigation required to maintain 90% AWC; assumes 85% irrigation efficiency factor for spray irrigation systems. Refer to Appendix N for additional details.

Startup and Shut Down Procedures

The DAF units, gravity filters, and disinfection system are operated year round; therefore startup and shutdown procedures at the wastewater treatment plant are not applicable. Prior to the beginning of the irrigation season, all valves, pipes, and sprinklers are inspected for proper functionality. Shut down procedures mainly consist of draining of the irrigation pipes.

Site Monitoring

Site monitoring activities for the North Coleman Ranch site consists of the following:

- Recycled water monitoring as discussed throughout this plan.
- Measure depth to groundwater to ensure that the groundwater depth is at least one foot deep before irrigating.
- Record soil moisture readings as described above to calculate maximum allowable gross irrigation rate for each irrigation section.
- Document irrigation rate (gallons/day and inches/acre) and date.
- Visually observe site daily to ensure there is no ponding or runoff.

9.2 South Coleman Ranch Site

The South Coleman Ranch site is located immediately south of the North Coleman Ranch, south of Feyrer Park Road. The South Coleman Ranch site is owned by Coleman Corrals, Incorporated and includes two tax lots, as shown in Appendix D. Appendix D also includes a table that lists the legal descriptions for each tax lot. All tax lots are zoned for exclusive farm use. The site is primarily used for

cattle grazing (pasture) with some hay production. As depicted in Figure C.2 in Appendix C, useable land for irrigation was estimated to be 163 acres. A registration of recycled water use is presented in Appendix E. Signs are posted around the perimeter of the property and the site is completely fenced.

Soils

The predominant soil is Dayton silt loam, which comprises 91 percent of the site. The NRCS soil report for the South Coleman Ranch site is presented in Appendix F. The soil has a Ksat value of 1.3 in/hr in the top 6 inches. The most limiting Ksat value (0.03 inch per hour) is found at a depth of 15 inches. The average AWC, as specified in the Consolidated Recycled Water Use Plan (2015) and provided in Appendix G, was calculated to be 5 inches.

Water Balance

Water balances were developed in the Consolidated Water Use Plan (2015), and included in Appendix H. The irrigation management premise ensures that crops receive suitable water while ensuring that no runoff occurs due to saturated soil conditions. Soil becomes saturated only when soil moisture exceeds 100 percent of the AWC, when all of the soils void space is displaced by water. This plan assumes that the soil moisture will be maintained at or below 90 percent of the AWC. The 90 percent AWC for the South Coleman Ranch site is 4.5 inches. The water balances take into account historic climate data, vegetation/crops, agricultural practices, and the soil AWC. As set forth in the Consolidated Recycled Water Use Plan (2015), during the irrigation season, including May and October, the total gross irrigation capacity of the South Coleman Ranch site is 16.88 inches. Table 9.2.1 summarizes the monthly gross irrigation allowances for the South Coleman Ranch site.

TABLE 9.2.1
SOUTH COLEMAN RANCH SITE WATER BALANCE SUMMARY

Component	Units	May	June	July	Aug.	Sept.	Oct.	Total
Net ET	inches	1.65	2.56	5	3.98	1.3	0.16	14.85
Soil Moisture	inches	3.15	4.5	4.5	4.5	4.5	4.5	
Net irrigation[1]	inches	1.35	2.56	5	3.98	1.3	0.16	
Gross irrigation[2]	inches	1.59	3.01	5.88	4.68	1.53	0.19	16.88

1. Net irrigation required to maintain 90% AWC.
2. Gross irrigation required to maintain 90% AWC; assumes 85% irrigation efficiency factor for spray irrigation systems.

Nitrogen Loading

At a gross irrigation rate of 16.88 inches/acre, and assuming a WWTP effluent TN of 15 mg/L, the Nitrogen loading rate is approximately 57 lb-N/acre. As such, the hydraulic loading rate controls the application of recycled water, not the Nitrogen loading rate. Nitrogen loading calculations are presented in Appendix I.

Irrigation System, Rates, and Scheduling

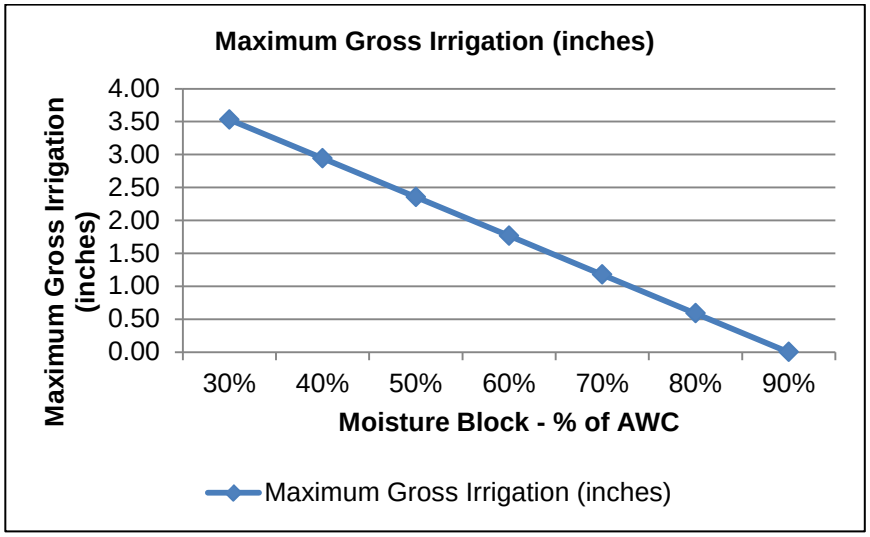
The effluent pump station, located at the WWTP, is used to pump recycled water from the WWTP to the South Coleman Ranch site. There are 17 risers at the South Coleman Ranch site and there are isolation valves at each sub main. A diagram of the force main and sub mains is presented in Appendix J. The effluent force main at the WWTP is maintained at a pressure between 100 to 110 psi, which correlates to 40 to 60 psi at the South Coleman Ranch site. Booster pumps on the hard hose reels increase the pressure

to between 90 and 100 psi. Due to the large percentage of Dayton soil and gross irrigation allowances, only traveling guns are used for irrigation at the South Coleman Ranch site. Big Guns (SR150), as manufactured by Nelson Irrigation, are used and fitted with 150T Taper Boar Nozzles. The spray height is between 20 to 30 feet (approximately). The spray diameter is approximately 400 feet or less when using the 1.1-inch nozzle, and 420 feet or less when using the 1.2-inch nozzle. Additional information pertaining to the performance of the Big Guns is provided in Appendix M. In May or September, the traveling gun retrieval rate must increase from one to two feet per minute, to not exceed the gross irrigation capacities listed in Table 9.2.1.

Soil Moisture Blocks

The South Coleman Ranch is divided into three irrigation zones (5 through 8), as shown in Appendix M. Moisture blocks, typically installed at 6-inches to 12-inches, are located throughout the South Coleman Ranch. Periodically, during the irrigation season, the moisture blocks are read, and then the average AWC reading will be determined for each section. Figure 9.2.1 will then be used to calculate the allowable gross irrigation as a function of the moisture block readings. Irrigation is allowed until the soil moisture block reaches 90 percent of the AWC, for the particular site. Typically, the soil moisture blocks will also be read following rain events.

FIGURE 9.2.1
MAXIMUM GROSS IRRIGATION[1] VS. SOIL MOISTURE BLOCK PERCENTAGE OF AWC
SOUTH COLEMAN RANCH SITE



1. Gross irrigation required to maintain 90% AWC; assumes 85% irrigation efficiency factor for spray irrigation systems.

Startup and Shut Down Procedures

Startup and shut down procedures are identical to those described for the North Coleman Ranch site.

Site Monitoring

Site Monitoring procedures are identical to those outlined for the North Coleman Ranch site.

9.3 WWTP Site

The WWTP site consists of two tax lots that are owned by the City, as shown in Appendix D. As depicted in Figure C.3 in Appendix C, useable land for irrigation was estimated to be 8.1 acres. The WWTP uses Class C for irrigating hay and pasture. A registration of recycled water use is presented in Appendix E. Signs are posted around the perimeter of the property and the site is completely fenced.

Soils

The predominant soil is Aloha silt loam, which comprises 89 percent of the site. The NRCS soil report for the WWTP site is presented in Appendix F. The soil has a Ksat value of 1.3 in/hr in the top 6 inches. For the WWTP site the most limiting Ksat value (0.39 inch per hour) is found at a depth of 8 inches. The average AWC, as specified in the Consolidated Recycled Water Use Plan (2015) and provided in Appendix G, was calculated to be 11.9 inches.

Water Balance

Water balances were developed in the Consolidated Water Use Plan (2015), and included in Appendix H. The irrigation management premise ensures that crops receive suitable water while ensuring that no runoff occurs due to saturated soil conditions. Soil becomes saturated only when soil moisture exceeds 100 percent of the AWC, when all of the soils void space is displaced by water. This plan assumes that the soil moisture will be maintained at or below 90 percent of the AWC. The 90 percent AWC for the WWTP site is 10.71 inches. The water balances take into account historic climate data, vegetation/crops, agricultural practices, and the soil AWC. As set forth in the Consolidated Recycled Water Use Plan (2015), during the irrigation season, including May and October, the total gross irrigation capacity of the WWTP site is 16.07 inches. Table 9.3.1 summarizes the monthly gross irrigation allowances for the WWTP site.

TABLE 9.3.1
WWTP SITE WATER BALANCE SUMMARY

Component	Units	May	June	July	Aug.	Sept.	Oct.	Total
Net ET	inches	1.65	2.56	5	3.98	1.3	0.16	14.85
Soil Moisture	inches	10.05	10.71	10.71	10.71	10.71	10.71	
Net irrigation[1]	inches	0.66	2.56	5	3.98	1.3	0.16	
Gross irrigation[2]	inches	0.78	3.01	5.88	4.68	1.53	0.19	16.07

1. Net irrigation required to maintain 90% AWC.
2. Gross irrigation required to maintain 90% AWC; assumes 85% irrigation efficiency factor for spray irrigation systems.

Nitrogen Loading

At a gross irrigation rate of 16.07 inches/acre, and assuming a WWTP effluent TN of 15 mg/L, the Nitrogen loading rate is approximately 55 lb-N/acre. As such, the hydraulic loading rate controls the application of recycled water, not the Nitrogen loading rate. Nitrogen loading calculations are presented in Appendix I.

Irrigation System, Rates, and Scheduling

The effluent pump system consists of a 40-hp pump that produces about 60 psi to operate pop-up sprinklers located on the dikes and hand-set irrigation pipe with sprinklers that are used for irrigating the remainder of the site. The pop-up sprinklers are manufactured by Rain Bird (model numbers vary) and

typically operate at a spray height of approximately five to ten feet, and a spray diameter of approximately 20 to 30 feet, or less. Sometimes, a small traveling gun is used. Information pertaining to the spray diameter for the traveling gun is provided in Appendix M. The irrigation system can also use recycled water from the effluent force main line that provides water to the Coleman Ranch and Cemetery sites.

Monthly gross irrigation allowances, as summarized in Table 9.3.1, will be used as guidance for dictating actual irrigation rates at the WWTP site. For example, if irrigation occurs in June, gross irrigation will not exceed 3.01 in/ac.

Startup and Shut Down Procedures

Irrigation of recycled water at the WWTP site only occurs after irrigation commences at the North and South Coleman Ranch sites. All of the recycled water in the force main associated with the WWTP site irrigation system drains back into the aeration basin.

Site Monitoring

Site Monitoring procedures are identical to those outlined for the North and South Coleman Ranch sites.

9.4 Cemetery Site

The Cemetery site is located approximately one mile southeast of the South Coleman Ranch site, at the end of Adams Cemetery Road. The site includes one tax parcel owned by Adams Cemetery Association, as shown in Appendix D. The tax lot is zoned for exclusive farm use. As depicted in Figure C.4 in Appendix C, useable land for irrigation was estimated to be 3.4 acres. The Cemetery uses Class C for irrigating grass. A registration of recycled water use is presented in Appendix E. Signs are posted around the perimeter of the property and the site is completely fenced.

Soils

The predominant soil is Nekia silty clay loam, which comprises 98 percent of the site. The NRCS soil report for the Cemetery site is presented in Appendix F. The soil has a Ksat value of 0.4 in/hr in the top 6 inches, which is greater than the flow rate for the solid set irrigation set irrigation system used at the Cemetery Site (0.24 in/hr), as shown in Appendix O. The average AWC, as specified in the Consolidated Recycled Water Use Plan (2015) and provided in Appendix G, was calculated to be 6.2 inches.

Water Balance

Water balances were developed in the Consolidated Water Use Plan (2015), and included in Appendix H. The irrigation management premise ensures that grass receive suitable water while ensuring that no runoff occurs due to saturated soil conditions. Soil becomes saturated only when soil moisture exceeds 100 percent of the AWC, when all of the soils void space is displaced by water. This plan assumes that the soil moisture will be maintained at or below 90 percent of the AWC. The 90 percent AWC for the Cemetery site is 5.58 inches. The water balances take into account historic climate data, vegetation/crops, agricultural practices, and the soil AWC. As set forth in the Consolidated Recycled Water Use Plan (2015), during the irrigation season, including May and October, the total gross irrigation capacity of the Cemetery site is 16.74 inches. Table 9.4.1 summarizes the monthly gross irrigation allowances for the Cemetery site.

TABLE 9.4.1
CEMETERY SITE WATER BALANCE SUMMARY

Component	Units	May	June	July	Aug.	Sept.	Oct.	Total
Net ET	inches	1.65	2.56	5	3.98	1.3	0.16	14.85
Soil Moisture	inches	4.35	5.58	5.58	5.58	5.58	5.58	
Net irrigation[1]	inches	1.23	2.56	5	3.98	1.3	0.16	
Gross irrigation[2]	inches	1.45	3.01	5.88	4.68	1.53	0.19	16.74

1. Net irrigation required to maintain 90% AWC.
2. Gross irrigation required to maintain 90% AWC; assumes 85% irrigation efficiency factor for spray irrigation systems.

Nitrogen Loading

At a gross irrigation rate of 16.74 inches/acre, and assuming a WWTP effluent TN of 15 mg/L, the Nitrogen loading rate is approximately 57 lb-N/acre. As such, the hydraulic loading rate controls the application of recycled water, not the Nitrogen loading rate. Nitrogen loading calculations are presented in Appendix I.

Irrigation System, Rates, and Scheduling

The same pumps that convey recycled water to the North and South Coleman Ranch sites are used to irrigate the Cemetery site. A 20-hp booster pump is also used to convey water to the site. The irrigation line is tied into a solid set system of pop-up sprinklers. The pop-up sprinklers are manufactured by Rain Bird (model numbers vary) and typically operate at a spray height of approximately 5 to 10 feet, and a spray diameter of approximately 20 to 30 feet, or less. There is one faucet remaining on site that uses City water for flowers when recycled water is not available. It is posted "Contaminated Water Do Not Drink." A backflow preventer is installed to prevent any cross contamination.

Monthly gross irrigation allowances, as summarized in Table 9.4.1, will be used as guidance for dictating actual irrigation rates at the Cemetery site. For example, if irrigation occurs in September, gross irrigation will not exceed 1.53 in/ac.

Startup and Shut Down Procedures

Startup and shut down procedures are identical to those described for the North and South Coleman Ranch sites.

Site Monitoring

Site Monitoring procedures are identical to those outlined for the North and South Coleman Ranch sites.

9.5 Total Capacity of Recycled Water Irrigation Sites

Assuming that some irrigation can occur in May and October, the total capacity of the North Coleman Ranch site, South Coleman Ranch site, WWTP site, and Cemetery site is 201.5 MG. If no irrigation occurs in May and October the total capacity is reduced to 182.3 MG. A summary of the land application site capacity calculations is included in Appendix P. Table 9.5.1 summarizes the useable acreage and recycled water capacity for each land application site. Table 9.5.2 lists the total monthly capacity for each of the land application sites.

TABLE 9.5.1
LAND APPLICATION SITE SUMMARY

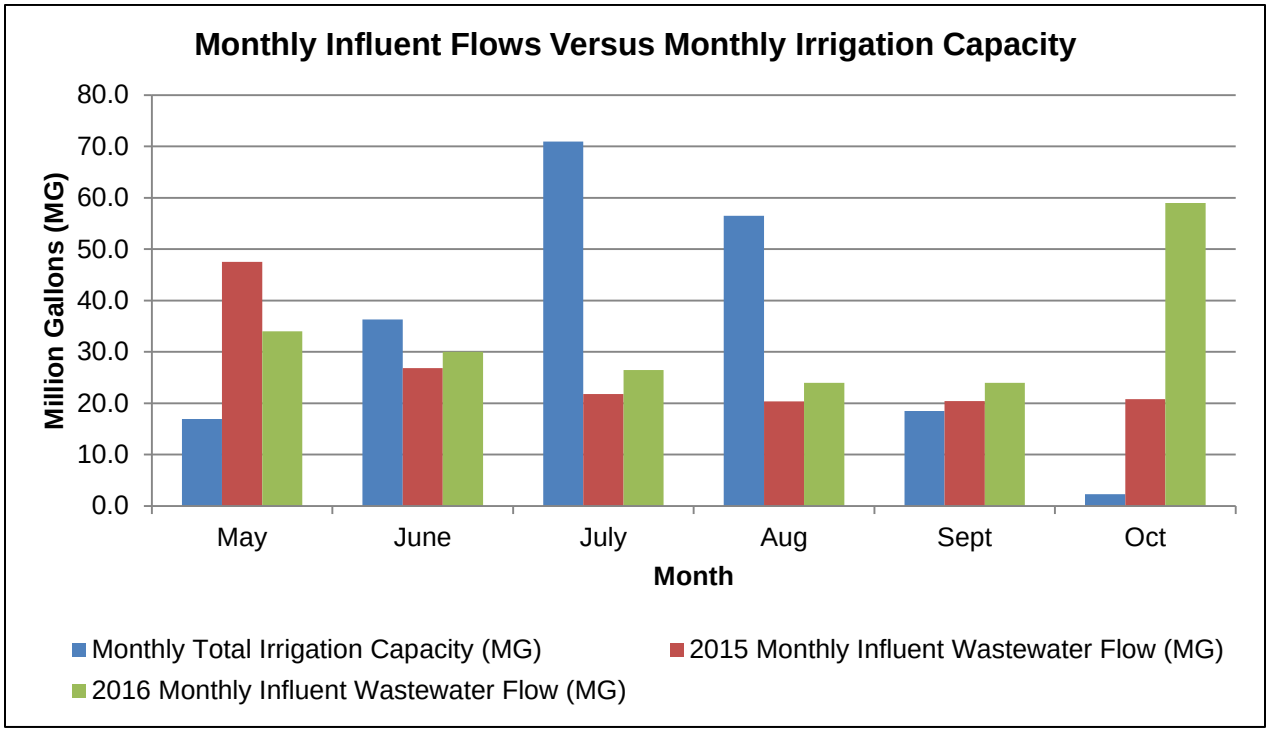
Site	Usable Acreage (Acres)	Recycled Water Capacity (MG)
North Coleman Ranch Site	270	121.7
South Coleman Ranch Site	163	74.7
Cemetery Site	3.4	1.55
WWTP Site	8.1	3.53
Total	**444.5**	**201.5**

TABLE 9.5.2
MONTHLY CAPACITY OF LAND APPLICATION SITES

Site	May	June	July	Aug	Sept	Oct
North Coleman Ranch Site (MG)	9.6	22.1	43.1	34.3	11.2	1.4
South Coleman Ranch Site (MG)	7.0	13.3	26.0	20.7	6.8	0.8
Cemetery Site (MG)	0.13	0.28	0.54	0.43	0.14	0.02
WWTP Site (MG)	0.17	0.66	1.29	1.03	0.34	0.04
Total Monthly Capacity (MG)	**16.9**	**36.3**	**71.0**	**56.5**	**18.5**	**2.3**

Figure 9.5.1 shows the monthly influent wastewater flows for 2015 and 2016, as well as the total monthly capacity of the irrigation sites.

FIGURE 9.5.1
MONTLY INFLUENT FLOWS VERSUS MONTHLY CAPACITY OF LAND APPLICATION SITES



SECTION 10:

REFERENCES

SECTION 10: **REFERENCES**

Consolidated Recycled Water Use Plan, City of Molalla, Oregon (Brown and Caldwell, July 2015)

Wastewater Treatment Facilities Operation and Maintenance Manual, City of Molalla, Oregon (The Dyer Partnership Engineers & Planners, May 2017)

Wastewater Treatment Plant Improvements, City of Molalla, Oregon (Tetra Tech / KCM, 2007)

Wastewater Treatment Plant Improvements, City of Molalla, Oregon (Tetra Tech / KCM, 2002)

Molalla Wastewater Facility Plan, City of Molalla, Oregon (Tetra Tech / KCM, 2000)

Internal Management Directive: Implementing Oregon's Recycled Water Use Rules (Oregon DEQ, June 2009)

Oregon Administrative Rules, Chapter 340, Division 55 (OAR 340-055)

Wastewater Treatment Plant 2017 Lagoon Test Report (The Dyer Partnership Engineers & Planners, July 2017)

Oregon Crop Water Use and Irrigation Requirements, Extension Miscellaneous 8530 (Oregon State University, 1999)

APPENDICES

APPENDIX A: NPDES PERMIT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTE DISCHARGE PERMIT

Oregon Department of Environmental Quality
Northwest Region – Portland Office
2020 SW 4th Avenue, Suite 400
Telephone: 503-229-5263

Issued pursuant to ORS 468B.050 and The Federal Water Pollution Control Act (The Clean Water Act)

ISSUED TO:

City of Molalla
PO Box 248
Molalla, OR 97038

SOURCES COVERED BY THIS PERMIT:

Type of Waste	Outfall Number	Location
Treated Wastewater	001	45.15°N -122.54085°W
Recycled Water	002	Specified in RWU Plan
Biosolids	N/A	Specified in BLA Plan

FACILITY TYPE AND LOCATION:

Pre-aerated lagoons with effluent filtration
Molalla STP, 12424 Toliver Road
Molalla, OR 97038

RECEIVING STREAM INFORMATION:

WRD Basin: Willamette
USGS Subbasin: Molalla-Pudding
Receiving Stream: Molalla River
LLID: 1227171452976-20.0-D
County: Clackamas

Treatment System Class Level: III
Collection System Class Level: II

EPA REFERENCE #: OR-002238-1
Issued in response to application #962753 received August 24, 2012, and based on the land use compatibility statement in the permit record.

Tiffany Yelton-Bram, Manager
WQ Source Control
Northwest Region

5/12/2014
Signature Date

June 1, 2014
Effective Date

PERMITTED ACTIVITIES

Until this permit expires or is modified or revoked, the permittee is authorized to: 1) operate a wastewater collection, treatment, control and disposal system; and 2) discharge treated wastewater to waters of the state only from the authorized discharge point or points in Schedule A in conformance with the requirements, limits, and conditions set forth in this permit.

Unless specifically authorized by this permit, by another NPDES or WPCF permit, or by Oregon statute or administrative rule, any other direct or indirect discharge of pollutants to waters of the state is prohibited.

Table of Contents

List of Tables

SCHEDULE A
Waste Discharge Limits

1. Treated Effluent Outfall 001

a. May 1 – October 31: During this time period the permittee may not discharge to waters of the state.

b. November 1 – April 30: During this time period the permittee must comply with the limits in Tables A1 and A2 while discharging to waters of the state:

i. Biochemical Oxygen Demand (BOD_5) and Total Suspended Solids (TSS).

Table A1: BOD_5 and TSS Limits

Parameter	Average Effluent Concentrations, mg/L		Monthly Average lbs/day	Weekly Average lbs/day	Daily Maximum Lbs
	Monthly	Weekly			
BOD_5	10 mg/L	15 mg/L	160	240	320
TSS	10 mg/L	15 mg/L	160	240	320

Mass load limits are based on the average wet weather design flow to the facility which equals 1.92 MGD.

ii. Additional Parameters

Table A2: Limits for Additional Parameters

November - April	Limits
BOD_5 and TSS Removal Efficiency	May not be less than 85% monthly average for BOD_5 and TSS
E. coli Bacteria (see Note 1.)	Monthly geometric mean may not exceed 126 organisms per 100 ml. No single sample may exceed 406 organisms per 100 ml.
pH	May not be outside the range of 6.0 to 9.0 S.U.
Total Residual Chlorine	Monthly average concentration may not exceed 0.07 mg/L. Daily maximum concentration may not exceed 0.18 mg/L
Ammonia (NH_3-N)	Monthly average concentration may not exceed 16.7 mg/L. Daily maximum concentration may not exceed 25.9 mg/L.
Dilution	Discharge may not commence until gauged stream flow exceeds 350 cfs and will cease when the average stream flow for the previous seven-day-period is less than 350 cfs.
Temperature	Effluent discharge will cease when the 7-day moving average effluent temperature exceeds 18.0 degrees C.
Notes 1. No single *E. coli* sample may exceed 406 organisms per 100 mL; however, no violation has occurred if the permittee takes at least 5 consecutive re-samples at 4 hour intervals beginning within 28 hours after the original sample was taken and the log mean of the 5 re-samples is less than or equal to 126 *E. coli* organisms/100 mL.	

2. Regulatory Mixing Zone

No wastes may be discharged or activities conducted that cause or contribute to a violation of water quality standards in OAR Chapter 340, Division 41 applicable to the Willamette Basin except within the following regulatory mixing zone:

The allowable mixing zone includes that portion of the Molalla River with boundary dimensions equal to the length of the effluent diffuser plus 10-feet on each end with the mixing zone extending 5-feet upstream and 50-feet downstream of the diffuser. The Zone of Immediate Dilution (ZID) is defined as that portion of the allowable mixing zone within 5-feet of the diffuser.

3. Groundwater Protection

The permittee may not conduct any activities that could cause an adverse impact on existing or potential beneficial uses of groundwater. All wastewater and process related residuals must be managed and disposed of in a manner that will prevent a violation of the Groundwater Quality Protection Rules (OAR Chapter 340, Division 40).

4. Use of Recycled Water (Outfall 002)

The permittee is authorized to distribute recycled water if it is:

a. Treated and used according to the criteria listed in Table A3.
b. Managed as described in its DEQ-approved Recycled Water Use Plan unless exempt as provided in Schedule D, condition 3.
c. Used in a manner and applied at a rate that does not adversely impact groundwater quality.
d. Applied at a rate and in accordance with site management practices that ensure continued agricultural, horticultural, or silvicultural production and does not reduce the productivity of the site.
e. Irrigated using sound irrigation practices to prevent:
    i. Offsite surface runoff or subsurface drainage through drainage tile;
    ii. Creation of odors, fly and mosquito breeding, or other nuisance conditions; and
    iii. Overloading of land with nutrients, organics, or other pollutants.

Table A3: Recycled Water Limits

Class	Level of Treatment (after disinfection unless otherwise specified)	Beneficial Uses
A	Oxidized, filtered and disinfected. Before disinfection, turbidity may not exceed: • 2 NTUs within a 24-hour period. • 5 NTUs more than five percent of the time within a 24-hour period • 10 NTUs at any time. After disinfection, total coliform may not exceed: • A median of 2.2 organisms per 100 mL based on daily sampling over the last 7 days that analyses have been completed. • 23 organisms per 100 mL in any single sample.	• Class B, Class C, Class D, and nondisinfected uses. • Irrigation for any agricultural or horticultural use. • Landscape irrigation of parks, playgrounds, school yards, residential landscapes, or other landscapes accessible to the public. • Commercial car washing or fountains when the water is not intended for human consumption. • Water supply source for non restricted recreational impoundments.
B	Oxidized and disinfected. Total coliform may not exceed: • A median of 2.2 organisms per 100 mL, based on the last 7 days that analyses have been completed. • 23 total coliform organisms per 100 mL in any single sample.	• Class C, Class D, and nondisinfected uses. • Stand-alone fire suppression systems in commercial and residential building, non-residential toilet or urinal flushing, or floor drain trap priming. • Water supply source for restricted recreational impoundments.
C	Oxidized and disinfected. Total coliform may not exceed: • A median of 23 total coliform organisms per 100 mL, based on results of the last 7 days that analyses have been completed. • 240 total coliform organisms per 100 mL in any two consecutive samples.	• Class D and nondisinfected uses. • Irrigation of processed food crops; irrigation of orchards or vineyards if an irrigation method is used to apply recycled water directly to the soil. • Landscape irrigation of golf courses, cemeteries, highway medians, or industrial or business campuses. • Industrial, commercial, or construction uses limited to: industrial cooling, rock crushing, aggregate washing, mixing concrete, dust control, nonstructural fire fighting using aircraft, street sweeping, or sanitary sewer flushing.

5. Biosolids

The permittee may land apply biosolids or provide biosolids for sale or distribution, subject to the following conditions:

a. The permittee must manage biosolids in accordance with its DEQ-approved Biosolids Management Plan and Land Application Plan.

b. Except when used for land reclamation and approved by DEQ, biosolids must be applied at or below the agronomic rate required for maximum crop yield.

c. The permittee must obtain written site authorization from DEQ for each beneficial use site before land application (see Schedule D, Condition 6.b.), and follow the minimum site-specific management conditions in the site authorization letter.
d. Biosolids must meet one of the pathogen reduction standards under 40 CFR §503.32 and one of the vector attraction reduction standards under 40 CFR §503.33.
e. Pollutants in biosolids may not exceed the ceiling concentrations shown in Table A4 below. Biosolids exceeding the pollutant concentrations in Table A4 must be applied at a rate that does not exceed the corresponding cumulative pollutant loading rates.

Table A4: Biosolids Limits

Pollutant	Ceiling concentrations[1] (mg/kg)	Pollutant concentrations[1] (mg/kg)	Cumulative pollutant loading rates[1] (kg/ha)
Arsenic	75	41	41
Cadmium	85	39	39
Copper	4300	1500	1500
Lead	840	300	300
Mercury	57	17	17
Molybdenum	75	N/A	N/A
Nickel	420	420	420
Selenium	100	100	100
Zinc	7500	2800	2800

Note:
1. Biosolids pollutant limits are described in 40 CFR§503.13, which uses the terms *ceiling concentrations*, *pollutant concentrations*, and *cumulative pollutant loading rates*. Biosolids containing pollutants in excess of the ceiling concentrations may not be beneficially reused by application to the land. Biosolids containing pollutants in excess of the pollutant concentrations, but less than the ceiling concentrations, may be beneficially reused by application to the land; however, the total quantity of biosolids applied to the land may not exceed the cumulative pollutant loading rates.

6. Septage Requirements
Septage may not be accepted at this facility for treatment or processing without written approval from DEQ.

7. Re-opener
Upon EPA approval of a Total Maximum Daily Load (TMDL) addressing any pollutants during the discharge period, this permit may be re-opened to include any waste load allocations (WLA), best management practice or any other condition the TMDL requires.

SCHEDULE B
Minimum Monitoring and Reporting Requirements

1. Monitoring and Reporting Protocols

a. Test Methods, Quantitation Limits, and Laboratory Quality Assurance and Quality Control

i. Test Methods – monitoring must be conducted according to test procedures in 40 CFR Part 136.

ii. Quantitation Limits (QLs)[1] – all compliance analyses must meet the QLs specified in the permit. Effluent characterization monitoring must use the QLs unless one of the conditions below is met.

a) The monitoring result indicates nondetect at an MDL which is less than or equal to the QL, or

b) Monitoring is being conducted solely for the purpose of effluent characterization, and matrix effects prevent the attainment of QLs[2]. In such cases, DEQ may authorize re-sampling. If requested by the permit holder, Tier 1 re-sampling may be combined with Tier 2 monitoring.

Laboratories may need to modify methods as allowed in 40 CFR Part 136.6 or in EPA's Solutions for Analytical Chemistry Problems with Clean Water Methods, EPA 821-R-07-002, March 2007 in order to achieve some QLs.

iii. Laboratory Quality Assurance and Quality Control (QA/QC) – the permittee must develop and implement a written QA/QC program that conforms to the requirements of 40 CFR Part 136.7.

b. Re-analysis and Re-sampling if QA/QC Requirements Not Met

If QA/QC requirements are not met any analysis, the results must be included in reports, but not used in calculations required by this permit. The permittee must re-analyze the sample if QA/QC requirements are not met. If the sample cannot be re-analyzed, the permittee must re-sample and analyze at the earliest seasonally appropriate opportunity.

c. Significant Figures and Rounding Conventions

Mass load limits all have two significant figures unless otherwise noted. The permittee must report the same number of significant digits as the permit limit for a given parameter. Regardless of the rounding conventions used by the permittee (such as, rounding 5 up for the calculated results or, in the case of laboratory results, rounding 5 to the nearest even number), the permittee must use the convention consistently, and must ensure that laboratories employed by the permittee use the same convention[3].

d. Reporting of Detection Levels and Quantitation Limits

When reporting sampling results, the permittee must record the laboratory detection level and quantitation limit as defined below for each analyte except biochemical oxygen demand (BOD), suspended solids (TSS), fats, oil and grease (FOG), bacteria and pH).

i. Detection Level (DL): The Method Detection Limit (MDL) or Limit of Detection (LOD) and derived using 40 CFR Part 136 Appendix B; and

ii. Quantitation Limit (QL): The Method Reporting Limit (MRL) or Limit of Quantitation (LOQ). It is the lowest level at which the entire analytical system gives a recognizable signal and acceptable calibration for the analyte. It is equivalent to the concentration of the lowest calibration standard assuming that all method-specified sample weights, volumes, and cleanup procedures have been employed.

e. Reporting Sample Results

The permittee must follow the procedures listed below when reporting sampling results.

i. If a sample result is below the DL, the permittee must report the result as less than the specified DL. For example, if the DL is 1.0 µg/L and the result is non-detect, report "<1.0 µg/L" on the discharge monitoring report (DMR).
ii. If a sample result is above the DL but below the QL, the permittee must report the result as the DL preceded by DEQ's data code "e". For example, if the DL is 1.0 µg/l, the QL is 3.0 µg/L, and the result is estimated to be between the DL and QL, the permittee must report "e1.0 µg/L" on the DMR.
iii. If a sample result does not meet QA/QC requirements, the result must be included in the DMR along with a notation but must not be used in any calculation required by this permit.
iv. Requirements i. and ii. above do not apply to the following parameters: biochemical oxygen demand (BOD), suspended solids (TSS), fats, oil and grease (FOG), bacteria and pH.

f. Calculating and Reporting Mass Loads
The permittee must follow the procedures listed below when calculating and reporting mass loads.

Flow (MGD) X Concentration (mg/L) X 8.34 = Pounds per day

i. When concentration data are below the DL: To calculate the mass load from this result, use the DL. Report the mass load as less than the calculated mass load. For example, if flow is 2 MGD and the reported sample result is <1.0 µg/L, report "<0.02 lb/day" for mass load on the DMR (1.0 µg/L x 2 MGD x conversion factor = 0.017 lb/day, round off to 0.02 lb/day).
ii. When concentration data are above the DL, but below the QL: To calculate the mass load from this result, use the detection level. Report the mass load as the calculated mass load preceded by "e". For example, if flow is 2 MGD and the reported sample result is e1.0 µg/L, report "e0.02 lb/day" for mass load on the DMR (1.0 µg/L x 2 MGD x conversion factor = 0.017 lb/day, round off to 0.02 lb/day).

2. Influent Monitoring Requirements
The permittee must monitor influent just downstream of the Parshall flume and ahead of the pre-aeration basin in accordance with the table below.

Table B1: Influent Monitoring

Item or Parameter	Time Period	Minimum Frequency	Sample Type/Action	Report
flow (MGD)	year-round	daily	measurement by totalizing meter	1. daily values 2. monthly total 3. monthly average
flow meter calibration		annually	verification	report date that calibration was completed
BOD_5 and TSS (mg/L)	year-round	2/Week	24-hour composite	1. daily values 2. monthly average
pH (S.U.)	year-round	3/week	continuous	1. daily values 2. maximum daily value 3. minimum daily value

3. Compliance Effluent Monitoring

When discharging to the Molalla River, the permittee must monitor effluent for Outfall 001 at the discharge monitoring structure (DMS) located near the Molalla River and in accordance with the table below:

Table B2: Effluent Monitoring (November - April)

Item or Parameter	Minimum Frequency	Sample Type/Action	Report
flow (MGD)	daily	measurement by totalizing meter	1. daily values 2. monthly total 3. monthly average
BOD_5 and TSS (mg/L)	2/week	24-hour composite	1. daily values 2. monthly average 3. weekly averages 4. maximum weekly average 5. maximum daily value
BOD_5 and TSS mass load (lb/day)	2/week	calculation	1. daily values 2. monthly average 3. weekly averages 4. maximum weekly average 5. maximum daily value
BOD_5 and TSS percent removal (%)	monthly	calculation	monthly average percentage
pH (S.U.)	3/week	continuous	1. daily values 2. maximum daily value 3. minimum daily value
temperature (° C)	daily	continuous	1. daily maximum 2. weekly average of daily maximum
E. coli (colonies/100 mL or MPN/100mL depending on method)	1/week	grab	1. daily values 2. maximum daily value 3. monthly geometric mean
quantity chlorine used (lbs)	daily	measurement	1. daily values 2. monthly average
total residual chlorine (mg/L)	daily	continuous	1. daily values 2. maximum daily value 3. monthly average
Lagoon Depth	weekly	staff gauge reading	monthly values

4. Ambient Stream Monitoring (Molalla River)

The permit holder must report stream data using online USGS recordings from gauge station 14200000 located at river mile 6.01 according to the table below:

Table B3: Molalla River

Item or Parameter	Time period	Frequency	Sample type/action	Report
flow (cfs)	November-May	daily	on-line reading from USGS gauge station 14200000	1. daily values 2. monthly average
temperature	November-May	5/week	continuous	1. monthly average 2. 7-day average of daily maximum
alkalinity	November-May	annually	grab	daily values

5. Effluent Toxics Characterization Monitoring

The permittee must analyze effluent samples for the parameters listed in tables B4-B7 below. Samples must be collected at the DMS during two sample events each year in 2015 and 2016. Samples must be 24-hour composites except as noted in Table B4, B5 and B6 for Total Cyanide, Free Cyanide, Total Phenolic Compounds and Volatile Organic Compounds.

Table B4: Metals, Cyanide, Total Phenols, Nutrients and Hardness
(µg/L unless otherwise specified)

Pollutant[a]	CAS[b]	QL	Pollutant	CAS	QL
Antimony	7440360	0.10	Mercury	7439976	0.005
Arsenic (total)[c]	7440382	0.50	Nickel	7440020	10
Arsenic (Inorganic)[c]	7440382	1.0	Selenium	7782492	2.0
Arsenic III[c]	22541544	50	Silver	7440224	1.0
Beryllium	7440417	0.10	Thallium	7440280	0.10
Cadmium	7440439	0.10	Zinc	7440666	5.0
Chromium (total)	7440473	0.40	Cyanide (Free)[e]	57125	10
Chromium III[d]	16065831	10	Cyanide (Total)[e]	57125	5.0
Chromium VI[d]	18540299	10	Total Phenolic Compounds[f]		5.0
Copper	7440508	10	Nitrates-Nitrite (NO_3+NO_2-N)	14797558	100
Iron	7439896	100	Ammonia (NH_3-N)	7664417	1000
Lead	7439921	5	Hardness (Total as $CaCO^3$)		
Alkalinity					

a. All metals must be analyzed for total recoverable concentration unless otherwise specified.
b. Chemical Abstract Service
c. If the result for Total Arsenic does not exceed 1.0 µg/L, it is not necessary to monitor for Inorganic Arsenic and Arsenic III. Otherwise, Method 1632A must be used to monitor for Inorganic Arsenic and Arsenic III.
d. If the result for Total Chromium does not exceed 10 µg/L, then it is not necessary to monitor for Chromium III and Chromium VI.
e. When sampling for Cyanide, at least six discrete grab samples must be collected over the operating day with samples collected no less than one hour apart. The aliquot must be at least 100 mL and collected and composited into a larger container that has been preserved with sodium hydroxide to insure sample integrity. If the result for Total Cyanide does not exceed 5.0 µg/L, it is not necessary to test for free cyanide.
f. When sampling for Total Phenolic Compounds, at least six discrete grab samples must be collected over the operating day with samples collected no less than one hour apart. "Total Phenolic Compounds" is identified as Phenols in 40 CFR Part 136.3, Table 1B.

Table B5: Volatile Organic Compounds
(µg/L unless otherwise specified)

Pollutant[a]	CAS	QL	Pollutant[a]	CAS	QL
Acrolein	107028	5.0	1,1-dichloroethylene[e]	75354	0.50
acrylonitrile	107131	5.0	1,2-dichloropropane	78875	0.50
Benzene	71432	0.50	1,3-dichloropropylene[f]	542756	0.50
bromoform	75252	0.50	Ethylbenzene	100414	0.50
carbon tetrachloride	56235	0.50	methyl bromide[g]	74839	0.50
chlorobenzene	108907	0.50	methyl chloride[h]	74873	0.50
Chlorodibromomethane[b]	124481	0.50	methylene chloride	75092	0.50
chloroethane	75003	0.50	1,1,2,2-tetrachloroethane	79345	0.50
2-chloroethylvinyl ether	110758	5.0	tetrachloroethylene[i]	127184	0.50
chloroform	67663	0.50	Toluene	108883	0.50
dichlorobromomethane[c]	75274	0.50	1,1,1-trichloroethane	71556	0.50
1,1-dichloroethane	75343	0.50	1,1,2-trichloroethane	79005	0.50
1,2-dichloroethane	107062	0.50	Trichloroethylene[j]	79016	0.50
1,2-trans-dichloroethylene[d]	156605	0.50	vinyl chloride	75014	0.50

a. Permit holders with lagoon facilities that have retention times in excess of 24 hours may collect a single sample over the operating day. Permit holders with other types of facilities must collect six discrete samples (not less than 40 mL) over the operating day at intervals of at least one hour. The samples may be analyzed separately or composited. If analyzed separately, the analytical results for all samples must be averaged for reporting purposes. If composited, they must be proportionally composited in the laboratory at the time of analysis and this must be done in a manner that maintains the integrity of the samples and prevents the loss of volatile analytes. The quantitation limits listed above remain in effect for composite samples.

b. Chlorodibromomethane is identified as dibromochloromethane in 40 CFR Part 136.3, Table 1C.

c. Dichlorobromomethane is identified as Bromodichloromethane in 40 CFR Part 136.3, Table 1C.

d. 1,2-trans-dichloroethylene is identified as trans-1,2-dichloroethene in 40 CFR Part 136.3, Table 1C.

e. 1,1-dichloroethylene is identified as 1,1-dichloroethene in 40 CFR Part 136.3, Table 1C.

f. 1,3-dichloropropylene consists of both cis-1,3-dichloropropene and trans-1,3-dichloropropene. Both should be reported individually.

g. Methyl bromide is identified as Bromomethane in 40 CFR Part 136.3, Table 1C.

h. Methyl chloride is identified as chloromethane in 40 CFR Part 136.3, Table 1C.

i. Tetrachloroethylene is identified as tetrachloroethene in 40 CFR Part 136.3, Table 1C.

j. Trichloroethylene is identified as trichloroethene in 40 CFR Part 136.3, Table 1C.

Table B6: Acid-Extractable Compounds

(µg/L unless otherwise specified)

Pollutant	CAS	QL[a]	Pollutant	CAS	QL[a]
p-chloro-m-cresol	59507	1.0	2-nitrophenol	88755	2.0
2-chlorophenol	95578	1.0	4-nitrophenol	100027	5.0
2,4-dichlorophenol	120832	1.0	pentachlorophenol	87865	2.0
2,4-dimethylphenol	105679	5.0	Phenol	108952	1.0
4,6-dinitro-o-cresol[c]	534521	2.0	2,4,5-trichlorophenol[d]	95954	2.0
2,4-dinitrophenol	51285	5.0	2,4,6-trichlorophenol	88062	1.0

a. Some QLs may need methods with modification allowed in 40 CFR Part 136.6 or EPA's *Solutions for Analytical Chemistry Problems w/Clean Water Methods, March 2007.* **(url: http://water.epa.gov/scitech/methods/cwa/atp/upload/2008_02_06_methods_pumpkin.pdf)**

b. p-chloro-m-cresol is identified as 4-Chloro-3-methylphenol in 40 CFR Part 136.3, Table 1C.

c. 4,6-dinitro-o-cresol is identified as 2-Methyl-4,6-dinitrophenol in 40 CFR Part 136.3, Table 1C.

d. To monitor for 2,4,5-trichlorophenol, use EPA Method 625.

Table B7: Base-Extractable Compounds

(µg/L unless otherwise specified)

Pollutant	CAS	QL[a]	Pollutant	CAS	QL
acenaphthene	83329	1.0	3,3-Dichlorobenzidine	91941	1.0
acenaphthylene	208968	1.0	diethyl phthalate	84662	1.0
anthracene	120127	1.0	dimethyl phthalate	131113	1.0
benzidine	92875	10	2,4-dinitrotoluene	121142	1.0
benzo(a)anthracene	56553	1.0	2,6-dinitrotoluene	606202	1.0
benzo(a)pyrene	50328	1.0	1,2-diphenylhydrazine[d]	122667	5.0
3,4-benzofluoranthene[b]	205992	1.0	fluoranthene	206440	2.0
benzo(ghi)perylene	191242	1.0	fluorene	86737	1.0
benzo(k)fluoranthene	207089	1.0	hexachlorobenzene	118741	1.0
bis(2-chloroethoxy)methane	111911	2.0	hexachlorobutadiene	87683	2.0
bis(2-chloroethyl)ether	111444	1.0	hexachlorocyclopentadiene	77474	2.0
bis(2-chloroisopropyl)ether[c]	108601	2.0	hexachloroethane	67721	2.0
bis (2-ethylhexyl)phthalate	117817	1.0	indeno(1,2,3-cd)pyrene	193395	1.0
4-bromophenyl phenyl ether	101553	1.0	isophorone	78591	10
butylbenzyl phthalate	85687	1.0	napthalene	91203	1.0
2-chloronaphthalene	91587	1.0	nitrobenzene	98953	1.0
4-chlorophenyl phenyl ether	7005723	1.0	N-nitrosodimethylamine	62759	1.0
chrysene	218019	1.0	N-nitrosodi-n-propylamine	621647	2.0
di-n-butyl phthalate	84742	1.0	N-nitrosodiphenylamine	86306	1.0
di-n-octyl phthalate	117817	1.0	Pentachlorobenzene[e]	608935	10
dibenzo(a,h)anthracene	53703	1.0	phenanthrene	85018	1.0
1,2-Dichlorobenzene (o)	95501	0.50	pyrene	129000	1.0
1,3-Dichlorobenzene (m)	541731	0.50	1,2,4-trichlorobenzene	128821	5.0
1,4-Dichlorobenzene (p)	106467	0.50	Tetrachlorobenzene,1,2,4,5[e]	95943	1.0

a. Some QLs may need methods with modification allowed in 40 CFR Part 136.6 or EPA's *Solutions for Analytical chemistry Problems w/Clean Water Methods, March 2007.*
b. 3,4-benzofluoranthene is listed as Benzo(b)fluoranthene in 40 CFR Part 136.
c. Bis(2-chloroisopropyl)ether is listed as 2,2'-oxybis(2-chloro-propane in 40 CFR Part 136.
d. 1,2-diphenylhydrazine is difficult to analyze given its rapid decomposition rate in water. Azobenzene (a decomposition product of 1,2-diphenylhydrazine), should be analyzed as an estimate of this chemical.
e. To analyze for Pentachlorobenzene and Tetrachlorobenzene 1,2,4,5, use EPA Method 625.

6. Ambient and Additional Effluent Characterization Monitoring

DEQ will evaluate the results of monitoring required under Schedule B, condition 5: Effluent Toxics Characterization Monitoring, to determine whether the permittee will be required to conduct additional ambient water quality and/or effluent monitoring. DEQ will notify the permittee of its determination through a written "Monitoring Action Letter."

a. Sampling Plan

If additional monitoring is needed, the permittee must submit a sample and analysis plan to DEQ for approval within 3 months of receipt of the DEQ Monitoring Action Letter. The sampling plan must include the following:

i. Characterization of ambient water quality for any pollutants identified as having the reasonable potential to exceed the water quality criterion at the point of discharge .
ii. Completion of Schedule B sampling requirements that could not be completed due to analytical interferences.
iii. Characterization of effluent and ambient water quality for new pollutant parameter(s) adopted by the EQC after permit issuance.

iv. Characterization of effluent and ambient water quality, if necessary, when the receiving stream is listed as impaired on the DEQ 303(d) list for new parameter(s).
v. Sampling locations for receiving water must be located as far upstream from outfall location as necessary to insure that samples contain no effluent.
vi. Timing of sampling must coincide with the critical period.

b. Implementation
The permittee must begin implementing the approved plan within 3 months of DEQ approval.

7. Whole Effluent Toxicity Testing Requirements

The permittee must monitor final effluent for whole effluent toxicity as described below using the testing protocols specified in Schedule D, Condition 9, Whole Effluent Toxicity Testing for Freshwater. Samples for Outfall 001 must be collected at the DMS.

Table B8: WET Test Monitoring

Parameter	Minimum Frequency	Sample Type/Location
Acute toxicity	The permit holder must monitor 4 times over the permit cycle with each sample collected during a different month of the discharge period. All four samples may be collected in the first year of the permit or they may be collected during a different month each year over 4 years (i.e., Year 1, November, Year 2, December). When possible, conduct WET testing concurrent with Effluent Toxics Characterization Monitoring as described in Schedule B, Condition 5. If the four consecutive tests show no toxicity at the acute (ZID) and the chronic (RMZ) dilutions, no further testing is required. Otherwise, the permittee must re-test and if necessary, evaluate the cause of toxicity as described in Schedule D, Condition 9.	For acute toxicity: 24-hr composite taken at the DMS after dechlorination and before the effluent flume.
Chronic toxicity		For chronic toxicity: 24-hr composite, taken at the DMS after dechlorination and before the effluent flume.

8. Recycled Water Monitoring Requirements: Outfall no. 002

The permittee must monitor recycled water as listed below. The samples must be representative of the recycled water delivered for beneficial reuse at a location identified in the Recycled Water Use Plan.

Table B9: Recycled Water Monitoring

Item or Parameter	Minimum Frequency	Sample Type
flow (MGD) or quantity irrigated (inches/acre)	daily	measurement
flow meter calibration	annually	verification
quantity chlorine used (lbs)	daily	measurement
chlorine, total residual (mg/L)	daily	grab
pH	2/week	grab

Item or Parameter	Minimum Frequency	Sample Type
total coliform	daily (Class A) 3/week (Class B) 1/week (Class C)	grab
turbidity	hourly (Class A only)	measurement
nutrients (TKN, NO_2+NO_3-N, NH_3-N, Total Phosphorus)	quarterly	grab

9. Biosolids Monitoring Requirements

The permittee must monitor biosolids land applied or produced for sale or distribution as listed below. The samples must be representative of the quality and quantity of biosolids generated and the treatment process used to prepare the biosolids.

Table B10: Biosolids Monitoring

Item or Parameter	Minimum Frequency	Sample Type
nutrient and conventional parameters (% dry weight unless otherwise specified): 1) Total Kjeldahl Nitrogen (TKN) 2) Nitrate-Nitrogen (NO_3-N) 3) Ammonium Nitrogen (NH_4-N) 4) Total Phosphorus (P) 5) Potassium (K) 6) pH (S.U.) 7) Total Solids 8) Volatile Solids	as described in the DEQ-approved Biosolids Management Plan, but not less than the frequency in Table B11.	
pollutants: As, Cd, Cu, Hg, Pb, Mo, Ni, Se, Zn, mg/kg dry weight	as described in the DEQ-approved Biosolids Management Plan, but not less than the frequency in Table B11	
pathogen reduction	as described in the DEQ-approved Biosolids Management Plan, but not less than the frequency in Table B11.	as described in the DEQ-approved Biosolids Management Plan
vector attraction reduction	as described in the DEQ-approved Biosolids Management Plan, but not less than the frequency in Table B11.	as described in the DEQ-approved Biosolids Management Plan
record of biosolids land application: date, quantity, location.	each event	record the date, quantity, and location of biosolids land applied on site location map or equivalent electronic system, such as GIS.

Table B11: Biosolids Minimum Monitoring Frequency

Quantity of biosolids land applied or produced for sale or distribution per calendar year		Minimum Sampling Frequency
(dry metric tons)	(dry U.S. tons)	
Less than 290	Less than 320	Once per year
290 to 1,500	320 to 1,653	Once per quarter
1,500 to 15,000	1,653 to 16,535	Once per 60 days
15,000 or more	16,535 or more	Once per month

10. Permit Application Monitoring Requirements

The following information is provided for the convenience of the permit holder and does not represent a requirement under the current permit. The renewal application for this permit requires 3 scans for the parameters listed in the table below. This data may be collected up to 4.5 years in advance of submittal of the renewal application. DEQ recognizes that some facilities may find it difficult to collect 3 scans that are representative of the seasonal variation in the discharge from each outfall within the permit renewal timeframe, and is therefore calling attention to it within this permit.

Table B12: Effluent Monitoring Required for NPDES Permit Application
(a minimum of 3 scans required)

Parameter
Ammonia (as N)
Chlorine (Total Residual, TRC)
Dissolved Oxygen
Total Kjeldahl Nitrogen (TKN)
Nitrate Plus Nitrite Nitrogen
Oil and Grease

11. Minimum Reporting Requirements

The permittee must report monitoring results as listed below.

Table B13: Reporting Requirements and Due Dates

Reporting Requirement	Frequency	Due Date	Report Form (unless otherwise specified in writing)	Submit To:
1. Table B1: Influent Monitoring 2. Table B2: Effluent Monitoring	monthly	15th day of the following month	DEQ-approved discharge monitoring report (DMR).	DEQ Regional Office (See notes a & b)

Reporting Requirement	Frequency	Due Date	Report Form (unless otherwise specified in writing)	Submit To:
Table B3: Ambient monitoring	Monthly (November-May)	15th day of the following month	DEQ-approved discharge monitoring report (DMR).	DEQ Regional Office
Tables B4 – B7: Effluent Toxics Characterization	once (See Note c.)	end of the 25th month of this permit term	• DEQ - approved electronic summary template • 1 hard copy	DEQ Regional Office
Table B8: WET Test Monitoring	See Table B8	within the month after performing the test.	1 hard copy	DEQ Regional Office
1. Recycled water annual report (see Schedule D for more detail) 2. Table B9: Recycled Water Monitoring	annually	January 31	2 hard copies	One each to: • DEQ Regional Office • DEQ Water Reuse Program Coordinator
1. Biosolids land application annual report describing solids handling activities for the previous year and includes the information described in OAR 340-050-0035(6)(a)-(e). 2. Table B10: Biosolids Monitoring	annually	February 19	3 hard copies	One each to: • DEQ Regional Office • DEQ Biosolids Program Coordinator • EPA Region 10
Inflow and infiltration report	annually	March 1	1 hard copy	DEQ Regional Office

Notes:

a. Name, certificate classification, and grade level of each responsible principal operator as well as identification of each system classification must be included on DMRs.
b. Equipment breakdowns and bypass events must be noted on DMRs.
c. Though the overall characterization only needs to be performed once during the permit cycle, a particular characterization may include multiple sampling events.

SCHEDULE D
Special Conditions

1. **Inflow Removal**
   a. Within 180 days of the effective date of the permit, the permittee must submit to DEQ for approval an updated Inflow Removal Program. The program must consist of the following:
      i. Identification of all overflow points.
      ii. Verification that sewer system overflows are not occurring up to a 24-hour, 5-year storm event or equivalent.
      iii. Monitoring of all pump station overflow points.
      iv. A process for identifying and removing all inflow sources into the permittee's sewer system over which the permittee has legal control, including a time .schedule for identifying and reducing inflow.
      v. If the permittee does not have the necessary legal authority for all portions of the sewer system or treatment facility, a strategy and schedule for gaining legal authority to require inflow reduction and a process and schedule for identifying and removing inflow sources once legal authority has been obtained.
   b. Within 60 days of receiving written DEQ comments, the permittee must submit a final approvable program and time schedule.
   c. A copy of the program must be kept at the wastewater treatment facility for review upon request by DEQ.
   d. An annual inflow and infiltration report must be submitted to the DEQ as directed in Schedule B. The report must include the following:
      i. Details of activities performed in the previous year to identify and reduce inflow and infiltration.
      ii. Details of activities planned for the following year to identify and reduce inflow and infiltration.
      iii. A summary of sanitary sewer overflows that occurred during the previous year.
      iv. Information that demonstrates compliance with the DEQ-approved Inflow Removal Plan required by condition 1.a above.

2. **Emergency Response and Public Notification Plan**
   The permittee must develop and maintain an Emergency Response and Public Notification Plan per Schedule F, Section B, Conditions 7 & 8. The permit holder must develop the plan within six months of permit issuance and update the plan annually to ensure that telephone and email contact information for applicable public agencies are current and accurate. An updated copy of the plan must be kept on file at the wastewater treatment facility for Department review. The latest plan revision date must be listed on the plan cover along with the reviewer's initials or signature.

3. **Recycled Water Use Plan**
   In order to distribute recycled water for reuse, the permittee must have and maintain a DEQ-approved Recycled Water Use Plan meeting the requirements in OAR 340-055-0025. The permittee must submit substantial modifications to an existing plan to DEQ for approval at least 60 days before making the proposed changes. Conditions in the plan are enforceable requirements under this permit.

4. **Exempt Wastewater Reuse at the Treatment System**
   The permittee is exempt from the recycled water use requirements in OAR 340-055 when recycled water is used at the wastewater treatment system for landscape irrigation or for in-plant processes at a wastewater treatment system, and all of the following conditions are met:
      i. The recycled water is an oxidized and disinfected wastewater.
      ii. The recycled water is used at the wastewater treatment system site where it is generated or at an auxiliary wastewater or sludge treatment facility that is subject to the same NPDES or WPCF permit as the wastewater treatment system. Contiguous property to the parcel of land upon which the treatment system is located is considered the wastewater treatment system site if under the same ownership.
      iii. Spray or drift or both from the use does not occur off the site.
      iv. Public access to the site is restricted.

5. Biosolids Management Plan

The permittee must maintain a Biosolids Management Plan meeting the requirements in OAR 340-050-0031(5). The permittee must keep the plan updated and submit substantial modifications to an existing plan to DEQ for approval at least 60 days before making the proposed changes. Conditions in the plan are enforceable requirements under this permit.

6. Land Application Plan

a. Plan Contents

The permittee must maintain a land application plan that contains the information listed below. The land application plan may be incorporated into the Biosolids Management Plan.

i. All known DEQ-approved sites that will receive biosolids while the permit is effective.
ii. The geographic location, identified by county or smaller unit, of new sites which are not specifically listed at the time of permit application.
iii. Criteria that will be used in the selection of new sites.
iv. Management practices that will be implemented at new sites authorized by the DEQ.
v. Procedures for notifying property owners adjacent to proposed sites of the proposed activity before starting the application.

b. Site Authorization

The permittee must obtain written authorization from DEQ for each land application site before its use. Conditions in site authorizations are enforceable requirements under this permit. The permittee may land apply biosolids to a DEQ-approved site only as described in the site authorization, while this permit is effective, and with the written approval of the property owner. DEQ may modify or revoke a site authorization, following the procedures for a permit modification described in OAR 340-045-0055.

c. Public Participation

iii. No DEQ-initiated public notice is required for continued use of sites identified in the DEQ-approved land application plan.
iv. For new sites that fail to meet the site selection criteria in the land application plan, or that DEQ deems to be sensitive with respect to residential housing, runoff potential, or threat to groundwater, DEQ will provide an opportunity for public comment as directed by OAR 340-050-0015(10).
v. For all other new sites, the permittee must provide for public participation, following procedures in its DEQ-approved land application plan.

7. Wastewater Solids Transfers

a. *Within state.* The permittee may transfer wastewater solids including Class A and Class B biosolids, to another facility permitted to process or dispose of wastewater solids, including but not limited to: another wastewater treatment facility, landfill, or incinerator. The permittee must monitor, report, and dispose of solids as required under the receiving facility's permit.
b. *Out of state.* If wastewater solids, including Class A and Class B biosolids, are transferred out of state for use or disposal, the permittee must obtain written authorization from DEQ, meet Oregon requirements for the use or disposal of wastewater solids, notify in writing the receiving state of the proposed use or disposal of wastewater solids, and satisfy the requirements of the receiving state.

8. Hauled Waste Control

The permittee may accept hauled wastes at discharge points designated by the POTW after receiving written DEQ approval of a hauled waste control plan. Hauled wastes may include wastewater solids from another wastewater treatment facility, septage, grease trap wastes, portable and chemical toilet wastes, landfill leachate, groundwater remediation wastewaters and commercial/industrial wastewaters. Wastewater solids from out-of-state facilities must not exceed the ceiling concentration limits in Schedule A, Table A5: Biosolids Limits.

9. Lagoon Solids

At least 60 days, and preferably six months before removing accumulated solids from the lagoon, the permittee must submit to DEQ a biosolids management plan and land application plan as required in conditions 4 and 5 respectively.

DEQ will provide an opportunity for comment on the biosolids management plan and land application plan, as directed by OAR 340-050-0015(8). The permittee must follow the conditions in the approved plan.

10. Whole Effluent Toxicity Testing for Freshwater

a. The permit holder must conduct whole effluent toxicity (WET) tests as specified here and in Schedule B of this permit.

b. Acute Toxicity Testing - Organisms and Protocols

i. The permittee must conduct 48-hour static renewal tests with *Ceriodaphnia dubia* (water flea) and 96-hour static renewal tests with *Pimephales promelas* (fathead minnow).

ii. All test methods and procedures must be in accordance with Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, EPA-821-R-02-012, October 2002. Any deviation of the bioassay procedures outlined in this method must be submitted in writing to DEQ for review and approval before use.

iii. Treatments to the final effluent samples (for example, dechlorination), except those included as part of the methodology, may not be performed by the laboratory unless approved by DEQ before analysis.

iv. Unless otherwise approved by DEQ in writing, acute tests must be conducted on a control (0%) and the following dilution series: 6.25%, 10%, 25%, 50%, and 100%. An acute WET test will be considered to show toxicity if there is a statistically significant difference in survival between the control and 10% effluent reported as the NOEC $\leq$ 10 percent effluent.

c. Chronic Toxicity Testing - Organisms and Protocols

i. The permittee must conduct tests with *Ceriodaphnia dubia* (water flea) for reproduction and survival test endpoint, *Pimephales promelas* (fathead minnow) for growth and survival test endpoint, and *Raphidocelis subcapitata* (green alga formerly known as *Selanastrum capricornutum*) for growth test endpoint.

ii. All test methods and procedures must be in accordance with Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition, EPA-821-R-02-013, October 2002. Any deviation of the bioassay procedures outlined in this method must be submitted in writing to DEQ for review and approval before use.

iii. Treatments to the final effluent samples (for example, dechlorination), except those included as part of the methodology, may not be performed by the laboratory unless approved by DEQ before analysis.

iv. Unless otherwise approved by DEQ in writing, chronic tests must be conducted on a control (0%) and the following dilution series: 2%, 4%, 10%, 40%, and 100% A chronic WET test will be considered to show toxicity if the IC_{25} (25% inhibition concentration) occurs at dilutions equal to or less than the dilution that is known to occur at the edge of the mixing zone, that is, $IC_{25} \leq 4\%$

d. Dual End-Point Tests

i. WET tests may be dual end-point tests in which both acute and chronic end-points can be determined from the results of a single chronic test. The acute end-point will be based on 48-hours for the *Ceriodaphnia dubia* (water flea) and 96-hours for the *Pimephales promelas* (fathead minnow).

ii. All test methods and procedures must be in accordance with Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition, EPA-821-R-02-013, October 2002. Any deviation of the bioassay procedures outlined in this method must be submitted in writing to DEQ for review and approval before use.

iii. Unless otherwise approved by DEQ in writing, tests run as dual end-point tests must be conducted on a control (0%) and the following dilution series: 2%, 4%, 10%, 40%, and 100%. Toxicity determinations for dual end-point tests must correspond to the acute and chronic tests described in conditions 9.b.iv. and 9.c.iv. above.

e. Evaluation of Causes and Exceedances
   i. If any test exhibits toxicity as described in conditions 9.b.iv. and 9.c.iv. above, the permittee must conduct another toxicity test using the same species and DEQ-approved methodology within two weeks unless DEQ approves otherwise.
   ii. If two consecutive WET test results indicate acute or chronic toxicity as described in conditions 9.b.iv. and 9.c.iv. above, the permittee must immediately notify DEQ of the results. DEQ will work with the permittee to determine the appropriate course of action to evaluate and address the toxicity.

f. Quality Assurance and Reporting
   i. Quality assurance criteria, statistical analyses, and data reporting for the WET tests must be in accordance with the EPA documents stated in this condition.
   ii. A bioassay laboratory report for each test must be prepared according to the EPA method documents referenced in this Schedule. The report must include all QA/QC documentation, statistical analysis for each test performed, standard reference toxicant test (SRT) conducted on each species required for the toxicity tests, and completed Chain-of-Custody forms for the samples including time of sample collection and receipt. Reports must be submitted to DEQ within 45 days of test completion.
   iii. The report must include all endpoints measured in the test: NOEC, LOEC, and IC_{25}.
   iv. The permittee must make available to DEQ upon request the written standard operating procedures they, or the laboratory performing the WET tests, use for all toxicity tests DEQ requires.

g. Reopener
   DEQ may reopen and modify this permit to include new limits, monitoring requirements, and/or conditions as determined by DEQ to be appropriate, and in accordance with procedures outlined in OAR Chapter 340, Division 45 if:
   i. WET testing data indicate acute and/or chronic toxicity.
   ii. The facility undergoes any process changes.
   iii. Discharge monitoring data indicate a change in the reasonable potential to exhibit toxicity.

11. Operator Certification

a. Definitions
   i. "Supervise" means to have full and active responsibility for the daily on-site technical operation of a wastewater treatment system or wastewater collection system.
   ii. "Supervisor" or "designated operator" means the operator delegated authority by the permittee for establishing and executing the specific practice and procedures for operating the wastewater treatment system or wastewater collection system in accordance with the policies of the owner of the system and any permit requirements.
   iii. "Shift Supervisor" means the operator delegated authority by the permittee for executing the specific practice and procedures for operating the wastewater treatment system or wastewater collection system when the system is operated on more than one daily shift.
   iv. "System" includes both the collection system and the treatment systems.

b. The permittee must comply with OAR Chapter 340, Division 49, "Regulations Pertaining to Certification of Wastewater System Operator Personnel" and designate a supervisor whose certification corresponds with the classification of the collection and/or treatment system, as specified on page 1 of this permit.

c. The permittee must have its system supervised full-time by one or more operators who hold a valid certificate for the type of wastewater treatment or wastewater collection system, and at a grade equal to or greater than the wastewater system's classification, as specified on page 1 of this permit.

d. The permittee's wastewater system may not be without the designated supervisor for more than 30 days. During this period, there must be another person available to supervise who is certified at no more than one grade lower than the classification of the wastewater system. The permittee must delegate authority to this operator to supervise the operation of the system.

e. If the wastewater system has more than one daily shift, the permittee must have another properly certified operator available to supervise system operation. Each shift supervisor, if any, must be certified at no more than one grade lower than the system classification.

f. The permittee is not required to have a supervisor on-site at all times; however, the supervisor must be available to the permittee and operator at all times.

g. The permittee must notify DEQ in writing of the name of the system supervisor. The permittee may replace or re-designate the system supervisor with another properly certified operator at any time and must notify DEQ in writing within 30 days of replacement or re-designation of operator in charge. The notice of replacement or re-designation must be sent to DEQ-Water Quality Division, Operator Certification Program, 2020 SW 4th Avenue, Suite 150, Portland, OR 97201

h. Upon written request, DEQ may grant the permittee reasonable time, not to exceed 120 days, to obtain the services of a qualified person to supervise the wastewater system. The written request must include a justification for the time needed, schedule for recruiting and hiring, date the system supervisor availability ceased, and name of the alternate system supervisor as required above.

12. Industrial Waste Survey/Pretreatment Program

The permittee must conduct an industrial user survey to determine the presence of any industrial users discharging wastewaters subject to pretreatment and submit a report on the findings to DEQ within 24 months of permit issuance. The purpose of the survey is to identify whether there are any categorical industrial users discharging to the POTW, and ensure regulatory oversight of these discharges to state waters. If the POTW has already completed a baseline IU Survey the results of this survey are to be provided to DEQ within two months of permit re-issuance.

Guidance on conducting IU Surveys can be found at
http://www.deq.state.or.us/wq/pretreatment/docs/guidance/IUSurveyGuidance.pdf

Once an initial baseline IU Survey is conducted it is to be maintained by the POTW and made available for inspection by DEQ. Every 5 years from permit renewal, the permittee must submit an updated IU survey.

13. Cooperative Operating Agreement with City of Canby

The permittee must maintain a copy of the Cooperative Operating Agreement with the city of Canby, and meet all Agreement conditions, particularly regarding contacting Canby when the permittee plans to begin discharging to the Molalla River.

14. Leak Test.

Within one year following permit issuance, the permittee must perform a lagoon leak test. Within 30 days after completing the test, the permittee must report the test results to DEQ. Depending on the test results, the permittee may need to take a further action, such as perform groundwater monitoring to determine if the leakage has adversely impacted groundwater quality.

SCHEDULE F
NPDES GENERAL CONDITIONS – DOMESTIC FACILITIES

SECTION A. STANDARD CONDITIONS

A1. Duty to Comply with Permit

The permittee must comply with all conditions of this permit. Failure to comply with any permit condition is a violation of Oregon Revised Statutes (ORS) 468B.025 and the federal Clean Water Act and is grounds for an enforcement action. Failure to comply is also grounds for DEQ to terminate, modify and reissue, revoke, or deny renewal of a permit.

A2. Penalties for Water Pollution and Permit Condition Violations

The permit is enforceable by DEQ or EPA, and in some circumstances also by third-parties under the citizen suit provisions 33 USC § 1365. DEQ enforcement is generally based on provisions of state statutes and Environmental Quality Commission (EQC) rules, and EPA enforcement is generally based on provisions of federal statutes and EPA regulations.

ORS 468.140 allows DEQ to impose civil penalties up to $10,000 per day for violation of a term, condition, or requirement of a permit. The federal Clean Water Act provides for civil penalties not to exceed $32,500 and administrative penalties not to exceed $11,000 per day for each violation of any condition or limitation of this permit.

Under ORS 468.943, unlawful water pollution, if committed by a person with criminal negligence, is punishable by a fine of up to $25,000, imprisonment for not more than one year, or both. Each day on which a violation occurs or continues is a separately punishable offense. The federal Clean Water Act provides for criminal penalties of not more than $50,000 per day of violation, or imprisonment of not more than 2 years, or both for second or subsequent negligent violations of this permit.

Under ORS 468.946, a person who knowingly discharges, places, or causes to be placed any waste into the waters of the state or in a location where the waste is likely to escape into the waters of the state is subject to a Class B felony punishable by a fine not to exceed $250,000 and up to 10 years in prison per ORS chapter 161. The federal Clean Water Act provides for criminal penalties of $5,000 to $50,000 per day of violation, or imprisonment of not more than 3 years, or both for knowing violations of the permit. In the case of a second or subsequent conviction for knowing violation, a person is subject to criminal penalties of not more than $100,000 per day of violation, or imprisonment of not more than 6 years, or both.

A3. Duty to Mitigate

The permittee must take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment. In addition, upon request of DEQ, the permittee must correct any adverse impact on the environment or human health resulting from noncompliance with this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

A4. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and have the permit renewed. The application must be submitted at least 180 days before the expiration date of this permit.

DEQ may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date.

A5. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause including, but not limited to, the following:

a. Violation of any term, condition, or requirement of this permit, a rule, or a statute.
b. Obtaining this permit by misrepresentation or failure to disclose fully all material facts.
c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.
d. The permittee is identified as a Designated Management Agency or allocated a wasteload under a total maximum daily load (TMDL).
e. New information or regulations.
f. Modification of compliance schedules.
g. Requirements of permit reopener conditions
h. Correction of technical mistakes made in determining permit conditions.
i. Determination that the permitted activity endangers human health or the environment.
j. Other causes as specified in 40 CFR §§ 122.62, 122.64, and 124.5.
k. For communities with combined sewer overflows (CSOs):
   (1) To comply with any state or federal law regulation for CSOs that is adopted or promulgated subsequent to the effective date of this permit.
   (2) If new information that was not available at the time of permit issuance indicates that CSO controls imposed under this permit have failed to ensure attainment of water quality standards, including protection of designated uses.
   (3) Resulting from implementation of the permittee's long-term control plan and/or permit conditions related to CSOs.

The filing of a request by the permittee for a permit modification, revocation or reissuance, termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

A6. Toxic Pollutants
The permittee must comply with any applicable effluent standards or prohibitions established under Oregon Administrative Rule (OAR) 340-041-0033 and section 307(a) of the federal Clean Water Act for toxic pollutants, and with standards for sewage sludge use or disposal established under section 405(d) of the federal Clean Water Act, within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

A7. Property Rights and Other Legal Requirements
The issuance of this permit does not convey any property rights of any sort, or any exclusive privilege, or authorize any injury to persons or property or invasion of any other private rights, or any infringement of federal, tribal, state, or local laws or regulations.

A8. Permit References
Except for effluent standards or prohibitions established under section 307(a) of the federal Clean Water Act and OAR 340-041-0033 for toxic pollutants, and standards for sewage sludge use or disposal established under section 405(d) of the federal Clean Water Act, all rules and statutes referred to in this permit are those in effect on the date this permit is issued.

A9. Permit Fees
The permittee must pay the fees required by OAR.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

B1. Proper Operation and Maintenance
The permittee must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems that are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

B2. Need to Halt or Reduce Activity Not a Defense

For industrial or commercial facilities, upon reduction, loss, or failure of the treatment facility, the permittee must, to the extent necessary to maintain compliance with its permit, control production or all discharges or both until the facility is restored or an alternative method of treatment is provided. This requirement applies, for example, when the primary source of power of the treatment facility fails or is reduced or lost. It is not a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

B3. Bypass of Treatment Facilities

a. Definitions
   (1) "Bypass" means intentional diversion of waste streams from any portion of the treatment facility. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, provided the diversion is to allow essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs b and c of this section.
   (2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Prohibition of bypass.
   (1) Bypass is prohibited and DEQ may take enforcement action against a permittee for bypass unless:
      i. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
      ii. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventative maintenance; and
      iii. The permittee submitted notices and requests as required under General Condition B3.c.
   (2) DEQ may approve an anticipated bypass, after considering its adverse effects and any alternatives to bypassing, if DEQ determines that it will meet the three conditions listed above in General Condition B3.b.(1).

c. Notice and request for bypass.
   (1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, a written notice must be submitted to DEQ at least ten days before the date of the bypass.
   (2) Unanticipated bypass. The permittee must submit notice of an unanticipated bypass as required in General Condition D5.

B4. Upset

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operation error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of General Condition B4.c are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
   (1) An upset occurred and that the permittee can identify the causes(s) of the upset;
   (2) The permitted facility was at the time being properly operated;

(3) The permittee submitted notice of the upset as required in General Condition D5, hereof (24-hour notice); and
(4) The permittee complied with any remedial measures required under General Condition A3 hereof.

d. Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

B5. Treatment of Single Operational Upset

For purposes of this permit, a single operational upset that leads to simultaneous violations of more than one pollutant parameter will be treated as a single violation. A single operational upset is an exceptional incident that causes simultaneous, unintentional, unknowing (not the result of a knowing act or omission), temporary noncompliance with more than one federal Clean Water Act effluent discharge pollutant parameter. A single operational upset does not include federal Clean Water Act violations involving discharge without a NPDES permit or noncompliance to the extent caused by improperly designed or inadequate treatment facilities. Each day of a single operational upset is a violation.

B6. Overflows from Wastewater Conveyance Systems and Associated Pump Stations

a. Definition. "Overflow" means any spill, release or diversion of sewage including:
(1) An overflow that results in a discharge to waters of the United States; and
(2) An overflow of wastewater, including a wastewater backup into a building (other than a backup caused solely by a blockage or other malfunction in a privately owned sewer or building lateral), even if that overflow does not reach waters of the United States.

b. Reporting required. All overflows must be reported orally to DEQ within 24 hours from the time the permittee becomes aware of the overflow. Reporting procedures are described in more detail in General Condition D5.

B7. Public Notification of Effluent Violation or Overflow

If effluent limitations specified in this permit are exceeded or an overflow occurs that threatens public health, the permittee must take such steps as are necessary to alert the public, health agencies and other affected entities (for example, public water systems) about the extent and nature of the discharge in accordance with the notification procedures developed under General Condition B8. Such steps may include, but are not limited to, posting of the river at access points and other places, news releases, and paid announcements on radio and television.

B8. Emergency Response and Public Notification Plan

The permittee must develop and implement an emergency response and public notification plan that identifies measures to protect public health from overflows, bypasses, or upsets that may endanger public health. At a minimum the plan must include mechanisms to:

a. Ensure that the permittee is aware (to the greatest extent possible) of such events;
b. Ensure notification of appropriate personnel and ensure that they are immediately dispatched for investigation and response;
c. Ensure immediate notification to the public, health agencies, and other affected public entities (including public water systems). The overflow response plan must identify the public health and other officials who will receive immediate notification;
d. Ensure that appropriate personnel are aware of and follow the plan and are appropriately trained;
e. Provide emergency operations; and
f. Ensure that DEQ is notified of the public notification steps taken.

B9. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters must be disposed of in such a manner as to prevent any pollutant from such materials from entering waters of the state, causing nuisance conditions, or creating a public health hazard.

SECTION C. MONITORING AND RECORDS

C1. Representative Sampling

Sampling and measurements taken as required herein must be representative of the volume and nature of the monitored discharge. All samples must be taken at the monitoring points specified in this permit, and must be taken, unless otherwise specified, before the effluent joins or is diluted by any other waste stream, body of water, or substance. Monitoring points must not be changed without notification to and the approval of DEQ.

C2. Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices must be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices must be installed, calibrated and maintained to insure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected must be capable of measuring flows with a maximum deviation of less than ± 10 percent from true discharge rates throughout the range of expected discharge volumes.

C3. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR part 136 or, in the case of sludge use and disposal, approved under 40 CFR part 503 unless other test procedures have been specified in this permit.

C4. Penalties of Tampering

The federal Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit may, upon conviction, be punished by a fine of not more than $10,000 per violation, imprisonment for not more than two years, or both. If a conviction of a person is for a violation committed after a first conviction of such person, punishment is a fine not more than $20,000 per day of violation, or by imprisonment of not more than four years, or both.

C5. Reporting of Monitoring Results

Monitoring results must be summarized each month on a discharge monitoring report form approved by DEQ. The reports must be submitted monthly and are to be mailed, delivered or otherwise transmitted by the 15th day of the following month unless specifically approved otherwise in Schedule B of this permit.

C6. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR part 136 or, in the case of sludge use and disposal, approved under 40 CFR part 503, or as specified in this permit, the results of this monitoring must be included in the calculation and reporting of the data submitted in the discharge monitoring report. Such increased frequency must also be indicated. For a pollutant parameter that may be sampled more than once per day (for example, total residual chlorine), only the average daily value must be recorded unless otherwise specified in this permit.

C7. Averaging of Measurements

Calculations for all limitations that require averaging of measurements must utilize an arithmetic mean, except for bacteria which must be averaged as specified in this permit.

C8. Retention of Records

Records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities must be retained for a period of at least 5 years (or longer as required by 40 CFR part 503). Records of all monitoring information including all calibration and maintenance records, all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit and records of all data used to complete the application for this permit must be retained for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of DEQ at any time.

C9. Records Contents

Records of monitoring information must include:

a. The date, exact place, time, and methods of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) analyses were performed;
d. The individual(s) who performed the analyses;
e. The analytical techniques or methods used; and
f. The results of such analyses.

C10. Inspection and Entry

The permittee must allow DEQ or EPA upon the presentation of credentials to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
d. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by state law, any substances or parameters at any location.

C11. Confidentiality of Information

Any information relating to this permit that is submitted to or obtained by DEQ is available to the public unless classified as confidential by the Director of DEQ under ORS 468.095. The permittee may request that information be classified as confidential if it is a trade secret as defined by that statute. The name and address of the permittee, permit applications, permits, effluent data, and information required by NPDES application forms under 40 CFR § 122.21 are not classified as confidential [40 CFR § 122.7(b)].

SECTION D. REPORTING REQUIREMENTS

D1. Planned Changes

The permittee must comply with OAR 340-052, "Review of Plans and Specifications" and 40 CFR § 122.41(l)(1). Except where exempted under OAR 340-052, no construction, installation, or modification involving disposal systems, treatment works, sewerage systems, or common sewers may be commenced until the plans and specifications are submitted to and approved by DEQ. The permittee must give notice to DEQ as soon as possible of any planned physical alternations or additions to the permitted facility.

D2. Anticipated Noncompliance

The permittee must give advance notice to DEQ of any planned changes in the permitted facility or activity that may result in noncompliance with permit requirements.

D3. Transfers

This permit may be transferred to a new permittee provided the transferee acquires a property interest in the permitted activity and agrees in writing to fully comply with all the terms and conditions of the permit and EQC rules. No permit may be transferred to a third party without prior written approval from DEQ. DEQ may require modification, revocation, and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under 40 CFR § 122.61. The permittee must notify DEQ when a transfer of property interest takes place.

D4. Compliance Schedule

Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any compliance schedule of this permit must be submitted no later than 14 days following each schedule date. Any reports of noncompliance must include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements.

D5. Twenty-Four Hour Reporting

The permittee must report any noncompliance that may endanger health or the environment. Any information must be provided orally (by telephone) to the DEQ regional office or Oregon Emergency Response System (1-800-452-0311) as specified below within 24 hours from the time the permittee becomes aware of the circumstances.

a. Overflows.
   (1) Oral Reporting within 24 hours.
      i. For overflows other than basement backups, the following information must be reported to the Oregon Emergency Response System (OERS) at 1-800-452-0311. For basement backups, this information should be reported directly to the DEQ regional office.
         (a) The location of the overflow;
         (b) The receiving water (if there is one);
         (c) An estimate of the volume of the overflow;
         (d) A description of the sewer system component from which the release occurred (for example, manhole, constructed overflow pipe, crack in pipe); and
         (e) The estimated date and time when the overflow began and stopped or will be stopped.
      ii. The following information must be reported to the DEQ regional office within 24 hours, or during normal business hours, whichever is earlier:
         (a) The OERS incident number (if applicable); and
         (b) A brief description of the event.
   (2) Written reporting within 5 days.
      i. The following information must be provided in writing to the DEQ regional office within 5 days of the time the permittee becomes aware of the overflow:
         (a) The OERS incident number (if applicable);
         (b) The cause or suspected cause of the overflow;
         (c) Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the overflow and a schedule of major milestones for those steps;
         (d) Steps taken or planned to mitigate the impact(s) of the overflow and a schedule of major milestones for those steps; and
         (e) For storm-related overflows, the rainfall intensity (inches/hour) and duration of the storm associated with the overflow.

      DEQ may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

b. Other instances of noncompliance.
   (1) The following instances of noncompliance must be reported:
      i. Any unanticipated bypass that exceeds any effluent limitation in this permit;
      ii. Any upset that exceeds any effluent limitation in this permit;
      iii. Violation of maximum daily discharge limitation for any of the pollutants listed by DEQ in this permit; and
      iv. Any noncompliance that may endanger human health or the environment.
   (2) During normal business hours, the DEQ regional office must be called. Outside of normal business hours, DEQ must be contacted at 1-800-452-0311 (Oregon Emergency Response System).
   (3) A written submission must be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission must contain:
      i. A description of the noncompliance and its cause;
      ii. The period of noncompliance, including exact dates and times;
      iii. The estimated time noncompliance is expected to continue if it has not been corrected;
      iv. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance; and
      v. Public notification steps taken, pursuant to General Condition B7.
   (4) DEQ may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

D6. Other Noncompliance

The permittee must report all instances of noncompliance not reported under General Condition D4 or D5 at the time monitoring reports are submitted. The reports must contain:

a. A description of the noncompliance and its cause;
b. The period of noncompliance, including exact dates and times;
c. The estimated time noncompliance is expected to continue if it has not been corrected; and
d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

D7. Duty to Provide Information

The permittee must furnish to DEQ within a reasonable time any information that DEQ may request to determine compliance with the permit or to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit. The permittee must also furnish to DEQ, upon request, copies of records required to be kept by this permit.

Other Information: When the permittee becomes aware that it has failed to submit any relevant facts or has submitted incorrect information in a permit application or any report to DEQ, it must promptly submit such facts or information.

D8. Signatory Requirements

All applications, reports or information submitted to DEQ must be signed and certified in accordance with 40 CFR § 122.22.

D9. Falsification of Information

Under ORS 468.953, any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, is subject to a Class C felony punishable by a fine not to exceed $125,000 per violation and up to 5 years in prison per ORS chapter 161. Additionally, according to 40 CFR § 122.41(k)(2), any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit including monitoring reports or reports of compliance or non-compliance will, upon conviction, be punished by a federal civil penalty not to exceed $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

D10. Changes to Indirect Dischargers

The permittee must provide adequate notice to DEQ of the following:

a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of the federal Clean Water Act if it were directly discharging those pollutants and;
b. Any substantial change in the volume or character of pollutants being introduced into the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.
c. For the purposes of this paragraph, adequate notice must include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

SECTION E. DEFINITIONS

E1. *BOD* or BOD_5 means five-day biochemical oxygen demand.
E2. *CBOD* or $CBOD_5$ means five-day carbonaceous biochemical oxygen demand.
E3. *TSS* means total suspended solids.
E4. *Bacteria* means but is not limited to fecal coliform bacteria, total coliform bacteria, *Escherichia coli* (*E. coli*) bacteria, and *Enterococcus* bacteria.
E5. *FC* means fecal coliform bacteria.
E6. *Total residual chlorine* means combined chlorine forms plus free residual chlorine
E7. *Technology based permit effluent limitations* means technology-based treatment requirements as defined in 40 CFR § 125.3, and concentration and mass load effluent limitations that are based on minimum design criteria specified in OAR 340-041.

E8. *mg/l* means milligrams per liter.
E9. *µg/l* means microgram per liter.
E10. *kg* means kilograms.
E11. m^3/d means cubic meters per day.
E12. *MGD* means million gallons per day.
E13. *Average monthly effluent limitation* as defined at 40 CFR § 122.2 means the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.
E14. *Average weekly effluent limitation* as defined at 40 CFR § 122.2 means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week.
E15. *Daily discharge* as defined at 40 CFR § 122.2 means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the daily discharge must be calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the daily discharge must be calculated as the average measurement of the pollutant over the day.
E16. *24-hour composite sample* means a sample formed by collecting and mixing discrete samples taken periodically and based on time or flow. The sample must be collected and stored in accordance with 40 CFR part 136.
E17. *Grab sample* means an individual discrete sample collected over a period of time not to exceed 15 minutes.
E18. *Quarter* means January through March, April through June, July through September, or October through December.
E19. *Month* means calendar month.
E20. *Week* means a calendar week of Sunday through Saturday.
E21. *POTW* means a publicly-owned treatment works.

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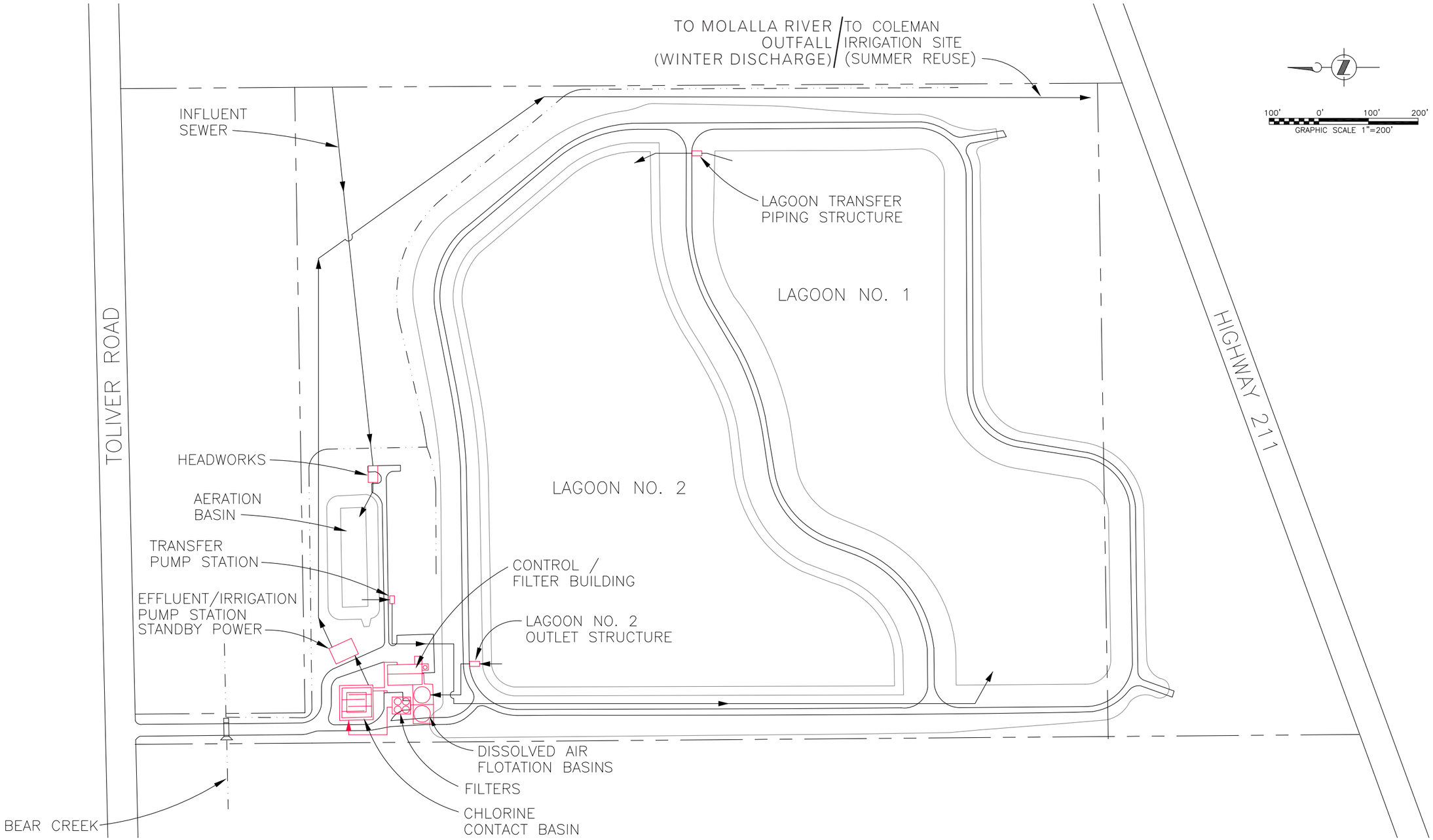
[1] DEQ recognizes that high TSS levels in influent can make achievement of QLs difficult, and at this time DEQ is not requiring that influent monitoring be performed using the QLs listed in the permit.

[2] Elevated TSS levels can result in matrix effects.
[3] For more information, refer to the Significant Figures IMD at http://www.deq.state.or.us/wq/pubs/imds/SigFigsIMD.pdf

APPENDIX B: WWTP DRAWINGS AND SPECIFICATIONS



TETRA TECH

7080 SW Fir Loop
Portland, Oregon 97223
Tel 503.684.9097 Fax 503.598.0583

City of Molalla, Oregon

2008 NPDES PERMIT RENEWAL

FIGURE 2
WWTP SITE PLAN

FLOW DATA

Existing and Projected Flows

	2005	2015	2025
ADWF – Average dry weather flow	0.80 mgd	1.1 mgd	1.4 mgd
MMDWF – Max month dry weather flow	1.28 mgd	1.7 mgd	2.3 mgd
AWWF – Average wet weather flow	1.30 mgd	2.3 mgd	3.0 mgd
MMWWF – Max month wet weather flow	2.04 mgd	3.1 mgd	4.1 mgd
PDF – Peak day flow	7.06 mgd	8.5 mgd	10.3 mgd

DESIGN DATA

Effluent Quality

Required Effluent Quality	BOD5 < 10 mg/l	TSS < 10 mg/l
Anticipated Filter Effluent Quality	BOD5 < 5 mg/l	TSS < 5 mg/l

Headworks (2002 Construction)

Type of screens	In-channel fine screens, perforated plate
Number of screens	1
Peak flow capacity, each	9.25 mgd
Bypass screen	Manually cleaned screen
Screenings washing	Yes
Screenings compaction	Yes
Septage	Excluded
Headworks, influent flow measurement	
Number of flumes	1
Throat width	24 inches
Peak flow capacity	21.4 mgd
Minimum flow capability	0.27 mgd

Aeration Basin (1980 Construction)

Dimensions	
Size (bottom of basin)	200 feet by 54 feet
Side slopes (horiz:vert)	2:1
Maximum side water depth	10 feet with 2 feet freeboard
Basin volume, maximum	1,300,000 gallons
Basin liner	Asphalt-concrete
Aerators	
Type	Aspirating
Number	6
Horsepower, each	10 horsepower
Basin outlet	Overflow weir to pump station

Transfer Pump Station (2002 Construction)

Estimated PIF from basin	9.25 mgd
Main pump type	Centrifugal submersible w/vfd
Main pumps	
Operating	1
Standby	1
Main pump capacity each	5800 gpm at 51 ft tdh
Jockey pump type	Centrifugal submersible w/vfd
Jockey pump number	1
Jockey pump capacity (one forcemain)	2500 gpm at 49 ft tdh and 2100 gpm at 56 ft tdh
Station peak capacity	7800 gpm (11.23 mgd)
Required operating volume	4060 gal
Wet well levels	
Maximum W.S. El	286.0 ft
Minimum W.S. El	272.0 ft
Operating volume	55,820 gal (includes aeration basin)

Transfer Forcemain (2002 Construction)

Number	2
Material	HDPE
Size	18-inch (nominal, ID)
Length	1630 feet
Velocity at 2500 gpm	3.2 feet/sec
Velocity at 2100 gpm	2.6 feet/sec
Velocity at 7800 gpm	4.9 feet/sec
Outlet to lagoon 1	
Number/size	4-ports/12-inch

Lagoon No. 1 (1980 Construction)

Lagoon dimensions	
Surface area	11.4 acres (at 6-foot (average) depth)
Maximum depth	12 feet with 3 feet of freeboard
Working depth (max. To min.)	9 feet
Lagoon volume, maximum	137 acre-feet (45 mg)
Lagoon liner	Native clay
Aeration	None
Outlet	
Size	10-inch
Type	Surface weir and fixed pipe on bottom of lagoon

Lagoon No. 2 (1980 Construction)

Lagoon dimensions	
Surface area	13.6 acres (at 6-foot average depth)
Maximum depth	12 feet with 3 feet of freeboard
Working depth	9 feet
Lagoon volume, maximum	163 acre-feet (53 mg)
Lagoon liner	Native clay
Outlet	
Size	14-inch
Type	Fixed pipes at two depths

Dissolved Air Flotation (DAF) (1980 Construction)

Capacity	2.0 mgd
Tank Diameter	31 feet
Surface area	750 square feet (sf)
Hydraulic loading rate	2.59 gpm/sf, including recycle
Hydraulic capacity	2.80 mgd, including recycle
Chemical feed rates	
Alum	75 – 150 mg/l (not used)
Soda	37 – 75 mg/l (not used)
Polyaluminum Chloride	35 – 70 mg/l
Acid	0 – 10 mg/l (not used)
Operating parameters	
Pressurized recycle flow	350 to 700 gpm
Operating pressure	45 to 80 pounds per square inch (psi)
Maximum horizontal velocity	3.1 feet per second
Maximum daily sludge	2290 pounds dry solids, 15,300 gallons
Recycle Pumps	
Number	2
Size	20 HP
Flow	350 gpm
Recycle Flow Meter (Existing)	
Type	Propeller
Size	6 Inch
Range	0-2 MGD
Influent Flow Meter (FM-2) **(2007 Construction)**	
Type	Electromagnetic Insertion Type
Size	12 Inch
Range	0-10 MGD

Dissolved Air Flotation (DAF) **(2007 Construction)**

Capacity	2.0 mgd
Tank Diameter	38 feet
Surface area	1,075 square feet (sf)
Maximum surface loading rate	2.0 gpm/sf, including recycle
Hydraulic capacity	3.1 mgd, including recycle
Chemical feed rates	
Polyaluminum Chloride	35 – 70 mg/l
Operating parameters	
Pressurized recycle flow	350-700 gpm
Operating pressure	125 PSI
Maximum horizontal velocity	<3.1 FPS
Maximum daily sludge	1,670 pounds dry solids, 10,000 gallons
Recycle Pumps	
Number	2
Size	25 HP
Flow	350 gpm
Recycle Flow Meter (FM-3)	
Type	**Propeller**
Size	6 Inch
Range	0-2.5 MGD
Influent Flow Meter (FM-1)	
Type	**Doppler**
Size	14 Inch
Range	0-14 MGD

Plant Air (Proposed)

Air Compressor	
Type	Rotary Screw
Size	15 HP
Output	51 ACFM
Operating Pressure	125 psig

Gravity Filters (1980 Construction) – To Be Abandoned

Capacity	2.1 mgd
Number of filters	2
Surface area, total	310 square feet
Maximum loading rate	5 gpm/sf
Hydraulic capacity	2.2 mgd
Media	
Type	Gravel, sand, and anthracite coal
Depth	22" gravel, 9" sand, 21" coal
Backwash / surface wash	Automatic on timer or pressure differential
Backwash rate	20 gpm/sf
Surface wash	103 gpm

Gravity Filters **(2007 Construction)**

Capacity	4.0 mgd
Number of filters	4
Surface area, total	573 square feet
Maximum loading rate	4.85 gpm/sf
Hydraulic capacity	4.0 mgd
Media	
Type	Gravel, sand, and anthracite coal
Depth	12" silica sand, 24" anthracite coal
Backwash control	Manual, timed or pressure differential
Backwash rate	15 gpm/sf
Backwash flow (1 filter)	2,147 gpm
Backwash duration	4 – 8 minutes
Backwash volume	8,600 – 17,200 gallons
Air Scour Blower	
Type	Rotary Positive Displacement
Size	15 HP
Air scour rate	3.0 scfm/sf
Air Scour flow (1 filter)	429 scfm @ 4 psig
Backwash Flow Meter (FM-5)	
Type	**Transit Time**
Size	16 Inch
Range	0-17 MGD
Filter Effluent Flow Meter (FM-4)	
Type	**Transit Time**
Size	18 Inch
Range	0-23 MGD

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APPROVED: JGM

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STRUC REVIEW:
MECH REVIEW:

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Portland, Oregon 97223
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CITY OF MOLALLA
2008 NPDES PERMIT RENEWAL
Figure 3
DESIGN DATA 1

Disinfection (1980 Construction)

Type	150–pound gas cylinders
Chlorinator capacity	100 ppd
Feed rate, minimum	30 to 50 pounds / million gallons
Residual, minimum	2 mg/l
Chlorine Contact Chamber	
Sidewater depth	4 feet with 1 foot of freeboard
Volume	67,500 gallons
Length to width ratio	24

Outfall to Bear Creek (1980 Construction) – To Be Abandoned

Size and material	18–inch concrete
Length	270 feet
Single port	
Type	Perpendicular to streamflow
Stream gauge	
Type	Box culvert with 10' weir
Measurement	Manual staff guage

Effluent/Irrigation Pump Station (2000 Construction)

Pumps	
Type	Vertical turbine
No. Of pumps	2 + 1 future
Capacity	500–7,000 gpm
Motor horsepower	300 bhp
Motor control	VFD
Wet well	
Type	12–ft id manhole
Operating volume, pump 1 on to pump off	3,800 gal
Level control	Pressure transducer
Lift station (In Plant)	
Pump type	Submersible
No. Of pumps	2
Capacity, each pump	175 gpm at 15 ft tdh
Motor horsepower	3 bhp
Speed	1750 rpm
Wet well	6–ft ID manhole
Level control	Pressure transducer

Plant Standby Power Generator (2000 Construction)

Reliability Class	I
Location	Eff/Irr Pump Station
Type	Diesel Engine
Size	750 KW
Transfer Switch	Automatic

Plant Alarm System

Type	After Hours via Auto Telephone Dialer

Effluent/Irrigation Forcemain (2000 & 2006 Construction)

Material	PVC and HDPE
Size (Nominal Inside diameter)	24 inches
Length	27,000 feet (approx. entire length)
Capacity	
Design Capacity	10.1 mgd
Design Velocity	5.0 fps
Approx. Operating Range of Flows	1.0 to 4.0 mgd
Operating Velocities	0.5 to 2.0 fps

Discharge Monitoring Structure (2006 Construction)

Dechlorination (for surface water discharge conditions only)	
Feed Solution	Ascorbic Acid
Chemical Feed Pumps	2 – 13 gph (with 1000:1 Turndown)
Feed Control	Flow and Cl2 residual paced
Effluent Sampler:	
Type: Flow Paced or Time Composite	For Bacteria BOD, TSS, NH3, pH,
Continuous Monitoring/Recording:	
Temperature	Probe.
DO	Probe
Chlorine	Residual Analyzer (2)
Flow Measurement:	
Type	Electromagnetic Multi–port Insertion Type
Size	12–inch

Molalla River Outfall (2006 Construction)

Material (for outfall extension and diffuser)	HDPE
Size (Nominal ID)	24 inches
Length	23 feet
Diffuser Design	
Number of Ports	Three (Duckbill)
Diameter of Port	Eight inches
Minimum Summer Submergence	One Inch
Minimum Winter Submergence	12 Inches

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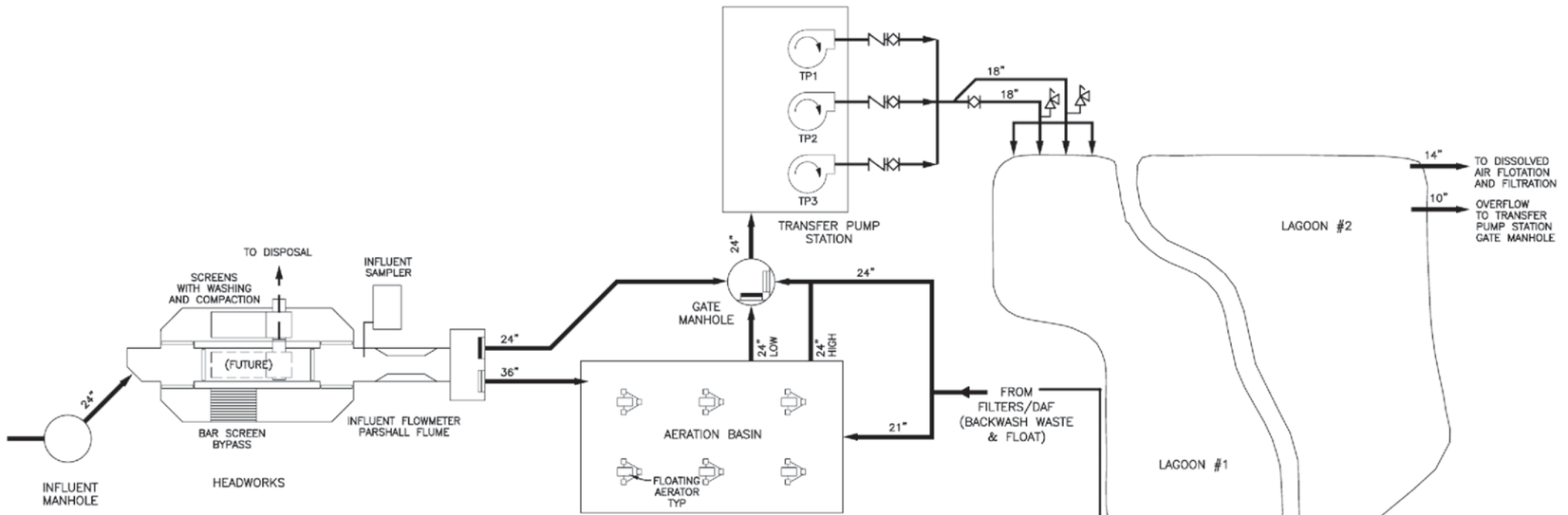
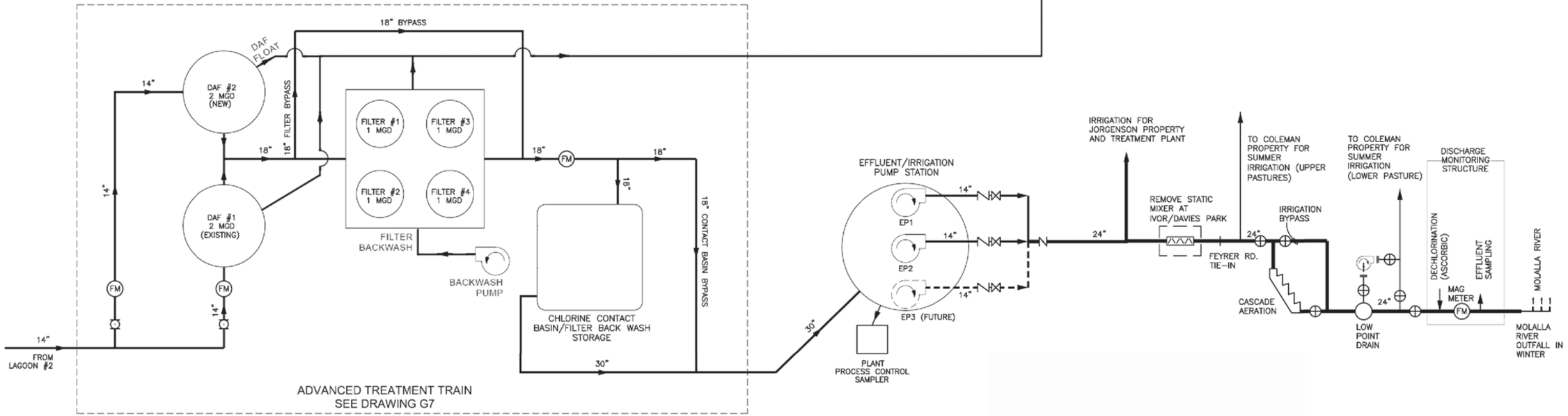
CITY OF MOLALLA
2008 NPDES PERMIT RENEWAL
Figure 4
DESIGN DATA 2

LEGEND

- AIR RELIEF VALVE
- CHECK VALVE
- BUTTERFLY VALVE
- PLUG VALVE, NORMALLY CLOSED
- PLUG VALVE, NOMRALLY OPEN
- BALL VALVE
- GATE VALVE
- VALVE MOTOR OPERATOR
- WAS PIPING
- PROCESS PIPING
- AIR, OTHER PIPING
- OPEN/CLOSE VALVE
- EXISTING FACILITIES
- BLOWER OR PUMP
- SLIDE GATE NORMALLY OPEN
- SLIDE GATE NORMALLY CLOSED
- STOP GATE
- FM FLOW METER





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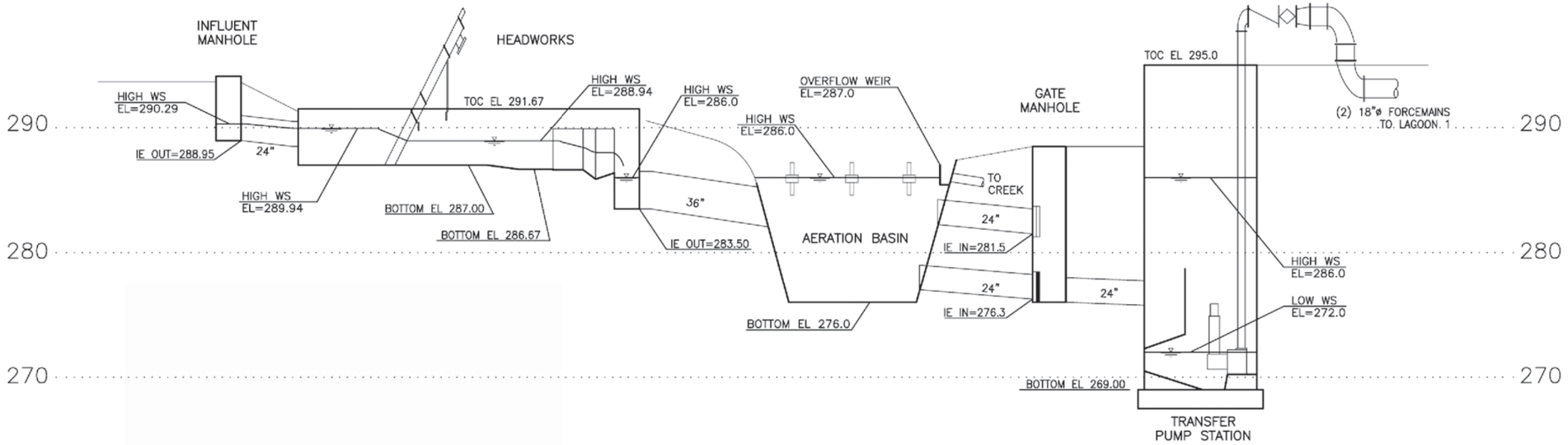
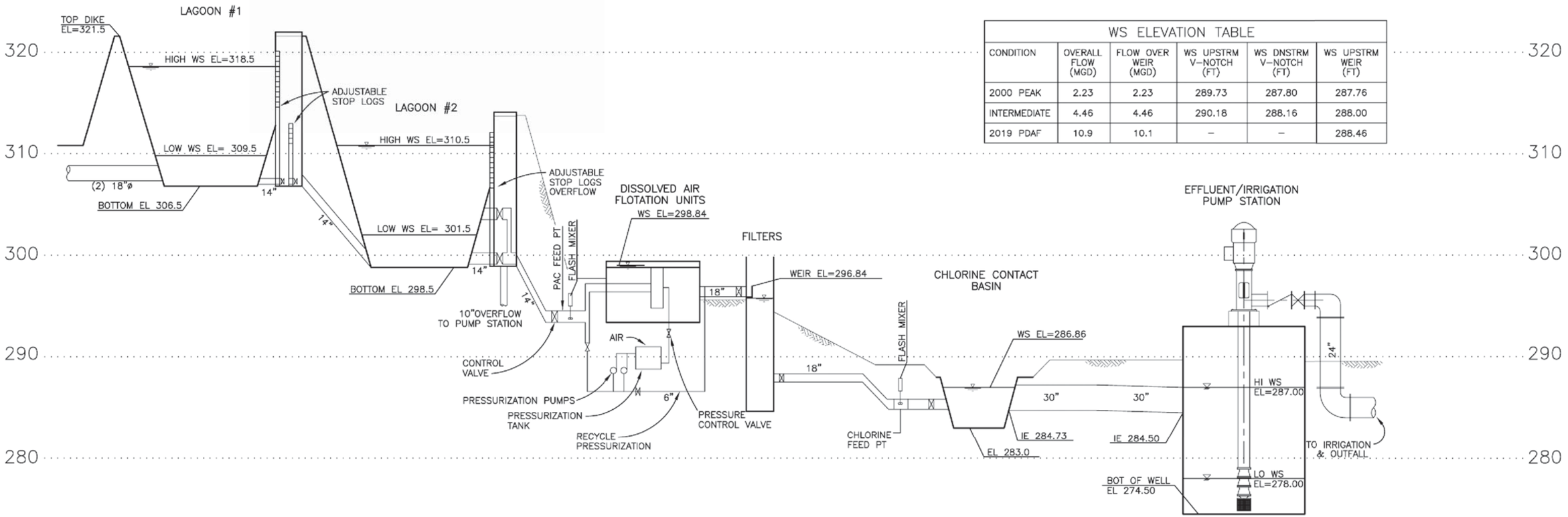
CITY OF MOLALLA
2008 NPDES PERMIT RENEWAL
Figure 5
PLANT SCHEMATIC





WS ELEVATION TABLE					
CONDITION	OVERALL FLOW (MGD)	FLOW OVER WEIR (MGD)	WS UPSTRM V-NOTCH (FT)	WS DNSTRM V-NOTCH (FT)	WS UPSTRM WEIR (FT)
2000 PEAK	2.23	2.23	289.73	287.80	287.76
INTERMEDIATE	4.46	4.46	290.18	288.16	288.00
2019 PDAF	10.9	10.1	–	–	288.46

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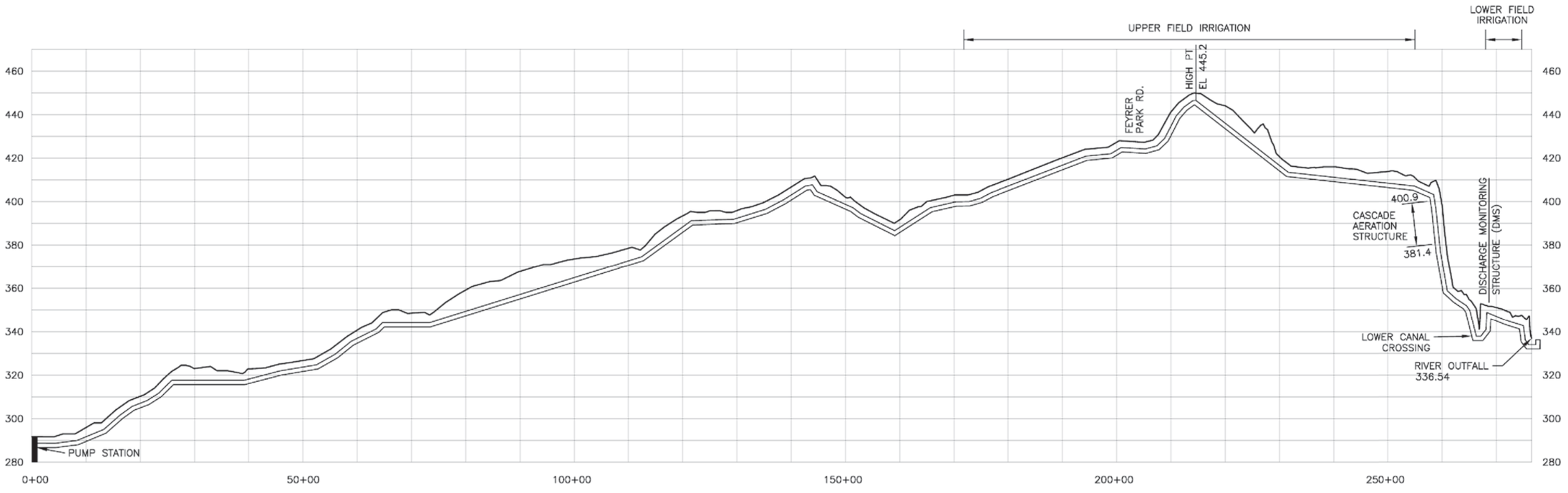
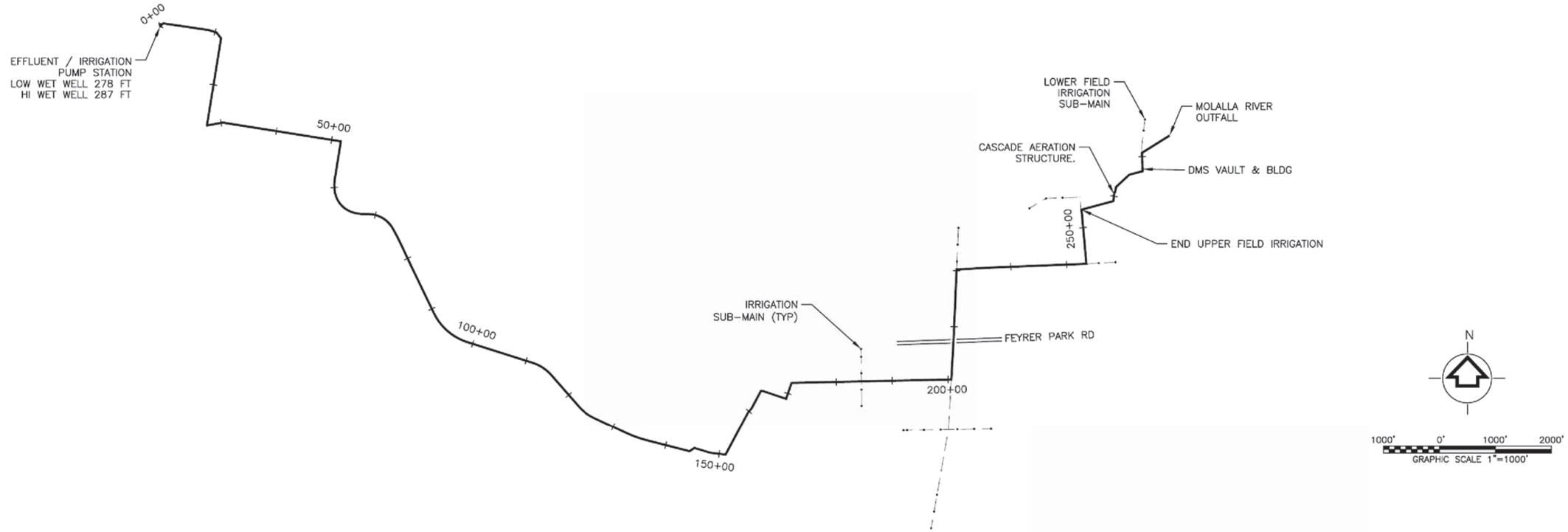
CITY OF MOLALLA
2008 NPDES PERMIT RENEWAL
Figure 6
HYDRAULIC PROFILE





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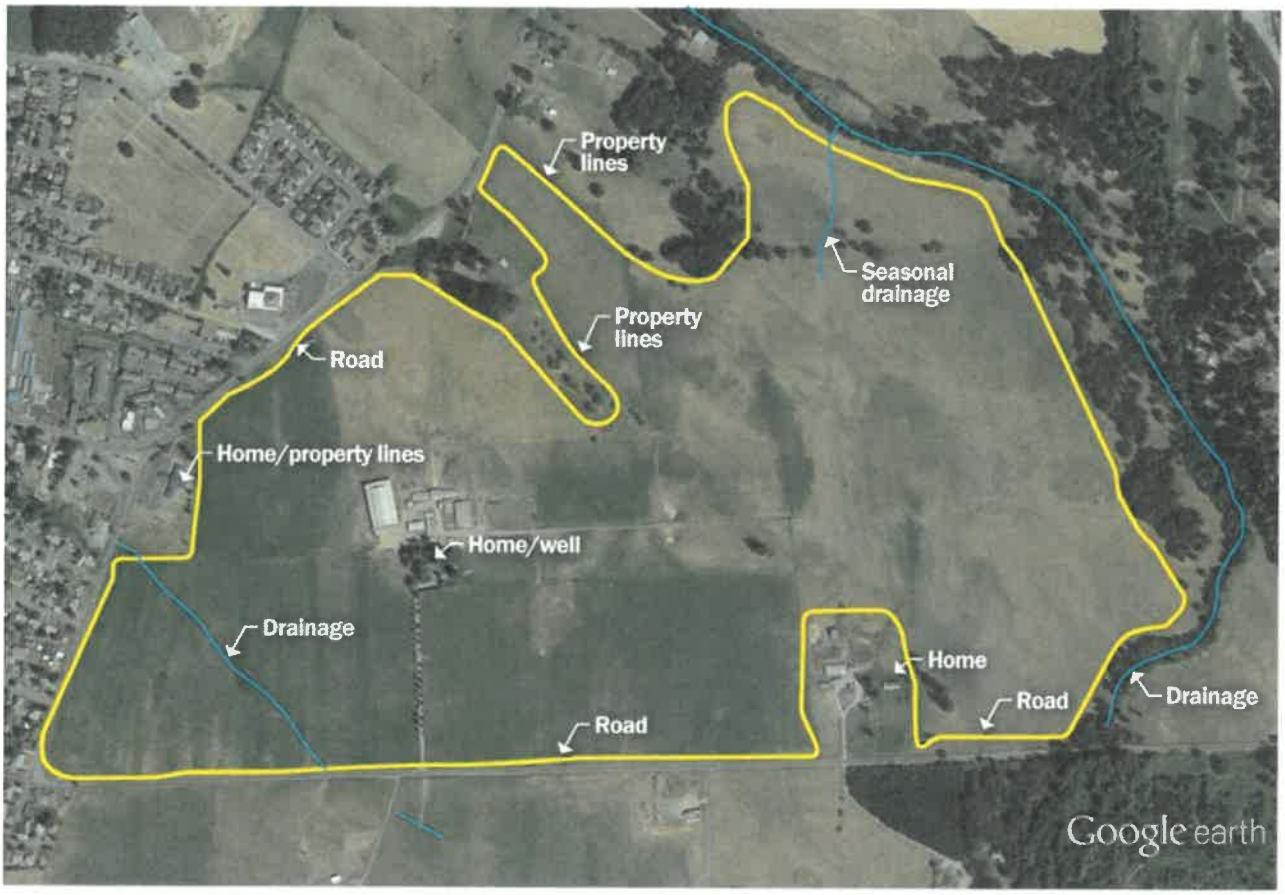
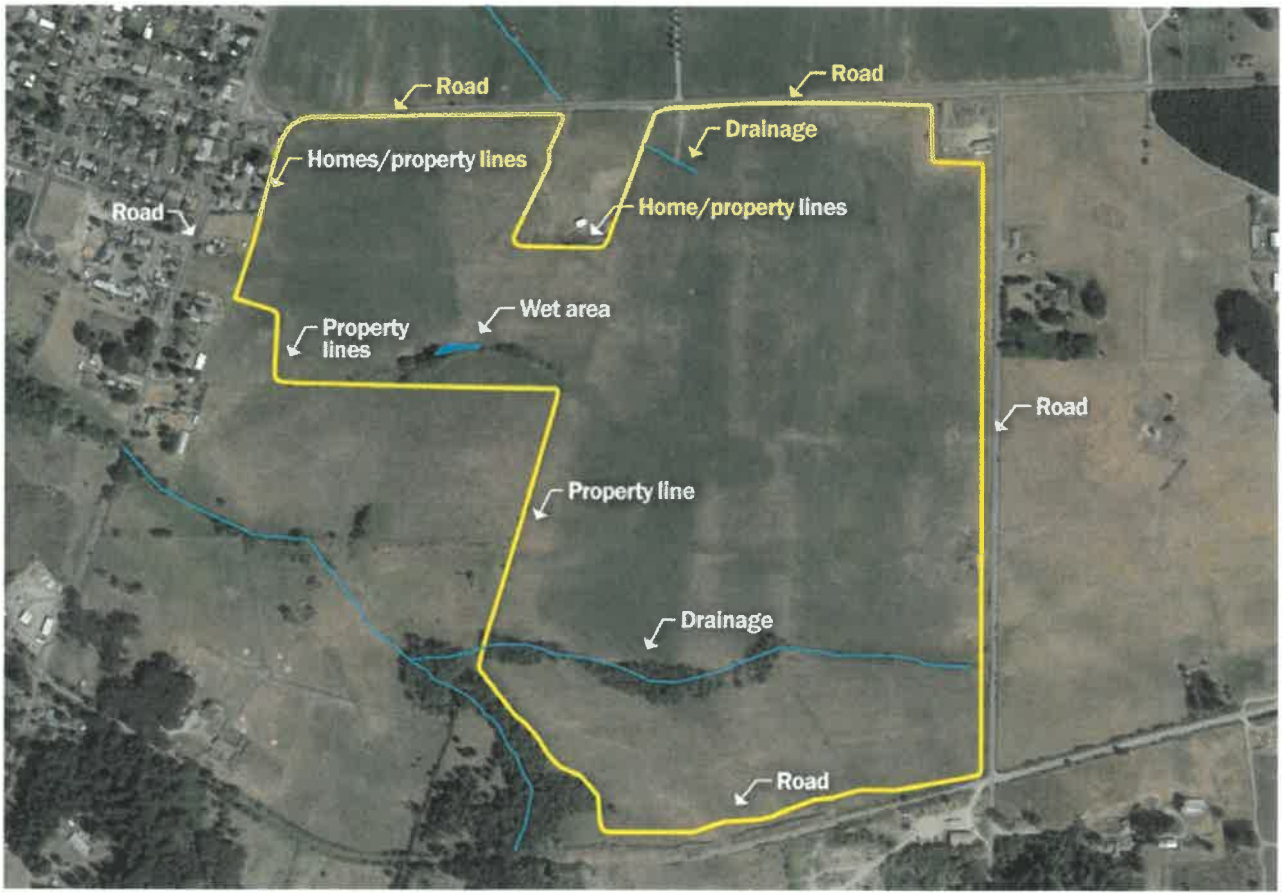
CITY OF MOLALLA
2008 NPDES PERMIT RENEWAL
Figure 7
EFFLUENT/IRRIGATION FORCE MAIN PLAN AND PROFILE

APPENDIX C: LAND APPLICATION SITE PLANS



Site plan for North Coleman Ranch located at 15151 South Feyrer Park Road, Molalla, Oregon 97038

THE DYER PARTNERSHIP ENGINEERS & PLANNERS	CITY OF MOLALLA - RWUP
DATE: NOV. 2017	NORTH COLEMAN RANCH SITE - "CLASS C" LAND APPLICATION PLAN
PROJECT NO.: 100.31	FIGURE # C.1



Site plan for South Coleman Ranch located at 15151 South Feyrer Park Road, Molalla, Oregon 97038

THE DYER PARTNERSHIP ENGINEERS & PLANNERS	*CITY OF MOLALLA - RWUP*	FIGURE #
DATE: NOV. 2017	*SOUTH COLEMAN RANCH SITE - "CLASS C" LAND APPLICATION PLAN*	*C.2*
PROJECT NO.: 100.31		

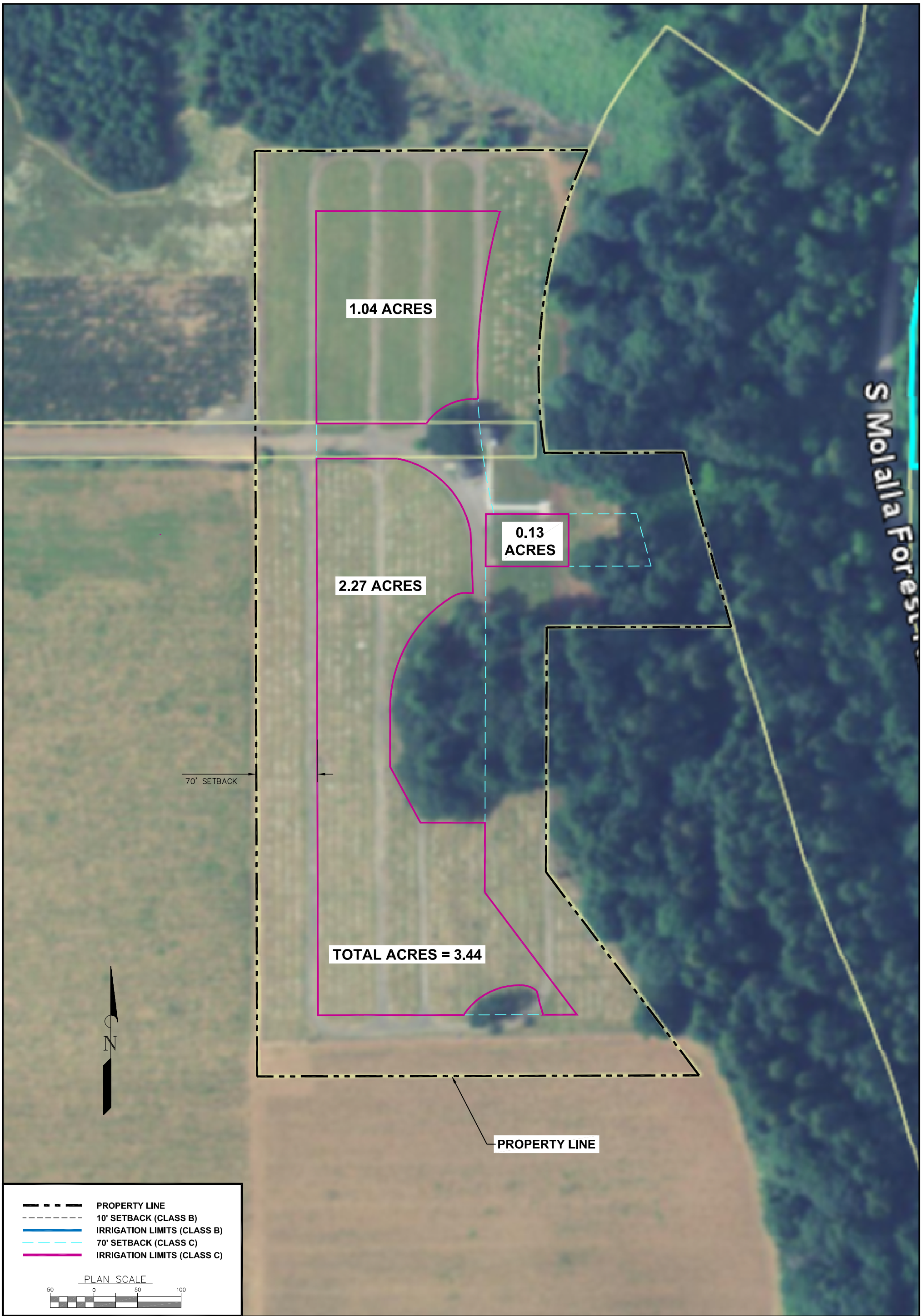
Site plan for the WWTP located at 12424 S. Tolliver Road, Molalla, Oregon 97038

PROPERTY LINE
10' SETBACK (CLASS B)
IRRIGATION LIMITS (CLASS B)
70' SETBACK (CLASS C)
IRRIGATION LIMITS (CLASS C)
CREEK OR DRAINAGE

PLAN SCALE
100 0 100 200

THE DYER PARTNERSHIP ENGINEERS & PLANNERS	*CITY OF MOLALLA - RWUP*	FIGURE #
DATE: NOV. 2017	*WWTP SITE - "CLASS C" LAND APPLICATION PLAN*	*C.3*
PROJECT NO.: 100.31		

Site plan for the Cemetery site located at the termination of South Adams Cemetery Road, Molalla, Oregon 97038



THE DYER PARTNERSHIP ENGINEERS & PLANNERS	CITY OF MOLALLA - RWUP	FIGURE #
DATE: NOV. 2017	CEMETERY SITE - "CLASS C" LAND APPLICATION PLAN	C. 4
PROJECT NO.: 100.31		

APPENDIX D: TAX LOT AND LEGAL DESCRIPTIONS

Molalla RWUP Amendment
Project No. 100.31

Tax Lots

Site	Township	Range	Section	Parcel Number	Tax Lot Acres	Owner Name	Owner Address	City	State	Zip Code	Zoning
North Coleman	05-S	02-E	10	3104	27.99	Coleman Corrals, Inc.	15151 Feyrer Park Road	Molalla	OR	97038	Exclusive Farm Use
North Coleman	05-S	02-E	10	3106	20.37	Coleman Corrals, Inc.	15151 Feyrer Park Road	Molalla	OR	97039	Exclusive Farm Use
North Coleman	05-S	02-E	10	3101	5.18	Coleman Corrals, Inc.	15151 Feyrer Park Road	Molalla	OR	97040	Exclusive Farm Use
North Coleman	05-S	02-E	10	3105	129.54	Coleman Corrals, Inc.	15151 S Feyrer Park Road	Molalla	OR	97041	Exclusive Farm Use
North Coleman	05-S	02-E	10	3100	112.1	Coleman Corrals, Inc.	15151 S Feyrer Park Road	Molalla	OR	97042	Exclusive Farm Use
North Coleman	05-S	02-E	10	3190	30	Coleman Corrals, Inc.	15151 S Feyrer Park Road	Molalla	OR	97043	Exclusive Farm Use
North Coleman	05-S	02-E	10	3107	45.56	Coleman Corrals, Inc.	15151 S Feyrer Park Road	Molalla	OR	97044	Exclusive Farm Use
North Coleman	05-S	02-E	9D	2100	25.88	Coleman Corrals, Inc.	15151 S Feyrer Park Road	Molalla	OR	97045	Exclusive Farm Use
South Coleman	05-S	02-E	16	100	19.63	Coleman Corrals, Inc.	15152 S Feyrer Park Road	Molalla	OR	97046	Exclusive Farm Use
South Coleman	05-S	02-E	16	601	23.33	Coleman Corrals, Inc.	15153 S Feyrer Park Road	Molalla	OR	97047	Exclusive Farm Use
South Coleman	05-S	02-E	15	704	166.37	Coleman Steve D & Cathy	15154 S Feyrer Park Road	Molalla	OR	97048	Exclusive Farm Use
Cemetery	05-S	02-E	22	600	9.22	Adams Cemetery Assoc.	PO Box 209	Molalla	OR	97049	Exclusive Farm Use
WWTP	05-S	02-E	7	1201	48.76	City of Molalla	PO Box 248	Molalla	OR	97050	City Zoning
WWTP	05-S	02-E	7	1300	8.87	City of Molalla	PO Box 248	Molalla	OR	97051	City Zoning

Tax Lot Map for North Coleman Ranch

Tax Lot Map for South Coleman Ranch

Tax Lot Map for the Cemetery Site

Tax Lot Map for WWTP Site

APPENDIX E: OREGON WATER RESOURCES DEPARTMENT REGISTRATIONS

CITY OF MOLALLA
DEPARTMENT OF PUBLIC WORKS
117 N Molalla Ave PO Box 248 Molalla Or 97038
Phone (503) 829-6855 Fax (503) 829-3676 e-mail dpw @ molalla . net

May 2, 2005

O W R D
ATTEN: Mr. Bill Fujii
725 Summer Street NE Suite A
Salem Or, 97301-1271

Re: Registration of Reclaimed Municipal Water Use

Dear Mr. Fujii,

Enclosed please find "Registration of Reclaimed Municipal Water Use" form for the Steve Coleman ranch here in Molalla.

If you need anything further, please advise.

Sincerely Yours,

Dean Madison
Public Works Director

Cc; Jerry Minor, TetraTeck KCM

52
Registration No.
(Dept. Use Only)

Oregon Water Resources Department

Registration of Reclaimed Municipal Water Use

"Reclaimed water" means water that has been used for municipal purposes and after such use has been treated in a sewage treatment system and that, as a result of treatment, is suitable for a direct beneficial purpose or a controlled use that could not otherwise occur. (ORS 537.131 and 537.132)

NOTE: *Please type or print in dark ink. If your registration is found to be incomplete or inaccurate, we will return it to you. If any requested information does not apply to your registration, insert "n/a."*

✓ ***Registrant(s)*** Steve and Cathy Coleman
(owner of the land where reclaimed water is to be used)

Mailing Address 15151 Feyrer Park Road

Molalla (*City*) OR (*State*) 97038 (*Zip*) 503- 829-3140 (*Daytime Telephone No.*)

1. Municipal Discharge Permit

✓ *NPDES* *Permit No.* 101514 *Effective Date* 4/21/04 *Expiration Date* 12/31/08

WPCF *Permit No.* _____ *Effective Date* _____ *Expiration Date* _____

✓ *Date use of Reclaimed Water began, or is scheduled to begin* May, 2001

Annual Period of Use: *from* May *to* November

2. Supplier of the Municipal Water which produces the Reclaimed Water

If more than one supplier is used, please provide a list in the ***Remarks*** *section on page 4.*

Name of Supplier City of Molalla

Address PO Box 248, Molalla OR 97038

Telephone No. 503-829-6855 *Fax No.* 503-829-3676

Original Source of Municipal Supply Molalla River

3. Supplier of Reclaimed Water

✓ *Name of Supplier* City of Molalla

Name of Facility Molalla Wastewater Treatment Plant

Street Address of Facility 12424 Toliver Road, Molalla OR 97038

Name of Facility Owner City of Molalla

Address of Facility Owner Above

Telephone No. of Supplier Above *Telephone No. of Facility* 503-829-5407

Fax No. _____

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WATER RESOURCES DEPT
SALEM, OREGON

- 4. User of Reclaimed Water

Name of Water User Steve and Cathy Coleman

Address 15151 Feyrer Park Road

Telephone No. 503-829-3140 *Fax No.* _____

- 5. Agreement/Contract

Period of Agreement and Contract 12/30/1999 (Date of Contracts)

Term of Agreement 12/30/1999 to 11/1/2025

Special Limitations _____

- 6. Total Amount of Reclaimed Water

Enter the amount to be applied to beneficial use:

_____ *cubic feet per second, OR* up to 2000 *gallons per minute*

If reclaimed water is to be used from more than one treatment facility, give the quantity from each.

- 7. Intended Use(s) of Reclaimed Water

Land Application on primarily pasture land.

(If for more than one use, give the quantity of reclaimed water from each treatment facility for each use.)

*If for **IRRIGATION**, or other land application, state the **TOTAL** number of acres to receive reclaimed water under each use;*

Irrigation 190 acres

Other (describe) _____

(Temperature Control, Mitigation, Wetland, etc.)

- 8. Description of Delivery System

Include dimensions and type of construction of diversion works, length and dimensions of supply ditches or pipelines, size and type of pump and motor. If for irrigation, describe the type of system (i.e., flood, wheel line, hand line, drip, other).

Supply pipeline is approximately 27,000 lf of 24-inch diameter.

Supply pumps are vertical turbine pumps, driven by 300 HP electric motors.

- 9. Existing Water Rights

Please provide a description of all the existing water rights appurtenant to the lands where the reclaimed water will be applied.

Application No. _____ *Permit No.* 204

Certificate No. _____ *Decree vol & pg* _____

(Only one number needs to be provided. Attach a separate list if more than one water right is involved.)

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MAY 0 4 2005
WATER RESOURCES DEPT
SALEM, OREGON

10. Property Ownership

Do you own all the land where you propose to divert, transport and use water?

☑ Yes *(Skip to section no. 11 "Historic Disposal Method")*

☐ No *(Please check the appropriate box below and, in the **Remarks** section, list the names and addresses of all affected landowners.**)*

- ☐ *I have a recorded easement or written authorization permitting access.*
- ☐ *I do not currently have written authorization or an easement permitting access.*

***If more than 25 landowners are involved, a list is not required. Contact WRD for instructions.*

11. Historic Disposal Method

Has the reclaimed water being registered in this process been discharged into a natural watercourse for 5 or more years?

☑ No *(Skip to section no. 12 "Signature")*

☐ Yes *(Please answer the following questions)*

a) Name of the receiving natural watercourse: _____

b) Description of the location where the discharge historically entered the natural watercourse: _____

_____

c) Does the amount of reclaimed water proposed for use under this registration represent 50% or more of the total average daily flow of the natural watercourse? ☐ Yes ☐ No

12. Signature

I/We certify that the information provided in this application is an accurate representation of the proposed reclaimed water use and is true and correct to the best of my knowledge:

Steve Coleman 4/15/05 — Signature of Registrant / Date

Dean Madesen 4-15-05 — Supplier's Signature / Date

Owner — Title

Public Works Director, City of Molalla — Title / Date

Signature of Co-Registrant

4/18/05 — DEQ Signature / Date

DEQ/NWR

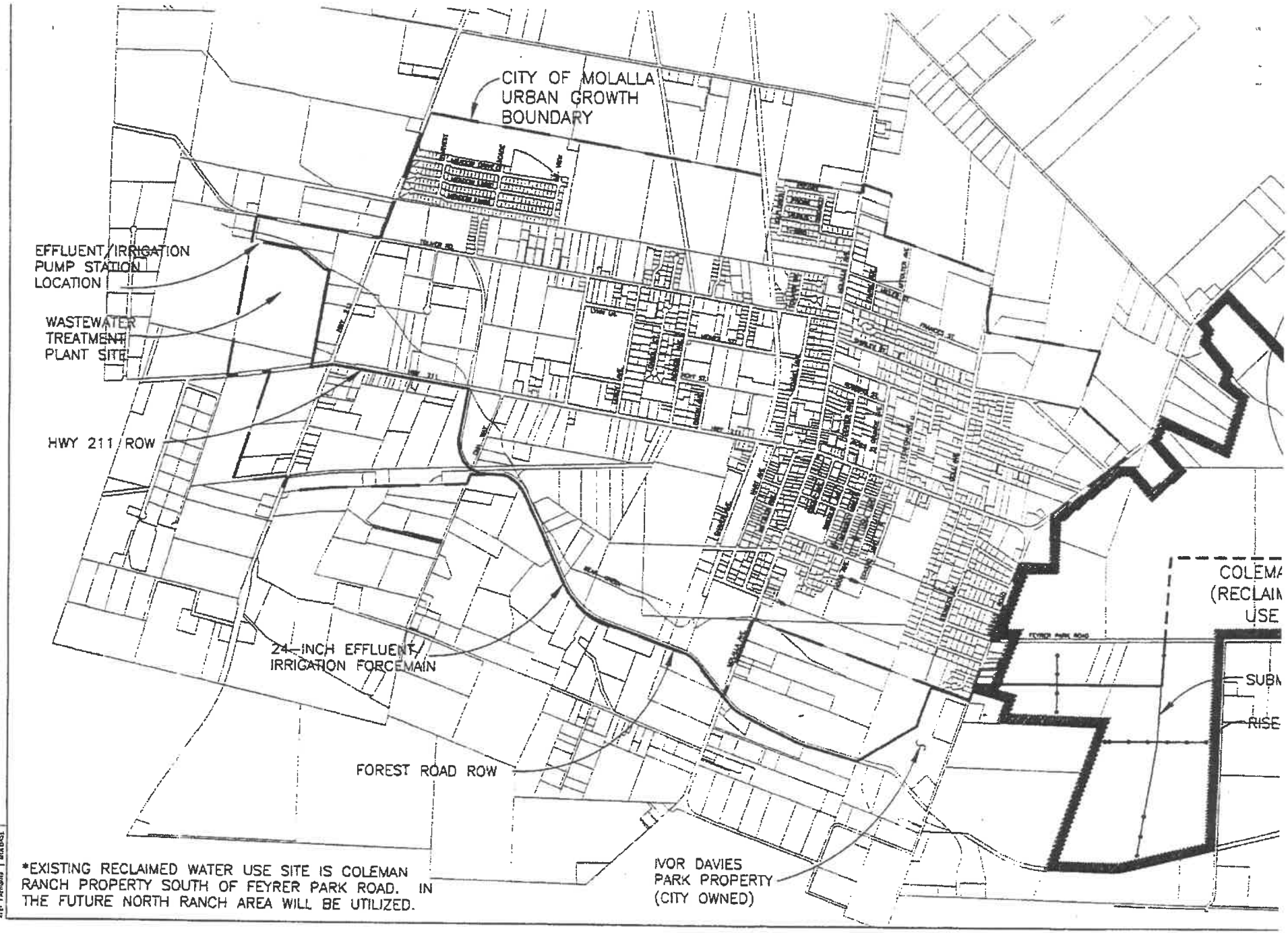
NOTE: This registration must be accompanied by a map which shows the location of the treatment plant, approximate location of conveyance system (pipelines, canals, etc.) and place of use. The map must be drawn to scale with the scale stated on the map. The land area where the reclaimed water is to be applied shall be identified on the map. Topographic maps with the facilities and place of use shown will meet the map requirement.

RECEIVED
MAY 04 2005
WATER RESOURCES DEPT
SALEM, OREGON

Remarks

No. 10. Conveyance to the Reclaimed Water Use Site is located in Public ROW or City owned property from the Treatment Plant to the Reused Site.

No. 11. No summer/dry weather Reclaimed Water has been discharged into a water course for more than 25 years.



TETRA TECH/KCM
7080 SW Fir Loop
Portland, Oregon 97223

CITY OF MOLALLA

EFFLUENT IRRIGATION

FORCE
SEC

Oregon Water Resources Department

Registration No. *(Dept. Use Only)*

Registration of Reclaimed Municipal Water Use

"Reclaimed water" means water that has been used for municipal purposes and after such use has been treated in a sewage treatment system and that, as a result of treatment, is suitable for a direct beneficial purpose or a controlled use that could not otherwise occur. (ORS 537.131 and 537.132)

NOTE: *Please type or print in dark ink. If your registration is found to be incomplete or inaccurate, we will return it to you. If any requested information does not apply to your registration, insert "n/a."*

Registrant(s) Adams Cemetery Association (Managed by Dennis Kyllo)
(owner of the land where reclaimed water is to be used)

Mailing Address 32891 S. Sawtell Rd. Molalla, OR 97038

Molalla	OR	97038	503-781-5534
City	*State*	*Zip*	*Daytime Telephone No.*

1. Municipal Discharge Permit

NPDES Permit No. 101514 *Effective Date* 12/11/2009 *Expiration Date* 3/31/2013*

WPCF Permit No. _____ *Effective Date* _____ *Expiration Date* _____

Date use of Reclaimed Water began, or is scheduled to begin Immediately after approval

Annual Period of Use: from May *to* November

2. Supplier of the Municipal Water which produces the Reclaimed Water

If more than one supplier is used, please provide a list in the ***Remarks*** *section on page 4.*

Name of Supplier City of Molalla

Address P.O. Box 248 Molalla, OR 97038

Telephone No. 503-829-6855 *Fax No.* 503-829-3676

Original Source of Municipal Supply Molalla River

3. Supplier of Reclaimed Water

Name of Supplier City of Molalla

Name of Facility City of Molalla Wastewater Treatment Plant

Street Address of Facility 12424 S. Toliver rd. Molalla, OR 97038

Name of Facility Owner City of Molalla

Address of Facility Owner P.O. Box 248 Molalla, OR 97038

Telephone No. of Supplier 503-829-6855 *Telephone No. of Facility* 503-829-5407

Fax No. 503-829-4298

4. User of Reclaimed Water

Name of Water User Adams Cemetery

Address Clackamas County T5S R2E Sec22 00600 (No Site Address)

Telephone No. 503-781-5534 *Fax No.* _____

5. Agreement/Contract

Period of Agreement and Contract 5/19/2008-11/1/2032

Term of Agreement Water is provided as long as the terms and conditions RWUP and the permit are met.

Special Limitations Water availability is limited to the reuse operating season (when the WWTP is discharging to outfall 002).

6. Total Amount of Reclaimed Water

Enter the amount to be applied to beneficial use:

_____ *cubic feet per second, OR* 500 (based on availability) *gallons per minute*

If reclaimed water is to be used from more than one treatment facility, give the quantity from each.

7. Intended Use(s) of Reclaimed Water

Irrigation

(If for more than one use, give the quantity of reclaimed water from each treatment facility for each use.)

*If for **IRRIGATION**, or other land application, state the **TOTAL** number of acres to receive reclaimed water under each use;*

Irrigation 8.2

Other (describe) _____

(Temperature Control, Mitigation, Wetland, etc.)

8. Description of Delivery System

Include dimensions and type of construction of diversion works, length and dimensions of supply ditches or pipelines, size and type of pump and motor. If for irrigation, describe the type of system (i.e., flood, wheel line, hand line, drip, other).

A 4 inch line is tied into the irrigation at the Coleman Ranch. It is pumped up to cemetery with a 20 hp centrifugal pump. It is irrigated by sprinkler irrigation.

9. Existing Water Rights

Please provide a description of all the existing water rights appurtenant to the lands where the reclaimed water will be applied.

Application No. _____ *Permit No.* _____

Certificate No. _____ *Decree vol & pg* _____

(Only one number needs to be provided. Attach a separate list if more than one water right is involved.)

-10. Property Ownership

Do you own all the land where you propose to divert, transport and use water?

☑ Yes *(Skip to section no. 11 "Historic Disposal Method")*

☐ No *(Please check the appropriate box below and, in the Remarks section, list the names and addresses of all affected landowners.**)*

- ☐ *I have a recorded easement or written authorization permitting access.*
- ☐ *I do not currently have written authorization or an easement permitting access.*

***If more than 25 landowners are involved, a list is not required. Contact WRD for instructions.*

-11. Historic Disposal Method

Has the reclaimed water being registered in this process been discharged into a natural watercourse for 5 or more years?

☑ No *(Skip to section no. 12 "Signature")*

☐ Yes *(Please answer the following questions)*

a) Name of the receiving natural watercourse: _____

b) Description of the location where the discharge historically entered the natural watercourse: _____

_____

c) Does the amount of reclaimed water proposed for use under this registration represent 50% or more of the total average daily flow of the natural watercourse? ☐ Yes ☐ No

-12. Signature

I/We certify that the information provided in this application is an accurate representation of the proposed reclaimed water use and is true and correct to the best of my knowledge:

J. K. 10/14/13
Signature of Registrant *Date*

[signature] 10/14/13
Supplier's Signature *Title* *Date*

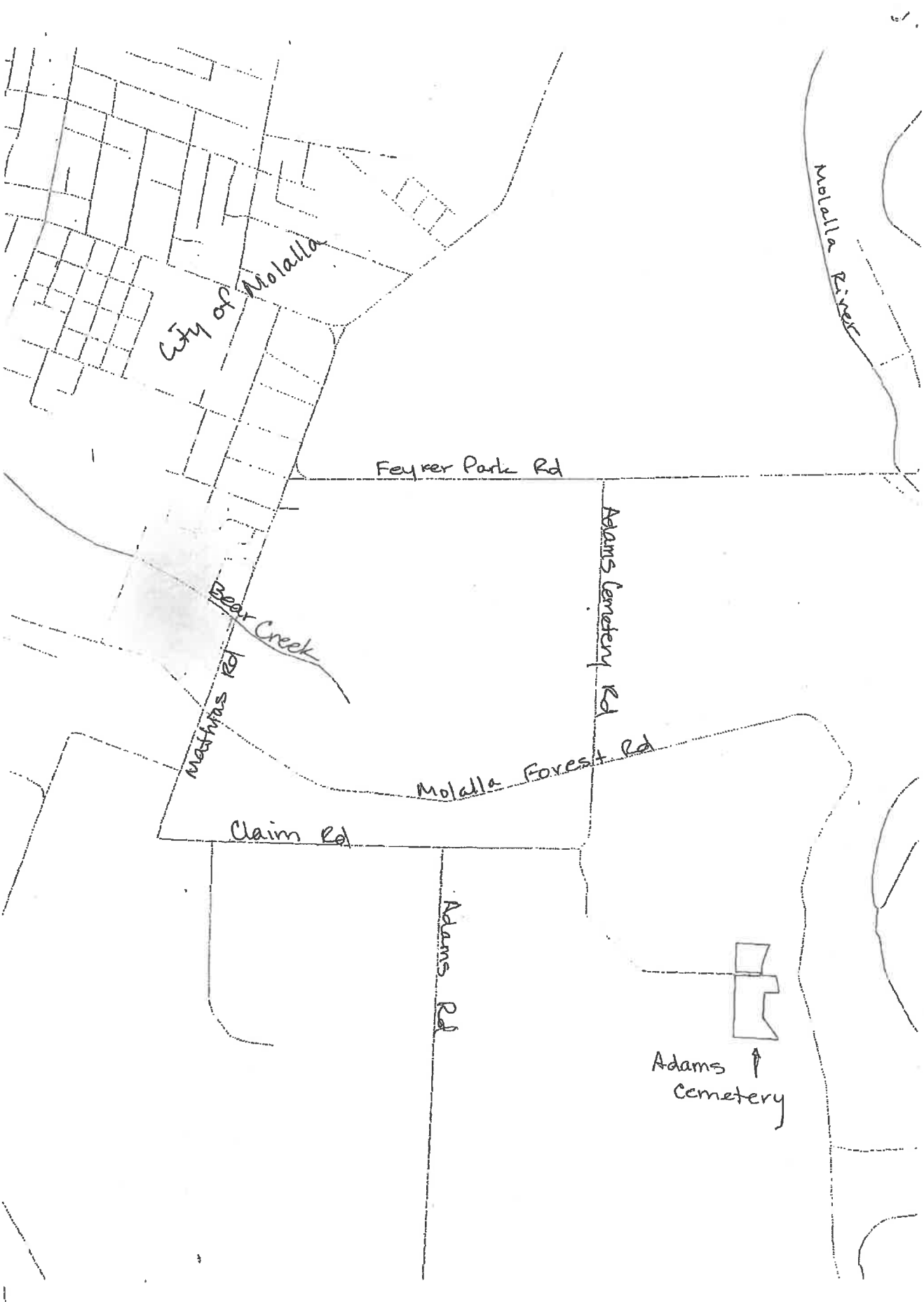
Wastewater Treatment Plant Operator
Signature of Co-Registrant *Title* *Date*

Connie Schwandt 10/16/2013
DEQ Signature *Date*

NOTE: This registration must be accompanied by a map which shows the location of the treatment plant, approximate location of conveyance system (pipelines, canals, etc.) and place of use. The map must be drawn to scale with the scale stated on the map. The land area where the reclaimed water is to be applied shall be identified on the map. Topographic maps with the facilities and place of use shown will meet the map requirement.

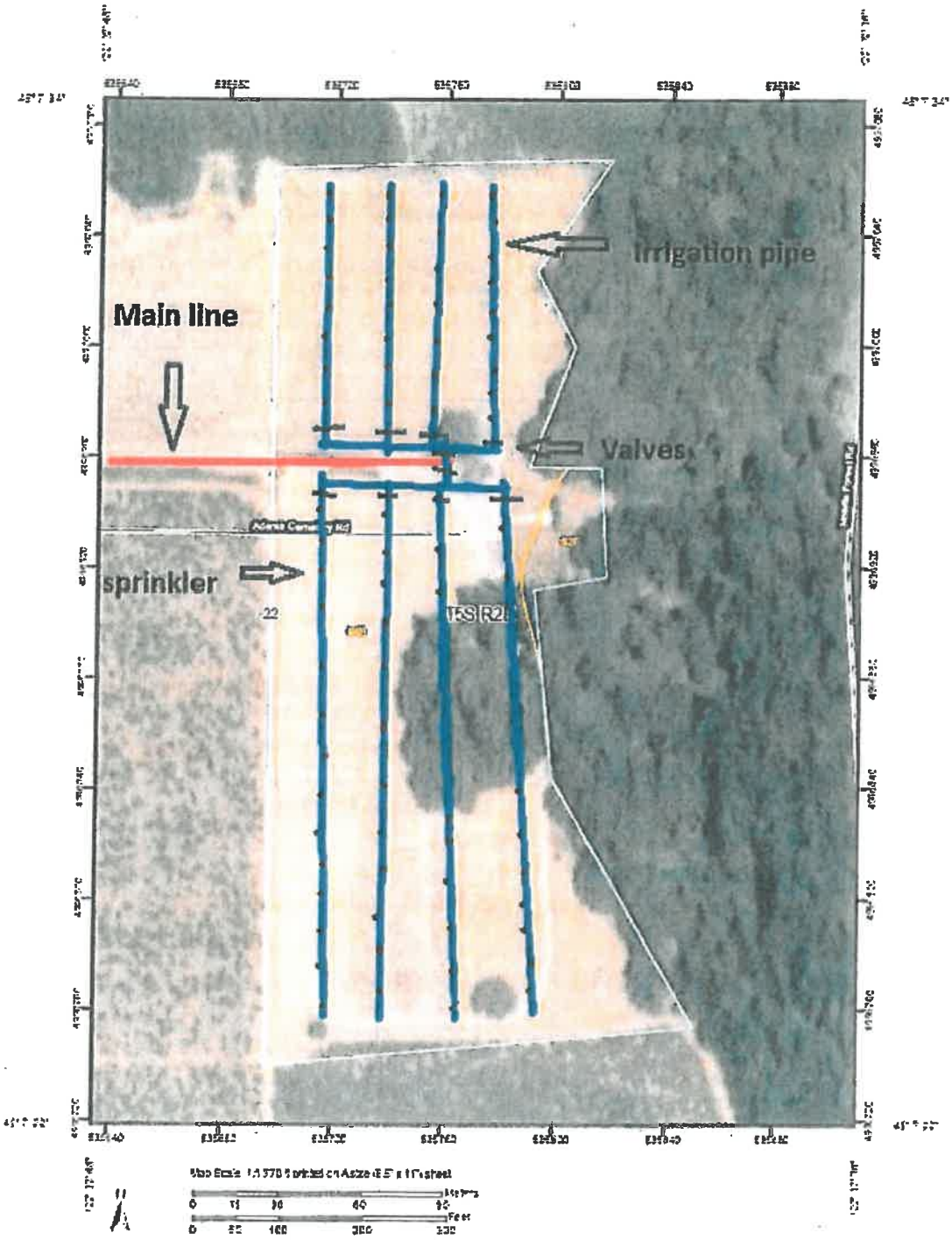
Remarks

* NPDES permit expiration date has been extended by DEQ until the permit is renewed.


City of Molalla
Molalla River
Feyrer Park Rd
Adams Cemetery Rd
Bear Creek
Mathias Rd
Molalla Forest Rd
Claim Rd
Adams Rd
Adams Cemetery

Attachment 1

Soil Map—Clackamas County Area, Oregon



Oregon Water Resources Department

Registration No. (Dept. Use Only)

Registration of Reclaimed Municipal Water Use

"Reclaimed water" means water that has been used for municipal purposes and after such use has been treated in a sewage treatment system and that, as a result of treatment, is suitable for a direct beneficial purpose or a controlled use that could not otherwise occur. (ORS 537.131 and 537.132)

NOTE: *Please type or print in dark ink. If your registration is found to be incomplete or inaccurate, we will return it to you. If any requested information does not apply to your registration, insert "n/a."*

Registrant(s) City of Molalla
(owner of the land where reclaimed water is to be used)

Mailing Address P.O. Box 248

Molalla (City) OR (State) 97038 (Zip) 503-829-6855 (Daytime Telephone No.)

1. Municipal Discharge Permit

NPDES Permit No. 101514 *Effective Date* 12/11/2009 *Expiration Date* 3/31/2013*

WPCF Permit No. _____ *Effective Date* _____ *Expiration Date* _____

Date use of Reclaimed Water began, or is scheduled to begin 1980

Annual Period of Use: from May *to* November

2. Supplier of the Municipal Water which produces the Reclaimed Water

If more than one supplier is used, please provide a list in the Remarks section on page 4.

Name of Supplier City of Molalla

Address Molalla Forest Road Molalla, OR

Telephone No. 503-829-5408 *Fax No.* 503-829-7709

Original Source of Municipal Supply Molalla River

3. Supplier of Reclaimed Water

Name of Supplier City of Molalla

Name of Facility City of Molalla Wastewater Treatment Plant

Street Address of Facility 12424 S. Toliver Rd. Molalla OR

Name of Facility Owner City of Molalla

Address of Facility Owner P.O. Box 248 Molalla, OR

Telephone No. of Supplier 503-829-6855 *Telephone No. of Facility* 503-829-5407

Fax No. 503-829-4208

4. User of Reclaimed Water

Name of Water User City of Molalla Wastewater Treatment Plant

Address 12424 S. Toliver Rd. Molalla, OR 97038

Telephone No. 503-829-5407 *Fax No.* 503-829-4298

5. Agreement/Contract

Period of Agreement and Contract _____

Term of Agreement _____

Special Limitations _____

6. Total Amount of Reclaimed Water

Enter the amount to be applied to beneficial use:

_____ *cubic feet per second, OR* 300 *gallons per minute*

If reclaimed water is to be used from more than one treatment facility, give the quantity from each.

7. Intended Use(s) of Reclaimed Water

Irrigation

(If for more than one use, give the quantity of reclaimed water from each treatment facility for each use.)

*If for **IRRIGATION**, or other land application, state the **TOTAL** number of acres to receive reclaimed water under each use;*

Irrigation 20

Other (describe) _____

(Temperature Control, Mitigation, Wetland, etc.)

8. Description of Delivery System

Include dimensions and type of construction of diversion works, length and dimensions of supply ditches or pipelines, size and type of pump and motor. If for irrigation, describe the type of system (i.e., flood, wheel line, hand line, drip, other).

We use pressure off the main effluent line. 24 inch forced main driven by one of two 300 hp pumps.

There is a 2 inch line tapped in that runs the plant sprinklers. The lawn is irrigated by a 5hp pump that runs a system of pop up sprinklers.

There is an additional 30 hp pump that can be used to irrigate a portion of the property.

9. Existing Water Rights

Please provide a description of all the existing water rights appurtenant to the lands where the reclaimed water will be applied.

Application No. _____ *Permit No.* _____

Certificate No. _____ *Decree vol & pg* _____

(Only one number needs to be provided Attach a separate list if more than one water right is involved.)

10. Property Ownership

Do you own all the land where you propose to divert, transport and use water?

☑ Yes *(Skip to section no. 11 "Historic Disposal Method")*

☐ No *(Please check the appropriate box below and, in the **Remarks** section, list the names and addresses of all affected landowners.**)*

- ☐ *I have a recorded easement or written authorization permitting access.*
- ☐ *I do not currently have written authorization or an easement permitting access.*

***If more than 25 landowners are involved, a list is not required. Contact WRD for instructions.*

11. Historic Disposal Method

Has the reclaimed water being registered in this process been discharged into a natural watercourse for 5 or more years?

☑ No *(Skip to section no. 12 "Signature")*

☐ Yes *(Please answer the following questions)*

a) Name of the receiving natural watercourse: _____

b) Description of the location where the discharge historically entered the natural watercourse: _____

_____

c) Does the amount of reclaimed water proposed for use under this registration represent 50% or more of the total average daily flow of the natural watercourse? ☐ Yes ☐ No

12. Signature

I/We certify that the information provided in this application is an accurate representation of the proposed reclaimed water use and is true and correct to the best of my knowledge:

City of Molalla — *Signature of Registrant* — *Date*

Supplier's Signature — *Date*

Signature of Co-Registrant — *Title*: Wastewater Treatment Plant Operator — *Date*

DEQ Signature — *Date*: 10/10/2013

NOTE: This registration must be accompanied by a map which shows the location of the treatment plant, approximate location of conveyance system (pipelines, canals, etc.) and place of use. The map must be drawn to scale with the scale stated on the map. The land area where the reclaimed water is to be applied shall be identified on the map. Topographic maps with the facilities and place of use shown will meet the map requirement.

Remarks

* NPDES permit expiration date has been extended by DEQ until the permit is renewed.

APPENDIX F: NRCS SOILS REPORT

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Clackamas County Area, Oregon

July 18, 2014

Custom Soil Resource Report
Soil Map

Map Scale: 1:9,910 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 450 900 1800 2700

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 8, Dec 4, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
17	Clackamas silt loam	11.1	3.9%
29	Dayton silt loam	22.3	7.8%
79B	Sawtell silt loam, 0 to 8 percent slopes	242.0	84.8%
79C	Sawtell silt loam, 8 to 15 percent slopes	9.8	3.4%
Totals for Area of Interest		**285.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that

have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Clackamas County Area, Oregon

17—Clackamas silt loam

Map Unit Setting

Elevation: 150 to 700 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Clackamas and similar soils: 85 percent
Minor components: 4 percent

Description of Clackamas

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed gravelly alluvium

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 36 inches: silty clay loam
H3 - 36 to 60 inches: extremely gravelly silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.9 inches)

Interpretive groups

Farmland classification: Prime farmland if drained
Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D

Minor Components

Conser

Percent of map unit: 4 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

29—Dayton silt loam

Map Unit Setting

Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Dayton, thick surface, and similar soils: 90 percent
Minor components: 5 percent

Description of Dayton, Thick Surface

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 21 inches: silty clay loam
H3 - 21 to 60 inches: clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance
Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D

Minor Components

Concord

Percent of map unit: 3 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear

Huberly

Percent of map unit: 2 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

79B—Sawtell silt loam, 0 to 8 percent slopes

Map Unit Setting

Elevation: 150 to 500 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Sawtell and similar soils: 90 percent
Minor components: 4 percent

Description of Sawtell

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Old gravelly alluvium

Typical profile

H1 - 0 to 13 inches: silt loam
H2 - 13 to 20 inches: gravelly clay loam
H3 - 20 to 43 inches: very gravelly clay loam
H4 - 43 to 60 inches: very gravelly clay

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w

Hydrologic Soil Group: C

Minor Components

Dayton

Percent of map unit: 3 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Concord

Percent of map unit: 1 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

79C—Sawtell silt loam, 8 to 15 percent slopes

Map Unit Setting

Elevation: 150 to 500 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Sawtell and similar soils: 90 percent
Minor components: 2 percent

Description of Sawtell

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Old gravelly alluvium

Typical profile

H1 - 0 to 13 inches: silt loam
H2 - 13 to 20 inches: gravelly clay loam
H3 - 20 to 43 inches: very gravelly clay loam
H4 - 43 to 60 inches: very gravelly clay

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)

Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C

Minor Components

Concord

Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Clackamas County Area, Oregon

July 15, 2014

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 8, Dec 4, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
64B	Nekia silty clay loam, 2 to 8 percent slopes	7.4	98.0%
92F	Xerochrepts and Haploxerolls, very steep	0.1	2.0%
Totals for Area of Interest		**7.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If

intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

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Clackamas County Area, Oregon

64B—Nekia silty clay loam, 2 to 8 percent slopes

Map Unit Setting

Elevation: 250 to 1,200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Nekia and similar soils: 80 percent

Description of Nekia

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Nose slope, crest, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from basalt

Typical profile

H1 - 0 to 48 inches: silty clay loam
H2 - 48 to 99 inches: clay
H3 - 99 to 109 inches: unweathered bedrock

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C

92F—Xerochrepts and Haploxerolls, very steep

Map Unit Setting

Elevation: 50 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 165 to 210 days

Map Unit Composition

Xerochrepts and similar soils: 50 percent
Haploxerolls and similar soils: 35 percent

Description of Xerochrepts

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 20 inches: silt loam
H2 - 20 to 122 inches: gravelly clay loam
H3 - 122 to 152 inches: very cobbly clay loam

Properties and qualities

Slope: 20 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

Description of Haploxerolls

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 30 inches: silt loam
H2 - 30 to 152 inches: very gravelly loam

Properties and qualities

Slope: 20 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 36 to 48 inches
Frequency of flooding: None

Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

United States Department of Agriculture

NRCS

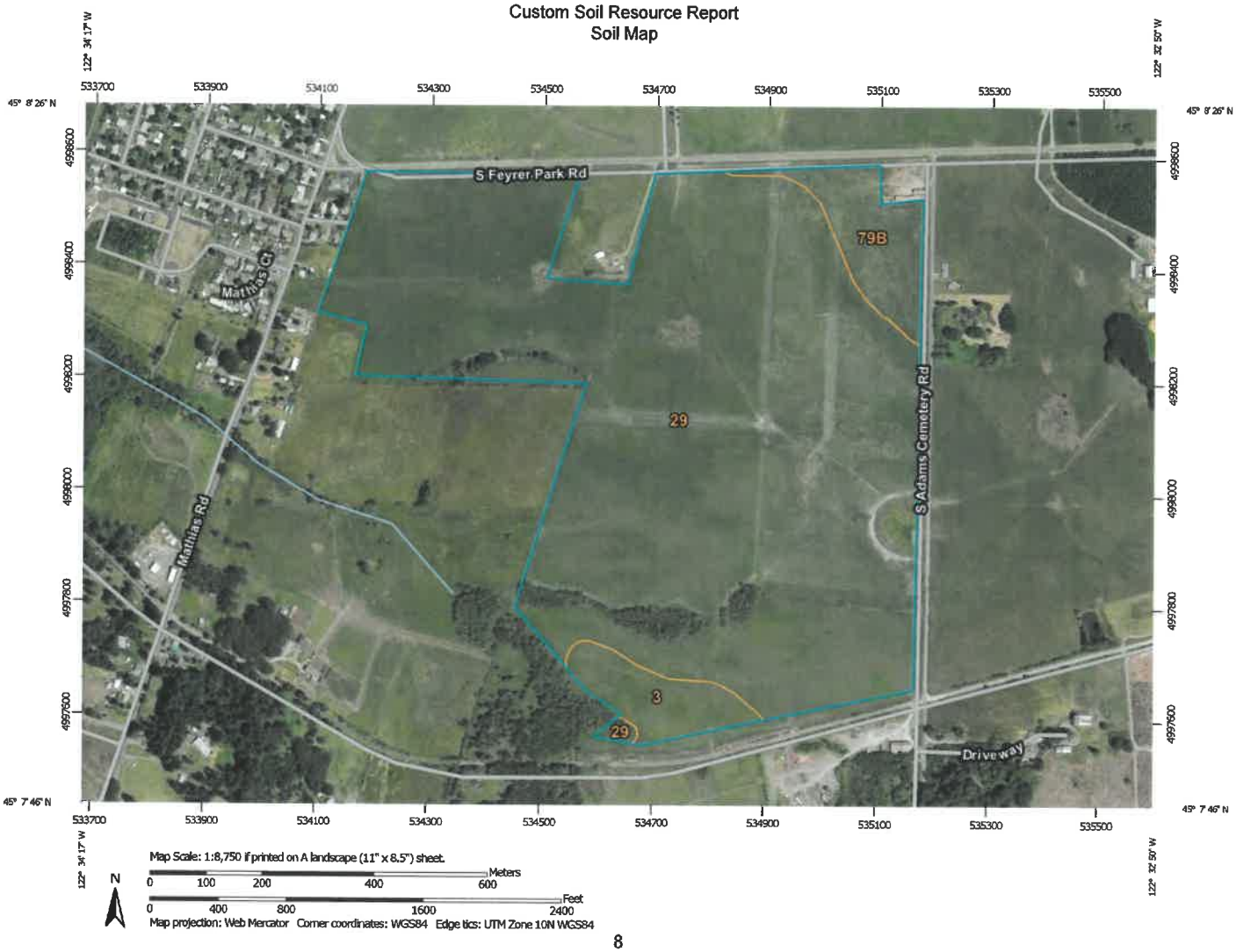
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Clackamas County Area, Oregon

July 18, 2014

Custom Soil Resource Report
Soil Map



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Map Unit Legend

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
3	Amity silt loam	7.7	4.2%
29	Dayton silt loam	165.5	90.5%
79B	Sawtell silt loam, 0 to 8 percent slopes	9.7	5.3%
Totals for Area of Interest		**182.9**	**100.0%**

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Clackamas County Area, Oregon

3—Amity silt loam

Map Unit Setting

Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Amity and similar soils: 85 percent
Minor components: 5 percent

Description of Amity

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 22 inches: silt loam
H2 - 22 to 62 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Farmland classification: Prime farmland if drained
Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D

Minor Components

Dayton

Percent of map unit: 3 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Huberly

Percent of map unit: 2 percent
Landform: Swales on terraces

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

29—Dayton silt loam

Map Unit Setting

Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Dayton, thick surface, and similar soils: 90 percent
Minor components: 5 percent

Description of Dayton, Thick Surface

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 21 inches: silty clay loam
H3 - 21 to 60 inches: clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance
Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D

Minor Components

Concord

Percent of map unit: 3 percent

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Huberly
Percent of map unit: 2 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

79B—Sawtell silt loam, 0 to 8 percent slopes

Map Unit Setting
Elevation: 150 to 500 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition
Sawtell and similar soils: 90 percent
Minor components: 4 percent

Description of Sawtell

Setting
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Old gravelly alluvium

Typical profile
H1 - 0 to 13 inches: silt loam
H2 - 13 to 20 inches: gravelly clay loam
H3 - 20 to 43 inches: very gravelly clay loam
H4 - 43 to 60 inches: very gravelly clay

Properties and qualities
Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C

Minor Components

Dayton

Percent of map unit: 3 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Concord

Percent of map unit: 1 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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Custom Soil Resource Report for Clackamas County Area, Oregon

July 18, 2014

Custom Soil Resource Report
Soil Map

Map Scale: 1:3,610 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
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Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

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Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
1A	Aloha silt loam, 0 to 3 percent slopes	14.3	89.5%
3	Amity silt loam	1.6	9.9%
84	Wapato silty clay loam	0.1	0.6%
Totals for Area of Interest		**16.0**	**100.0%**

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A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Clackamas County Area, Oregon

1A—Aloha silt loam, 0 to 3 percent slopes

Map Unit Setting

Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Aloha and similar soils: 85 percent
Minor components: 5 percent

Description of Aloha

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 51 inches: silt loam
H3 - 51 to 80 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.9 inches)

Interpretive groups

Farmland classification: Prime farmland if drained
Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D

Minor Components

Huberly

Percent of map unit: 3 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Dayton

Percent of map unit: 2 percent

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

3—Amity silt loam

Map Unit Setting

Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Amity and similar soils: 85 percent
Minor components: 5 percent

Description of Amity

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 22 inches: silt loam
H2 - 22 to 62 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Farmland classification: Prime farmland if drained
Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D

Minor Components

Dayton

Percent of map unit: 3 percent

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Huberly
Percent of map unit: 2 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

84—Wapato silty clay loam

Map Unit Setting
Elevation: 100 to 1,500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition
Wapato and similar soils: 85 percent
Minor components: 10 percent

Description of Wapato

Setting
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile
H1 - 0 to 18 inches: silty clay loam
H2 - 18 to 45 inches: silty clay loam
H3 - 45 to 60 inches: silty clay

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Available water storage in profile: High (about 10.3 inches)

Interpretive groups

Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D

Minor Components

Cove

Percent of map unit: 6 percent
Landform: Flood plains
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear

Humaquepts

Percent of map unit: 4 percent
Landform: Flood plains

APPENDIX G: SUMMARY OF SOIL PROPERTIES

Molalla RWUP Amendment
Project No. 100.31

Soil Types

Site	Soil Type No.	Soil Type Name	Drainage Class	Area Covered (%)	AWC (inches)	AWC Weighted Fraction (inches)	Average AWC (inches)	Ksat (top 6 inches) in/hr	Ksat (most limiting layer)			Depth of most limiting layer, in
									low end in/hr	high end in/hr	average in/hr	
North Coleman	17	Clackamas silt loam	somewhat poorly	4	6.9	0.3	7.4	1.3	0.2	0.57	0.39	7
North Coleman	29	Dayton silt loam	poorly drained	8	4.5	0.4		1.3	0	0.06	0.03	15
North Coleman	79B	Sawtell silt loam	moderately well	85	7.7	6.5		1.3	0.2	0.57	0.39	43
North Coleman	79C	Sawtell silt loam	moderately well	3	7.7	0.3		1.3	0.2	0.57	0.39	43
South Coleman	3	Amity silt loam	somewhat poorly	4	12	0.5	5	1.3	0.2	0.57	0.39	22
South Coleman	29	Dayton silt loam	poorly drained	91	4.5	4.1		1.3	0	0.06	0.03	15
South Coleman	79B	Sawtell silt loam	moderately well	5	7.7	0.4		1.3	0.2	0.57	0.39	43
Cemetery	64B	Nekia silty clay loam	well drained	98	6.2	6.1	6.2	0.4	0.2	0.57	0.39	0
Cemetery	92F	Xerochrepts	well drained	2	8	0.2		1.3	0.2	0.57	0.39	20
WWTP	1A	Aloha silt loam	somewhat poorly	89	11.9	10.6	11.9	1.3	0.2	0.57	0.39	8
WWTP	3	Amity silt loam	somewhat poorly	10	12	1.2		1.3	0.2	0.57	0.39	22
WWTP	84	Wapato silty clay loam	poorly drained	1	10.3	0.1		1.1	0.2	0.57	0.39	45

APPENDIX H: WATER BALANCE CALCULATIONS FOR IRRIGATION SITES

City of Molalla
RWUP Amendment
Project No. 100.31

Water Balance
Site North Coleman Ranch Site

Soil Average AWC (100%)	7.4	inches
Soil Average AWC (90%)	6.66	inches
Useable Acres	270	acres

Component	Units	January	February	March	April	May	June	July	August	September	October	November	December	Total
Net ET	inches	0	0	0.04	0.16	1.65	2.56	5	3.98	1.3	0.16	0	0	**14.85**
Soil Moisture	inches	7.4	7.4	7.36	7.24	5.55	6.66	6.66	6.66	6.66	6.66	7.4	7.4	
Net irrigation required to maintain 90% AWC	inches	0	0	0	0	1.11	2.56	5	3.98	1.3	0.16	0	0	
Gross irrigation required to maintain 90% AWC (1)	inches	0.00	0.00	0.00	0.00	1.31	3.01	5.88	4.68	1.53	0.19	0.00	0.00	**16.60**

(1) Gross irrigation capacity assumes 85% irrigation efficiency for sprinkler irrigation.

Site Capacity (MG)	122

City of Molalla
RWUP Amendment
Project No. 100.31

Water Balance
Site South Coleman Ranch Site

Soil Average AWC (100%)	5	inches
Soil Average AWC (90%)	4.5	inches
Useable Acres	163	acres

Component	Units	January	February	March	April	May	June	July	August	September	October	November	December	Total
Net ET	inches	0	0	0.04	0.16	1.65	2.56	5	3.98	1.3	0.16	0	0	**14.85**
Soil Moisture	inches	5	5	4.96	4.84	3.15	4.5	4.5	4.5	4.5	4.5	5	5	
Net irrigation required to maintain 90% AWC	inches	0	0	0	0	1.35	2.56	5	3.98	1.3	0.16	0	0	
Gross irrigation required to maintain 90% AWC (1)	inches	0.00	0.00	0.00	0.00	1.59	3.01	5.88	4.68	1.53	0.19	0.00	0.00	**16.88**

(1) Gross irrigation capacity assumes 85% irrigation efficiency for sprinkler irrigation.

Site Capacity (MG)	75

City of Molalla
RWUP Amendment
Project No. 100.31

Water Balance
Site Cemetery Site

Soil Average AWC (100%)	6.2	inches
Soil Average AWC (90%)	5.58	inches
Useable Acres	3.44	acres

Component	Units	January	February	March	April	May	June	July	August	September	October	November	December	Total
Net ET	inches	0	0	0.04	0.16	1.65	2.56	5	3.98	1.3	0.16	0	0	**14.85**
Soil Moisture	inches	6.2	6.2	6.16	6.04	4.35	5.58	5.58	5.58	5.58	5.58	6.2	6.2	
Net irrigation required to maintain 90% AWC	inches	0	0	0	0	1.23	2.56	5	3.98	1.3	0.16	0	0	
Gross irrigation required to maintain 90% AWC (1)	inches	0.00	0.00	0.00	0.00	1.45	3.01	5.88	4.68	1.53	0.19	0.00	0.00	**16.74**

(1) Gross irrigation capacity assumes 85% irrigation efficiency for sprinkler irrigation.

Site Capacity (MG)	1.6

City of Molalla
RWUP Amendment
Project No. 100.31

Water Balance
Site WWTP Site

Soil Average AWC (100%)	11.9	inches
Soil Average AWC (90%)	10.71	inches
Useable Acres	8.1	acres

Component	Units	January	February	March	April	May	June	July	August	September	October	November	December	Total
Net ET	inches	0	0	0.04	0.16	1.65	2.56	5	3.98	1.3	0.16	0	0	**14.85**
Soil Moisture	inches	11.9	11.9	11.86	11.74	10.05	10.71	10.71	10.71	10.71	10.71	11.9	11.9	
Net irrigation required to maintain 90% AWC	inches	0	0	0	0	0.66	2.56	5	3.98	1.3	0.16	0	0	
Gross irrigation required to maintain 90% AWC (1)	inches	0.00	0.00	0.00	0.00	0.78	3.01	5.88	4.68	1.53	0.19	0.00	0.00	**16.07**

(1) Gross irrigation capacity assumes 85% irrigation efficiency for sprinkler irrigation.

Site Capacity (MG)	3.5

APPENDIX I: NITROGEN LOADING CALCULATIONS

Molalla RWUP Amendment
Project No. 100.31

Nitrogen Calculations

Site	Useable Acres	Gross Irrigation	May	June	July	Aug	Sept	Oct	Totals
North Coleman	270	inches	1.31	3.01	5.88	4.68	1.53	0.19	16.6
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	35572	81734	159666	127081	41546	5159	
		useable acres	270	270	270	270	270	270	
		gallons	9604369.8	22068056	43109690	34311794	11217317	1393000	
		million gallons	9.6	22.1	43.1	34.3	11.2	1.4	121.7
		Effluent TN, mg/L	15	15	15	15	15	15	
		lbs N/acre	4	10	20	16	5	1	56
South Coleman	163	inches	1.59	3.01	5.88	4.68	1.53	0.19	16.88
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	43175	81734	159666	127081	41546	5159	
		useable acres	163	163	163	163	163	163	
		gallons	7037502	13322567	26025480	20714157	6771936	840959	
		million gallons	7.0	13.3	26.0	20.7	6.8	0.8	74.7
		Effluent TN, mg/L	15	15	15	15	15	15	
		lbs N/acre	5	10	20	16	5	1	57
Cemetery	3.4	inches	1.45	3.01	5.88	4.68	1.53	0.19	16.74
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	39373	81734	159666	127081	41546	5159	
		useable acres	3.4	3.4	3.4	3.4	3.4	3.4	
		gallons	133869	277894	542863	432074	141255	17541	
		million gallons	0.13	0.28	0.54	0.43	0.14	0.02	1.5
		Effluent TN, mg/L	15	15	15	15	15	15	
		lbs N/acre	5	10	20	16	5	1	57
WWTP	8.1	inches	0.78	3.01	5.88	4.68	1.53	0.19	16.07
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	21180	81734	159666	127081	41546	5159	
		useable acres	8.1	8.1	8.1	8.1	8.1	8.1	
		gallons	171559	662042	1293291	1029354	336520	41790	
		million gallons	0.17	0.66	1.29	1.03	0.34	0.04	3.5
		Effluent TN, mg/L	15	15	15	15	15	15	
		lbs N/acre	3	10	20	16	5	1	55

APPENDIX J: COLEMAN RANCH (NORTH AND SOUTH) SUB MAIN IRRIGATION LAYOUT

COLEMAN RANCH
24 INCH EFFLUENT FORCE MAIN
8 INCH EFFLUENT LINE
8 INCH EFFLUENT HAND LINE
HYD HYDRANT

PLAN SCALE
350 0 350 700

THE DYER PARTNERSHIP ENGINEERS & PLANNERS	***CITY OF MOLALLA - RWUP***	FIGURE #
DATE: NOV. 2017	***COLEMAN RANCH SITE - RECYCLED WATER SUB-MAIN LAYOUT***	***J.1***
PROJECT NO.: 100.31		

APPENDIX K: HAND LINE AND TRAVELING GUN IRRIGATION RATE CALCULATIONS

Table 1. Calculations for the gross irrigation application rate using hand lines at North Coleman Ranch

Lateral spacing length (feet)	Lateral spacing width (feet)	Area irrigated per spacing (feet^2)	Area irrigated per spacing (acres)	Flow rate				Set time	Gross application rate per set
				(gallons/minute)	(gallons/hour)	(acre-inches/hour)[a]	(inches/hour)[b]	(hours)	(inches/acre)
40	40	1,600	0.04	5	300	0.01	0.30	12	3.6

[a]acre-inches/hour = (gallons/hour) / (27,154 gallons / acre-inch)

[b]inches/hour = (acre-inches/hour) / (acres)

Table 2. Calculations for the gross irrigation application rate using the traveling gun at the Coleman Ranch

Length per set (feet)	Width per set (feet)	Area irrigated per set ($feet^2$)	Area irrigated per set (acres)	Flow rate			Gross application rate per set	
				(gallons/minute)	(gallons/hour)	(gallons/24 hrs)	(gallons/acre)[a]	(inches/acre)[b]
1,400	300	420,000	9.64	350	21,000	504,000	52,272	1.9

[a]gallons/acre = (gallons/day) / (acres)

[b]inches/acre = (gallons/acre) / (27,154 gallons/acre-inch)

APPENDIX L: IRRIGATION SYSTEM INSPECTION CHECKLIST

PNW 293
Reprinted October 1997

Making The Most Of IRRIGATION

Irrigation System Walk-through Inspection Analysis

H. Hansen and W. Trimmer

This "walk-through" worksheet provides a method for making an organized inspection of an entire irrigation system, both hydraulics and hardware. This inspection will help identify components that need maintenance, repair, replacement, or other attention—so that the system will provide the most satisfactory, safe, and efficient performance.

Suction system

Inspect system from water supply to pump intake. Generally, suction line should provide smooth water flow with a minimum of fittings that cause obstructions, water turbulence, or head losses.

From surface supplies and shallow wells

Note: On shallow wells with above-ground pump mounting, consider pulling suction line to make starred (*) checks.

		OK	Needs attention
1	Trash screening device (if used) clean and properly placed	____	____
*2.	Intake screen clean, good condition, properly placed.	____	____
*3	Foot or check valve operating smoothly.	____	____
*4.	Suction line does not collapse when pumping.	____	____
*5.	Suction pipe size/pump capacity properly matched to maintain flow velocity at 5 feet per second (fps) or less (preferably 2–3 fps).	____	____
*6	Maximum elevation rise from water surface to pump impeller eye does not exceed 10 feet. Required net positive suction head (NPSH) must not exceed NPSH available; see pump performance curve	____	____
*7.	Suction pipe inlet submerged adequately to prevent entrance of air and eddying of water.	____	____
*8.	Suction line free of air leaks	____	____
9	No unnecessary or undersized plumbing fittings in suction line to increase friction losses	____	____
10	Elbows, bends of flanged type.	____	____
11	Couplings flanged or smooth interior bore.	____	____
12.	Eccentric adapter to pump with 12° taper (not over 28°).	____	____
13	Eccentric adapter installed with slope on bottom side.	____	____
14	Straight pipe at least 4 diameters in length before pump inlet to reduce water turbulence, cavitation.	____	____
15.	Horizontal suction line to pump sloped upward at least 1 inch per foot.	____	____
16	High point of suction line at pump entrance to eliminate air entrapment.	____	____
17	Vacuum gauge or port installed on suction line.	____	____
18	No part of suction piping smaller in diameter than pump suction inlet.	____	____

Hugh J. Hansen, Extension agricultural engineer emeritus; and Walter L. Trimmer, former Extension irrigation specialist; Oregon State University

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	OK	Needs attention
From deep wells		
1 Well casings properly located and perforated to allow water intake without cascading or introducing air into impellers.	____	____
2. Bowls set below water drawdown level.	____	____
3. Bowl settings properly adjusted	____	____
Pump and fittings		
Inspect pump assembly with its associated inlet and discharge fittings. Consider motor separately.		
Above-ground centrifugal pumps		
1. Sturdy pump base with pump firmly attached.	____	____
2 Intake pipe firmly supported within 3 feet of pump.	____	____
3. Discharge pipe firmly supported within 3 feet of pump.	____	____
4 Impeller rotates freely in casing.	____	____
5. Pump operates with no excess vibration.	____	____
6. Bearings in good condition.	____	____
7. Shaft properly aligned with motor	____	____
8 Impeller firmly attached to shaft	____	____
9. Stuffing, seals, shaft packing adjusted for proper water drip lubrication.	____	____
10. Wear ring in good condition with no deposition, cavitation, or abnormal configuration	____	____
11. Water velocity in pipeline at 5 fps or less.	____	____
12. Pressure gauge or port at pump discharge	____	____
13. Discharge increaser has 12° taper (maximum 28°)	____	____
14. Increaser near as possible to pump	____	____
15. Straight pipe run out of pump discharge to minimize turbulence (for flow measurement).	____	____
16 No unnecessary or undersized fittings in discharge line that increase friction losses:		
Size, location of tees	____	____
Size, location of elbows, bends	____	____
Size, location of valves	____	____
Size, location of couplings, unions	____	____
Size, location, taper of enlargers	____	____
17 Flow meter with low flow restriction.	____	____
18. Air relief valve at high point in system to release trapped air.	____	____
19. Isolation valve on primer pump.	____	____
Deep well turbines		
1 Sturdy motor base; motor firmly supported.	____	____
2. Discharge pipe firmly supported.	____	____
3 Pump operates with no excess vibration.	____	____
4. Pump lubricated with turbine-type oil.	____	____
5 Oilers working properly	____	____
6 Working airline in well to measure drawdown	____	____
7 Water velocity in pipeline at 5 fps or less	____	____
8 Pressure gauge or port in discharge line.	____	____
9. Concentric discharge fitting, if appropriate.	____	____
10. Straight pipe run out of pump discharge to minimize turbulence (for flow measurement)	____	____
11 No unnecessary or undersized plumbing fittings in discharge line that increase friction losses		
Size, location of tees	____	____
Size, location of elbows, bends	____	____
Size, location of valves	____	____
Size, location of couplings, unions	____	____
Size, location, taper of enlargers	____	____
12 Flow meter with low-flow restriction	____	____
13. Air relief valve at high point in system to release trapped air.	____	____

Electric motor

Inspect motor for mechanical and electrical soundness.

	OK	Needs attention
1. Sturdy base mounting.	____	____
2. Proper shaft alignment with pump.	____	____
3. Proper belt alignment and tension between motor and pump	____	____
4. Motor bearings in good condition, properly lubricated.	____	____
5. Motor frame free of debris, vegetation, straw, caked-on dirt and oil, rodent or insect nests.	____	____
6. Motor ventilation vents open, unobstructed, and protected with ¼- to ½-inch mesh screen.	____	____
7. Cover over motor for shade and rain protection.	____	____
8. Unobstructed ventilation around motor—if in motor house, ample-sized openings on opposite walls for ventilation.	____	____
9. Good drainage away from motor base.	____	____
10. Wiring to motor in good, safe condition.	____	____
11. Safety shields attached and functioning.	____	____
12. Access plates and cover dome in place and secure.	____	____
13. Motor free of evidence of excess heat due to electrical overloading.	____	____
14. Motor runs quietly, free of excess vibration or noise.	____	____

Electric service

Inspect electric service for safety and serviceability.

	OK	Needs attention
1. Overhead lines free of tree branches, other physical obstructions.	____	____
2. Conductors properly secured to prevent flexing, shorting hazards.	____	____
3. Conductors free of frayed, cracked, or worn insulation	____	____
4. Service panel properly grounded independently of pumping plant	____	____
5. Service head grommets in place, in good condition.	____	____
6. All conduit or shielded cable in good condition.	____	____
7. Service panel properly, securely installed.	____	____
8. Service panel has functioning interlocking door latches, padlock.	____	____
9. Service panel door has adequate seals and/or drip traps.	____	____
10. Service panel free of open holes missing knockout plugs.	____	____
11. Electrical connections within service panel secure, free of signs of arcing.	____	____
12. Service panel interior free of moisture, corrosion, insects, rodents, snakes.	____	____
13. Lightning arrestors properly installed on meter and motor side of buss and breaker.	____	____
14. Overload protection properly sized	____	____
15. Circuit breakers operable; no slugs or copper bars used in place of fuses.	____	____
16. Shade over service panel to cool thermal breakers.	____	____

Mainline system

Inspect entire mainline from pump to terminal end.

	OK	Needs attention
1. Pipe condition:		
Bent or flattened piping	____	____
Split seams	____	____
Bullet holes or other punctures	____	____
Leaky joints, connections, valves	____	____
Gaskets worn, sand or dirt behind	____	____
Leaky end plugs	____	____
2. If buried, mainline protected and covered.	____	____
3. Evidence of sink holes indicating unsupported piping.	____	____
4. Line designed and sized for minimum hydraulic turbulence or friction.	____	____
5. Pipe size adequate to handle water discharge at flow rate of 5 fps or less.	____	____

	OK	Needs attention
6. No unnecessary or undersized plumbing fittings in line to increase friction losses:		
Elbows, bends	____	____
Tees	____	____
Valves	____	____
Reducers, enlargers	____	____
Couplings, unions	____	____
7. Flow meter with low flow restriction	____	____
8. Air release valves and vacuum relief installed as needed on high points of line.	____	____
9. Provision made to drain and flush line if subject to freezing	____	____
10. Line equipped with check valve, if needed.	____	____
11. Pressure relief valve set at 10 psi above normal operating pressure	____	____

Stationary and moving laterals

1. System layout compatible with topography; if not, appropriate pressure control devices used.	____	____
2. Lateral spacing on mainline satisfactory.	____	____
3. Adequate water flow rate and pressure.	____	____
4. System free of leaks from breaks, couplers, drain valves, risers, end plugs.	____	____
5. System free of excessive corrosion or wear.	____	____
6. Chains, bearings, drive gears of all wheelmove systems in good operating condition.	____	____
7. Electric motors covered and protected.	____	____
8. Pipe condition:		
Bent or flattened piping	____	____
Split seams	____	____
Bullet holes or other punctures	____	____
Leaky joints, connections, valves	____	____
Gaskets worn, sand or dirt behind	____	____

Risers and sprinklers

Walk the entire sprinkler line to inspect the following:

1. Mainline valves and gaskets in good condition.	____	____
2. Risers all in place, no broken units.	____	____
3. Self-leveler risers operating freely, properly aligned.	____	____
4. Sprinkler heads operating properly, no plugged nozzles.	____	____
5. Sprinkler nozzles properly sized, not worn (check orifice by using shank of high-speed drill bit as a gauge).	____	____
6. Sprinkler heads rotate smoothly and freely at 1 to 2 revolutions per minute	____	____
7. Sprinkler head base gaskets in good condition	____	____
8. Visual inspection of each sprinkler indicates uniform application pattern	____	____
9. Pressure at sprinkler appropriate.	____	____
10. Sprinklers match operating pressure.	____	____

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MAKING THE MOST OF IRRIGATION

Sizing Irrigation Mainlines and Fittings

W. Trimmer and H. Hansen

When designing or retrofitting an irrigation system, one of the key decisions is picking the proper size pipes and fittings for the system. The best pipe size or fitting is not always the one with the lowest initial cost. The important consideration is the lowest cost of ownership. The objective is to minimize the sum of capital, pumping, maintenance, and energy costs during the life of the system.

Cost categories

In general, costs can be classified under two categories. The first is capital or fixed cost of the pipe and fittings. This cost is determined by the initial installed purchase price of the pipe or fitting and the number of years of service that it is projected to last (usually 20 years). The annual cost of different-sized pipe or fittings is found by amortizing the purchase price, using the interest rate and service life. This amortization is similar to the repayments that are made on a loan. In fact, if all the money to purchase the pipe or fittings is borrowed, the annual cost will be the loan repayment.

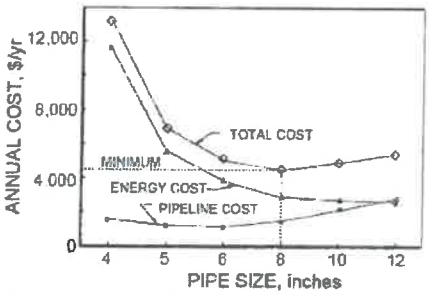

Figure 1.—*Annual irrigation cost as varied by mainline pipe size.*

The second cost category is the operating or variable cost. These costs depend on the number of hours the irrigation system is operated and the expected friction loss in the pipeline and fittings. Smaller pipelines and fittings will have a greater friction loss and, hence, a higher operating cost than larger-diameter pipes and fittings. The total operating cost will depend on the number of hours the system is operated, the total friction loss, and the present and future cost per unit (kWh) of electrical energy. The friction loss depends on pipe size, pipe material, pipe length, and flow rate in gallons per minute.

An economic analysis of a typical system is illustrated in Figure 1. This example assumes the following conditions:

Flow rate (in gallons per minute) = 600
Operating hours per year = 2,500
Pumping plant wire-to-water efficiency = 60%
Cost per kWh for electricity = 4¢[a]
Length of pipeline = 3,000 feet[b]
Minimum sprinkler pressure = 52 psi
Projected life of system = 20 years
Interest = 12%

[a]The cost per kWh for electricity is the average over the entire irrigation season and includes applicable demand charges prorated proportionately over all the kWh used.

[b]Include "equivalent length of pipe" for fittings from Table 3

Prepared originally for the Bonneville Power Administration by Walter L. Trimmer, former Extension irrigation specialist, and Hugh J. Hansen, Extension agricultural engineer emeritus; Oregon State University.

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The 8-inch pipe offers the lowest total annual operating cost. It is obvious that an undersized pipe has very high energy costs. If the pipeline is too small, the fixed costs may be higher than for the next larger pipe size due to the requirement and cost of a larger pump.

Friction losses in pipes

As a general rule of thumb, a water velocity in the pipe of 5 feet per second is the maximum allowable in most circumstances except suction pipes on centrifugal pumps, which should be between 2 and 3 feet per second. Table 1 shows the flow rate for various size pipelines when the velocity is 5 feet per second.

There also are differences between types of pipes. Smooth pipe has less friction loss and, hence, a lower operating cost than rough pipes. Plastic pipe, such as PVC, is the smoothest, followed by aluminum, steel, and concrete, in that order. Therefore, pipeline cost comparisons should be based on total operating costs rather than on only initial installed purchase price.

Table 2 shows some typical friction losses in commonly used pipe; it can be used for estimating operating costs for pipelines and fittings. More precise figures from manufacturers' specifications should be used for design purposes.

Friction losses in valves and fittings

The least cost of operating a system also extends to selecting the proper size valves and fittings. The economic analysis is similar to that of the pipeline.

The friction loss in a fitting can be estimated by a technique called "equivalent length of steel pipe." To do so, the friction loss through the fitting is equated to the friction loss in an equivalent length of straight steel pipe of the same diameter as the fitting. Table 3 provides factors needed to calculate equivalent lengths of several types of fittings and valves. It generally is best to select fittings and valves of the same size as the main pipeline.

Table 1.—*Maximum flow rate in different pipe sizes.*

Pipe size (in.)	2	3	4	5	6	8	10	12	16
Flow rate (gpm)	50	110	200	310	440	780	1,225	1,760	3,140

Table 2.—*Friction losses in feet of head per 100 feet of pipe*

Pipe size	4-inch			6-inch			8-inch			10-inch			12-inch		
	Steel	Alum.	PVC	Steel	Alum.	PVC	Steel	Alum.	PVC	Steel	Alum.	PVC	Steel	Alum.	PVC
Flow rate (gpm)															
100	1.2	0.9	0.6	—	—	—	—	—	—	—	—				
150	2.5	1.8	1.2	0.3	0.2	0.2	—	—	—	—	—	—			
200	4.3	3.0	2.1	0.6	0.4	0.3	0.1	0.1	0.1	—	—	—	—		
250	6.7	4.8	3.2	0.9	0.6	0.4	0.2	0.1	0.1	0.1	0.1	—	—	—	
300	9.5	6.2	4.3	1.3	0.8	0.6	0.3	0.2	0.1	0.1	0.1	—	—	—	—
400	16.0	10.6	7.2	2.2	1.5	1.0	0.5	0.3	0.2	0.2	0.1	0.1	0.1	—	—
500	24.1	17.1	11.4	3.4	2.4	1.6	0.8	0.6	0.4	0.3	0.2	0.1	0.1	0.1	0.1
750	51.1	36.3	24.1	7.1	5.0	3.4	1.8	1.3	0.8	0.6	0.4	0.3	0.2	0.1	0.1
1,000	87.0	61.8	41.1	12.1	8.6	5.7	3.0	2.1	1.4	1.0	0.7	0.5	0.4	0.3	0.2
1,250	131.4	93.3	62.1	18.3	13.0	8.6	4.5	3.2	2.1	1.5	1.1	0.7	0.6	0.4	0.3
1,500	184.1	130.7	87.0	25.6	18.2	12.1	6.3	4.5	3.0	2.1	1.5	1.0	0.9	0.6	0.4
1,750	244.9	173.9	115.7	34.1	24.2	16.1	8.4	6.0	4.0	2.8	2.0	1.3	1.2	0.9	0.6
2,000	313.4	222.5	148.1	43.6	31.0	20.6	10.8	7.7	5.1	3.6	2.6	1.7	1.5	1.1	0.7

Note: Flow rates below horizontal line for each pipe size exceed the recommended 5-feet-per-second velocity

Table 3.—*Friction loss in valves and fittings.*

Fitting	Equivalent length in feet per inch diameter
Angle valve (fully open)	12.0
Butterfly valve	3.3
Gate valve (fully open)	1.1
Globe valve (fully open)	28.0
Foot valve with strainer	6.3
Swing check valve	11.0
Water check valve	12.5
90° elbow	2.5

Example: A 6-inch butterfly valve is to be installed in an 8-inch pipeline. The "equivalent length of steel pipe" for the 6-inch butterfly valve is 3.3 (from table) times 6 (diameter) or 3.3 x 6 = 20 ft of steel pipe.

Estimating fixed costs

A simple method of comparing the fixed costs of two different pipe sizes or two different fittings or valves is to compare the relative total costs of each. The fixed costs can be estimated by multiplying the purchase price of the pipe or fitting by the appropriate factor from Table 4. This gives the annual ownership cost.

Estimating operating costs

The annual operating cost of a fitting or pipeline can be estimated with the following equation:

$$\$ = \frac{gpm \times H \times T \times C}{E \times 5{,}300}$$

where

$\$$ = annual operating cost
gpm = flow rate in gallons per minute
H = head loss in feet
T = number of operating hours per year
C = cost per kWh ($/kWh), including prorated demand charges
E = pumping plant efficiency (decimal)

For example, on the discharge of a centrifugal pump a butterfly valve is to be installed. The flow rate is 1,000 gpm, the pump discharge size is 6-inch, and the steel pipeline size is 10-inch. What size valve is most economical? Calculate the operating costs for each size valve. Assume 12 percent interest, 2,000 hours of operation, 70 percent pumping plant efficiency, and $0.04/kWh energy costs.

Using the equation above, Table 5 can be generated. The lowest operating cost is for the 10-inch valve. A similar analysis can be made for pipe using the cost per 100 feet of pipe.

Table 4.—*Amortization factors for 20-year life equipment.*

Interest rate (%)	8	10	12	14	16
Factor	.1019	.1175	.1339	.1510	.1687

Table 5.—*Total valve operating costs.*

Valve size (inches)	Price	Fixed cost[a]	Eq. l. ft[b]	Friction loss (ft)[c]	Operating cost[d]	Total cost
6	$135	$18	20	2.4	$52	$70
8	180	24	26	0.8	17	41
10	240	32	33	0.3	6	38
12	305	41	40	0.2	4	45

[a]From Table 4. [b]From Table 3 [c]From Table 2. [d]From equation.

Summary

Selecting pipeline sizes and fittings by this method provides the minimum cost for an irrigation system. It should be noted that if a system is not operated a large number of hours per year, smaller-size pipelines and fittings and higher energy costs are somewhat more attractive. Smaller-size pipelines and fittings also are more attractive with higher interest rates. One factor not easily accounted for, however, is that with increasing energy costs, larger-size pipes and fittings will become more economical with time. However, the 5-feet-per-second pipeline velocity rule is applicable over a very wide range of pipeline prices, interest rates, and annual operating hours. This lends a certain amount of assurance that a properly sized pipeline under today's economic conditions will tend to be properly sized even under future economic conditions that may change a great deal.

For more information

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Converting Sprinkler Systems to Lower Pressure

Sprinkler irrigation presently accounts for about 4,500,000 acres of irrigated land in the Pacific Northwest. Center pivot systems are used on about 1,250,000 acres. Almost 100% of sprinkler irrigation systems in the Pacific Northwest use electric energy as their source of power. During the past decade, electric energy rates have increased sharply. Even though irrigation costs are still one of the lesser costs of production, irrigators have sought and adopted practices that reduce pumping costs.

Several factors affect energy use in sprinkler irrigation—total amount of water pumped, pumping depth, pumping plant efficiency, and system pressure. *Reducing the system operating pressure* is one economically effective cost-reduction measure.

Low-pressure sprinkler systems

A low-pressure sprinkler system is one that has been converted or modified to operate satisfactorily with a lowered pressure at the sprinkler heads. Examples are fixed-spacing sprinkler systems—solid sets, hand moves, and side rolls—operating at about 35 psi (pounds per square inch) and moving systems—center pivots and linear moves—operating at pressures down to 20 psi at the last tower or outer ends.

Potential for saving energy

When converting a sprinkler system to low pressure, the energy savings are accomplished only by the reduction in sprinkler pressure, assuming that total volume of water applied and overall pumping plant efficiency remain constant after conversion to low pressure (this should be the case). The energy and dollars saved are easily calculated, and the total savings can then be compared to the installation or retrofitting cost to determine if the conversion is economically worthwhile. Use the following equations:

Energy savings.

$$kWh = \frac{A \times in \times psi \times 0.2}{E}$$

kWh = energy savings in kilowatt hours
A = acres in field
in = inches of water applied per season
psi = pressure reduction at sprinkler in pounds per square inch
0.2 = conversion factor constant
E = overall pumping plant efficiency (decimal)

Dollar savings.

Annual cost savings equals kWh saved times cost per kWh

$$\$ = kWh \times rate$$

Example: An irrigation system on a 40-acre alfalfa field has operated at 55 psi at the sprinkler. After conversion, the system operates at 35 psi. The annual gross irrigation application is 18 inches. The overall pumping plant efficiency is 70% and electric energy price is $.04 per kWh.

Note that overall pumping plant efficiency (E) varies for each installation. For this example, an overall pumping plant efficiency of 70% is assumed. This would be a good to excellent efficiency for a small centrifugal pumping plant but only a fair to poor efficiency for a large turbine or deep-well pumping plant.

$$kWh = \frac{A \times in \times psi \times 0.2}{E}$$

$$kWh = \frac{40 \times 18 \times 20 \times 0.2}{.70}$$

$$kWh = 4114$$

$$\$ = kWh \times rate$$

$$= 4114 \times \$.04$$

$$= \$164.56 \text{ per year}$$

Making the conversion

The conversion to low pressure requires installing low-pressure nozzles or sprinkler heads and modifying the pump to match the new operating pressure. The replacement low-pressure nozzles or sprinklers should be sized to discharge the same flow rate as the existing nozzles. A complete set of matching nozzles is recommended for fixed-spacing systems such as solid sets, hand moves, and side rolls. New low-pressure sprinkler packages are recommended for center pivots.

The new system pressure must be selected carefully. Just reducing the pressure by the difference in sprinkler pressure requirements may not be advisable. After the conversion, head losses in individual mainlines and laterals will be the same as before the conversion. The rule-of-thumb for high-pressure systems allowed the pressure drop in a lateral to be 20% of the total pressure. For low-pressure systems, allowable pressure variation is more critical to good flow distribution, thus the rule-of-thumb for these systems is a 10% allowable pressure drop.

After the conversion, the total pressure may be only half of what it was previously. The pressure drop may now be 40% of the total, allowing a 23% variation in flow rate between the head and far end of a lateral. This uniformity problem in fields with large elevation variations can be eased by adding about 5 psi to the after-conversion system pressure and using pressure regulators, although this will limit the energy savings.

It may not be practical to convert water-drive center pivots or travelling big guns since high pressures are needed for locomotion.

If the nozzles or sprinklers are replaced without modifying the pump to reduce operating pressure, the system will put out a greater flow rate than previously (figure 1) and will likely use more energy. To realize energy savings, the pump must be modified by either trimming the impellers or, in the case of a deep-well turbine, dropping off one or more turbine bowls. The original electric motor can be used since underloading the motor will cause no harm and motor efficiency will generally be maintained.

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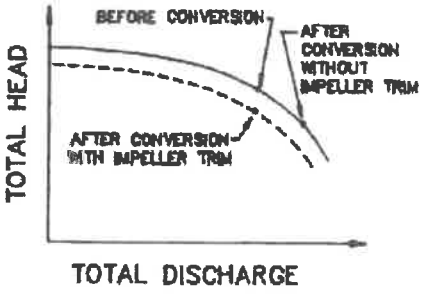

Figure 1.—Pump must be modified to establish new performance curve to give desired pressure and discharge rate after converting to low-pressure sprinklers.

Systems using internal combustion engines connected directly to pumps can accomplish the pressure reduction by throttling back engine speed, thus reducing pump speed.

Results of low pressure conversion

The primary purpose of a low pressure conversion is to reduce the energy required by the irrigation system. Unfortunately, reducing operating pressure affects more than just pumping costs. Reducing the system pressure can lead to one or more of the following problems: sprinklers may not throw water as far, droplet size may increase, and pattern shapes of individual sprinklers may change. This can cause application rates on moving sprinklers to be higher, the uniformity on fixed-spacing sprinklers to decrease, and potential runoff to generally increase. Increased droplet size can cause soil surface compaction due to the greater impact energy of larger drops.

Moving sprinkler systems such as center pivots and linear moves with low pressure can still have good uniformity due to their continuous motion.The potential for evaporation loss from sprinklers may drop slightly with lower pressure. On the other hand, wind-drift losses become greater with spray heads on center pivots.

Alleviating the problems

There are several things that can be done to relieve some of the problems created by converting to lower pressure. One is using sprinkler nozzles that employ unconventional orifice configurations. These sprinkler nozzles have oval, square, or odd-shaped orifices which cause better breakup of the stream at low pressure than conventional circular orifices while maintaining a good individual sprinkler pattern.

The use of sprinkler lateral offsets can also help reduce the poorer uniformity on fixed-spacing sprinklers. Offsets offer a simple and inexpensive way to compensate for the low-pressure pattern reduction without changing spacing on hand-set or side-roll systems. Offsets cut the lateral spacing in half when used on two successive irrigations. The use of offsets or swinglines on low-pressure conversions can actually make possible a more uniform water distribution than was originally obtained with the high-pressure nozzles on 40 × 50 foot or 40 × 60 foot spacings.

When low-pressure spray heads are used on center pivot systems, water application rates can be reduced by placing the spray heads on booms to widen the application pattern.

Runoff can be controlled by using smaller sprinklers and more laterals on fixed-spacing systems, using booms, conservation tillage, or reservoir tillage. The low end pressures on center pivots means that it is not possible to use large sprinklers on the end of the machine to cover the corners unless an end gun booster pump is used.

When converting systems to be used on rough terrain, it is recommended that pressure-regulating devices be used because the pressure changes involved in going up and down hills are much larger relative to the new, lower total-operating pressure now being used (see figure 2). In addition, it will be necessary to

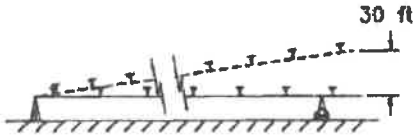

Figure 2.—A system with 60 psi end pressure on level ground will drop 20% in pressure and 10% in flow rate when encountering a 30-feet rise. The same system with 20 psi end pressure on level will drop 65% in pressure and 40% in flow rate on a 30-feet rise.

maintain proper system pressure at the highest point in the field plus about 3-5 psi extra to operate the pressure regulators.

Net benefits

The energy cost savings that can be achieved by reducing system pressure are available to offset the costs of new low-pressure nozzles or sprinkler packages and/or reworking the pump. These total energy cost savings and the cost of retrofitting should be carefully analyzed. Any change in the irrigation system must be well thought out to avoid expensive mistakes.

Prepared originally for the Bonneville Power Administration by Hugh J. Hansen, Extension agricultural engineer, and Walter L. Trimmer, Extension irrigation specialist, Oregon State University.

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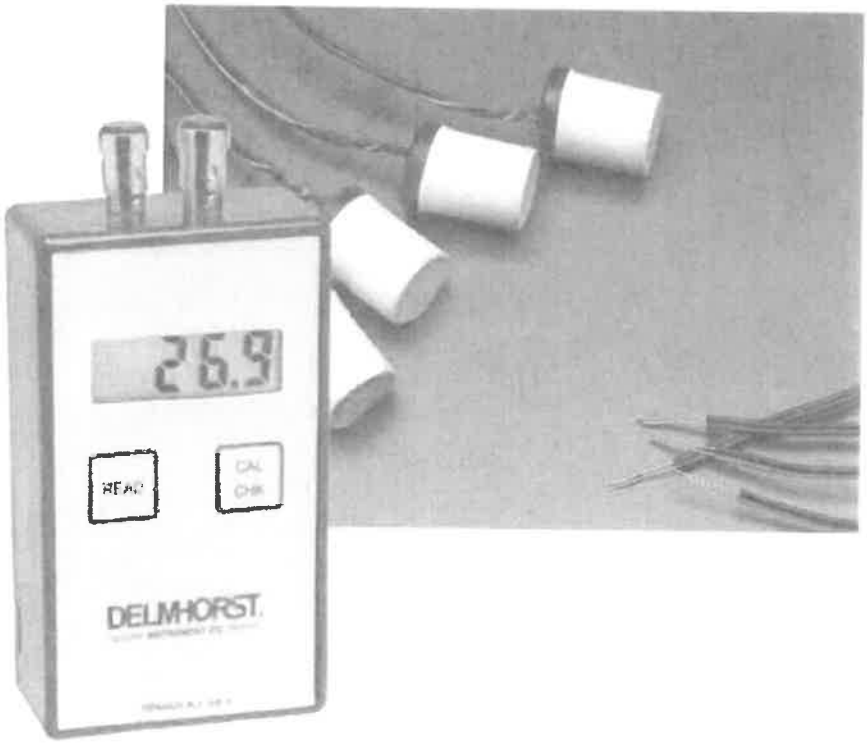
APPENDIX M: SOIL MOISTURE BLOCK LOCATIONS AT NORTH AND SOUTH COLEMAN RANCH SITES AND SOIL MOISTURE BLOCK OWNER'S MANUAL

THE DYER PARTNERSHIP ENGINEERS & PLANNERS	***CITY OF MOLALLA - RWUP***	FIGURE #
DATE: NOV. 2017	***COLEMAN RANCH SITE - MOISTURE BLOCK & PIEZOMETER LOCATIONS***	***M.1***
PROJECT NO.: 100.31		

Model KS-D1

owner's manual



DELMHORST®
INSTRUMENT CO.

WHEN ACCURACY IS THE POINT.™

TABLE OF CONTENTS

INTRODUCTION

The Delmhorst soil moisture measuring system consists of two parts: the gypsum soil blocks (sensors) and the measuring instrument, Model KS-D1 moisture tester. The blocks (GB-1) are made of gypsum cast around two concentric electrodes. The gypsum acts as a buffer against the effect that salts or other chemicals might have on the electrical conductivity. The concentric electrodes confine the flow of current to the interior of the block, eliminating the effects of soil conductivity.

When a block is buried in the soil it absorbs moisture from the soil or releases moisture into the soil, until its moisture content approaches equilibrium with the moisture content of the soil. When the block is connected to the meter, current flows between the electrodes and the electrical resistance of the gypsum is measured. Such readings are an indication of the moisture available to the plants.

For irrigation purposes, the water of importance is that amount which can be extracted from the soil by the roots of the plants, and not the percent moisture content (which is related to the weight of the soil). We refer to this reservoir of moisture as "available moisture" and it is expressed within a given range of soil moisture tension.

Each soil has a different capacity to hold water, depending on its structure and texture. The maximum amount of water available to the plants (called Field Capacity) is the amount held by the soil against drainage by gravity. When virtually all available water has been used (that is when no further moisture can be extracted by the plant) soil moisture has reached the level known as the "Permanent Wilting Point." With soil moisture at this level, plants permanently wilt and die.

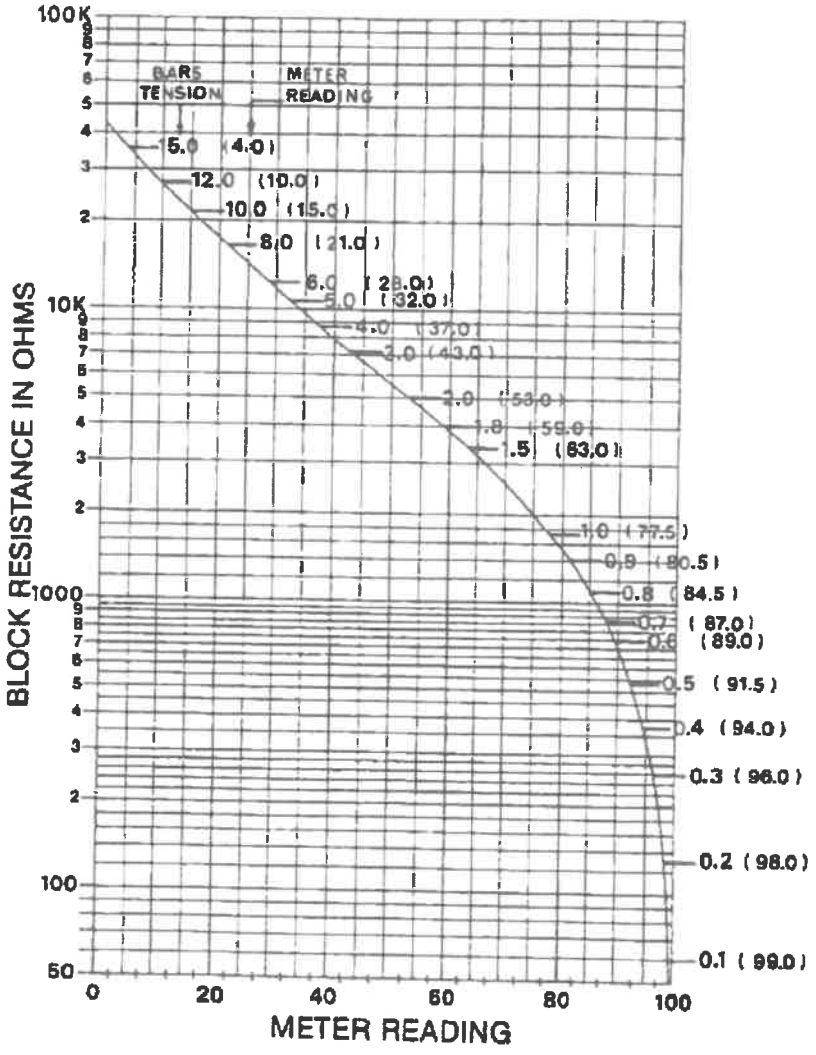
Gypsum block systems work best in finely textured soils such as fine sandy loams and clay loams. These soils hold a greater amount of water at field capacity then coarsely textured soils such as coarse sandy loams. Blocks are not recommended for use in sandy soils because the coarse texture of the sand does not interface well with the fine gypsum texture. As a guideline, blocks work best in soils with a water-holding capacity greater than 1.2in/ft.

The available soil moisture can be measured either in percent of the total potential reserve (Fig. 2) or in terms of suction necessary to draw the moisture from the soil particles. Such suction is referred to as soil moisture tension. (Fig. 1, and 1A).

Fig. 1

KS-D1

Meter Readings vs. Soil Moisture Tension and Electrical Resistance



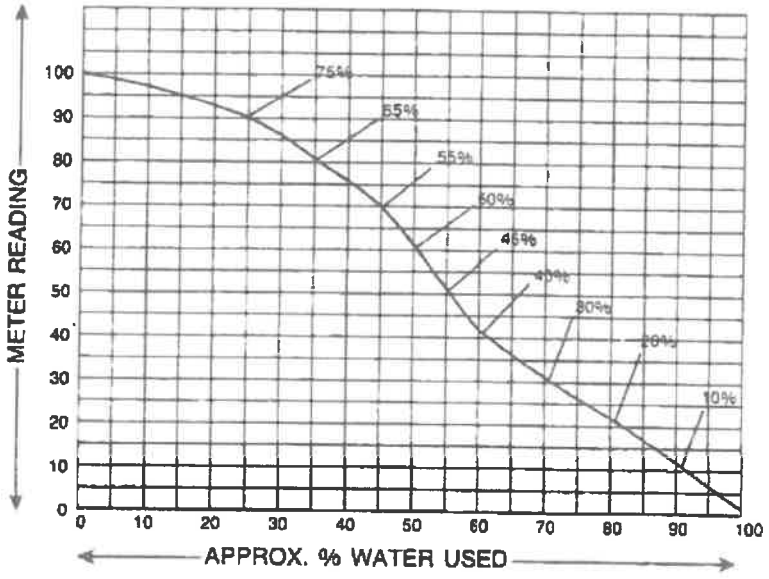
KS-D1 **Fig. 1A**

Meter Reading vs. Soil Moisture Tension and Electrical Resistance

METER READING KS-D1	MOISTURE TENSION BARS	RESISTANCE OHMS
99.0	0.1	60
98.0	0.2	130
96.0	0.3	260
94.0	0.4	370
91.5	0.5	540
89.0	0.6	750
87.0	0.7	860
84.5	0.8	1100
80.5	0.9	1400
77.5	1.0	1700
63.0	1.5	3400
59.0	1.8	4000
53.0	2.0	5000
43.0	3.0	7200
37.0	4.0	9000
32.0	5.0	10700
28.0	6.0	12500
21.0	8.0	16540
15.0	10.0	21130
10.0	12.0	26270
4.0	15.0	35000

Fig. 2

Meter Reading vs. Available Soil Moisture



4

OPERATING PROCEDURE

① To check the meter calibration:
Press the **CAL CHK** button. The meter should read 80.0 ± 1.0.
Note: Instrument serial numbers from 0100-0584 require pressing both **READ** and **CAL CHK** buttons simultaneously.

② To "read" the blocks:

- Push the tinned ends of the lead wires of the block into two springloaded binding posts on the meter.
- Press the **READ** button and record the reading on the Soil Moisture Observation Chart.
- NOTE: Only readings between 5.0 and 100.0 are valid. Readings outside of this range should be disregarded.

INTERPRETATION OF METER READINGS

- Meter readings are interpreted in terms of "Soil Moisture Tension," or "Blocks Resistance" by referring to figure 1 and 1A; in terms of "available soil moisture" by referring to figure 2.
- The data in the chart below provides guidelines of "Available Moisture" and "Irrigation Requirements" for three groups of soil in terms of their texture make-up.
- Since soils are not strictly divided into three groups only, but changes from "fine" to "coarse" soil are gradual, the information below should be used as a guideline. Consideration should be given to other factors such as:

  Type of crop;
  Stage of crop growth and root system;
  Climactic conditions;
  Structure of sub-soil.

METER READING GUIDELINES

Soil Type	No Irrigation Required	Irrigation to be Applied	Danger Zone Insufficient Soil Moisture
Fine	80-100	60-80	Below 60
Medium	88-100	70-88	Below 70
Coarse	90-100	80-90	Below 80

The above guidelines are determined by the fact that different soils have a different capacity to hold and release moisture to the plants.

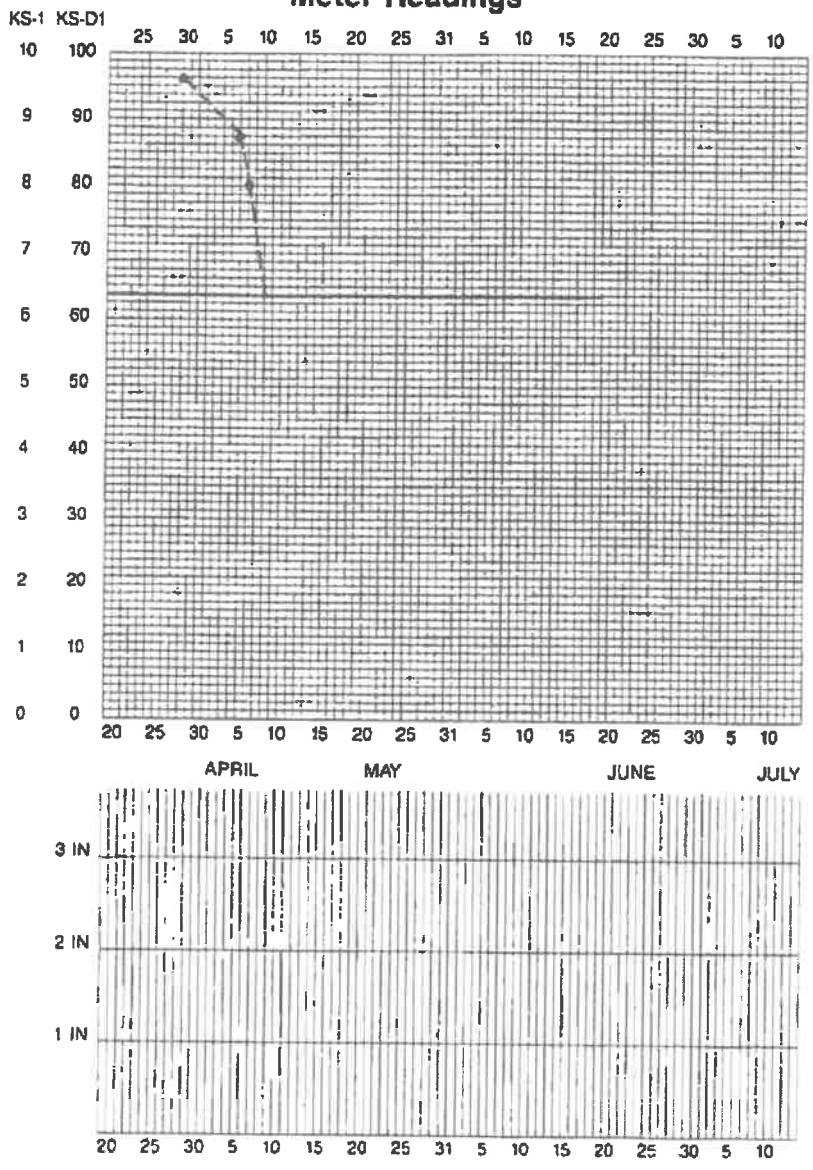
Fine textured soils (clay type) store a larger amount of water, but they also hold a larger amount of residual water than do coarse textured soils (sandy type). Clay soils hold more available moisture than sandy soils. Loam and sandy loam-type soils fall in between.

For these reasons, irrigation in sandy loam is normally applied at higher meter readings than in clay loam soils, since available moisture can be used up more rapidly by the plants and dry climatic conditions in sandy loam.

There is an optimum range of moisture for optimum plant growth. Over- irrigation, which tends to prevent adequate root aeration and possibly lead to root rot, can be prevented with proper irrigation scheduling. This requires recording and observing soil moisture meter readings, recording of rainfall, knowledge of the soil and of the crops involved.

A grower with a good understanding of soil moisture meter readings and of all the other factors playing a role in plant growth will, in a short time, be able to establish his own guidelines for optimum irrigation scheduling in relation to his soil(s), crop and climate.

Fig. 3
Meter Readings



Stake No. _____ Year _____
Farm _____ Soil Type _____
Crop _____ County _____

RAINFALL ■

IRRIGATION □

NOTE: Actual Chart Covers Over 5 Months

Scale ½" Vertical = 1" Moisture

HOW TO USE IRRIGATION CHARTS

Irrigation charts are provided with each instrument. Additional charts are available on order. Regular use of the charts helps in planning irrigation.

All readings should be recorded using a line of different identity to indicate the readings of each particular block.

As readings are made and recorded, a curve of soil moisture changes will result. By extending the slope of the lines, it will be possible to see well in advance when the soil moisture will reach the level at which irrigation is required. In addition, the chart will also indicate how much water is needed to restore the moisture to field capacity.

For example, assume that irrigation should be applied when a block planted at 18" and yielding a reading of 63, indicates roughly 1.5 in terms of bars tension. Soon after irrigation, this block may read 96; a few days later (without irrigation or rainfall) it may read 88; the next day 80. If these three readings are plotted on the irrigation chart, and a line extended through them, it is possible to project the time at which the 1.5 bars tension level (or irrigation point) will be reached; in this case it would be less than three days.

NOTE: The gypsum blocks must be soaked in water for 1 hour and allowed to dry as soon as received. This wetting-drying cycle will improve their uniformity. Before planting the blocks, they should be soaked again for 2 to 3 minutes to improve contact with the soil.

INSTALLATION OF THE BLOCKS

① Dig a hole in the ground with 1" soil auger or better, a 7/8" soil probe.

② Make a soil and water slurry of creamy consistency and place 1 or 2 tablespoons of the slurry in the hole.

③ Push the block to the bottom of the hole, forcing the slurry to envelop the block. The block can be pushed by using a tube (plastic or aluminum will suffice) or a slotted rod.

④ Back fill the hole and tamp in small increments.

⑤ Install only one block in each hole and fasten the leads to a stake so that they can be kept clean and are easily located for reading. Identify the lead wire according to the depth of the blocks by using a colored tag or by making a knot on the shallow block, 2 knots on the deep one (3 knots on the next, if three blocks are used in the same station).

WHERE TO PLACE BLOCKS

The location and depth of the blocks depends on the nature of the crops, the potential root zone, the type of soil and subsurface formation, and the profile of the field. While it is not possible to give specific instructions applicable to all cases, there are some guidelines to be followed: (A "string" of blocks 2, 3, or 4, depending on the depth to be reached, is called "station").

- Select a station locations where the plant population is representative of the field. Do not place the blocks in low or high spots or near changes in slope of the irrigation run unless you wish to measure variability in water penetration caused by such differences.
- Keep the soil around the stations from becoming compacted when taking readings, especially where blocks are planted near the surface. Do not walk in furrows in which soil moisture readings are being measured. Walk in the next furrow. Mark each "walk" furrow when installing the blocks.
- When using sprinkler systems, make sure the blocks are set so they will not be damaged when the sprinkler is moved. Inaccurate readings can also result if the blocks are placed too close to the sprinkler head.
- The blocks should not be shielded by any low hanging branches or in an area that may be flooded by run-off. In the case of row crops, the blocks should be located directly in the row. In orchards, the blocks are located at the drip line of a tree.

We recommend that a second string of a few blocks be placed in the ground not far from the first – 10" to 20" apart. This will serve as a control on the blocks and on other factors. If the readings of two adjacent blocks at the same depth show a significant discrepancy, the cause should be determined. It may be poor distribution of water from the sprinkler system, or difference in sprinkler distribution caused by wind, differences in root concentration surrounding the block installations, or differences in the soil.

DEPTH OF INSTALLATION

The active root zone of the crop determines the depth at which to place the blocks. Type of crop, soil depth, and state of growth should also be considered.

When seeds are first planted, irrigation is necessary to assure quick and uniform seed germination. Visual inspection of the soil near the seeds will indicate whether irrigation is needed at that time. A minimum of two blocks per station is recommended; one shallow, one deep. The table below gives recommended depths for setting the blocks according to soil depth or active root zone.

Recommended depths for placing electrical resistance blocks according to soil depth or active root zones.

Soil depth or active root zone (Inches)	Shallow blocks (Inches)	Deep blocks (Inches)
18	8	12
24	12	18
36	12	24
48	18	36

CARE OF YOUR METER

- Store your meter in a clean, dry place. The protective carrying case is an ideal storage place when the meter is not in use.
- Change the 9-Volt battery as needed. Continued use with a low battery may cause the meter to go out of calibration.
- Clean the meter with any biodegradable cleaner. Use the cleaner sparingly and on external parts only.
- Remove the battery if the meter will not to be used for one month or longer.

SERVICE FOR YOUR METER

If your meter is not working properly, replace the battery with a new one and check the calibration. If this does not resolve the problem, go to **www.delmhorst.com** and follow the instructions under the Product Support tab.

If you require further assistance please call
877-DELMHORST (335-6467) or **973-334-2557**

WARRANTY

Delmhorst Instrument Co., referred to hereafter as Delmhorst, guarantees its KS-D1 meter for one year from date of purchase and any optional electrodes against defects in material or workmanship for 90 days. If, within the warranty period of the KS-D1, you find any defect in material or workmanship return the meter following the instructions in the **Service for Your Meter** section. This limited warranty does not cover abuse, alteration, misuse, damage during shipment, improper service, unauthorized or unreasonable use of the meter or electrodes. This warranty does not cover batteries, pin assemblies, or pins. If the meter or any optional electrodes have been tampered with, the warranty shall be void. At our option we may replace or repair the meter.

Delmhorst shall not be liable for incidental or consequential damages for the breach of any express or implied warranty with respect to this product or its calibration. With proper care and maintenance the meter should stay in calibration; follow the instructions in the **Care of Your Meter** section.

UNDER NO CIRCUMSTANCES SHALL DELMHORST BE LIABLE FOR ANY INCIDENTAL, INDIRECT, SPECIAL, OR CONSEQUENTIAL DAMAGES OF ANY TYPE WHATSOEVER, INCLUDING, BUT NOT LIMITED TO, LOST PROFITS OR DOWNTIME ARISING OUT OF OR RELATED IN ANY RESPECT TO ITS METERS OR ELECTRODES AND NO OTHER WARRANTY, WRITTEN, ORAL OR IMPLIED APPLIES. DELMHORST SHALL IN NO EVENT BE LIABLE FOR ANY BREACH OF WARRANTY OR DEFECT IN THIS PRODUCT THAT EXCEEDS THE AMOUNT OF PURCHASE OF THIS PRODUCT.

The express warranty set forth above constitutes the entire warranty with respect to Delmhorst meters and electrodes and no other warranty, written, oral, or implied applies. This warranty is personal to the customer purchasing the product and is not transferable.

NOTES

For 65 years Delmhorst has been the leading manufacturer of high quality, US-made moisture meters and thermo-hygrometers. Today we offer a wide range of meters for applications including water damage restoration, construction, flooring, lumber/woodworking, paper, and agriculture.

DELMHORST
INSTRUMENT CO.
WHEN ACCURACY IS THE POINT. ™

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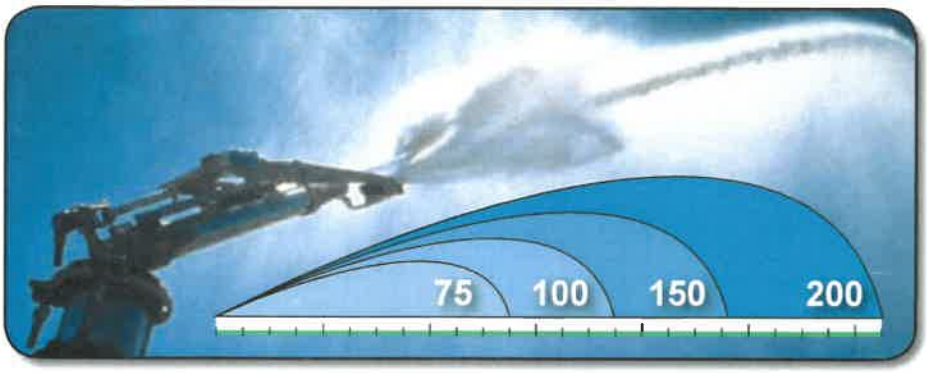
BIG GUN® OPTIONS AVAILABLE



TO ORDER BIG GUNS® SPECIFY THE FOLLOWING:

Model No., Trajectory, Connection Size & Type, Nozzle Size & Type, Optional Coatings (Anodized or Anodized and Powder Coated) NOTE: Extended lead time may be necessary for large quantities of anodized or anodized and powder coated products.

Specification Example:
SR100 (24°), 2" FNPT, 100T-0.8"

	75 SERIES	100 SERIES	150 SERIES	200 SERIES
PERFORMANCE	30-160 GPM (6.8-36.3 M³/H) 25-80 PSI (1.75-6 Kg/cm²)	50-300 GPM (10-70 M³/H) 40-110 PSI (3.5-8 Kg/cm²)	100-630 GPM (23-150 M³/H) 50-120 PSI (3.5-9 Kg/cm²)	250-1200 GPM (55-275 M³/H) 60-130 PSI (4-9 Kg/cm²)
MODEL & TRAJECTORY	Full Circle F75 / Part Circle SR75	Full Circle F100 / Part Circle SR100 / Part Circle SRA100	Full Circle F150 / Part Circle SR150 / Part Circle SRA150	Full Circle F200 / Part Circle SR200
	21°, 24° / 18°, 21°, 24°, 43°	18°, 21°, 24°, 43° / 15-45° Adjustable	21°, 24° / 21°, 24°, 27°, 43° / 15-45° Adjustable	21°, 24°, 27°
NOZZLE OPTIONS – TAPER	0.4-0.8" (10.2-20.3 mm): Not Available	0.5-1.0" (12.7-25.4 mm): 100T (Specify Size)	0.7-1.4" (17.8-35.6 mm): 150T (Specify Size)	1.05-1.9" (26.7-48.3 mm): 200T (Specify Size)
NOZZLE OPTIONS – TAPER RING	TR75 (Specify Size)	100TR (Specify Size) — NA for SRNV	150TR (Specify Size)	Not Available
NOZZLE OPTIONS – RING	Not Available	100R (Includes Set of Rings) — NA for SRNV	150R (Includes Set of Rings)	200R (Includes Set of Rings)
SPECIAL OPTIONS	Not Available	Anodized & Powder Coated, Vaneless Range Tube*	Anodized & Powder Coated, Stainless Steel (SRA150 N/A), Vaneless Range Tube	Anodized & Powder Coated
ADD-ON KITS	HD Lower Bearing, 12° Wedge Kit, Counterbalance Kit, Stream Straightener Vane	Low-Pressure Drive Vane Kit, Counterbalance Kit, Secondary Nozzle Kit, 12° Wedge Kit, Stream Straightener Vane	Counterbalance Kit, Secondary Nozzle Kit, Stream Straightener Vane	Secondary Nozzle Kit (standard), 12° Wedge Kit (SR200 only)
MOUNTING DETAILS	Fits QC** & 2" 800 Series Valve	Fits QC** & 2" 800 Series Valve (QC NA for SRNV100)	Substantial thrust on riser, use 3" valve minimum	Substantial thrust on riser, use 4" valve minimum
CONNECTION OPTIONS	1 1/2" or 2" FNPT or FBSP ANSI/DIN Nelson or Euro Flange	2" FNPT or FBSP, 2 1/2" FNPT ANSI/DIN, Nelson or Euro Flange / 2" FNPT or FBSP for SRNV	Nelson, Euro or ANSI/DIN Flange Also, Nelson Flange to Female Adapters	Nelson, Euro or ANSI/DIN Flange Also, Nelson Flange to Female Adapters

*Vaneless Range Tube option is for wastewater applications containing hair, straw, etc.

** The "Quick Coupling Valve" inlet is available in both 2" and 3" FNPT and FBSP for connection to the piping system. The "Quick Coupling Key" outlet is available in 2" FNPT, 2" FBSP, and Nelson Flange Connection for connection to the Big Gun.

BIG GUN® PERFORMANCE (U.S. UNITS)

Flow and diameter (feet) information at various pressures with different nozzle sizes. (See information at bottom of page 11.)

75 TAPER RING NOZZLE — 24° TRAJECTORY

PSI	0.4"		0.45"		0.5"		0.55"		0.6"		0.65"		0.7"		0.75"		0.8"	
	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT
25*	—	—	—	—	—	—	42	146	50	155	59	161	69	167	80	174	91	182
30*	—	—	—	—	37	158	45	158	55	165	64	172	75	182	87	187	99	192
35	—	—	32	154	40	164	49	172	59	178	69	191	81	196	93	202	106	208
40	27	149	35	160	43	171	52	180	63	190	74	198	87	204	98	213	112	221
45	29	155	37	167	46	180	56	189	67	198	79	206	91	214	104	223	118	230
50	30	161	39	174	48	186	59	195	70	203	83	212	95	220	109	230	123	237
55	32	165	41	179	50	193	62	203	74	213	87	221	100	230	115	239	130	247
60	33	169	42	184	53	198	64	208	77	220	91	228	104	237	120	245	136	254
65	35	172	44	189	55	205	67	216	80	227	95	237	109	247	125	254	142	263
70	36	175	45	194	57	210	69	221	83	232	98	243	113	254	129	260	147	270
75	37	179	47	201	59	217	72	228	86	239	101	250	117	261	134	268	153	277
80	39	182	49	207	61	222	74	234	89	244	105	256	121	266	138	274	158	283

*Operating at pressures above 30 PSI provides better performance.

100 TAPER BORE NOZZLE — 24° TRAJECTORY

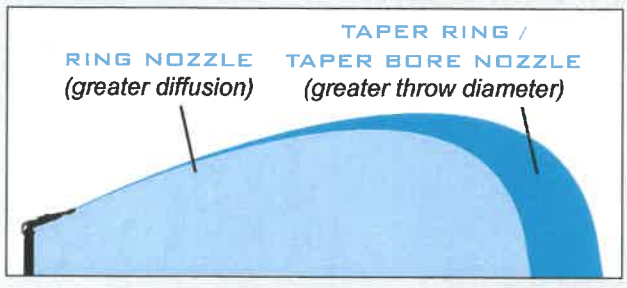
PSI	0.5"		0.55"		0.6"		0.65"		0.7"		0.75"		0.8"		0.85"		0.9"		1.0"	
	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT
40	47	191	57	202	66	213	78	222	91	230	103	240	118	250	134	256	152	262	—	—
50	50	205	64	215	74	225	87	235	100	245	115	256	130	265	150	273	165	280	204	300
60	55	215	69	227	81	240	96	250	110	260	126	270	143	280	164	288	182	295	224	316
70	60	225	75	238	88	250	103	263	120	275	136	283	155	295	177	302	197	310	243	338
80	64	235	79	248	94	260	110	273	128	285	146	295	165	305	189	314	210	325	258	354
90	68	245	83	258	100	270	117	283	135	295	155	306	175	315	201	326	223	335	274	362
100	72	255	87	268	106	280	123	293	143	305	163	316	185	325	212	336	235	345	289	372
110	76	265	92	278	111	290	129	303	150	315	171	324	195	335	222	344	247	355	304	380

150 TAPER BORE NOZZLE — 24° TRAJECTORY

PSI	0.7"		0.8"		0.9"		1.0"		1.1"		1.2"		1.3"		1.4"	
	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT
50	100	250	130	270	165	290	205	310	255	330	300	345	350	360	408	373
60	110	265	143	285	182	305	225	325	275	345	330	365	385	380	446	396
70	120	280	155	300	197	320	245	340	295	360	355	380	415	395	483	412
80	128	290	165	310	210	335	260	355	315	375	380	395	445	410	516	427
90	135	300	175	320	223	345	275	365	335	390	405	410	475	425	547	442
100	143	310	185	330	235	355	290	375	355	400	425	420	500	440	577	458
110	150	320	195	340	247	365	305	385	370	410	445	430	525	450	605	471
120	157	330	204	350	258	375	320	395	385	420	465	440	545	460	632	481

200 TAPER BORE NOZZLE — 27° TRAJECTORY

PSI	1.05"		1.1"		1.2"		1.3"		1.4"		1.5"		1.6"		1.75"		1.9"	
	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT	GPM	DIAM. FT
60	250	345	285	355	330	375	385	390	445	410	515	430	585	445	695	470	825	495
70	270	360	310	380	355	395	415	410	480	430	555	450	630	465	755	495	890	515
80	290	375	330	395	380	410	445	430	515	450	590	470	675	485	805	515	950	535
90	310	390	350	410	405	425	475	445	545	465	625	485	715	505	855	535	1005	555
100	325	400	370	420	425	440	500	460	575	480	660	500	755	520	900	550	1060	575
110	340	410	390	430	445	450	525	470	605	495	695	515	790	535	945	565	1110	590
120	355	420	405	440	465	460	545	480	630	505	725	530	825	550	985	580	1160	605
130	370	425	425	445	485	465	565	485	655	515	755	540	860	560	1025	590	1210	620



See opposite page for nozzle descriptions.

BIG GUN® PERFORMANCE (METRIC)

Flow and diameter (meters) information at various pressures with different nozzle sizes. (See information at bottom of page.)

75 TAPER RING NOZZLE TR75 — 24° TRAJECTORY

Kg/cm²	10.2 mm			11.4 mm			12.7 mm			14.0 mm			15.2 mm			16.5 mm			17.8 mm			19.1 mm			20.3 mm		
	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M
1.75*	—	—	—	—	—	—	—	—	—	2.64	9.5	44	3.17	11.4	48	3.72	13.4	49	4.30	15.5	51	4.91	17.7	54	5.59	20.1	56
2.00*	—	—	—	—	—	—	2.33	8.4	48	2.82	10.2	48	3.39	12.2	51	3.98	14.3	52	4.59	16.5	56	5.25	18.9	58	5.97	21.5	59
2.50	—	—	—	2.11	7.6	47	2.61	9.4	50	3.16	11.4	53	3.79	13.6	55	4.45	16.0	58	5.14	18.5	60	5.87	21.1	62	6.68	24.0	64
3.00	1.83	6.6	47	2.32	8.3	50	2.86	10.3	53	3.46	12.4	57	4.15	14.9	59	4.88	17.6	61	5.63	20.3	63	6.43	23.1	66	7.32	26.3	69
3.50	1.98	7.1	49	2.50	9.0	52	3.09	11.1	57	3.74	13.4	60	4.48	16.1	62	5.27	19.0	64	6.08	21.9	67	6.95	25.0	70	7.90	28.4	73
4.00	2.11	7.6	50	2.67	9.6	54	3.30	11.9	59	3.99	14.4	62	4.79	17.2	65	5.63	20.3	67	6.50	23.4	71	7.43	26.7	73	8.45	30.4	76
4.50	2.24	8.1	52	2.84	10.2	57	3.50	12.6	62	4.24	15.2	66	5.08	18.3	68	5.97	21.5	71	6.89	24.8	75	7.88	28.4	78	8.96	32.3	80
5.00	2.36	8.5	53	2.99	10.8	60	3.69	13.3	64	4.46	16.1	68	5.35	19.3	70	6.30	22.7	74	7.26	26.1	78	8.30	29.9	80	9.45	34.0	84
5.50	2.48	8.9	55	3.13	11.3	62	3.87	13.9	66	4.68	16.9	70	5.61	20.2	73	6.60	23.8	77	7.62	27.4	81	8.71	31.3	83	9.90	35.7	86
6.00	2.59	9.3	56	3.27	11.8	63	4.04	14.6	68	4.89	17.6	72	5.86	21.1	74	6.90	24.8	79	7.96	28.6	84	9.09	32.7	85	10.3	37.2	87

*Operating at pressures above 2 Kg/cm² provides better performance.

100 TAPER BORE NOZZLE — 24° TRAJECTORY

Kg/cm²	12.7 mm			14.0 mm			15.2 mm			16.5 mm			17.8 mm			19.1mm			20.3 mm			21.6 mm			22.9 mm			25.4 mm		
	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M
3.0	3.00	10.8	59.5	3.73	13.4	62.6	4.33	15.6	66.1	5.09	18.3	66.8	5.84	21.0	71.4	6.71	24.1	74.5	7.64	27.5	77.5	8.74	31.5	79.5	9.67	34.8	81.4	11.9	42.8	88.1
4.0	3.40	12.2	64.3	4.25	15.3	67.8	5.00	18.0	71.8	5.86	21.1	74.8	6.82	24.6	77.8	7.73	27.8	81.0	8.66	31.2	82.8	10.1	36.2	86.4	11.2	40.4	88.6	13.8	49.5	94.8
5.0	3.79	13.6	69.0	4.72	17.0	72.7	5.59	20.1	76.4	6.56	23.6	80.2	7.62	27.5	84.4	8.66	31.2	86.7	9.91	34.9	90.4	11.3	40.5	92.5	12.5	45.2	94.7	15.5	55.6	103
6.0	4.17	15.0	73.4	5.14	18.5	77.3	6.12	22.1	80.7	7.19	25.9	85.0	8.35	30.1	88.7	9.51	34.3	91.8	10.9	38.2	94.7	12.4	44.5	97.7	13.7	49.5	101	16.8	60.5	109
7.0	4.53	16.3	77.6	5.52	19.9	81.6	6.61	23.8	85.0	7.75	27.9	89.3	9.02	32.5	93.0	10.3	37.0	96.1	11.7	41.3	99.0	13.3	48.0	102.2	14.8	53.5	105	18.2	65.5	113
8.0	4.89	17.6	81.7	5.84	21.0	85.7	7.07	25.5	89.3	8.25	29.7	93.1	9.64	34.8	97.3	11.0	39.4	99.7	12.5	44.1	103	14.2	51.2	105.8	15.9	57.2	109	19.5	70.2	116

150 TAPER BORE NOZZLE — 24° TRAJECTORY

Kg/cm²	17.8 mm			20.3 mm			22.9 mm			25.4 mm			27.9 mm			30.5 mm			33.0 mm			35.6 mm		
	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M
3.5	6.39	23.0	76.0	8.29	29.8	82.0	10.5	37.8	88.0	13.0	46.9	95.0	15.9	57.1	101	19.0	68.3	105	22.3	80.1	110	25.8	92.9	114
4.0	6.83	24.6	79.6	8.86	31.9	85.6	11.2	40.4	91.6	13.9	50.1	97.8	16.9	61.0	104	20.3	73.0	109	23.8	85.7	114	27.4	98.6	118
5.0	7.63	27.5	85.4	9.91	35.7	91.6	12.6	45.2	98.6	15.6	56.0	105	18.9	68.2	111	22.7	81.7	117	26.6	95.8	121	30.8	111	126
6.0	8.36	30.1	89.7	10.9	39.1	96.7	13.8	49.5	104	17.0	61.3	110	20.8	74.7	117	24.9	89.5	123	29.1	105	128	33.6	121	133
7.0	9.03	32.5	95.0	11.7	42.2	101	14.9	53.5	108	18.4	66.3	114	22.4	80.7	122	26.8	96.6	128	31.5	113	134	36.4	131	139
8.0	9.66	34.8	99.3	12.5	45.1	105	15.9	57.2	112	19.7	70.8	118	24.0	86.3	126	28.7	103	132	33.7	121	138	38.9	140	145
9.0	10.2	36.9	104	13.3	47.9	110	16.8	60.6	117	20.9	75.1	123	25.4	91.5	131	30.4	110	137	35.7	129	143	41.1	148	149

200 TAPER BORE NOZZLE — 27° TRAJECTORY

Kg/cm²	26.7 mm			27.9 mm			30.5 mm			33.0 mm			35.6 mm			38.1 mm			40.6 mm			44.5 mm			48.3 mm		
	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M	L/S	M³/H	DIAM. M
4.0	15.5	55.7	104	17.8	63.9	106	20.3	73.1	112	23.8	85.8	117	27.5	98.9	123	32.2	116	129	36.1	130	134	42.9	154	141	50.7	183	149
5.0	17.3	62.3	111	19.9	71.5	117	22.7	81.7	121	26.7	96.0	126	30.7	111	132	36.0	130	138	40.3	145	143	48.0	173	152	56.7	204	158
6.0	19.0	68.2	115	21.8	78.3	121	24.9	89.5	126	29.2	105	132	33.7	121	138	39.4	142	144	44.2	159	149	52.6	189	158	62.1	224	164
7.0	20.5	73.7	122	23.5	84.6	128	26.9	96.7	134	31.5	114	140	36.3	131	146	42.6	153	152	47.7	172	159	56.8	204	168	67.1	241	175
8.0	21.9	78.8	126	25.1	90.4	132	28.7	103	138	33.7	121	144	38.9	140	152	45.5	164	159	51.0	184	165	60.7	218	174	71.7	258	182
9.0	23.2	83.6	130	26.6	95.9	136	30.4	110	142	35.8	129	148	41.2	148	157	48.3	174	164	54.1	195	170	64.4	232	180	76.0	274	188

Diameters are based on a 24° trajectory for the 75, 100 and 150 Series and a 27° trajectory for the 200 Series. The lower trajectory angles result in better wind fighting ability, but reduced throw distances. Throw reduction depends upon nozzle flow rate. In general, the throw distance is reduced approximately 3% with each 3° drop in trajectory angle. Use of the wedge insert to modify trajectory will affect distance. Big Gun® performance data has been obtained under ideal test conditions and may be adversely affected by wind, poor hydraulic entrance conditions or other factors. Test riser height of 3 feet (0.91 meters) above measurement surface. No representation regarding droplet condition, uniformity, application rate, or suitability for a particular application is made herein.

Additional nozzle options and sizes available. Go to www.nelsonirrigation.com or contact the factory for nozzle performance.

TAPER BORE NOZZLE. Most common nozzle type. Used where the available water flow and pressure are consistent. A nozzle size must be specified when ordering a Big Gun with a Taper Bore Nozzle. *The Nozzle Valve End Gun requires a Taper Bore Nozzle.*

RING NOZZLE SET. The Ring Nozzle Set is an easy and economic way of changing nozzles to match the available water flow and pressure. These are commonly used where the available water flow and pressure are variable and or when the Big Gun is shifted between various water sources with different capacities. The abrupt orifice of the nozzle is less efficient so the radius of throw is less than that achieved with an equivalent diameter Taper Bore nozzle. The abrupt orifice of the Ring Nozzle does break the stream of water up more, which can be an advantage in low pressure applications. The Ring Nozzle comes with a set of rings. *The Ring Nozzle should not be used with the Nozzle Valve End Gun.*

TAPER RING NOZZLE. This nozzle combines the changeability of a Ring Nozzle with some of the efficiency of a Taper Bore Nozzle. When ordering the Taper Ring Nozzle, specify the size as only one Taper Ring comes with the nozzle body and cap. Additional taper ring sizes can be purchased. *The Taper Ring Nozzle should not be used with the Nozzle Valve End Gun.*

APPENDIX N: TABLES TO CALCULATE MAXIMUM ALLOWABLE IRRIGATION RATES

City of Molalla
Recycled Water Use Plan Amendment
Project 100.31

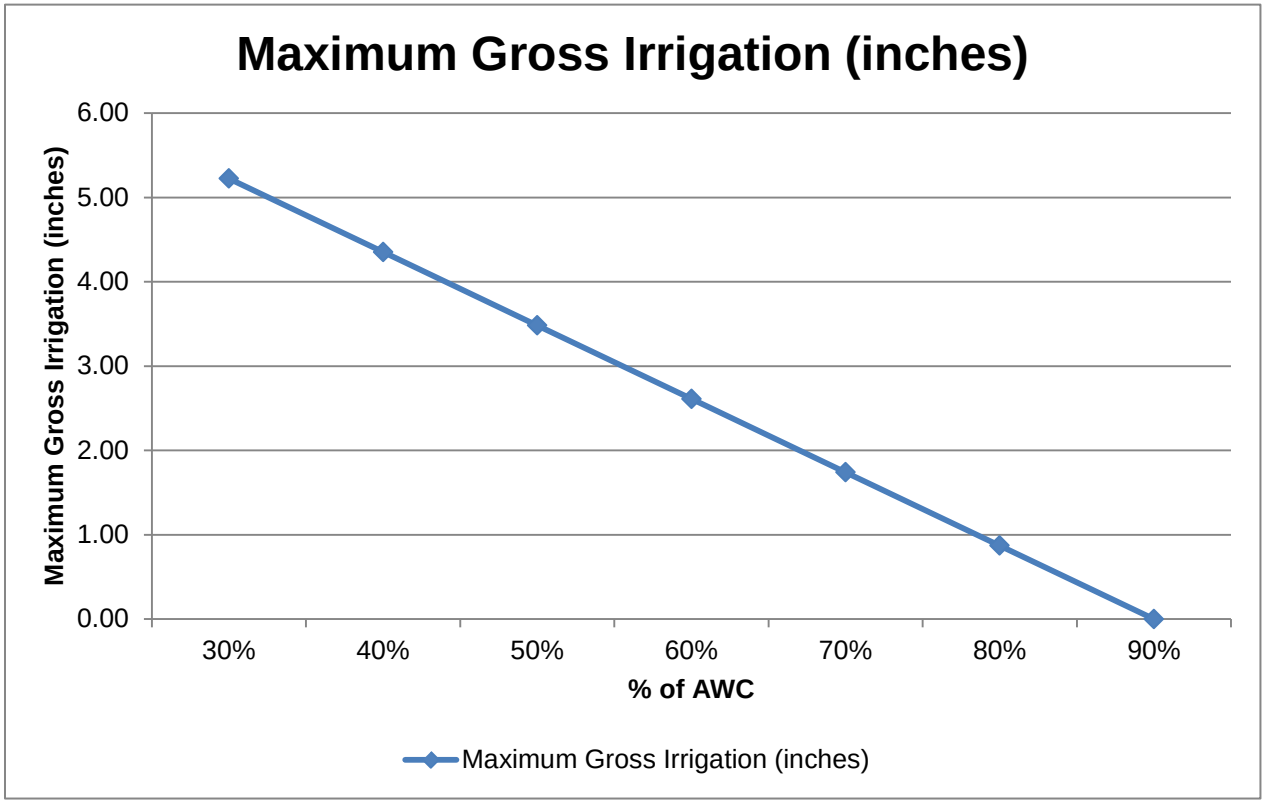
Soil Moisture Block Irrigation Calculations

North Coleman

Average AWC reading before irrigation		AWC for the field	90% of AWC	Maximum gross irrigation allowed
(percent of AWC)	(inches)[a]	(inches)	(inches)	(inches)[b]
0.60	4.44	7.40	6.66	2.61

[a]Average AWC reading (inches) = Average AWC reading (percent of AWC) x AWC for the field (inches).

[b]Maximum gross irrigation allowed (inches) = 90% of AWC (inches) - Average AWC reading (inches).
Assumes 85% irrigation efficiency.



City of Molalla
Recycled Water Use Plan Amendment
Project 100.31

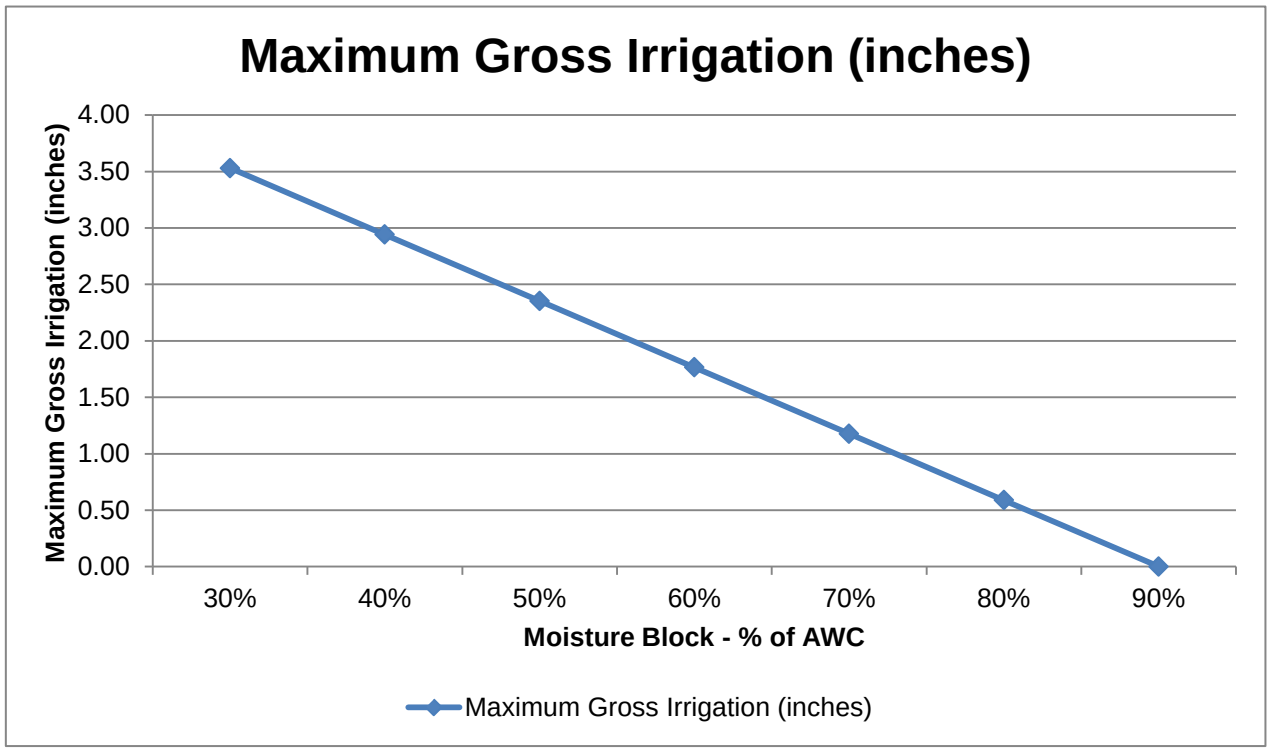
Soil Moisture Block Irrigation Calculations

South Coleman

Average AWC reading before irrigation		AWC for the field	90% of AWC	Maximum gross irrigation allowed
(percent of AWC)	(inches)[a]	(inches)	(inches)	(inches)[b]
0.50	2.50	5.00	4.50	2.35

[a]Average AWC reading (inches) = Average AWC reading (percent of AWC) x AWC for the field (inches).

[b]Maximum gross irrigation allowed (inches) = 90% of AWC (inches) - Average AWC reading (inches).
Assumes 85% irrigation efficiency.



APPENDIX O: CALCULATIONS FOR GROSS IRRIGATION CAPACITY FOR CEMETERY SITE

Table 1. Calculations for the gross irrigation application rate using the solid set system at the Cemetery site

Lateral spacing length (feet)	Lateral spacing width (feet)	Area irrigated per spacing (feet^2)	Area irrigated per spacing (acres)	Flow rate				Set time	Gross application rate per set
				(gallons/minute)	(gallons/hour)	(acre-inches/hour)[a]	(inches/hour)[b]	(hours)	(inches/acre)
40	30	1,200	0.03	3	180	0.01	0.24	10	2.4

[a]acre-inches/hour = (gallons/hour) / (27,154 gallons / acre-inch)

[b]inches/hour = (acre-inches/hour) / (acres)

APPENDIX P: SUMMARY OF IRRIGATION CAPACITY OF EACH SITE

Molalla RWUP Amendment
Project No. 100.31

Recycled Water Application Rates - Class C

Site	Useable Acres	Gross Irrigation	May	June	July	Aug	Sept	Oct	Totals
North Coleman	270	inches	1.31	3.01	5.88	4.68	1.53	0.19	16.6
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	35572	81734	159666	127081	41546	5159	
		useable acres	270	270	270	270	270	270	
		gallons	9604369.8	22068055.8	43109690.4	34311794.4	11217317.4	1393000	
		million gallons	9.6	22.1	43.1	34.3	11.2	1.4	121.7
South Coleman	163	inches	1.59	3.01	5.88	4.68	1.53	0.19	16.88
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	43175	81734	159666	127081	41546	5159	
		useable acres	163	163	163	163	163	163	
		gallons	7037502	13322567	26025480	20714157	6771936	840959	
		million gallons	7.0	13.3	26.0	20.7	6.8	0.8	74.7
Cemetery	3.4	inches	1.45	3.01	5.88	4.68	1.53	0.19	16.74
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	39373	81734	159666	127081	41546	5159	
		useable acres	3.4	3.4	3.4	3.4	3.4	3.4	
		gallons	133869	277894	542863	432074	141255	17541	
		million gallons	0.13	0.28	0.54	0.43	0.14	0.02	1.5
WWTP	8.1	inches	0.78	3.01	5.88	4.68	1.53	0.19	16.07
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	21180	81734	159666	127081	41546	5159	
		useable acres	8.1	8.1	8.1	8.1	8.1	8.1	
		gallons	171559	662042	1293291	1029354	336520	41790	
		million gallons	0.17	0.66	1.29	1.03	0.34	0.04	3.5
								Total	201.5

Molalla RWUP Amendment
Project No. 100.31

Recycled Water Application Rates - Class C (No irrigation in May and Oct.)

Site	Useable Acres	Gross Irrigation	May	June	July	Aug	Sept	Oct	Totals
North Coleman	270	inches	0	3.01	5.88	4.68	1.53	0	16.6
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	0	81734	159666	127081	41546	0	
		usable acres	270	270	270	270	270	270	
		gallons	0	22068055.8	43109690.4	34311794.4	11217317.4	0	
		million gallons	0.0	22.1	43.1	34.3	11.2	0.0	110.7
South Coleman	163	inches	0	3.01	5.88	4.68	1.53	0	15.1
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	0	81734	159666	127081	41546	0	
		usable acres	163	163	163	163	163	163	
		gallons	0	13322567	26025480	20714157	6771936	0	
		million gallons	0.0	13.3	26.0	20.7	6.8	0.0	66.8
Cemetery	3.4	inches	0	3.01	5.88	4.68	1.53	0	15.1
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	0	81734	159666	127081	41546	0	
		usable acres	3.4	3.4	3.4	3.4	3.4	3.4	
		gallons	0	277894	542863	432074	141255	0	
		million gallons	0.00	0.28	0.54	0.43	0.14	0.00	1.4
WWTP	8.1	inches	0	3.01	5.88	4.68	1.53	0	15.1
		gallons/acre-inch	27154	27154	27154	27154	27154	27154	
		gallons/acre	0	81734	159666	127081	41546	0	
		usable acres	8.1	8.1	8.1	8.1	8.1	8.1	
		gallons	0	662042	1293291	1029354	336520	0	
		million gallons	0.00	0.66	1.29	1.03	0.34	0.00	3.3

Total	182.3

APPENDIX Q: WASTEWATER STORAGE WATER BALANCE CALCULATIONS

City of Molalla
Monthly Water Balance
Existing Condition w/ No Discharge in May and October
Project Number 100.31

Influent Flow Information:	AWWF	2.48	mgd
	ADWF	1.1	mgd
Lagoon Information (7):	Average Lagoon Area	25	acres
	Future Additional Lagoon Area	0	acres
	Assumed Level at beginning of summer	7	ft
	Maximum water level	12	ft
	Maximum total storage capacity	300	ac-ft
	Maximum surge volume	125	ac-ft
	Irrigation area	444.5	acres
	Additional Irrigation Area	0	acres
	Irrigation efficiency	100%	

Month	Influent (1)		Precipitation (2)		Evap. (3)		Irrigation (4)		Lagoon Leakage (5)			Molalla River Discharge (6)		Net Storage	Storage Accum.	Surge Volume
	(MG)	(ac-ft)	(in)	(ac-ft)	(in)	(ac-ft)	(in)	(ac-ft)	(MG)	(in)	(ac-ft)	(MG)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
															175	
May	47	145	2.59	5.4	4.1	-8.54	0	0.0	0.0	7.8	-16.1	-5.3			125	300	125
June	31	95	2.07	4.3	5.1	-10.63	3.0	-111.5	-36.3	7.5	-15.6	-5.1			-38	262	87
July	28	86	0.52	1.1	6.9	-14.38	5.9	-217.8	-71.0	7.8	-16.1	-5.3			-161	175	0
August	27	83	1.07	2.2	6.2	-12.92	4.7	-173.4	-56.5	7.8	-16.1	-5.3			-117	175	0
September	29	89	2.02	4.2	4.2	-8.75	1.5	-56.7	-18.5	7.5	-15.6	-5.1			12	187	12
October	34	104	4.29	8.9	1.9	-3.96	0	0.0	0.0	7.8	-16.1	-5.3			93	280	105
November	56	173	6.38	13.3	0.0	0.00	0	0.0	0.0	7.5	-15.6	-5.1	-90	-276	-105	175	0
December	112	342	7.13	14.9	0.0	0.00	0	0.0	0.0	7.8	-16.1	-5.3	-93	-285	56	231	56
January	82	252	7.31	15.2	0.0	0.00	0	0.0	0.0	7.8	-16.1	-5.3	-93	-285	-34	196	21
February	67	206	4.99	10.4	0.0	0.00	0	0.0	0.0	7.0	-14.6	-4.8	-84	-258	-56	175	0
March	84	258	5.13	10.7	0.0	0.00	0	0.0	0.0	7.8	-16.1	-5.3	-93	-285	-33	175	0
April	48	146	3.2	6.7	3.1	-6.46	0	0.0	0.0	7.5	-15.6	-5.1	-90	-276	-145	175	0
Total	645		46.7		31.5		15.1	-559.3	-182.3	91.3	-190.1	-61.9	-543.0	-1666.4	Required	300	125

(1) Influent based on AWWF and ADWF and historical distribution of flows.
(2) Precipitation data derived from NOAA Molalla station.
(3) Evaporation based on historical means for Corvallis in the Climatology Handbook, September 1969.
(4) Irrigation based on 2015 RWUP.
(5) Lagoon leakage (0.25 inches per day) based on 2017 leak test performed by The Dyer Partnership.
(6) Molalla River discharge based on modified DEQ permit to allow 3 mgd at higher mass load allowance.
(7) Assumed 100% irrigation efficiency. No irrigation in May and Oct. Assumed sludge is removed from lagoons to accomplish flow equalization.

AWWF	3	mgd