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# **2025 Irrigation and Crop Management Plan**

**Tree Top, Inc.  
Selah, Washington  
February 2025**

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## **2024 Irrigation and Crop Management Plan Tree Top, Inc. - Selah, Washington**

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## **EXECUTIVE SUMMARY**

The Tree Top, Inc. plant in Selah, Washington operates a land treatment system for its treated fruit processing wastewater, referred to as process water. Process water is recycled through spray irrigation onto farmland according to the terms of State Waste Discharge Permit Number WA-0002437, effective July 1, 2024. This 2025 Irrigation and Crop Management Plan contains an annual summary of land treatment operations for 2024 and a cropping and irrigation schedule for 2025 land treatment operations.

### **2024 Farm Operations Summary**

In 2024, 141.5 million gallons of process water was applied to 305 crop acres. In addition, 93.3 million gallons of fresh water from the Yakima River was applied as supplemental irrigation. The irrigated water was applied to cool season grasses and alfalfa. The total gross irrigated water averaged approximately 28 inches per land treatment field (field) compared to potential evapotranspiration ranging from 41.5 to 43.7 inches. The water balances indicate that leaching fractions were greater than the leaching requirement on 3 fields due to winter precipitation in January.

The annual net nitrogen load to the fields was 36,279 pounds, while measured crop nitrogen removal was 89,848 pounds. The fields had an acreage-weighted nitrogen deficit of -128 pounds per acre. The average hay yield was 4.8 dry tons per acre across all fields with a combined total of 1,324 tons of dry crop biomass removed.

Crop yield improved in 2024 compared to previous years. The soil pH across the fields ranges from moderately to strongly alkaline. The soil electrical conductivity by saturation paste extract was maintained at appropriate levels across all fields. The soil exchangeable sodium percentage observed across all fields in the top foot range from 7% to 15%, and should be closely monitored to determine if an increasing trend is observed, but do not warrant remediation with gypsum at this time.

### **2025 Cropping Schedule**

The Cropping and Irrigation Schedule for 2025 was developed based on scheduled cropping plans, and previous site data. An annual total of 234.7 million gallons of blended process water and fresh water is projected for application to the 305 crop acres. Additional supplemental fresh water may be used depending on crop water demands. The cropping plan balances the nutrient and hydraulic loads from all sources to provide sufficient water and nutrients for productive crops. The management practices described in this plan are within the agronomic capacity of the fields, and the land treatment system can function effectively. As process water, soil nitrogen, and crop tissues are monitored; hydraulic and nitrogen loads should be managed within the capability of the crops to control soil residual nitrogen each season. Monitoring will continue according to the Permit.

## **1.0 INTRODUCTION**

The Tree Top, Inc. (Tree Top) plant in Selah, Washington operates a land treatment system for its treated fruit processing wastewater (process water) northeast of the city of Selah and west of the Yakima River (Figure 1). The land treatment system (Site) is operated under the conditions of State Waste Discharge Permit No. WA-0002437 (Permit), which became effective December 1, 2007 (State of Washington Department of Ecology, 2024). Two additional facilities also discharge process water to the Site under the Permit: the Tree Top Ross plant, and Food Service Slicing, LLC, Fresh Slice plant. The Site consists of 5 land treatment spray fields (fields), totaling 305 acres.

Apple processing at the facilities varies annually. The lowest levels of processing occur in mid-summer while the highest processing occurs in late fall. Process water treatment for the 3 facilities begins with the collection of flows from cleaning activities and unit processes. These flows are delivered to screens by gutter and pump systems, and after screening are discharged to the main lift station for transport approximately 1.5 miles to the Site.

There are 3 process water treatment cells at the Site with a combined water storage capacity of 57.02 million gallons (MG). The screened process water is delivered to Cell #1 (2.1 MG capacity) for extensive aerobic treatment. The soluble organic materials are largely converted to microbial biomass in Cell #1, and the treated process water, with the remaining solids, flows into Cell #2 (2.81 MG capacity) for further aeration. Cell #2 contains fewer aerators, and can either completely mix the contents or allow the solids to settle and accumulate, if needed. Process water is blended with supplemental fresh water (fresh water) and the resulting irrigation water (irrigated water) can be applied to fields directly from Cell #2 or transferred to aerated Cell #3 for winter storage during non-irrigation months. Additional supplemental fresh water is available for irrigation on an as-needed basis and can be supplied separately from the blended irrigation water.

This 2025 Irrigation and Crop Management Plan (ICMP) contains an annual summary of land treatment farm operations for 2024 and a cropping and irrigation schedule of land treatment farm operations for 2025.

## **2.0 ANNUAL SUMMARY OF 2024 FARM OPERATIONS**

The farm operations summary covers data from January 1, 2024, through December 31, 2024. This section summarizes the farm operations and monitoring, including process water quantity and quality, hydraulic and constituent loads, crop management; and farm monitoring including crop harvest, nutrient and water balances, and soil test results.

### **2.1 Irrigated Water Quantity**

Process water and fresh water were irrigated from March through November 2024 for land treatment and reuse to meet crop water needs. Monthly process water irrigation ranged from 1.7 MG in August to 27.7 in June (Table 1). All process water irrigation was below the monthly limits established in Permit Special Condition S1.B as shown in Table 2. Annual process water irrigation was 141.5 MG and annual fresh water irrigation was 93.3 MG (Table 2).

## **2.2 Irrigated Water Quality**

The Permit S2.C requires that irrigation water quality be monitored once to twice monthly for a host of constituents including, but not limited to, five-day biochemical oxygen demand (BOD<sub>5</sub>), soluble five-day biochemical oxygen demand (sBOD<sub>5</sub>), total nitrogen, pH, fixed dissolved solids (FDS), and chloride.

Results of the 2024 irrigated water analyses for all parameters are summarized in Table 1 and are representative of the blended process plus fresh water irrigated at the Site. Some parameters shown in Table 1 were not required for testing prior to the new Permit, effective date July 1, 2024. Average monthly concentrations of BOD<sub>5</sub> and sBOD<sub>5</sub> ranged from 47 to 175 milligrams per liter (mg/L) and 2 to 41 mg/L, respectively. Average monthly total nitrogen concentrations ranged between 1 to 41 mg/L and average chloride concentrations ranged between 15 to 42 mg/L. Average monthly FDS concentrations ranged between 180 to 280 mg/L.

## **2.3 Hydraulic Loads**

Soil moisture monitoring probes were installed in Fields 1, 2, and 3 (Figure 2) in May 2019, and work in conjunction with Valley Scheduling™ moisture monitoring to guide irrigation rates and timing to meet crop demands. This scheduling helps manage soil water storage and improves crop growth and performance by managing soil water within an acceptable range.

Total irrigated water was calculated and recorded on monthly discharge monitoring reports submitted to the Washington State Department of Ecology (Ecology). Total irrigation including fresh water was 234.7 MG during 2024 (Table 2). Process water supplied approximately 60% of the applied irrigation with annual irrigated process water averaging approximately 17 inches across the Site (Table 2). In addition, the irrigated fresh water averaged approximately 11 inches across the Site (Table 2).

## **2.4 Constituent Loads**

Nutrient loads were calculated from the measured irrigated water constituent analyses and total hydraulic loads (Tables 2 and 3).

### **2.4.1 Nitrogen**

The average net irrigation nitrogen load (total nitrogen) was 116 pounds per acre (lb/ac) across the Site (Table 2). Monthly nitrogen applied to the Site ranged from 36 pounds (lb) to 9,240 lb per month, with a maximum daily load of 1.0 pound per acre per day (lb/ac/day). The annual net nitrogen load to the fields was 36,279 pounds. All nitrogen loads were below the Permit S1.B limits for nitrogen effluent loadings (Table 2).

### **2.4.2 Five-Day Soluble Biochemical Oxygen Demand**

The total average annual sBOD<sub>5</sub> load across the Site was 101 lb/ac (Table 2). The daily sBOD<sub>5</sub> load ranged from .01 lb/ac/day in March to 1.1 lb/ac per day in June, which is below the 7.0 lb/ac/day Permit limit. Annual sBOD<sub>5</sub> load was 31,560 lb with the largest monthly load occurring in June at 9,750 lb, which is less than the Permit limit of 65,000 lb/month.

### **2.4.3 Salts**

The FDS is a measure of the mineral salts present in the irrigation water and is monitored to evaluate the salinity and mass of salts discharged to the Site. The total average annual FDS load across the Site was 1,519 lb/ac (Table 2). Monthly FDS loads ranged from 10,733 lb in March to 89,097 lb in July. The total annual FDS Site load was 473,108 lb.

## **2.5 Crop Management**

Cropping consisted of 305 acres of perennial cool season grass and alfalfa, harvested as hay, across the 5 fields (Table 3). Hay cuttings occurred in the months of May, June, July, August, September and October (now shown). The hay harvest ranged from 2 to 4 cuttings depending on the field (Table 3).

## **2.6 Farm Monitoring**

Monitoring crop harvest, nutrient and water balances, and soil test results provide a means to evaluate land treatment system performance. Nutrient and water balances were constructed by comparing nutrient load and hydraulic load to crop nutrient removal and evapotranspiration (ET).

### **2.6.1 Crop Harvest**

The total hay removal was 1,466 tons across the Site with an average crop yield of 4.8 tons per acre (Table 3). Crop dry weight was calculated to determine crop nutrient removals. The total dry crop biomass removed was 1,466 tons across the Site with an average of 4.3 dry tons per acre. Crop tissue analytical results are attached as Appendix A.

### **2.6.2 Crop Nitrogen and Salts Removal and Balance**

Crop nitrogen removal was 74,960 pounds across the Site (Table 3) and averaged 246 lb/ac (Table 4). Crop nitrogen removals were subtracted from the net nitrogen loads to determine the nitrogen balances. The nitrogen load represents the irrigated water nitrogen as no commercial fertilizer was applied in 2024. Gaseous nitrogen losses from volatilization and denitrification were subtracted from the nitrogen load to determine the net nitrogen available to the crop (net load nitrogen, Table 4). Gaseous losses are estimated to amount to about 6% of total nitrogen through volatilization of ammonia and denitrification of nitrate.

The nitrogen balances indicate that net nitrogen additions exceeded crop nitrogen removals on 2 fields and averaged a negative 129 lb/ac across the Site (Table 4). For fields with positive nitrogen balances, when crops take up less nitrogen than applied, the additional nitrogen may be used as a reserve of available nitrogen if it remains in the soil for the following growing season. The inorganic proportion of field soil nitrogen concentrations may be susceptible to translocation to lower depths in the soil profile if excessive percolate loss occurs due to irrigation or precipitation beyond the crop water need and soil hydraulic capacity.

Crop FDS removal, calculated from the ash content of crop biomass, averaged 897 lb/ac across the Site (Table 4). Crop FDS removals were subtracted from the FDS loads to determine the FDS balances. The FDS balances ranged from -12 to 1,498 lb/ac with an average Site wide positive FDS balance of 622 lb/ac. An FDS surplus is typical of irrigated agricultural systems and includes FDS



contributions from fresh irrigation water, process water as well as fertilizers or soil amendments, when applied, such as gypsum and sulfur.

### **2.6.3 Water Balance**

Table 4 and Appendix B present the monthly water balances discussed in this section. The water balance model uses precipitation and ET from the Washington State University AgWeatherNet WSU Pomona (HQ) weather station in Pomona, Washington (Washington State University, n.d.). Potential ET was adjusted by using estimated available soil water content compared to soil water holding capacity to approximate actual ET (ET estimate, Appendix B) in the water balance.

Total irrigation values were adjusted to account for estimated irrigation efficiency and to determine net (effective) irrigation rates. The estimated monthly irrigation efficiencies are 70% for May through August; 80% for April, September, and October; and 90% for November through March. Total effective water input (precipitation plus net irrigation) ranged from 22.1 to 32.3 inches, compared to the potential ET of 41.5 to 43.7 inches (Appendix B).

The estimated ET ranged from 22.9 inches to 30.7 inches across the 5 fields (Appendix B). Table 4 compares the projected and calculated leaching fractions and leaching requirements. The leaching requirement for each field ranged from 1.1 to 1.2%. The leaching fraction for all fields ranged from 0.9 to 4.6%. The leaching requirement is based on the FDS load in irrigation water and determines the amount of additional irrigation needed to leach excess salts from the soil root zone. A moderate amount of leaching is beneficial for proper management of salts in the root zone to maintain good crop production. All estimated leaching occurred during winter months when no process water irrigation occurred (Appendix B).

The monthly minimum average daily soil temperature at 8 inches below ground surface (bgs) using data from the Washington State University AgWeatherNet WSU Pomona (HQ) weather station is presented in Appendix B for each field water balance. During months where irrigation occurred, the minimum average daily soil temperature at 8 inches bgs ranged from 35.7 °F in May to 67.3 °F in September.

### **2.6.4 Soil Analyses**

Representative, composite soil samples were collected from each field. Soils were sampled in one-foot soil increments to either auger refusal or 72 inches bgs. Actual total sample depths ranged from 36 to 48 inches due to auger refusal. Soil samples were analyzed for all required parameters as stated in the Permit S2.H. The soil analytical results are summarized in Table 5.

The Oregon State University Extension Service has published a Soil Test Interpretation Guide (Horneck, Sullivan, Owen, & Hart, 2011) that provides a consistent reference for evaluating soil test results and guiding general fertility recommendations in Oregon and Washington. That document was used to evaluate the soil test results presented in the following paragraphs.

#### **pH**

Soil analyses demonstrate slightly to strongly alkaline pH levels, ranging from 7.7 to 8.7 standard units (s.u.) in the top foot. Soils at higher pH values may reduce nutrient availability to the crops.

Soil pH trends should continue to be monitored as application of elemental sulfur may be required on specific fields to lower the soil pH levels closer to neutral depending on level of soil alkalinity and crop performance.

## **Nitrogen**

Soil inorganic nitrogen can help confirm the nitrogen balance deficits or partially explain unaccounted nitrogen excess. Concentrations of  $\text{NO}_3\text{-N}$  less than 10 milligrams per kilogram (mg/kg) are considered low. The soil  $\text{NO}_3\text{-N}$  concentrations ranged from 1.0 to 13.6 mg/kg.  $\text{NO}_3\text{-N}$  concentrations generally decreased with depth in all fields. Soil  $\text{NO}_3\text{-N}$  concentrations remained below the 25 mg/kg S1.E Permit limit for depth intervals greater than 24 inches bgs. Concentrations of  $\text{NH}_4\text{-N}$  in soil between 2 and 10 mg/kg are typical, and cold or wet soils may cause concentrations greater than 10 mg/kg (Horneck, Sullivan, Owen, & Hart, 2011). The  $\text{NH}_4\text{-N}$  concentrations in the top foot ranged from 6.0 to 16.2 mg/kg across all fields (Table 5).

## **Salts**

Monitoring soil salts (salinity) is important for maintaining soil productivity and structure. Soil salts content can be measured by electrical conductivity tested on the soil saturation paste extract (ECe). This method allows direct comparison to published data for soil salts management. A soil ECe of 2 to 4 millimhos per centimeter (mmhos/cm) can result in reduction in the yields of salt sensitive crops (Bohn, McNeal, & O'Connor, 1979).

The ECe in the top profile depth was within the tolerance range for the grass crop at 0.8 to 1.3 mmhos/cm across the Site. ECe in the top foot are within the typically observed ranges for all fields when compared to soil concentrations observed over the past 6 years.

Sodium is one component of soil salts. Excess soil sodium concentration in relation to soil calcium and magnesium concentration can cause sodium to dominate negatively charged soil exchange sites, especially in conjunction with physical manipulation such as tillage, and negatively affect soil structure. The negative effects of sodium on soil structure are more predominant as soil clay content increases. Soil sodium concentrations are often evaluated by calculating the exchangeable sodium percentage (ESP). High ESP in the surface can lead to lower crop yields and decreased infiltration rates. An ESP of 15% or higher can result in clay particle dispersion, which can lead to soil sealing and physical structure deterioration (U.S. Salinity Laboratory Staff, 1954).

The soil ESP at the Site in the first foot of soil ranged from 7 to 15% across the Site in 2024 (Table 1). Soil water infiltration, ponding, runoff, and crop yields will continue to be monitored for evidence of negative impacts from elevated ESP. Continued monitoring of ESP during spring and fall of 2025 should continue to determine if gypsum amendments are recommended.

## **Ferrous Iron**

As required by Permit Special Condition S2.H, surface soils are required to be observed for any indications of ponding or collection of irrigated water into low areas or any areas where plant growth is visibly reduced in vigor. Valley examined the surface 6 inches of soil at each field soil sampling location during the fall sampling event for the presence or absence of ferrous iron using 1,000 mg/L 2,2'-dipyridyl indicator solution. Ferrous iron was absent at all sampling locations.

## **2.7 Groundwater Monitoring Results**

Groundwater was monitored at the 8 shallow monitoring wells; MW-1, MW-2R, MW-3, MW-4, WW-1, WW-2, WW-3, and WW-4R (Charts 1 through 3 and Figure 2), as required by Permit Special Condition S2.F. MW-1 is positioned to represent upgradient groundwater conditions.

During sampling, field measurements were made to determine depth to groundwater, pH, EC, and temperature. Groundwater well water samples were tested by Cascade Analytical Laboratory. All analyses required by the Permit were performed in 2024.

The information in this report is not intended to be an evaluation of the groundwater quality for all monitored parameters or an evaluation of the Site hydrogeology. The purpose of this section is to provide observations on the range of values and general groundwater quality for 3 specific parameters pertaining to land treatment system operations: NO<sub>3</sub>-N, TDS, and fecal coliform bacteria. Data used to generate Charts 1 through 3 was sourced from the monthly Tree Top Discharge Monitoring Reports submitted to Ecology. The following sections describe the groundwater results during calendar year 2024.

### **2.7.1 Total Dissolved Solids**

During 2024, the TDS at all downgradient wells ended the year below the 614 mg/L groundwater Permit special condition S1.F enforcement limit. The TDS in all downgradient wells, with the exception of WW-4R and MW-4, were under the concentration observed in upgradient MW-1 by the end of the calendar year.

### **2.7.2 Nitrate-Nitrogen**

During 2024, downgradient NO<sub>3</sub>-N concentrations remained below the Permit enforcement limit of 5.22 mg/L in all wells with the exception of MW-2R and MW-3. The NO<sub>3</sub>-N concentration during July for MW-3 was above the permit limit, then fell below the limit in October 2024. The NO<sub>3</sub>-N concentration in MW-2R exceeded the limit for all sampling events in 2024. The NO<sub>3</sub>-N concentration for all downgradient wells, with the exception of MW-2R, were below the upgradient MW-1 concentration by the end of the year.

### **2.7.3 Fecal Coliform**

Fecal coliform concentrations were not detected in the majority of wells throughout 2024. Elevated concentrations were observed in WW-2 in October. This elevated fecal coliform level is unusual and not likely due to management practices at the Site.

## **2.8 Summary**

Process water irrigation in 2024 was within than the crop hydraulic demand and supplemental fresh water irrigation from the Yakima River was required. Residual soil NO<sub>3</sub>-N and NH<sub>4</sub>-N in the top foot of soil indicate that inorganic nitrogen is available for crop uptake in 2025. Water balances indicate surplus soil moisture during some winter months. The soil ECe was within the tolerance range for the crops at this site. Soil pH is moderately to strongly alkaline for some fields and should be monitored in combination with crop health to determine if elemental sulfur applications are required to decrease pH. The soil ESP concentrations are elevated and should continue to be monitored to

determine if gypsum application may be required. Groundwater monitoring indicated no exceedances of the TDS groundwater criteria throughout 2024 and continuous exceedances of the NO<sub>3</sub>-N permit limit in downgradient monitoring well MW-2R throughout 2024.

### **3.0 CROPPING SCHEDULE FOR 2025**

This cropping schedule for the upcoming year provides specific information for managing the process water land treatment system. Farm operations for 2025 were planned using data from previous years. Table 6 summarizes the projected farm operations for 2025.

#### **3.1 Crops**

A total of 305 acres are permitted for process water land treatment and reuse. Fields 2, 3, and 5 will be used to grow a cool season grass mixture for hay production (grass hay). Fields 1 and 4 will continue in alfalfa for hay production.

#### **3.2 Planting and Cultivation Schedule**

The current crops will remain in all fields; therefore, no new planting activities are scheduled for 2024. Over seeding of cool season grasses on top of the existing stands may occur if deemed necessary.

#### **3.3 Harvest Schedule**

Haylage or baled hay will be harvested by cutting and chopping or cutting and baling. All harvests will be removed from the fields and sold for animal feed. Harvests will be scheduled as needed to obtain good yields and optimum crop quality. Two to 5 cuttings per season are expected. Harvests are projected to occur in May, June, July, August, and September, depending on climate and crop productivity.

#### **3.4 Pesticide Application**

Herbicides for weed control maybe used, if needed to improve quality and maintain stand density. Herbicides are typically applied once or twice during spring to early summer. Actual herbicide use will vary depending on the weeds, crop, and time of year. Insecticides or fungicides are not planned for use and will be used only if needed to treat specific problems. All pesticides will be applied by appropriately licensed applicators according to labeled rates and methods.

#### **3.5 Irrigation Management**

The irrigated water loading rates are based on the soil water intake rate and depend on crop consumptive water requirement (ET), potential crop nitrogen removal, soil nitrogen assimilative capacity, and salt leaching requirement.

##### **3.5.1 Crop Consumptive Water Use**

Projected irrigation and crop water capacity (Table 6) was estimated from monthly potential ET and average precipitation (Table 7). Potential ET was adjusted according to estimated available soil water content to determine the estimated ET as presented in the proposed water balances (Appendix C). If

available soil water is not maintained near field capacity it becomes more difficult for plants to extract soil water and actual ET is reduced compared to potential ET. Irrigation systems are typically designed to supply water at daily ET rates during peak water use months. Therefore, when crop harvesting or maintenance causes irrigation to be stopped, the soil dries and estimated ET is less than potential ET.

The crop type, growth stage, soil moisture status, precipitation, and potential ET determine estimated ET projections shown in Appendix C. Potential crop ET and projected precipitation values are 10-year averages of the most current 10 years from the AgWeatherNet WSU Pomona (HQ) weather station (Washington State University, n.d.) (Table 7).

### **3.5.2 Salt Leaching Rate**

High concentrations of soil salts (also known as soil salinity) reduce plant growth by lowering the soil osmotic potential. This makes it more difficult for the plants to extract water from the soil. Salts should be leached below the root zone regularly to prevent soil salt build-up. Leaching requirements are based on salinity of the irrigation water and the depth of water applied annually (Canessa & Hermanson, 1994). Leaching is required (leaching requirement) to control soil salinity and maximize crop yields, especially at this Site, which receives moderate to high salts loads as a result of process water irrigation.

The calculated leaching requirement, based on the process water quality and a goal of maintaining soil salts at 2.0 mmhos/cm or less, is 1.2% across all fields (Appendix C). Leaching is typically preferred in the fall and winter when trying to meet a leaching requirement. The leaching requirement for the Site can partially be met by precipitation during the dormant winter season when crop consumptive water use is low. Based on the projected leaching requirements (Appendix C), required leaching with supplemental fresh water or precipitation water amounts to approximately 0.6 inches.

### **3.5.3 System Efficiency and Uniformity**

Irrigation efficiency is defined as "the ratio of the volume of water delivered to the volume of water reaching the soil and stored for plant use" (U.S. Department of Agriculture - Soil Conservation Service and Washington State University Cooperative Extension Service, 1990). The State of Washington Irrigation Guide lists typical irrigation efficiencies for various irrigation methods. Efficiencies for irrigation methods used by Tree Top were estimated at 70% from May through August, 80% for April, September, and October, and 90% from November through March.

### **3.5.4 Infiltration Rates**

Irrigation practices to minimize the potential for ponding and avoid runoff allow the soil surface to dry or rest between irrigation events. Irrigation should be kept to the rate needed to replace consumptive water use. The center pivot systems will be operated fast enough to avoid runoff or ponding, while providing adequate soil moisture replacement for crop use.

### **3.5.5 Soil Water Holding Capacity**

Valley Scheduling soil moisture irrigation probes will be maintained for the irrigation season to monitor soil moisture profiles and schedule irrigation across the Site (Figure 2). Irrigation should be

managed to maintain soil moisture at or above 50% of the available water holding capacity to maintain vigorous crop growth.

### **3.5.6 Irrigation Frequency Considerations**

Short rest (non-irrigation) periods are necessary to allow the soil to assimilate process water organic and nutrient loads. Alternating cycles of wet and dry promotes effective treatment by alternating anaerobic and aerobic periods. This encourages both microbial nitrification and denitrification for nitrogen treatment and organic load (BOD<sub>5</sub>) decomposition.

Irrigation schedules will provide short rest periods during non-peak water use and maintain adequate soil water and oxygen levels. Harvest periods for the grass hay will provide rest periods. However, crop consumptive use can exceed irrigation system application rates during peak summer periods. Most forage crops, such as alfalfa or grasses, grow well as long as the plant available water content of the soil is not depleted by more than 50% (Trimmer & Hansen, 1994). As 50% depletion is reached, irrigation is required to maintain maximum crop production and avoid drought stress. During these periods, irrigation must be continuous to maintain soil water content.

### **3.5.7 Projected Process Water Load**

The monthly projected irrigation schedules for each field are shown in Table 8. Gross projected process water flow was determined by using past irrigation records. The 2025 projected blended irrigation water load is based on the previous year's load. Based on historical site hydraulic loads, Tree Top projects irrigation of 234.7 MG of blended process water and fresh water (Table 8). The flow is apportioned throughout the irrigation season based on historical patterns and crop need. The proposed monthly water balances for each field are shown in Appendix C. Actual irrigation rates depend on the climate conditions and availability of process water each year.

The object of the process water land treatment program is to balance available process water with crop water and nutrient needs. The proposed process water loading is designed to be as protective of groundwater as possible, while maintaining soil salt balance and crop productivity at the Site. Total blended irrigation water applications are forecast to range from 26.3 to 28.9 inches per field (Table 8 and Appendix C). Additional projected supplemental fresh water use, irrigated separately from the blended irrigation water, ranges from 13.5 to 23.5 inches (Appendix C).

### **3.5.8 Projected Nitrogen Loads**

Individual field loads and balances for nitrogen are provided in Table 9. Projected crop nitrogen removal is forecast to be greater than projected nitrogen loads (i.e., negative nitrogen balances for each field). There are 2 important assumptions built into these projections. One is that crop yields will be similar in 2025 compared to 2024, and the other is that process water nitrogen concentrations will be similar in 2025 compared to 2024. Alfalfa is projected for both Fields 1 and 4, and similar alfalfa yields and nitrogen removal are projected for these fields in 2025. Continued reduced usage of supplemental urea in the pretreatment cells is expected to achieve concentrations of total nitrogen in the irrigated process water similar to 2024. Maintaining and/or improving crop yields compared to 2024 levels are required in 2025 to ensure the hay crops can remove the process water nitrogen load projected for the 2025 season. Judicious use of supplemental fresh water in conjunction with use of Valley Scheduling moisture monitoring to guide irrigation rates and timing to meet crop demands

will support good crop performance. This type of irrigation scheduling using real-time data helps control soil water percolate losses to improve crop growth and performance by managing soil water within an acceptable range.

### **3.6 Farm Monitoring**

There are several important elements for monitoring the performance of an agricultural process water land treatment system. Observations and measurements must provide information about system function and potential impacts to groundwater and comply with Permit requirements. These involve an evaluation of management practices and result in a well-run system. The required monitoring plan has elements of each and is designed to satisfy Tree Top's Permit requirements.

Objectives for process water land treatment system monitoring at the Site can be accomplished by implementing the monitoring described below, in compliance with the Permit:

- Irrigated water monitoring: quantity and quality.
- Irrigation applications to the crops for each field.
- Crops grown and total acreage used for process water treatment.
- Crop water balances including evapotranspiration, precipitation, and irrigation from all sources.
- Crop constituent loading and removal summaries.
- Farm management data including crop harvests, crop nutrient content analyses, crop rotations, and soil sampling.

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## **TABLES**

<b>Table 1.</b>	<b>Irrigated Water Quality Summary</b>
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<b>Table 3.</b>	<b>Crop Yield and Nitrogen Removal</b>
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**Table 1. Irrigated Water Quality Summary**

Month	Process Water Flow	Total Irrigated Flow <sup>1</sup>	Average Monthly																			
			pH	Akalinity	sBOD <sub>5</sub>	BOD <sub>5</sub>	Ca	Cl	Cu	Mg	NO <sub>3</sub> + NO <sub>2</sub> -N	NH <sub>4</sub> -N	TKN	Total N	Total P	K	Na	FDS	TDS	TSS	Sulfate	Zinc
	million gallons		s.u.	milligrams per liter																		
Jan	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Feb	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mar	4.2	5.3	7.8	--	2	74	--	34	--	--	--	--	--	1	--	--	--	--	--	--	--	--
Apr	24.3	27.2	7.6	--	2	47	--	37	--	--	--	--	--	10	--	--	--	--	--	--	--	--
May	25.3	27.8	7.6	--	5	54	--	40	--	--	--	--	--	15	--	--	--	--	--	--	--	--
Jun	27.7	28.7	7.7	--	41	88	--	42	--	--	--	--	--	41	--	--	--	--	--	--	--	--
Jul	17.0	44.5	7.7	140	18	132	21	18	0.02	7	0.04	3	14	14	3	11	50	240	815	260	6	0.02
Aug	1.7	30.8	7.0	100	18	74	24	16	0.01	7	10	0.1	9	19	3	7	38	180	235	290	15	0.05
Sep	11.1	26.7	8.0	120	19	112	27	32	0.02	6	6	0.4	13	19	5	10	76	280	300	310	14	0.08
Oct	18.3	28.2	7.8	110	11	145	22	15	0.12	7	4	5	25	29	4	14	58	270	160	110	12	0.11
Nov	11.9	15.5	7.8	200	18	175	23	19	0.01	7	0.04	3	14	14	8	14	62	250	255	570	10	0.06
Dec	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	141.5	234.7																				
Flow Weighted Average <sup>2</sup>			7.6	128	16	101	23	27	0.04	7	4	2	15	20	4	11	55	242	412	279	11	0.06

NOTES:

Data is for the 2024 calendar year January 2024 through December 2024.

All values are the monthly averages of water quality data associated with land treatment system irrigation.

Abbreviations: -- = no sampled value, BOD<sub>5</sub> = five-day biochemical oxygen demand, Ca = calcium, Cl = chloride, Cu = copper, FDS = fixed dissolved solids, K = potassium, Mg = magnesium, NO<sub>3</sub>-N = nitrate nitrogen, NO<sub>2</sub>-N = nitrite nitrogen, NH<sub>4</sub>-N = ammonia nitrogen, sBOD<sub>5</sub> = soluble five-day biochemical oxygen demand, s.u. = standard units, TDS = total dissolved solids, TKN = total kjeldahl nitrogen, TSS = total suspended solids, total N = total nitrogen.

<sup>1</sup> Total irrigated flow is the sum of blended process water and supplemental fresh water irrigation flow.

<sup>2</sup> Average concentration based on monthly analytical value weighted by total irrigated flow per month, (i.e., sum [monthly-specific flow × monthly-specific concentration] ÷ sum of monthly flows).

**Table 2. Hydraulic and Constituent Loadings**

Field	Acres	Hydraulic (Gross) <sup>1</sup>			Nitrogen (Net) <sup>3</sup>			sBOD <sub>5</sub> <sup>4</sup>			FDS <sup>4</sup>			
		PW	FW	Total	Irrigation <sup>2</sup>		Fert	Total	Irrigation <sup>2</sup>					
		inches			pounds per acre									
Field 1	75	19	12	31	130		0	130	113			1,700		
Field 2	45	22	15	37	155		0	155	134			2,016		
Field 3	70	13	10	23	97		0	97	84			1,264		
Field 4	90	14	10	24	101		0	101	88			1,312		
Field 5	25	17	11	28	118		0	118	102			1,535		
Average <sup>5</sup>		17	11	28	116		0	116	101			1,519		
Month		PW Limit <sup>6</sup> (MG/mo)	million gallons		Limit <sup>6</sup> (lb/ac/day )	lb/ac/day	Limit <sup>6</sup> (lb/mo)	pounds	Limit <sup>6</sup> (lb/ac/day)	lb/ac/day	Limit <sup>6</sup> (lb/mo)	pounds		
Jan		0	0	0	0	0	0	0	0	0	0	0	0	
Feb			0	0		0				0		0		
Mar		45.6	4.2	1.2	1.43	0.004	13,320	36	7.0	0.01	65,000	89	10,733	
Apr			24.3	2.9		27.2		0.2		2,136		0.05	454	54,879
May		78.0	25.3	2.6	1.43	0.4	13,320	3,347	7.0	0.1	65,000	1,053	56,082	
Jun			27.7	1.1		28.7		1.0		9,240		1.1	9,750	57,902
Jul			17.0	27.4		44.5		0.5		4,885		0.7	6,682	89,097
Aug			1.7	29.1		30.8		0.5		4,579		0.5	4,499	46,274
Sep			11.1	15.6		26.7		0.4		4,065		0.5	4,124	62,419
Oct			36.2	18.3		9.8		28.2		0.7		6,323	0.3	2,585
Nov		11.9		3.5	15.5	0.2	1,667	0.2	2,323	32,265				
Dec		0		0	0	0	0	0	0	0	0			
Total			141.5	93.3	234.7			36,279				31,560	473,108	

**NOTES:**

Abbreviations: Fert = fertilizer, FDS = fixed dissolved solids, FW = fresh water, lb/ac/day = pounds per acre per day, lb/mo = pounds per month, MG/mo = million gallons per month,

PW = process water, sBOD<sub>5</sub> = soluble five-day biochemical oxygen demand.

1 Quantity of irrigated water provided by Tree Top Selah hydraulic loading records for each field. Fresh water is in addition to the wastewater to meet crop water needs.

2 Combined irrigated wastewater and fresh water.

3 Net nitrogen load is based on hydraulic loading for each field and average nitrogen concentration of irrigation water, with a 6% loss factor for wastewater to account for gaseous losses.

The supplemental fertilizer nitrogen loading values, if any, are estimated from Tree Top Selah records.

4 Loadings of sBOD<sub>5</sub> and FDS are based on hydraulic loading to each field and respective average constituent concentration of the irrigated wastewater. FDS calculations use the annual flow weighted average concentration for the months of March through June as no FDS data was collected for months prior to the July 1, 2024 permit effective date.

5 Averages are acreage-weighted.

6 Loading limits are for process water loadings from Section 1.B State Waste Discharge Permit Number WA0002437 (State of Washington Department of Ecology, 2024).

**Table 3. Crop Yield and Nitrogen Removal**

Field	Acres	Crop <sup>1</sup>	Number of Cuttings	Crop Yield <sup>2</sup>		Dry Matter Removed <sup>3</sup>		Crop Tissue Nitrogen <sup>4</sup>	Crop Nitrogen Removed <sup>5</sup>
				tons	tons/acre	tons	tons/acre	%	pounds
Field 1	75	Alfalfa	3	299	4.0	270	3.6	2.7	14,419
Field 2	45	Grass Hay	2	127	2.8	116	2.6	2.2	5,151
Field 3	70	Grass Hay	2	348	5.0	316	4.5	2.3	14,596
Field 4	90	Alfalfa	4	616	6.8	553	6.1	3.4	38,133
Field 5	25	Grass Hay	2	76	3.0	69	2.8	1.9	2,660
<b>Total</b>	<b>305</b>			<b>1,466</b>		<b>1,324</b>			<b>74,960</b>
<b>Acreage Weighted Average <sup>6</sup></b>					<b>4.8</b>		<b>4.3</b>	<b>2.8</b>	

**NOTES:**

Data is for the 2024 calendar year.

1 Grass hay represents a cool season grass mixture for hay production. Mixed hay is a mixture of both grass and alfalfa for hay production.

2 Weight of the crop as removed from the field.

3 Crop yield adjusted to account for the crop moisture content.

4 Yield-weighted average crop tissue nitrogen concentration for all cuttings. Analyses by DairyLand Laboratories, Inc.

5 Pounds of dry matter removed multiplied by the percent of crop tissue nitrogen.

6 Sum (field-specific acres x field-specific parameter) / 305 total acres.

**Table 4. Nitrogen, Salts, and Water Balance Summary**

Field	Acres	Crop	Nitrogen			Fixed Dissolved Solids			Water Balance	
			Net Load <sup>1</sup>	Crop Removal <sup>2</sup>	Balance <sup>3</sup>	Load	Crop Removal <sup>2</sup>	Balance <sup>3</sup>	Leaching Requirement <sup>4</sup>	Leaching Fraction <sup>5</sup>
			pounds per acre						%	
Field 1	75	Alfalfa	130	192	-62	1,700	749	951	1.2	4.6
Field 2	45	Grass Hay	155	114	40	2,016	518	1,498	1.2	0.9
Field 3	70	Grass Hay	97	209	-112	1,264	884	380	1.1	2.2
Field 4	90	Alfalfa	101	424	-323	1,312	1,324	-12	1.1	1.0
Field 5	25	Grass Hay	118	106	11	1,535	516	1,019	1.2	4.2
<b>Average <sup>5</sup></b>	<b>305</b>		<b>116</b>	<b>246</b>	<b>-129</b>	<b>1,519</b>	<b>897</b>	<b>622</b>	<b>1.2</b>	<b>2.4</b>

NOTES:

- 1 Estimated net nitrogen available to crops. It accounts for denitrification and volatilization losses of 6% of irrigation water nitrogen.
- 2 Calculated amount removed by the crop from the soil based on crop tissue concentration and dry matter yield. Ash content of crop tissue was used to calculate fixed dissolved solids removal.
- 3 The balance was calculated by subtracting the crop removal from the net load. A positive balance means more was applied than was taken up. A negative balance means more was taken up than was applied.
- 4 Leaching requirement = percolate loss as a percentage of gross input required to manage soil salts to levels that do not impede crop productivity.
- 5 Leaching fraction = percentage of gross water input estimated to percolate beyond root zone.

**Table 5. Soil Analytical Results**

Date	Depth <sup>1</sup>	pH	NO <sub>3</sub> -N	NH <sub>4</sub> -N	TKN	Total P	K	SO <sub>4</sub>	Na	Ca	Mg	CEC	ECe	OM	Moisture	ESP
	feet	s.u.	mg/kg						meq/100g				mmhos/cm	%		
Field 1 (75 Acres)																
11/7/2024	1	8.3	8.8	16.2	1,401	671	1,900	11	3.9	39.6	81.5	16.2	1.1	3.1	14.9	15%
	2	8.7	4.9	2.8	459	639	1,825	25	4.4	63.5	97.1	16.2	1.6	1.1	12.3	16%
	3	8.6	2.8	1.0	160	522	1,175	15	3.9	42.1	95.5	15.9	1.6	0.5	13.3	12%
Field 2 (45 Acres)																
11/7/2024	1	7.7	3.6	8.8	989	620	1,100	3	2.9	31.9	71.0	21.3	1.3	2.0	15.9	7%
	2	7.9	1.4	1.6	342	546	950	3	2.8	29.9	76.3	13.9	0.7	0.9	11.9	10%
	3	8.4	1.0	1.3	232	506	825	4	3.0	30.0	70.4	12.7	1.1	0.8	11.9	10%
Field 3 (70 Acres)																
11/7/2024	1	8.3	8.1	6.0	1,462	541	1,125	8	3.6	35.1	76.3	19.9	1.0	2.6	16.0	11%
	2	8.2	3.7	1.2	471	477	950	6	3.6	33.8	77.2	17.6	1.0	1.0	12.6	11%
	3	8.2	1.0	1.1	372	479	725	4	3.7	32.3	86.2	18.1	0.6	0.9	7.8	11%
Field 4 (90 Acres)																
11/7/2024	1	8.0	13.6	9.5	1,976	682	1,550	14	4.7	38.9	82.3	23.5	0.8	3.9	25.1	10%
	2	8.6	2.5	2.4	474	506	1,450	20	4.2	33.5	84.2	16.5	1.2	1.1	14.8	15%
	3	8.1	1.0	1.5	392	483	1,125	8	3.3	35.3	87.0	15.9	0.9	0.9	21.0	9%
	4	7.8	1.0	1.2	311	411	975	13	3.1	34.3	89.9	16.2	0.8	0.7	20.7	8%
Field 5 (25 Acres)																
11/7/2024	1	8.7	3.6	11.8	1,176	632	4,000	23	5.5	53.0	89.5	21.4	1.0	1.8	17.1	13%
	2	8.9	1.0	2.7	504	549	2,750	89	6.9	75.6	104.5	17.6	1.8	0.7	19.1	24%
	3	8.5	1.0	1.0	203	433	2,725	36	3.2	75.1	94.2	16.5	0.8	0.4	21.5	7%
	4	8.2	1.0	1.0	122	414	2,050	5	2.4	36.3	91.4	17.6	0.6	0.3	19.3	3%

**NOTES:**

Samples collected by Valley Science and Engineering November 7, 2024; analyzed by Northwest Agricultural Consultants Kennewick, Washington.

Abbreviations: "--" = not analyzed, Ca = calcium, CEC = cations exchange capacity, ECe = electrical conductivity by saturation paste extract,

ESP = exchangeable sodium percentage, K = potassium, Mg = magnesium, mg/kg = milligrams per kilogram, meq/100g = milliequivalents per 100 grams of soil,

mmhos/cm = millimhos per centimeter, Na = sodium, NH<sub>4</sub>-N = ammonia-nitrogen, NO<sub>3</sub>-N = nitrate-nitrogen, OM = organic matter, SO<sub>4</sub> = sulfate-sulfur,

s.u. = standard units, TKN = total Kjeldahl nitrogen, and Total P = total phosphorus.

1 Depth increments in feet are 1 = 0 to 12 inches, 2 = 12 to 24 inches, 3 = 24 to 36 inches, 4 = 36 to 48 inches.

2 The total crop available inorganic nitrogen is calculated as NO<sub>3</sub>-N + NH<sub>4</sub>-N.

**Table 6. Projected Farm Operation Summary Totals**

Field	Crop	Total Acres	Gross Blended Irrigation <sup>1</sup>	Gross Supplemental Fresh Water Irrigation <sup>2</sup>	Gross Total Irrigation <sup>3</sup>	Net Irrigation <sup>4</sup>	Crop Water Capacity <sup>5</sup>	Projected Loads <sup>6</sup>		Crop Nitrogen Uptake <sup>8</sup>
								sBOD <sub>5</sub>	Net Nitrogen <sup>7</sup>	
			million gallons					pounds		
Field 1	Alfalfa	75	57.7	30.5	88.3	66.1	80.3	74,131	8,160	30,000
Field 2	Grass Hay	45	34.6	16.5	51.1	38.0	46.5	42,939	4,896	7,070
Field 3	Grass Hay	70	53.9	34.2	88.1	65.4	78.2	73,978	7,616	12,680
Field 4	Alfalfa	90	70.6	57.4	128.1	95.1	107.9	107,550	9,984	36,000
Field 5	Grass Hay	25	17.9	10.9	28.7	21.3	25.7	24,140	2,528	2,601
<b>Total</b>		<b>305</b>	234.7	149.6	384.3	285.9	<b>338.7</b>	<b>322,739</b>	<b>33,183</b>	<b>88,350</b>

NOTES:

Abbreviation: sBOD<sub>5</sub> = soluble five-day biochemical oxygen demand.

1 Blended irrigation water consisting of treated process water and fresh water applied to agricultural crops during the growing season.

2 Supplemental fresh water irrigation applied separately from blended irrigation water.

3 Total irrigation water including blended process water and fresh water in addition to separately applied supplemental fresh water.

4 Net irrigation is the net amount of total irrigation water after accounting for irrigation efficiency losses.

5 Projected crop water capacity is based on annual total estimated evapotranspiration across the acreage of each field.

6 Projected irrigated water constituent loads based on historical irrigated water quality.

7 Accounts for nitrogen losses by volatilization and denitrification.

8 Estimate of crop removal based on previous crop tissue and harvest results from the site.

**Table 7. Projected Precipitation and Evapotranspiration**

Month	Precipitation	Grass ET	Alfalfa ET	Mixed Hay ET <sup>1</sup>
	inches			
Jan	0.9	0.6	0.8	0.7
Feb	0.7	0.7	0.9	0.8
Mar	0.8	1.4	1.7	1.5
Apr	0.6	1.6	2.7	2.4
May	0.7	2.3	4.4	4.1
Jun	0.4	5.3	5.7	5.3
Jul	0.5	6.9	7.3	6.8
Aug	0.5	6.7	6.9	6.4
Sep	0.5	6.0	6.2	5.8
Oct	0.4	4.6	4.6	4.2
Nov	0.6	2.0	2.4	2.2
Dec	0.9	1.1	1.4	1.3
<b>Annual Total</b>	<b>7.5</b>	<b>39.1</b>	<b>45.0</b>	<b>41.6</b>

NOTES:

Abbreviation: ET = evapotranspiration.

Values represent the averages from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.) for the 10 most current years.

<sup>1</sup> Mixed hay ET represents an average of alfalfa and grass ET.



**Table 8. Projected Gross Blended Irrigation Water and Nitrogen Concentration**

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Projected Nitrogen <sup>1</sup>	mg/L	--	--	0.9	10.0	15.3	41.0	14.0	19.0	19.4	28.6	13.7	--	
Field - Crop	Acres	inches												
Field 1 - Alfalfa	75	0	0	0.6	3.3	3.4	3.5	5.4	3.7	3.2	3.4	1.9	0	28.3
Field 2 - Grass Hay	45	0	0	0.6	1.3	2.9	6.0	5.4	3.7	3.2	3.4	1.9	0	28.3
Field 3 - Grass Hay	70	0	0	0.6	2.8	3.4	4.0	5.4	3.7	3.2	3.4	1.9	0	28.3
Field 4 - Alfalfa	90	0	0	0.6	3.3	3.4	3.5	5.9	3.7	3.2	3.4	1.9	0	28.9
Field 5 - Grass Hay	25	0	0	0.0	1.3	2.9	5.5	4.5	3.7	3.2	3.4	1.9	0	26.3
Projected Gross Blended Irrigation <sup>2</sup>		million gallons												
Field 1		0	0	1.3	6.7	6.8	7.1	10.9	7.6	6.6	6.9	3.8	0	57.7
Field 2		0	0	0.8	1.6	3.5	7.3	7	4.5	3.9	4.2	2.3	0	34.6
Field 3		0	0	1.2	5.3	6.4	7.5	10.2	7.1	6.1	6.5	3.5	0	53.9
Field 4		0	0	1.6	8.0	8.2	8.5	14.5	9.1	7.9	8.3	4.6	0	70.6
Field 5		0	0	0.0	0.9	1.9	3.7	3.1	2.5	2.2	2.3	1.3	0	17.9
Entire Site		0.0	0.0	4.9	22.5	26.9	34.1	45.3	30.8	26.7	28.2	15.5	0	234.7

NOTES:

Abbreviations: -- = no quality value, mg/L = milligrams per liter, PW = process water.

1 Projected nitrogen concentration based on the flow-weighted average quality from previous facility records.

2 Projected gross blended process water and fresh water irrigation based on previous facility flows and monthly irrigation records.

**Table 9. Projected Nitrogen Balance**

Field	Crop	Acres	Gross Total Nitrogen <sup>1</sup>	Nitrogen Losses			Agronomic Nitrogen Balance <sup>5</sup>
			Irrigated Water <sup>2</sup>	Crop Removal <sup>3</sup>	Gaseous Losses <sup>4</sup>	Total Losses	
			pounds nitrogen per acre				
Field 1	Alfalfa	75	116	400	7	407	-291
Field 2	Grass Hay	45	116	157	7	164	-48
Field 3	Grass Hay	70	116	181	7	188	-72
Field 4	Alfalfa	90	118	400	7	407	-289
Field 5	Grass Hay	25	108	104	6	110	-3
Acreage Weighted Mean				290	7	297	-181

NOTES:

- 1 Based on previously measured irrigated water nitrogen concentrations and projected irrigation volume.
- 2 Irrigated water is combined process water and supplemental fresh water.
- 3 Estimates of crop removal based on previous crop tissue and harvest results for the site.
- 4 Assumes a nitrogen loss of 6% through volatilization and denitrification.
- 5 Total gross nitrogen additions minus total nitrogen losses. Does not account for fertilizer additions, if needed.  
Positive value indicates nitrogen available exceeds crop removal. Negative value indicates nitrogen removal in excess of application rate.

## **FIGURES**

**Figure 1. Vicinity Map**  
**Figure 2. Site Map**

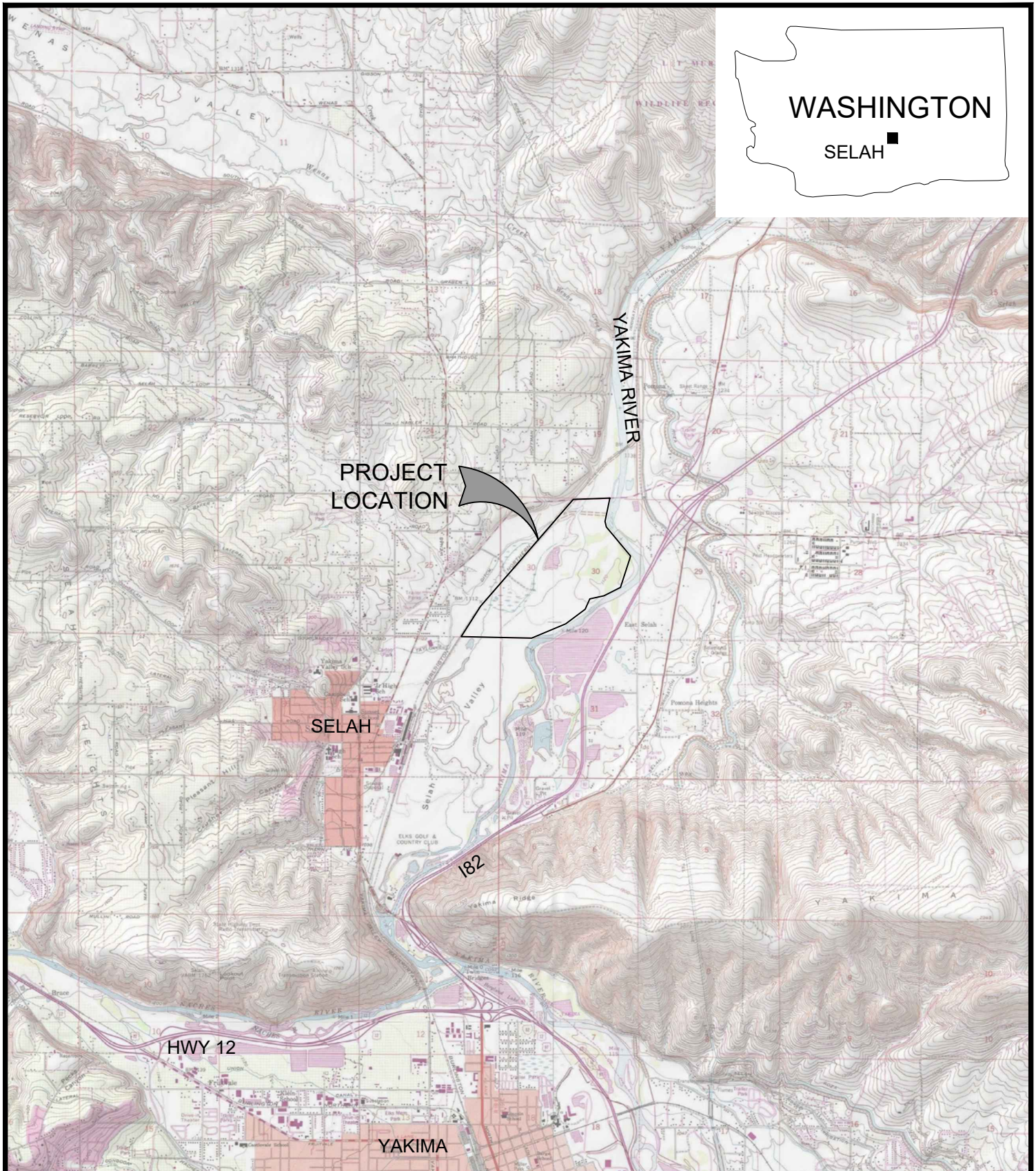


FIGURE 1. VICINITY MAP

0 5,000'

1" = 5,000'

(SCALE AND LOCATIONS ARE APPROXIMATE)

(SOURCE: ©2013 National Geographic Society, i-cubed)

PROJECT NUMBER: 2025210001

DATE: 1/22/2025

DWG NO: 20252100001 F1-2.DWG

DWG BY: DJR06

PROJECT MANAGER: SLV06

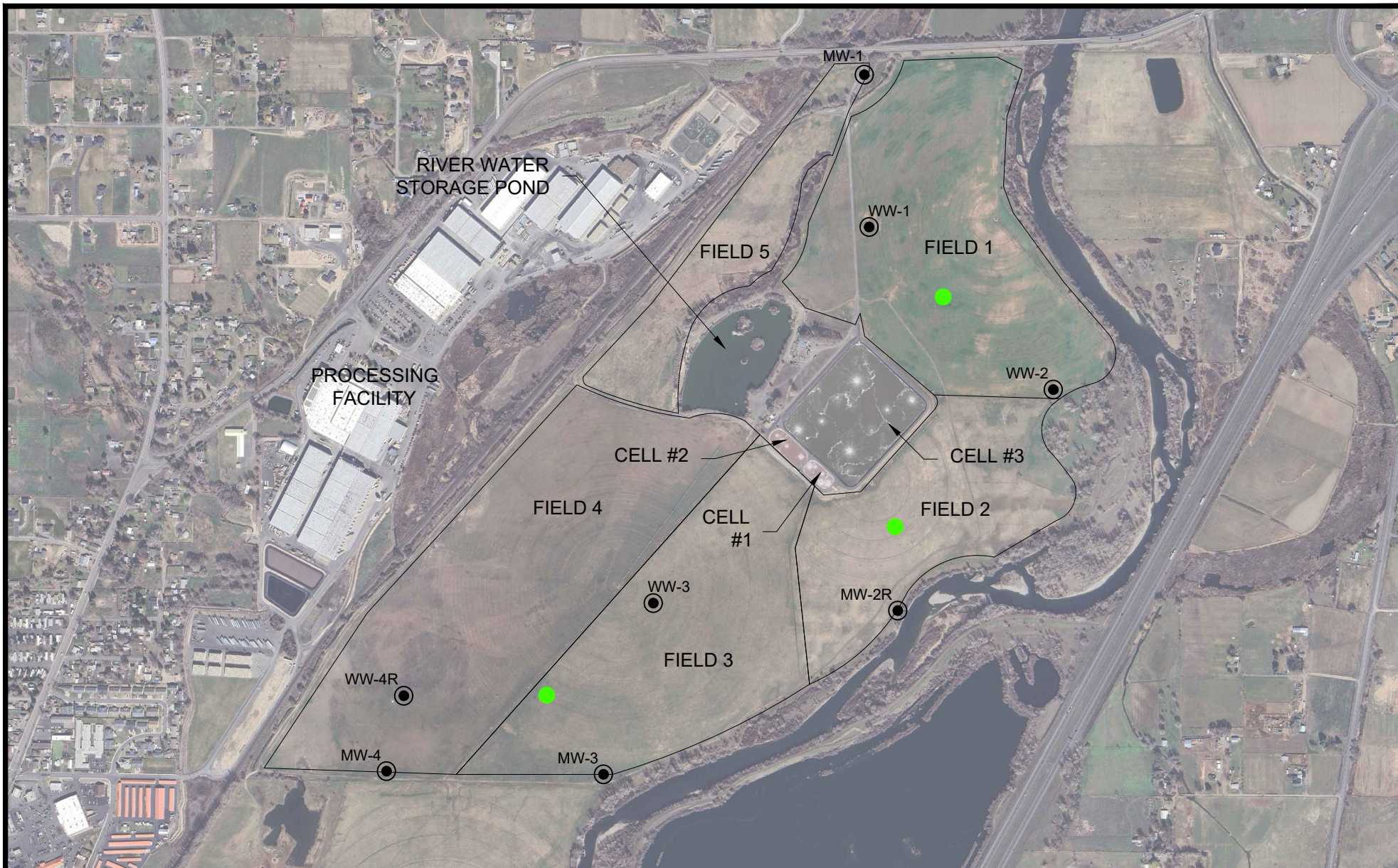
IRRIGATION AND CROP MANAGEMENT PLAN

TREE TOP, INC.  
SELAH, WASHINGTON



SCIENCE AND ENGINEERING





# LEGEND:

WW-4R/MW-4



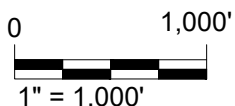
MONITORING WELL LOCATION



VALLEY SCHEDULING PROBE

FIELD 1

LAND TREATMENT FIELDS



(SCALE AND LOCATIONS ARE APPROXIMATE)

(SOURCE: GOOGLE EARTH PRO IMAGE, 3-14-2024)

FIGURE 2. SITE MAP

PROJECT NUMBER: 2025210001  
DATE: 1/22/2025  
DWG NO: 20252100001 F1-2.DWG  
DWG BY: DJR06  
PROJECT MANAGER: SLV06

IRRIGATION AND CROP MANAGEMENT PLAN

TREE TOP, INC.  
SELAH, WASHINGTON

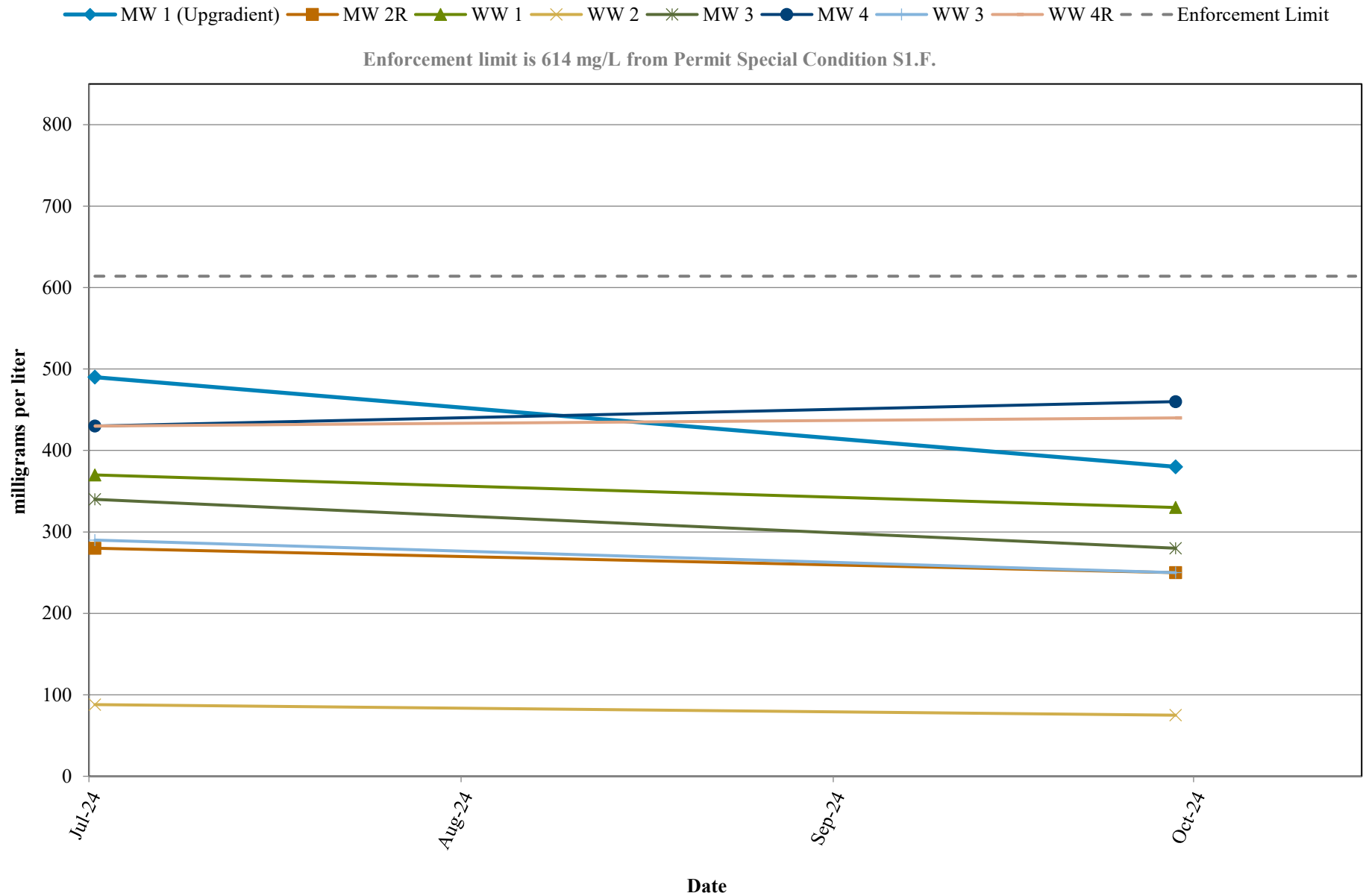


SCIENCE AND ENGINEERING

## **CHARTS**

- Chart 1.      Monitoring Wells – Total Dissolved Solids**
- Chart 2.      Monitoring Wells – Nitrate Nitrogen**
- Chart 3.      Monitoring Wells – Fecal Coliform**

**Chart 1. Monitoring Wells - Total Dissolved Solids**



**Chart 2. Monitoring Wells - Nitrate Nitrogen**

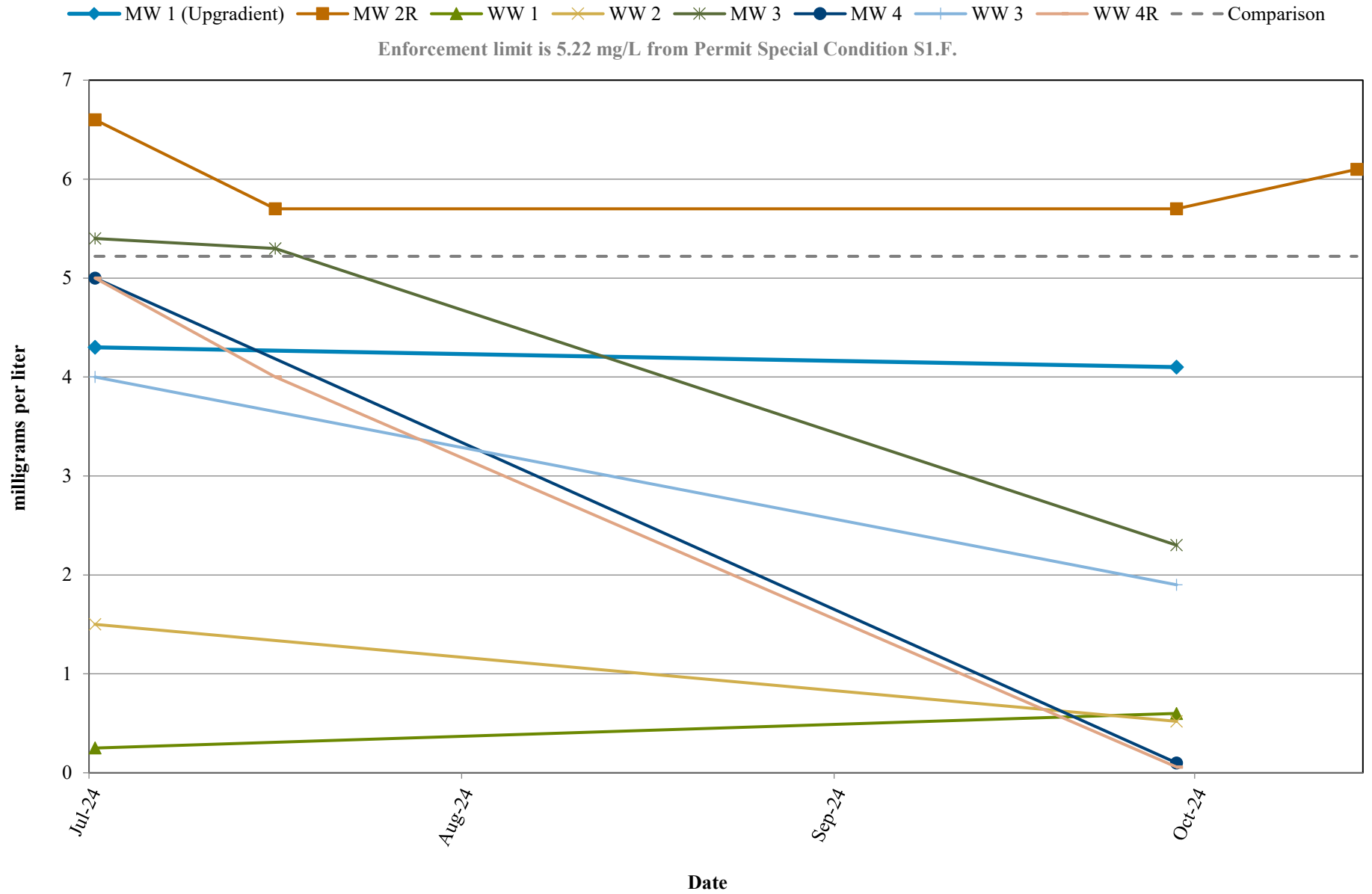
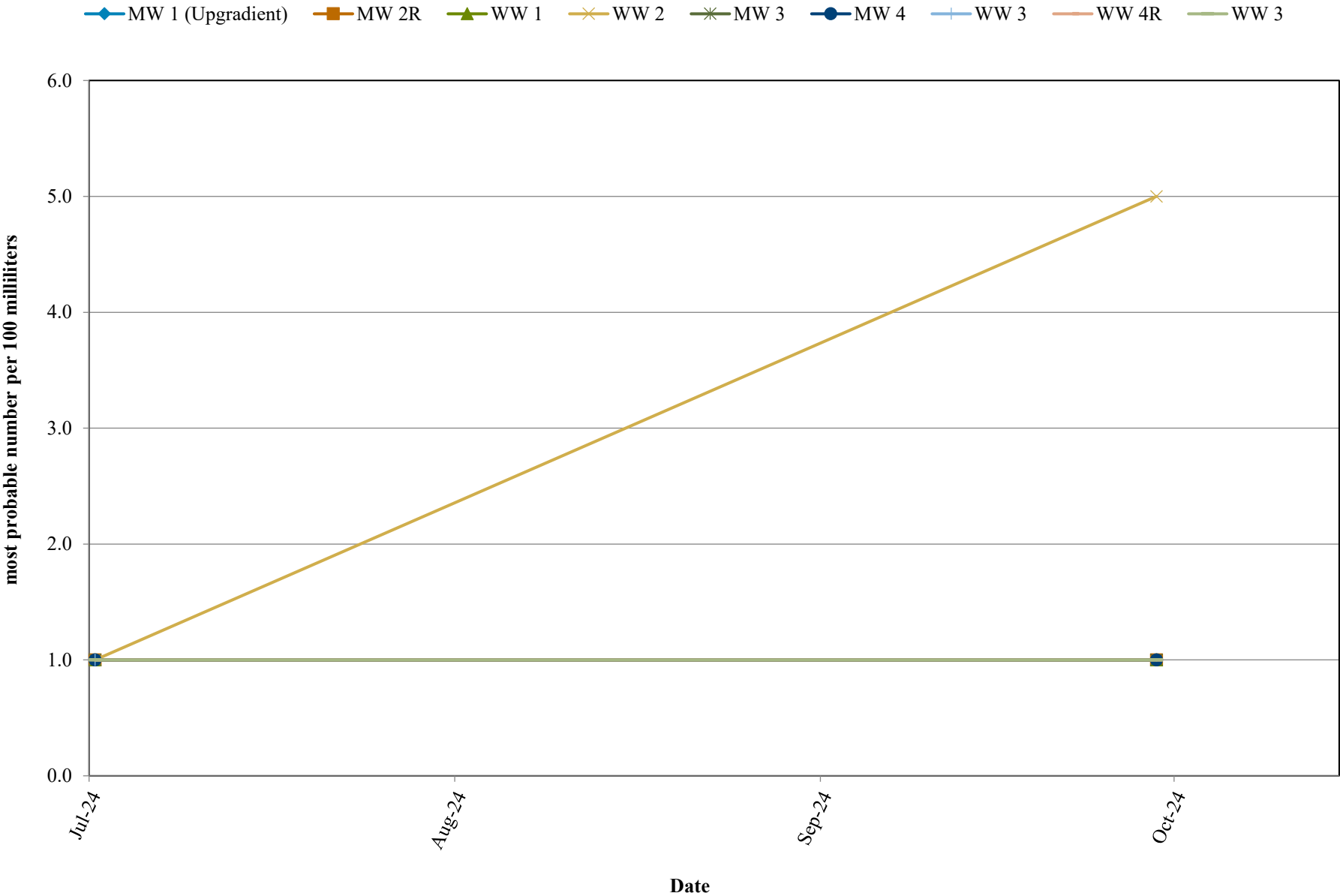




Chart 3. Monitoring Wells - Fecal Coliform



## **APPENDICES**

- Appendix A. Crop Harvest Analytical Results**
- Appendix B. Water Balance Calculations by Field**
- Appendix C. Projected Water Balance Calculations by Field**

## **Appendix A.**

### **Crop Harvest Analytical Results**

**TREE TOP INC  
PO BOX 248  
SELAH, WA 98942**

**REPORT: P12498-1-1  
GROWER: Selah Sprayfield  
SAMPLER: Vasilii Kravtsov  
DATE: December 10, 2024**

Sample ID	Moisture %	Total N %	Crude Protein %	Nitrate-N ppm	P %	K %	Ca %	Mg %	Na %	Ash %
SEC 1 CUT 1 ALFALFA	9.65	2.41	15.06	579	0.25	2.84	1.57	0.28	0.38	10.59
SEC 1 CUT 2 ALFALFA	9.96	2.62	16.38	1573	0.32	3.33	1.23	0.23	0.24	9.99
SEC 1 CUT 3 ALFALFA	9.74	3.31	20.69	1162	0.32	3.30	1.16	0.26	0.31	10.56
SEC 2 CUT 1 GRASS	8.85	2.28	14.25	147	0.32	3.13	0.34	0.15	0.15	8.98
SEC 2 CUT 2 GRASS	8.82	2.18	13.63	515	0.30	2.75	0.39	0.24	0.22	10.85
SEC 3 CUT 1 GRASS	8.93	1.78	11.13	325	0.28	2.79	0.36	0.16	0.15	9.57
SEC 3 CUT 2 GRASS	9.16	2.37	14.81	425	0.31	2.74	0.47	0.24	0.11	10.27
SEC 4 CUT 1 ALFALFA	10.41	3.48	21.75	598	0.33	2.87	1.41	0.27	0.32	10.25
SEC 4 CUT 2 ALFALFA	10.10	3.34	20.88	689	0.30	2.50	1.47	0.34	0.39	10.17
SEC 4 CUT 3 ALFALFA	10.08	3.52	22.00	1378	0.35	3.42	1.44	0.43	0.29	11.91
SEC 5 CUT 1 GRASS	8.61	1.68	10.50	229	0.22	2.20	0.29	0.16	0.20	8.47

## **Appendix B.**

### **Water Balance Calculations By Field**

# Appendix B1. Water Balance Calculations

Soil Unit: Weirman

Field: 1

Acres: 75

Soil Water Content at Field Capacity <sup>6</sup>: 4.8 inches

Crop: Alfalfa

Minimum Soil Depth: 60 inches

Initial Soil Water Content <sup>7</sup>: 4.8 inches

Month	Minimum Avg Daily Soil Temperature <sup>1</sup>	ppt <sup>1</sup>	Gross Irrigation <sup>2</sup>		Net Irrigation <sup>3</sup>		Total <sup>4</sup>	ET <sup>5</sup>		Soil Water Content <sup>8</sup>	Surplus <sup>9</sup>
	FW		PW	FW	PW	Potential		Estimate			
	°F	inches									
Jan	37.3	1.4	0.0	0.0	0.0	0.0	1.2	0.5	0.5	4.8	0.8
Feb	36.5	0.2	0.0	0.0	0.0	0.0	0.2	1.1	1.1	3.8	0.0
Mar	29.7	0.5	0.0	0.0	0.0	0.0	0.5	2.4	2.2	2.1	0.0
Apr	35.7	0.1	0.5	4.1	0.4	3.3	3.8	4.0	2.7	3.2	0.0
May	37.5	0.1	0.4	4.1	0.3	2.9	3.2	6.2	4.0	2.4	0.0
Jun	47.7	0.0	0.1	1.9	0.1	1.3	1.4	7.0	1.9	1.9	0.0
Jul	53.5	0.0	4.0	2.5	2.8	1.7	4.5	8.7	4.8	1.6	0.0
Aug	58.8	0.8	3.4	0.2	2.4	0.1	3.1	6.1	2.3	2.4	0.0
Sep	67.3	0.2	1.6	1.1	1.3	0.9	2.3	4.5	2.5	2.1	0.0
Oct	62.7	0.2	1.5	2.8	1.2	2.3	3.7	2.2	1.4	4.3	0.0
Nov	59.3	0.8	0.6	2.1	0.6	1.9	3.1	0.7	0.6	4.8	0.0
Dec	46.4	1.4	0.0	0.0	0.0	0.0	1.2	0.3	0.3	4.8	0.9
Total		5.6	12.1	18.9	9.0	14.4	28.3	43.7	24.5		1.7
NOTES:										Leaching Fraction <sup>10</sup>	4.6%
										Leaching Requirement <sup>11</sup>	1.2%

## NOTES:

Abbreviations: ET = potential evapotranspiration, FW = fresh water, ppt = precipitation, PW = process water.

1 The minimum monthly average daily soil temperature at 8" and precipitation data from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.).

2 Inches of irrigated treated process water and fresh water.

3 Irrigation efficiency of 70% assumed for May through August; 80% for April, September, and October; and 90% for November through March.

4 Total effective irrigation = net irrigation + precipitation.

5 Potential evapotranspiration estimated from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.). Estimated ET = potential ET adjusted based on the available soil moisture content.

6 Total soil water content at field capacity is based on the acreage-weighted average available water capacity plus the acreage-weighted estimate of the water content at permanent wilting point for the assumed rooting depth as determined using the Soil-Plant-Air-Water model (Saxton & Rawls & Ronberger & Papenlick, 2009).

7 Inches of water in soil profile root zone estimated from Valley Scheduling™ soil moisture monitoring probe readings.

8 Previous month's soil water content + total water input - ET estimate (cannot exceed soil available water holding capacity).

9 Estimate of water in excess of soil water holding capacity that moved beyond the root zone.

10 Percentage of gross water input estimated to percolate beyond root zone = surplus / ppt + gross irrigation.

11 The percentage of surplus required to move beyond the root zone to manage soil salts to levels that do not impede crop productivity. Calculated from estimated irrigation water conductivity (ECiw) and total gross water applied (precipitation + wastewater + freshwater), and a target soil EC of 2 millimhos per centimeter.

## Appendix B2. Water Balance Calculations

Soil Unit: Weirman

Field: 2

Acres: 45

Soil Water Content at Field Capacity <sup>6</sup>: 11.5 inches

Crop: Grass Hay

Minimum Soil Depth: 60 inches

Initial Soil Water Content <sup>7</sup>: 10.3 inches

Month	Minimum Avg Daily Soil Temperature <sup>1</sup>	ppt <sup>1</sup>	Gross Irrigation <sup>2</sup>		Net Irrigation <sup>3</sup>		Total <sup>4</sup>	ET <sup>5</sup>		Soil Water Content <sup>8</sup>	Surplus <sup>9</sup>
	FW		PW	FW	PW	Potential		Estimate			
	°F	inches									
Jan	37.3	1.4	0.0	0.0	0.0	0.0	1.2	0.4	0.4	11.1	0.0
Feb	36.5	0.2	0.0	0.0	0.0	0.0	0.2	0.9	0.9	10.4	0.0
Mar	29.7	0.5	0.0	0.0	0.0	0.0	0.5	2.1	2.0	8.9	0.0
Apr	35.7	0.1	0.4	3.0	0.3	2.4	2.8	3.8	3.4	8.3	0.0
May	37.5	0.1	0.4	3.7	0.3	2.6	2.9	6.0	4.1	7.2	0.0
Jun	47.7	0.0	0.2	5.7	0.2	4.0	4.1	6.8	4.3	7.0	0.0
Jul	53.5	0.0	4.3	2.7	3.0	1.9	4.9	8.4	6.6	5.4	0.0
Aug	58.8	0.8	3.9	0.2	2.8	0.2	3.5	5.8	4.0	4.8	0.0
Sep	67.3	0.2	3.3	2.4	2.6	1.9	4.7	4.4	2.8	6.7	0.0
Oct	62.7	0.2	1.7	3.2	1.4	2.6	4.1	2.0	1.6	9.2	0.0
Nov	59.3	0.8	0.4	1.3	0.3	1.1	2.2	0.5	0.5	10.9	0.0
Dec	46.4	1.4	0.0	0.0	0.0	0.0	1.2	0.3	0.3	11.5	0.4
Total		5.6	14.6	22.2	10.8	16.6	32.3	41.5	30.7		0.4
NOTES:										Leaching Fraction <sup>10</sup>	0.9%
										Leaching Requirement <sup>11</sup>	1.2%

### NOTES:

Abbreviations: ET = potential evapotranspiration, FW = fresh water, ppt = precipitation, PW = process water.

1 The minimum monthly average daily soil temperature at 8" and precipitation data from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.).

2 Inches of irrigated treated process water and fresh water.

3 Irrigation efficiency of 70% assumed for May through August; 80% for April, September, and October; and 90% for November through March.

4 Total effective irrigation = net irrigation + precipitation.

5 Potential evapotranspiration estimated from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.). Estimated ET = potential ET adjusted based on the available soil moisture content.

6 Total soil water content at field capacity is based on the acreage-weighted average available water capacity plus the acreage-weighted estimate of the water content at permanent wilting point for the assumed rooting depth as determined using the Soil-Plant-Air-Water model (Saxton & Rawls & Ronberger & Papenlick, 2009).

7 Inches of water in soil profile root zone estimated from Valley Scheduling™ soil moisture monitoring probe readings.

8 Previous month's soil water content + total water input - ET estimate (cannot exceed soil available water holding capacity).

9 Estimate of water in excess of soil water holding capacity that moved beyond the root zone.

10 Percentage of gross water input estimated to percolate beyond root zone = surplus / ppt + gross irrigation.

11 The percentage of surplus required to move beyond the root zone to manage soil salts to levels that do not impede crop productivity. Calculated from estimated irrigation water conductivity (ECiw) and total gross water applied (precipitation + wastewater + freshwater), and a target soil EC of 2 millimhos per centimeter.

# Appendix B3. Water Balance Calculations

Soil Unit: Weirman

Field: 3

Acres: 70

Soil Water Content at Field Capacity <sup>6</sup>: 11.5 inches

Crop: Grass Hay

Minimum Soil Depth: 60 inches

Initial Soil Water Content <sup>7</sup>: 11.3 inches

Month	Minimum Avg Daily Soil Temperature <sup>1</sup>	ppt <sup>1</sup>	Gross Irrigation <sup>2</sup>		Net Irrigation <sup>3</sup>		Total <sup>4</sup>	ET <sup>5</sup>		Soil Water Content <sup>8</sup>	Surplus <sup>9</sup>
	FW		PW	FW	PW	Potential		Estimate			
	°F	inches									
Jan	37.3	1.4	0.0	0.0	0.0	0.0	1.2	0.4	0.4	11.5	0.6
Feb	36.5	0.2	0.0	0.0	0.0	0.0	0.2	0.9	0.9	10.8	0.0
Mar	29.7	0.5	0.0	0.0	0.0	0.0	0.5	2.1	2.0	9.3	0.0
Apr	35.7	0.1	0.3	2.3	0.2	1.8	2.1	3.8	3.1	8.3	0.0
May	37.5	0.1	0.2	2.3	0.2	1.6	1.8	6.0	2.5	7.6	0.0
Jun	47.7	0.0	0.1	2.7	0.1	1.9	2.0	6.8	2.8	6.9	0.0
Jul	53.5	0.0	2.7	1.7	1.9	1.2	3.0	8.4	3.2	6.6	0.0
Aug	58.8	0.8	3.3	0.2	2.3	0.1	3.0	5.8	2.2	7.4	0.0
Sep	67.3	0.2	1.7	1.2	1.3	0.9	2.4	4.4	3.5	6.3	0.0
Oct	62.7	0.2	1.0	1.8	0.8	1.4	2.4	2.0	2.0	6.7	0.0
Nov	59.3	0.8	0.4	1.3	0.3	1.2	2.2	0.5	0.5	8.5	0.0
Dec	46.4	1.4	0.0	0.0	0.0	0.0	1.2	0.3	0.2	9.5	0.0
Total		5.6	9.6	13.4	7.1	10.2	22.1	41.5	23.3		0.6
										Leaching Fraction <sup>10</sup>	2.2%
										Leaching Requirement <sup>11</sup>	1.1%

NOTES:

## NOTES:

Abbreviations: ET = potential evapotranspiration, FW = fresh water, ppt = precipitation, PW = process water.

1 The minimum monthly average daily soil temperature at 8" and precipitation data from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.).

2 Inches of irrigated treated process water and fresh water.

3 Irrigation efficiency of 70% assumed for May through August; 80% for April, September, and October; and 90% for November through March.

4 Total effective irrigation = net irrigation + precipitation.

5 Potential evapotranspiration estimated from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.). Estimated ET = potential ET adjusted based on the available soil moisture content.

6 Total soil water content at field capacity is based on the acreage-weighted average available water capacity plus the acreage-weighted estimate of the water content at permanent wilting point for the assumed rooting depth as determined using the Soil-Plant-Air-Water model (Saxton & Rawls & Ronberger & Papenlick, 2009).

7 Inches of water in soil profile root zone estimated from Valley Scheduling™ soil moisture monitoring probe readings.

8 Previous month's soil water content + total water input - ET estimate (cannot exceed soil available water holding capacity).

9 Estimate of water in excess of soil water holding capacity that moved beyond the root zone.

10 Percentage of gross water input estimated to percolate beyond root zone = surplus / ppt + gross irrigation.

11 The percentage of surplus required to move beyond the root zone to manage soil salts to levels that do not impede crop productivity. Calculated from estimated irrigation water conductivity (ECiw) and total gross water applied (precipitation + wastewater + freshwater), and a target soil EC of 2 millimhos per centimeter.



# Appendix B4. Water Balance Calculations

Soil Unit: Weirman

Field: 4

Acres: 90

Soil Water Content at Field Capacity <sup>6</sup>: 11.5 inches

Crop: Alfalfa

Minimum Soil Depth: 60 inches

Initial Soil Water Content <sup>7</sup>: 11.0 inches

Month	Minimum Avg Daily Soil Temperature <sup>1</sup>	ppt <sup>1</sup>	Gross Irrigation <sup>2</sup>		Net Irrigation <sup>3</sup>		Total <sup>4</sup>	ET <sup>5</sup>		Soil Water Content <sup>8</sup>	Surplus <sup>9</sup>
	FW		PW	FW	PW	Potential		Estimate			
	°F	inches									
Jan	37.3	1.4	0.0	0.0	0.0	0.0	1.2	0.5	0.5	11.5	0.3
Feb	36.5	0.2	0.0	0.0	0.0	0.0	0.2	1.1	1.1	10.6	0.0
Mar	29.7	0.5	0.0	0.0	0.0	0.0	0.5	2.4	1.5	9.6	0.0
Apr	35.7	0.1	0.3	2.5	0.2	2.0	2.3	4.0	2.4	9.5	0.0
May	37.5	0.1	0.2	2.1	0.1	1.5	1.7	6.2	3.6	7.5	0.0
Jun	47.7	0.0	0.1	3.8	0.1	2.7	2.8	7.0	3.7	6.6	0.0
Jul	53.5	0.0	2.7	1.7	1.9	1.2	3.1	8.7	4.3	5.4	0.0
Aug	58.8	0.8	3.5	0.2	2.4	0.1	3.1	6.1	2.7	5.8	0.0
Sep	67.3	0.2	1.6	1.1	1.3	0.9	2.3	4.5	2.1	6.0	0.0
Oct	62.7	0.2	0.9	1.7	0.7	1.4	2.2	2.2	1.0	7.3	0.0
Nov	59.3	0.8	0.3	1.1	0.3	1.0	2.1	0.7	0.5	8.8	0.0
Dec	46.4	1.4	0.0	0.0	0.0	0.0	1.2	0.3	0.3	9.7	0.0
Total		5.6	9.7	14.3	7.1	10.7	22.7	43.7	23.7		0.3
NOTES:										Leaching Fraction <sup>10</sup>	1.0%
										Leaching Requirement <sup>11</sup>	1.1%

## NOTES:

Abbreviations: ET = potential evapotranspiration, FW = fresh water, ppt = precipitation, PW = process water.

1 The minimum monthly average daily soil temperature at 8" and precipitation data from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.).

2 Inches of irrigated treated process water and fresh water.

3 Irrigation efficiency of 70% assumed for May through August; 80% for April, September, and October; and 90% for November through March.

4 Total effective irrigation = net irrigation + precipitation.

5 Potential evapotranspiration estimated from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.). Estimated ET = potential ET adjusted based on the available soil moisture content.

6 Total soil water content at field capacity is based on the acreage-weighted average available water capacity plus the acreage-weighted estimate of the water content at permanent wilting point for the assumed rooting depth as determined using the Soil-Plant-Air-Water model (Saxton & Rawls & Ronberger & Papenlick, 2009).

7 Inches of water in soil profile root zone estimated from Valley Scheduling™ soil moisture monitoring probe readings.

8 Previous month's soil water content + total water input - ET estimate (cannot exceed soil available water holding capacity).

9 Estimate of water in excess of soil water holding capacity that moved beyond the root zone.

10 Percentage of gross water input estimated to percolate beyond root zone = surplus / ppt + gross irrigation.

11 The percentage of surplus required to move beyond the root zone to manage soil salts to levels that do not impede crop productivity. Calculated from estimated irrigation water conductivity (ECiw) and total gross water applied (precipitation + wastewater + freshwater), and a target soil EC of 2 millimhos per centimeter.

Formula:  $LR = ECiw \div [(Target\ EC \times 5) - ECiw]$  (Ayers & Westcot, 1985).

## Appendix B5. Water Balance Calculations

Field: 5

Acres: 25

Soil Unit: Weirman

Soil Water Content at Field Capacity <sup>6</sup>: 8.6 inches

Crop: Grass Hay

Minimum Soil Depth: 60 inches

Initial Soil Water Content <sup>7</sup>: 8.2 inches

Month	Minimum Avg Daily Soil Temperature <sup>1</sup>	ppt <sup>1</sup>	Gross Irrigation <sup>2</sup>		Net Irrigation <sup>3</sup>		Total <sup>4</sup>	ET <sup>5</sup>		Soil Water Content <sup>8</sup>	Surplus <sup>9</sup>
	FW		PW	FW	PW	Potential		Estimate			
	°F	inches									
Jan	37.3	1.4	0.0	0.0	0.0	0.0	1.2	0.4	0.4	8.6	0.5
Feb	36.5	0.2	0.0	0.0	0.0	0.0	0.2	0.9	0.9	7.9	0.0
Mar	29.7	0.5	0.0	0.0	0.0	0.0	0.5	2.1	1.2	7.2	0.0
Apr	35.7	0.1	0.3	2.6	0.3	2.1	2.4	3.8	2.1	7.5	0.0
May	37.5	0.1	0.4	4.1	0.3	2.9	3.2	6.0	3.3	7.3	0.0
Jun	47.7	0.0	0.1	3.4	0.1	2.4	2.5	6.8	3.8	6.0	0.0
Jul	53.5	0.0	3.4	2.1	2.4	1.5	3.9	8.4	4.2	5.7	0.0
Aug	58.8	0.8	3.8	0.2	2.6	0.2	3.3	5.8	2.8	6.2	0.0
Sep	67.3	0.2	1.9	1.3	1.5	1.1	2.7	4.4	2.2	6.7	0.0
Oct	62.7	0.2	0.9	1.7	0.7	1.3	2.2	2.0	1.1	7.8	0.0
Nov	59.3	0.8	0.4	1.4	0.4	1.2	2.3	0.5	0.5	8.6	0.0
Dec	46.4	1.4	0.0	0.0	0.0	0.0	1.2	0.3	0.3	8.6	0.9
Total		5.6	11.2	16.8	8.2	12.6	25.7	41.5	22.9		1.4
NOTES:										Leaching Fraction <sup>10</sup>	4.2%
										Leaching Requirement <sup>11</sup>	1.2%

### NOTES:

Abbreviations: ET = potential evapotranspiration, FW = fresh water, ppt = precipitation, PW = process water.

1 The minimum monthly average daily soil temperature at 8" and precipitation data from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.).

2 Inches of irrigated treated process water and fresh water.

3 Irrigation efficiency of 70% assumed for May through August; 80% for April, September, and October; and 90% for November through March.

4 Total effective irrigation = net irrigation + precipitation.

5 Potential evapotranspiration estimated from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.). Estimated ET = potential ET adjusted based on the available soil moisture content.

6 Total soil water content at field capacity is based on the acreage-weighted average available water capacity plus the acreage-weighted estimate of the water content at permanent wilting point for the assumed rooting depth as determined using the Soil-Plant-Air-Water model (Saxton & Rawls & Ronberger & Papenlick, 2009).

7 Inches of water in soil profile root zone estimated from Valley Scheduling™ soil moisture monitoring probe readings.

8 Previous month's soil water content + total water input - ET estimate (cannot exceed soil available water holding capacity).

9 Estimate of water in excess of soil water holding capacity that moved beyond the root zone.

10 Percentage of gross water input estimated to percolate beyond root zone = surplus / ppt + gross irrigation.

11 The percentage of surplus required to move beyond the root zone to manage soil salts to levels that do not impede crop productivity. Calculated from estimated irrigation water conductivity (ECiw) and total gross water applied (precipitation + wastewater + freshwater), and a target soil EC of 2 millimhos per centimeter.

Formula:  $LR = ECiw \div [(Target\ EC \times 5) - ECiw]$  (Ayers & Westcot, 1985).

## **Appendix C.**

### **Projected Water Balance Calculations By Field**

# Appendix C1. Projected Water Balance Calculations

Field: 1

Acres: 75

Crop: Alfalfa

Min. Soil Depth: 60 inches

Soil Unit: Weirman

Soil Water Content at Field Capacity <sup>6</sup>: 4.8 inches

Initial Soil Water Content <sup>7</sup>: 4.8 inches

Month	ppt <sup>1</sup>	Gross Irrigation <sup>2</sup>		Net Irrigation <sup>3</sup>		Total <sup>4</sup>	Evapotranspiration <sup>5</sup>		Soil Water Content <sup>8</sup>	Surplus <sup>9</sup>
		FW	PW	FW	PW		Potential	Estimate		
	inches									
Jan	0.9	0.0	0.0	0.0	0.0	0.8	0.8	0.8	4.8	0.0
Feb	0.7	0.0	0.0	0.0	0.0	0.6	0.9	0.9	4.5	0.0
Mar	0.8	0.0	0.6	0.0	0.6	1.3	1.7	1.6	4.2	0.0
Apr	0.6	0.0	3.3	0.0	2.6	3.1	2.7	2.6	4.7	0.0
May	0.7	0.0	3.4	0.0	2.4	2.8	4.4	4.3	3.2	0.0
Jun	0.4	1.0	3.5	0.7	2.4	3.4	5.7	4.7	1.9	0.0
Jul	0.5	3.0	5.4	2.1	3.8	6.2	7.3	4.6	3.5	0.0
Aug	0.5	5.0	3.7	3.5	2.6	6.5	6.9	5.9	4.1	0.0
Sep	0.5	4.0	3.2	3.2	2.6	6.2	6.2	5.8	4.5	0.0
Oct	0.4	2.0	3.4	1.6	2.7	4.6	4.6	4.4	4.7	0.0
Nov	0.6	0.0	1.9	0.0	1.7	2.2	2.4	2.4	4.5	0.0
Dec	0.9	0.0	0.0	0.0	0.0	0.8	1.4	1.4	4.0	0.0
Total	7.5	15.0	28.3	11.1	21.3	38.6	45.0	39.4		0.0
NOTES:									Leaching Fraction <sup>10</sup>	0.0%
									Leaching Requirement <sup>11</sup>	1.2%

## NOTES:

Abbreviations: FW = supplemental fresh water applied separately from process water, ppt = precipitation, PW = process water (includes blended fresh water).

1 Projected precipitation from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.) from the last 10 years.

2 Inches of irrigated treated process water and fresh water.

3 Irrigation efficiency of 70% assumed for May through August; 80% for April, September, and October; and 90% for November through March.

4. Total effective irrigation = net irrigation + precipitation.

5 Potential evapotranspiration estimated from Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.). Estimated ET = potential ET adjusted based on the available soil moisture content.

6 Total soil water content at field capacity is based on the acreage-weighted average available water capacity plus the acreage-weighted estimate of the water content at permanent wilting point for the assumed rooting depth as determined using the Soil-Plant-Air-Water model (Saxton & Rawls & Ronberger & Papenlick, 2009).

7 Projected inches of water in soil profile root zone for January based on the end of the season December estimate from the previous year's calculated field water budgets.

8 Previous month's soil water content + total water input - ET estimate (cannot exceed soil available water holding capacity).

9 Estimate of water in excess of soil water holding capacity that moved beyond the root zone.

10 Percentage of gross water input estimated to percolate beyond root zone = surplus ÷ ppt + gross irrigation.

11 The percentage of surplus required to move beyond the root zone to manage soil salts to levels that do not impede crop productivity. Calculated from estimated irrigation water conductivity (ECiw) and volume of total gross water applied (precipitation + wastewater + freshwater), and a target soil EC of 2 millimhos per centimeter.

Formula: LR = ECiw ÷ [(Target EC × 5) - ECiw] (Ayers & Westcot, 1985).

## Appendix C2. Projected Water Balance Calculations

Field: 2

Acres: 75

Soil Unit: Weirman  
Soil Water Content at Field Capacity <sup>6</sup>: 11.5 inches

Crop: Grass Hay

Min. Soil Depth: 60 inches

Initial Soil Water Content <sup>7</sup>: 11.5 inches

Month	ppt <sup>1</sup>	Gross Irrigation <sup>2</sup>		Net Irrigation <sup>3</sup>		Total <sup>4</sup>	Evapotranspiration <sup>5</sup>		Soil Water Content <sup>8</sup>	Surplus <sup>9</sup>
		FW	PW	FW	PW		Potential	Estimate		
	inches									
Jan	0.9	0.0	0.0	0.0	0.0	0.8	0.6	0.6	11.5	0.2
Feb	0.7	0.0	0.0	0.0	0.0	0.6	0.7	0.7	11.4	0.0
Mar	0.8	0.0	0.6	0.0	0.6	1.3	1.4	1.4	11.4	0.0
Apr	0.6	0.0	1.3	0.0	1.0	1.5	1.6	1.6	11.4	0.0
May	0.7	0.0	2.9	0.0	2.0	2.5	2.3	2.3	11.5	0.0
Jun	0.4	1.0	6.0	0.7	4.2	5.1	5.3	5.3	11.4	0.0
Jul	0.5	2.0	5.4	1.4	3.8	5.5	6.9	6.8	10.1	0.0
Aug	0.5	5.0	3.7	3.5	2.6	6.5	6.7	6.3	10.3	0.0
Sep	0.5	4.5	3.2	3.6	2.6	6.6	6.0	5.7	11.1	0.0
Oct	0.4	1.0	3.4	0.8	2.7	3.8	4.6	4.5	10.5	0.0
Nov	0.6	0.0	1.9	0.0	1.7	2.2	2.0	1.9	10.7	0.0
Dec	0.9	0.0	0.0	0.0	0.0	0.8	1.1	1.1	10.5	0.0
Total	7.5	13.5	28.3	10.0	21.1	37.3	39.1	38.1		0.2
NOTES:									Leaching Fraction <sup>10</sup>	0.5%
									Leaching Requirement <sup>11</sup>	1.2%

### NOTES:

Abbreviations: FW = supplemental fresh water applied separately from process water, ppt = precipitation, PW = process water (includes blended fresh water).

1 Projected precipitation from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington

(Washington State University, n.d.) from the last 10 years.

2 Inches of irrigated treated process water and fresh water.

3 Irrigation efficiency of 70% assumed for May through August; 80% for April, September, and October; and 90% for November through March.

4. Total effective irrigation = net irrigation + precipitation.

5 Potential evapotranspiration estimated from Washington State University AgWeatherNet weather station at Pomona in Yakima County,

Washington (Washington State University, n.d.). Estimated ET = potential ET adjusted based on the available soil moisture content.

6 Total soil water content at field capacity is based on the acreage-weighted average available water capacity plus the acreage-weighted estimate of the water content at permanent wilting point for the assumed rooting depth as determined using the Soil-Plant-Air-Water model (Saxton & Rawls & Ronberger & Papenlick, 2009).

7 Projected inches of water in soil profile root zone for January based on the end of the season December estimate from the previous year's calculated field water budgets.

8 Previous month's soil water content + total water input - ET estimate (cannot exceed soil available water holding capacity).

9 Estimate of water in excess of soil water holding capacity that moved beyond the root zone.

10 Percentage of gross water input estimated to percolate beyond root zone = surplus ÷ ppt + gross irrigation.

11 The percentage of surplus required to move beyond the root zone to manage soil salts to levels that do not impede crop productivity. Calculated from estimated irrigation water conductivity (ECiw) and volume of total gross water applied (precipitation + wastewater + freshwater), and a target soil EC of 2 millimhos per centimeter.

Formula: LR = ECiw ÷ [(Target EC × 5) - ECiw] (Ayers & Westcot, 1985).

### Appendix C3. Projected Water Balance Calculations

Field: 3

Acres: 75

Soil Unit: Weirman  
Soil Water Content at Field Capacity <sup>6</sup>: 11.5 inches

Crop: Grass Hay Min. Soil Depth: 60 inches

Initial Soil Water Content <sup>7</sup>: 11.5 inches

Month	ppt <sup>1</sup>	Gross Irrigation <sup>2</sup>		Net Irrigation <sup>3</sup>		Total <sup>4</sup>	Evapotranspiration <sup>5</sup>		Soil Water Content <sup>8</sup>	Surplus <sup>9</sup>
		FW	PW	FW	PW		Potential	Estimate		
	inches									
Jan	0.9	0.0	0.0	0.0	0.0	0.8	0.7	0.7	11.5	0.1
Feb	0.7	0.0	0.0	0.0	0.0	0.6	0.8	0.8	11.3	0.0
Mar	0.8	0.0	0.6	0.0	0.6	1.3	1.5	1.5	11.2	0.0
Apr	0.6	0.0	2.8	0.0	2.2	2.7	2.4	2.4	11.5	0.0
May	0.7	1.5	3.4	1.1	2.4	3.9	4.1	4.1	11.3	0.0
Jun	0.4	3.0	4.0	2.1	2.8	5.1	5.3	5.3	11.1	0.0
Jul	0.5	4.0	5.4	2.8	3.8	6.9	6.8	6.7	11.4	0.0
Aug	0.5	4.5	3.7	3.2	2.6	6.1	6.4	6.4	11.1	0.0
Sep	0.5	3.5	3.2	2.8	2.6	5.8	5.8	5.7	11.2	0.0
Oct	0.4	1.5	3.4	1.2	2.7	4.2	4.2	4.1	11.3	0.0
Nov	0.6	0.0	1.9	0.0	1.7	2.2	2.2	2.2	11.3	0.0
Dec	0.9	0.0	0.0	0.0	0.0	0.8	1.3	1.2	10.9	0.0
Total	7.5	18.0	28.3	13.1	21.3	40.6	41.6	41.1		0.1
NOTES:									Leaching Fraction <sup>10</sup>	0.2%
									Leaching Requirement <sup>11</sup>	1.2%

#### NOTES:

Abbreviations: FW = supplemental fresh water applied separately from process water, ppt = precipitation, PW = process water (includes blended fresh water).

1 Projected precipitation from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington

(Washington State University, n.d.) from the last 10 years.

2 Inches of irrigated treated process water and fresh water.

3 Irrigation efficiency of 70% assumed for May through August; 80% for April, September, and October; and 90% for November through March.

4. Total effective irrigation = net irrigation + precipitation.

5 Potential evapotranspiration estimated from Washington State University AgWeatherNet weather station at Pomona in Yakima County,

Washington (Washington State University, n.d.). Estimated ET = potential ET adjusted based on the available soil moisture content.

6 Total soil water content at field capacity is based on the acreage-weighted average available water capacity plus the acreage-weighted estimate of the water content at permanent wilting point for the assumed rooting depth as determined using the Soil-Plant-Air-Water model (Saxton & Rawls & Ronberger & Papenlick, 2009).

7 Projected inches of water in soil profile root zone for January based on the end of the season December estimate from the previous year's calculated field water budgets.

8 Previous month's soil water content + total water input - ET estimate (cannot exceed soil available water holding capacity).

9 Estimate of water in excess of soil water holding capacity that moved beyond the root zone.

10 Percentage of gross water input estimated to percolate beyond root zone = surplus ÷ ppt + gross irrigation.

11 The percentage of surplus required to move beyond the root zone to manage soil salts to levels that do not impede crop productivity. Calculated from estimated irrigation water conductivity (ECiw) and volume of total gross water applied (precipitation + wastewater + freshwater), and a target soil EC of 2 millimhos per centimeter.

Formula: LR = ECiw ÷ [(Target EC × 5) - ECiw] (Ayers & Westcot, 1985).

# Appendix C4. Projected Water Balance Calculations

Field: 4

Acres: 75

Crop: Alfalfa

Min. Soil Depth: 60 inches

Soil Unit: Weirman

Soil Water Content at Field Capacity <sup>6</sup>: 11.5 inches

Initial Soil Water Content <sup>7</sup>: 9.7 inches

Month	ppt <sup>1</sup>	Gross Irrigation <sup>2</sup>		Net Irrigation <sup>3</sup>		Total <sup>4</sup>	Evapotranspiration <sup>5</sup>		Soil Water Content <sup>8</sup>	Surplus <sup>9</sup>
		FW	PW	FW	PW		Potential	Estimate		
	inches									
Jan	0.9	0.0	0.0	0.0	0.0	0.8	0.8	0.8	9.8	0.0
Feb	0.7	0.0	0.0	0.0	0.0	0.6	0.9	0.9	9.6	0.0
Mar	0.8		0.6	0.0	0.6	1.3	1.7	1.5	9.4	0.0
Apr	0.6	1.5	3.3	1.2	2.6	4.3	2.7	2.4	11.3	0.0
May	0.7	2.5	3.4	1.8	2.4	4.6	4.4	4.3	11.5	0.0
Jun	0.4	4.0	3.5	2.8	2.4	5.5	5.7	5.7	11.3	0.0
Jul	0.5	4.0	5.9	2.8	4.2	7.3	7.3	7.2	11.4	0.0
Aug	0.5	5.5	3.7	3.9	2.6	6.8	6.9	6.8	11.4	0.0
Sep	0.5	4.0	3.2	3.2	2.6	6.2	6.2	6.2	11.4	0.0
Oct	0.4	2.0	3.4	1.6	2.7	4.6	4.6	4.5	11.4	0.0
Nov	0.6	0.0	1.9	0.0	1.7	2.2	2.4	2.4	11.2	0.0
Dec	0.9	0.0	0.0	0.0	0.0	0.8	1.4	1.4	10.7	0.0
Total	7.5	23.5	28.9	17.2	21.7	45.1	45.0	44.2		0.0
NOTES:									Leaching Fraction <sup>10</sup>	0.0%
									Leaching Requirement <sup>11</sup>	1.2%

## NOTES:

Abbreviations: FW = supplemental fresh water applied separately from process water, ppt = precipitation, PW = process water (includes blended fresh water).

1 Projected precipitation from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington

(Washington State University, n.d.) from the last 10 years.

2 Inches of irrigated treated process water and fresh water.

3 Irrigation efficiency of 70% assumed for May through August; 80% for April, September, and October; and 90% for November through March.

4. Total effective irrigation = net irrigation + precipitation.

5 Potential evapotranspiration estimated from Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.). Estimated ET = potential ET adjusted based on the available soil moisture content.

6 Total soil water content at field capacity is based on the acreage-weighted average available water capacity plus the acreage-weighted estimate of the water content at permanent wilting point for the assumed rooting depth as determined using the Soil-Plant-Air-Water model (Saxton & Rawls & Ronberger & Papenlick, 2009).

7 Projected inches of water in soil profile root zone for January based on the end of the season December estimate from the previous year's calculated field water budgets.

8 Previous month's soil water content + total water input - ET estimate (cannot exceed soil available water holding capacity).

9 Estimate of water in excess of soil water holding capacity that moved beyond the root zone.

10 Percentage of gross water input estimated to percolate beyond root zone = surplus ÷ ppt + gross irrigation.

11 The percentage of surplus required to move beyond the root zone to manage soil salts to levels that do not impede crop productivity. Calculated from estimated irrigation water conductivity (ECiw) and volume of total gross water applied (precipitation + wastewater + freshwater), and a target soil EC of 2 millimhos per centimeter.

Formula: LR = ECiw ÷ [(Target EC × 5) - ECiw] (Ayers & Westcot, 1985).

# Appendix C5. Projected Water Balance Calculations

Field: 5

Acres: 75

Soil Unit: Weirman  
Soil Water Content at Field Capacity <sup>6</sup>: 8.6 inches

Crop: Grass Hay

Min. Soil Depth: 60 inches

Initial Soil Water Content <sup>7</sup>: 8.6 inches

Month	ppt <sup>1</sup>	Gross Irrigation <sup>2</sup>		Net Irrigation <sup>3</sup>		Total <sup>4</sup>	Evapotranspiration <sup>5</sup>		Soil Water Content <sup>8</sup>	Surplus <sup>9</sup>
		FW	PW	FW	PW		Potential	Estimate		
	inches									
Jan	0.9	0.0	0.0	0.0	0.0	0.8	0.6	0.6	8.6	0.2
Feb	0.7	0.0	0.0	0.0	0.0	0.6	0.7	0.7	8.5	0.0
Mar	0.8	0.0	0.0	0.0	0.0	0.7	1.4	1.4	7.9	0.0
Apr	0.6	0.0	1.3	0.0	1.0	1.5	1.6	1.5	7.9	0.0
May	0.7	0.0	2.9	0.0	2.0	2.5	2.3	2.2	8.2	0.0
Jun	0.4	1.5	5.5	1.1	3.8	5.1	5.3	5.1	8.2	0.0
Jul	0.5	4.0	4.5	2.8	3.2	6.3	6.9	6.7	7.8	0.0
Aug	0.5	5.0	3.7	3.5	2.6	6.5	6.7	6.4	7.9	0.0
Sep	0.5	4.0	3.2	3.2	2.6	6.2	6.0	5.8	8.3	0.0
Oct	0.4	1.5	3.4	1.2	2.7	4.2	4.6	4.5	8.0	0.0
Nov	0.6	0.0	1.9	0.0	1.7	2.2	2.0	1.9	8.3	0.0
Dec	0.9	0.0	0.0	0.0	0.0	0.8	1.1	1.1	8.0	0.0
Total	7.5	16.0	26.3	11.8	19.6	37.6	39.1	37.9		0.2
NOTES:									Leaching Fraction <sup>10</sup>	0.4%
									Leaching Requirement <sup>11</sup>	1.2%

## NOTES:

Abbreviations: FW = supplemental fresh water applied separately from process water, ppt = precipitation, PW = process water (includes blended fresh water).

1 Projected precipitation from the Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington

(Washington State University, n.d.) from the last 10 years.

2 Inches of irrigated treated process water and fresh water.

3 Irrigation efficiency of 70% assumed for May through August; 80% for April, September, and October; and 90% for November through March.

4. Total effective irrigation = net irrigation + precipitation.

5 Potential evapotranspiration estimated from Washington State University AgWeatherNet weather station at Pomona in Yakima County, Washington (Washington State University, n.d.). Estimated ET = potential ET adjusted based on the available soil moisture content.

6 Total soil water content at field capacity is based on the acreage-weighted average available water capacity plus the acreage-weighted estimate of the water content at permanent wilting point for the assumed rooting depth as determined using the Soil-Plant-Air-Water model (Saxton & Rawls & Ronberger & Papenlick, 2009).

7 Projected inches of water in soil profile root zone for January based on the end of the season December estimate from the previous year's calculated field water budgets.

8 Previous month's soil water content + total water input - ET estimate (cannot exceed soil available water holding capacity).

9 Estimate of water in excess of soil water holding capacity that moved beyond the root zone.

10 Percentage of gross water input estimated to percolate beyond root zone = surplus ÷ ppt + gross irrigation.

11 The percentage of surplus required to move beyond the root zone to manage soil salts to levels that do not impede crop productivity. Calculated from estimated irrigation water conductivity (ECiw) and volume of total gross water applied (precipitation + wastewater + freshwater), and a target soil EC of 2 millimhos per centimeter.

Formula: LR = ECiw ÷ [(Target EC × 5) - ECiw] (Ayers & Westcot, 1985).