CITY OF PAYSON

WATER RECLAMATION FACILITY

CAPITAL FACILITIES PLAN

2019

AQUA ENGINEERING

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CHAPTER 1 - INTRODUCTION

1.1 Introduction and Purpose

This document is a Wastewater Systems Capital Facilities Plan for the City of Payson, located in Utah County, Utah. The purpose of this capital facilities plan is to appraise the capacities and condition of existing equipment and processes at the City of Payson Water Reclamation Facility and to evaluate the current and future needs. Information from previous facilities plans is referenced in this report, and older projections are compared against actual growth and WWTP record data to justify continuing with or adjusting previous recommendations and expansion plans.

This report provides additional data and evaluation to:

- Establish the design criteria for short-term and long-term expansion at the WRF including projected influent flows, organic loading, nutrient loading, and solids handling based on projected population growth.
- Review the condition and capacities for all major processes and equipment at the WRF.
- Explain and justify the recommended equipment, processes, and upgrades at the WRF to accommodate projected growth.
- Present preliminary design and configurations for the recommended expansion alternatives, as well as establish a preliminary budget for the improvements.

1.2 WRF Overview

The City of Payson first installed their water reclamation facility in 1930's. There have been several upgrades to the facility. The most recent completed expansion includes headworks, aeration tanks and aeration basins, a primary digester rehabilitation, new final clarifier and solid handling building. Currently the WRF has design capacity for average daily flow of 3.0 Million Gallons per Day (MGD), with a peak hydraulic capacity of 5.75 MGD.

1.3 Discharge Permit

The City is permitted under UPDES permits No. UT0020427, UTL0020427, UTR020427 A summary of the discharge requirements is summarized in Table 1-1.

Table 1-1 Current Discharge Permit

Parameter	30-Day Average	7-Day Average	Daily Maximum
BOD_5	25 mg/L	35 mg/L	NA
TSS	25 mg/L	35 mg/L	NA
Fecal Coliform	*200/100 mL	*250/100 mL	NA
Total Coliform	*2000/100 mL	*2500/100 mL	NA
Ammonia-Nitrogen			
Summer (June-August)	NA	NA	15.8 mg/L
Fall/Spring (Sept-Nov /March-May)	NA	NA	16.8 mg/L
Winter (Dec – Feb)	NA	NA	20.5 mg/L
Total Chlorine Residual	NA	NA	2.5 mg/L
Oil and Grease	NA	NA	10 mg/L
WET (Acute)	NA	NA	Pass/Fail

CHAPTER 2 - EXISTING CONDITIONS

2.1 Existing Environmental Conditions

The information in this section is a general environmental assessment for the area.

2.1.1 Surface and Groundwater Hydrology

In general, surface water in the City flows from Payson Canyon, southeast corner of the City limit to Utah Lake, northwest direction. Utah Lake is protected for the 2B beneficial use classification since 2013 for infrequent contact recreation. Utah lake has only one outlet, Jordan River, which is a tributary of the Great Salt Lake, and is also protected for the 2B beneficial use. The Great Salt Lake is an endorheic basin and has high salinity. Discharge from Payson WRF enters an unnamed irrigation return drainage ditch to Beer Creek then Benjamin Slough to Utah Lake. The groundwater depth is approximately 6 ft below the surface at the location of the Payson WRF. Groundwater will not be disturbed by the Payson WRF.

2.1.2 Physiology, Topography, Geology and Soils

The soil resource report and the topography map are attached at the end of this report, as Appendix A. Geology of the City of Payson consists of loam, silty clay and alluvium. Alluvium is derived from locally originated limestone and fine loamy alluvium derived from alluvium. The majority of the land in the Payson is prime farmland of statewide importance per the USDA Soil Survey website. (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

2.1.3 Precipitation, Temperature, and Prevailing Winds

The elevation of the City of Payson is approximately 4,600 feet above mean sea level. The climate of the City of Payson is semi-arid with an annual average precipitation of approximately 16 inches of rain per year, and the average snowfall is 53 inches per year. The average high temperature occurs in July at 90°F and the average low temperature occurs in January at 38°F. According to Western Regional Climate Center, the prevailing wind direction in the area is North West.

2.1.4 Terrestrial and aquatic Plants, Animals, and Natural Communities

The City of Payson is moderately vegetated with residential lawns and gardens and a variety of deciduous and evergreen trees. Some of the native plant species for the Northern Utah include greasewood, shadscale and salt brush with some saltgrass, sagebrush, seepweed, and rabbitbrush.

Federally listed Endangered species in the area include Brown Bear, Clay Phacelia, Desert Milkvetch, June Sucker, Ute Ladies' Tresses, and Western Yellow Billed Cuckoo.

2.1.5 Air Quality and Noise

Utah County was out of compliance on PM_{10} in 1987 but it has been attaining the standard since 1996. Maintenance Plans for Utah County have been developed by DAQ; these plans will allow Utah to petition the EPA to de-list the area as "nonattainment". Annual mean concentration of PM is 2.5 in Utah County has been below EPA's standard for at least the last 17 years. Overall, air quality is fair in the area and the WRF will not impact the existing air quality standard.

Noise in the area with WRF is usually due to highway noise from traffic on I-15 and other surface streets. According to Utah County Ordinance Chapter 12, Industrial areas such as where the WRF is, has been permitted to have a maximum noise level of 80 dB.

2.1.6 Land Use and Development

The region is mostly residential, with some industrial development. The Land Use Element Map is included in Appendix B. There is some tourism in the region but it is minimal compared to other development in the area.

The existing WRF is in the incorporated lands of Utah County, Utah. The parcel that is South of the boundary belongs to the Utah Dept. of Transportation and East of the boundary is owned by Utah Associated Municipal Power Systems. These areas have already been developed as industrial and there is not much space for new development.

2.1.7 Existing Water Quality and Public Health Concerns

Currently the effluent from the wastewater facility is discharging to the irrigation ditch through a 24 inch pipe. It flows into the Beer Creek which flows into Benjamin Trough that enters Utah Lake. The WRF currently holds three UPDES permits, UT0020427, UTL0020427, UTR020427 and the facility has been in compliance with all the permits. There are no public health problems caused by inadequate wastewater treatment disposal practices.

2.2 Existing Wastewater Flows and Treatment Systems

The WRF services the rural communities of Payson and Elk Ridge, Utah. Wastewater into the WRF is a mixture of typical municipal wastewater and industrial wastewater from nearby manufacturing facilities such as Payson Fruit Growers. Influent flow data including flow rates, biochemical oxygen demand (BOD) loading, total suspended solids (TSS) loading, and effluent water quality measurements from 2011 to 2014 are available and were used to establish per capita loading and flow rates. The primary design parameters to be established and confirmed are:

- Population and Growth (ERUs)
- Flow
- BOD
- TSS
- Ammonia

Based on the 2010 Demographic and Economic Analysis by Governor's Office of Planning and Budget, a growth rate for Payson is 2.2 % and it is 4.7 % for Elk Ridge until 2020, and then it will drop to 1.7 % for Payson and 1.9 % for Elk Ridge. These values will be utilized to project population growth in this report. Existing flow data is compared against the estimated population to establish a per capita flow in terms of gallons per day and to establish current and projected ERU's. On average, Payson and Elk Ridge contribute 89% and 11% of the total flow to the plant respectively. This report summarizes the most recent data and estimates available to establish and confirm the design criteria for the expansions and upgrades necessary at the WRF.

2.2.1 Existing Population, Projected Growth & ERU's

Based on the 2010 US Census data, the 2015 population was estimated at 23,257 including 20,140 for Payson and 3,117 for Elk Ridge by the Governor's Office of Planning and Budget – Demographic and Economic Analysis Section. According to the State's projections, the City of Payson has a growth rate of 2.2 % and Elk Ridge has a growth rate of 4.6 % until 2020, and then drops to 1.7 % and 1.9%, respectively. Table 2-1 provides a summary of projected population for Payson and Elk Ridge through 2050. Figure 2-1 is a graphical representation of the same data.

Table 2-1 Summary of projected population growth

Projected Population			
Year	Payson	Elk Ridge	Total
2010	18,294	2,436	20,730
2015	20,140	3,117	23,257
2020	22,832	3,898	26,730
2030	26,945	4,687	31,631
2040	31,798	5,635	37,433
2050	37,526	6,776	44,301

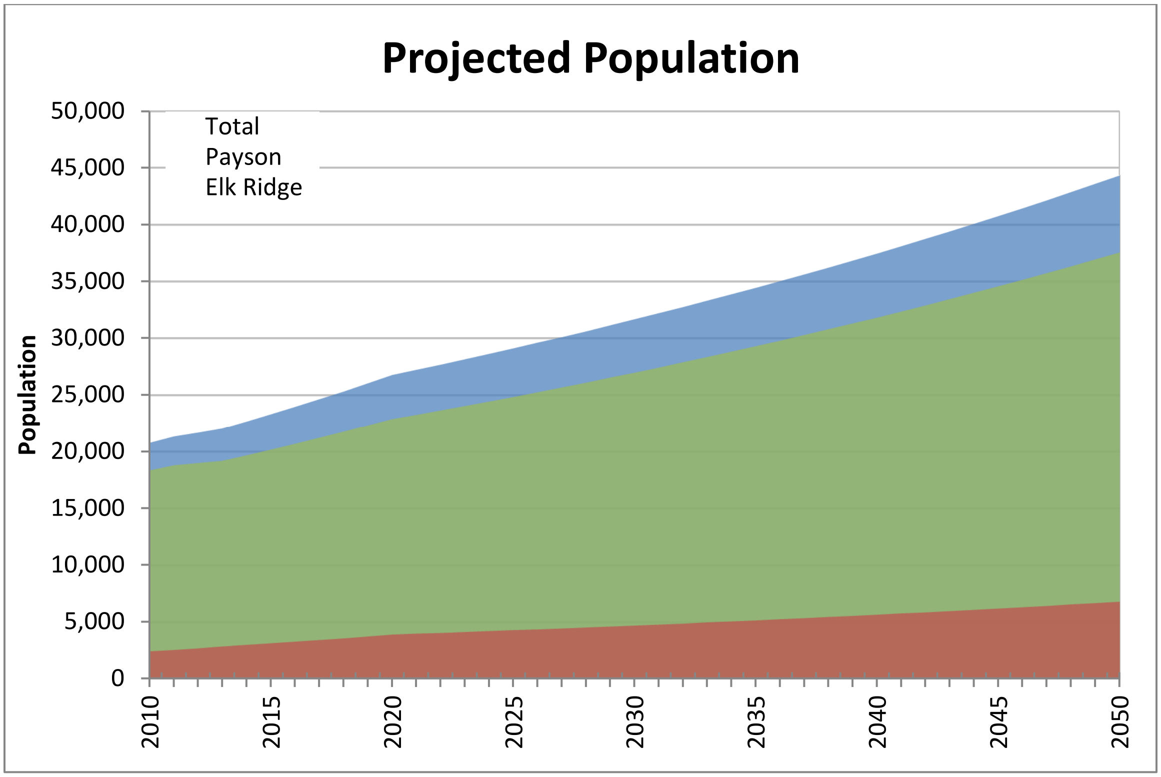


Figure 2-1 Projected population growth for Payson and Elk Ridge through 2050.

The use of and cost to construct/expand sanitary sewers and wastewater treatment plants needs to be equally divided among all users connected to the system. The basic unit used to equate population growth to flow rates and sewer connections is an Equivalent Residential Unit (ERU). An ERU represents the contribution of a typical detached single-family dwelling to the sewer system and WWTP. Since population is closely related to ERU count, population growth is used to estimate future ERU's and their impact on flow and loading on the WWTP. Currently, the WWTP is serving 6,547 ERUs (2017 personal communication). The information provided from the city regarding to its connection within the city of Payson and Elk Ridge calculates 1 ERU is equivalent to 3.6 people, where many cities in Utah use values from 3.0 to 3.5 people per ERU. Details regarding an actual per capita flow are discussed later in this report. For the purposes of this report and to stay consistent with the sewer collection system data, 1 ERU is equivalent to 360 gallons per day (gpd) flow. Growth and increased loading to the WWTP will be evaluated in terms of additional flow, which will be equated to additional ERU's. These values will be used to project the timing of when flowrates and loading may reach critical values that require expansion or upgrades to the WRF. This report will focus on growth and recommended improvements to the WRF for the next 10-years (through 2030) while providing some guidance for expansion and growth for the next several decades.

2.2.2 Influent Flow

Monthly average influent flow data was collected from January 2012 through December 2018. Average daily flow has been gradually increasing over the last few years due to the population growth of Payson and Elk Ridge. Figure 2-2 shows how the average monthly flow has changed as the population has increased.

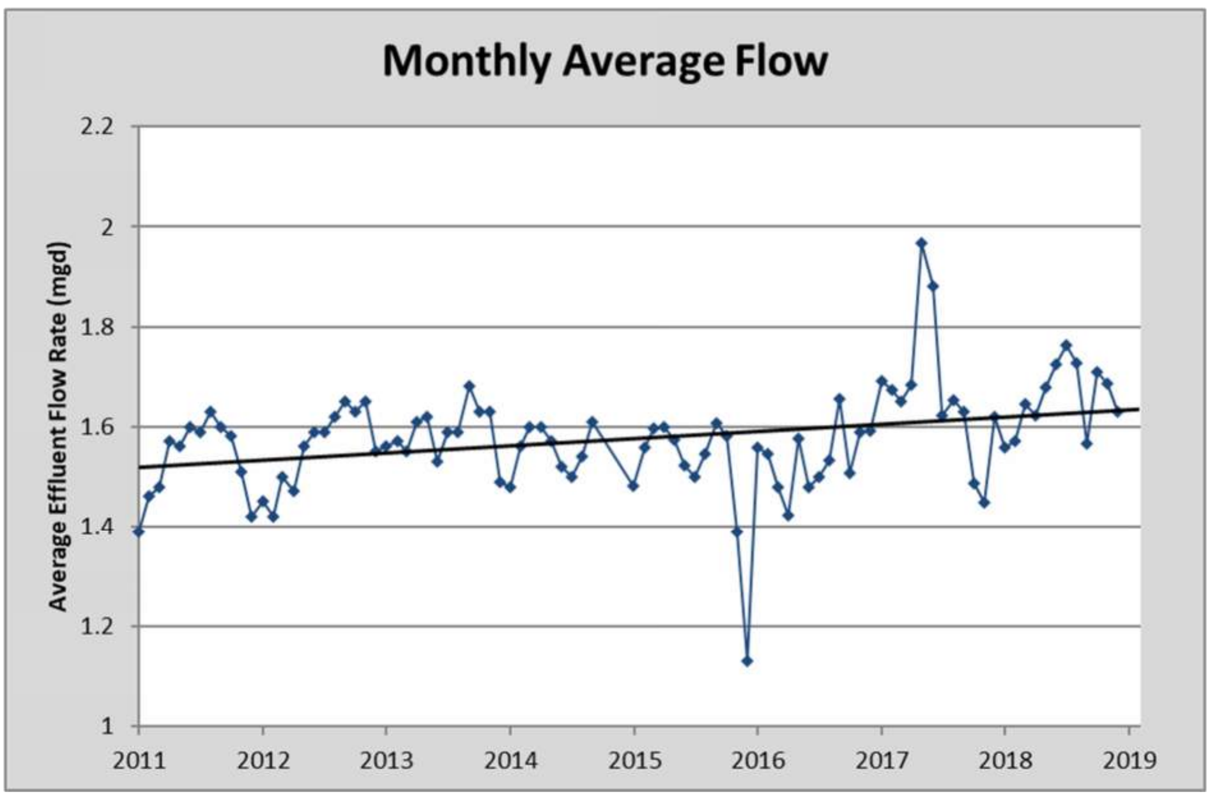


Figure 2-2 Average Monthly Flow

Monthly average flows over this time period range from 1.12 MGD to 1.96 MGD as shown in Figure 2-3. Over last four years, the monthly average influent flow has been relatively constant throughout the year. Typically the lowest monthly average inflow was recorded in January and the maximum average flow was recorded in September.

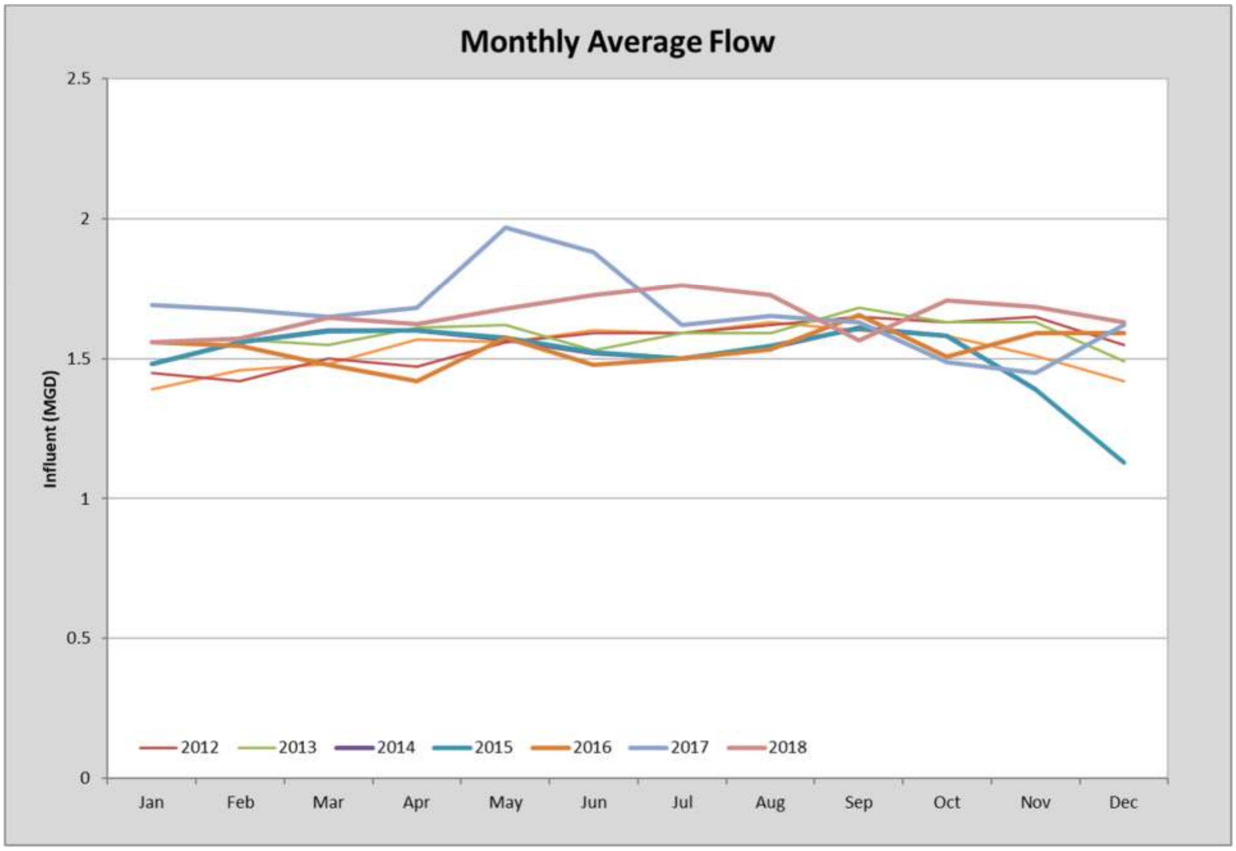


Figure 2-3 Monthly average daily flow

The overall average daily flow during 2018 was 1.7 MGD with a peak flow of 1.80 MGD which was calculated based on the rate of flow greater than 99.9 % of the daily flow data. Dry and Wet season flow was not calculated for the facility due to its consistent flow throughout the year.

The water usage per capita was calculated to be 67 gallons per day with the estimated population in 2018 of 25,279, which is below the state design allowance of 100 gallons per capita per day

(Utah Admin. Code R317-3-2). Therefore, no infiltration/inflow analysis has been done for this report. The residential sewer systems for this facility are designed on the basis of an annual average daily rate of flow of 100 gallons per capita per day as state requires per UAC, subsequently the design flow is 360 gpm per ERU. It is expected to reach the current capacity of the plant, 3.0 MGD, in 2027 if population grows as projected. Furthermore, the influent is anticipated to reach 5 MGD at year 2058 with the same assumption explained previously. The summary of projected influent can be found in Figure 2-4, and the City of Payson has had submitted and the State has approved their Water Conservation and Management Plan, as attached at Appendix C.

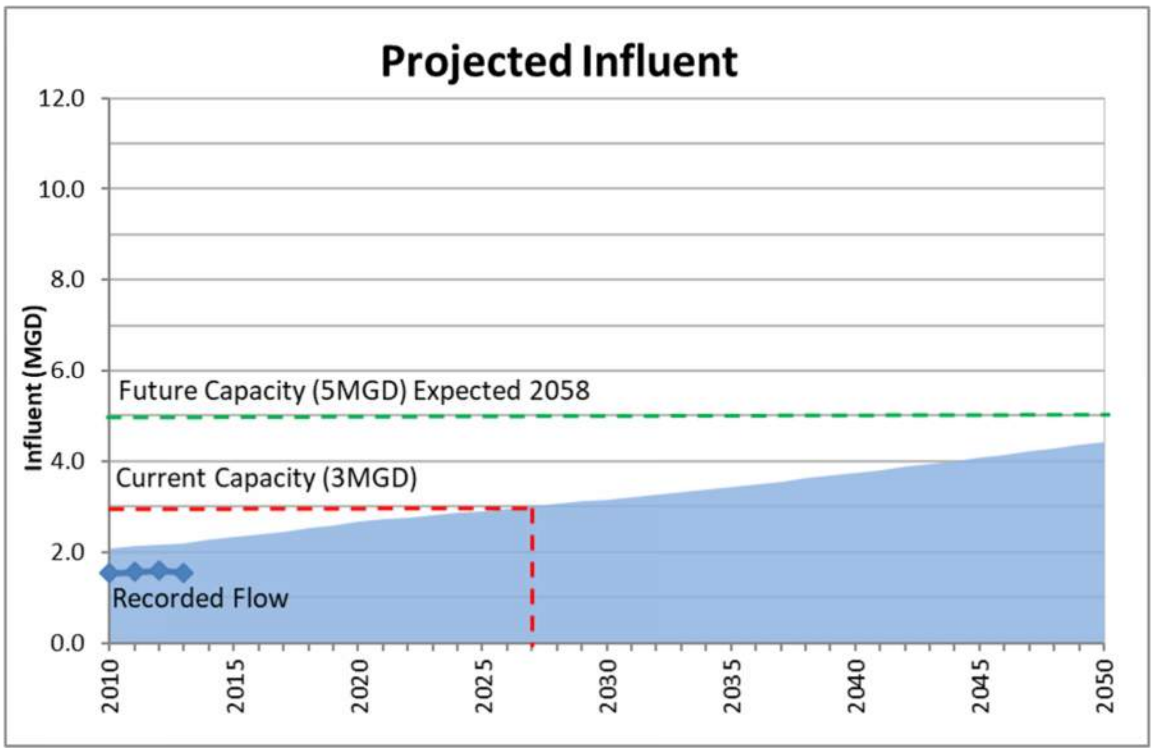


Figure 2-4 Projected Influent

2.2.3 Wasteload Analysis

A wasteload analysis was completed April 10th , 2017 to determine point source effluent limitations necessary to maintain designated beneficial uses by evaluating projected effects of discharge concentrations on n-stream water quality. This wasteload analysis is associated with the WWTF discharge permit into the Beer Creek. Appendix D contains a copy of the analysis. The wasteload analysis concluded that violations of receiving water beneficial uses with their associated water quality standards, including important downstream segments, will not occur for the evaluated parameters of concern listed in the wasteload analysis if the effluent limitations in the discharge permit are met. It is anticipated to have similar quality of the discharge from the treatment facility, except for the more stringent nutrient limit, consequently, the expected impact of this facility plan is minimal, including discharge volume increase based on population growth.

2.2.4 Influent BOD and TSS

Influent flow volume is not the only factor when considering the WWTP's loading and capacity. The concentration of constituents or strength of the influent also determines the ultimate load on the plant. A plant may be within its hydraulic capacity but exceeding its design biological and solids loading. Specific constituents of interest include biochemical oxygen demand (BOD) and total suspended solids (TSS). The total daily load, determined in pounds of BOD and TSS per day, is a function of each constituent's concentrations and the flow rate. Currently, the Payson

WRF has average BOD capacity for 5836 lbs/day and TSS capacity of 6255 lbs/day.

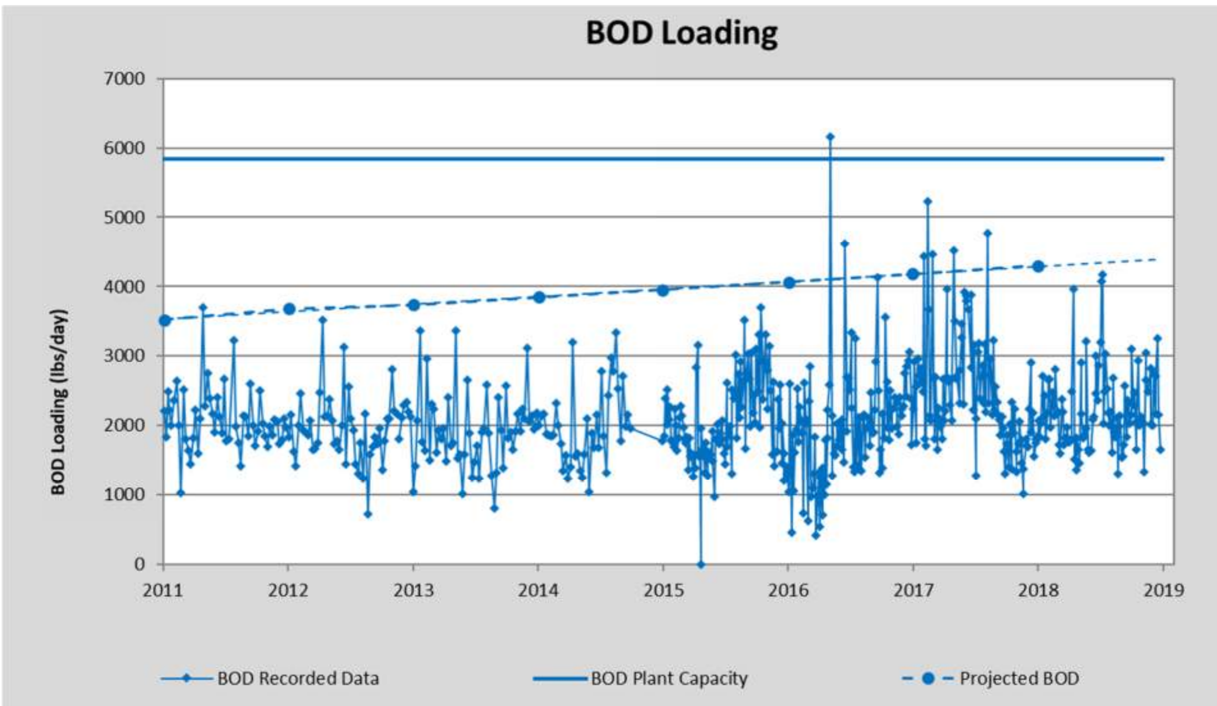


Figure 2-5 summarizes current loading data for BOD and projected loading for BOD based on the population. Figure 2-6 illustrates current loading data and projected loading data for TSS.

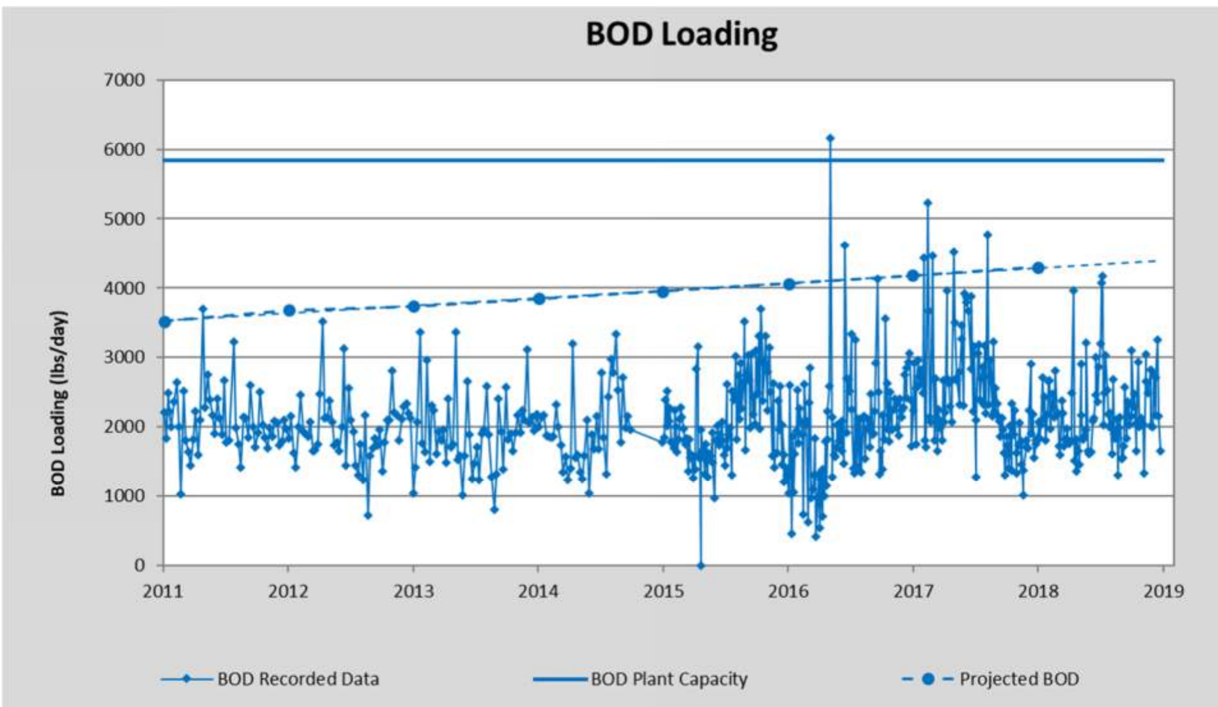


Figure 2-5 BOD Loading

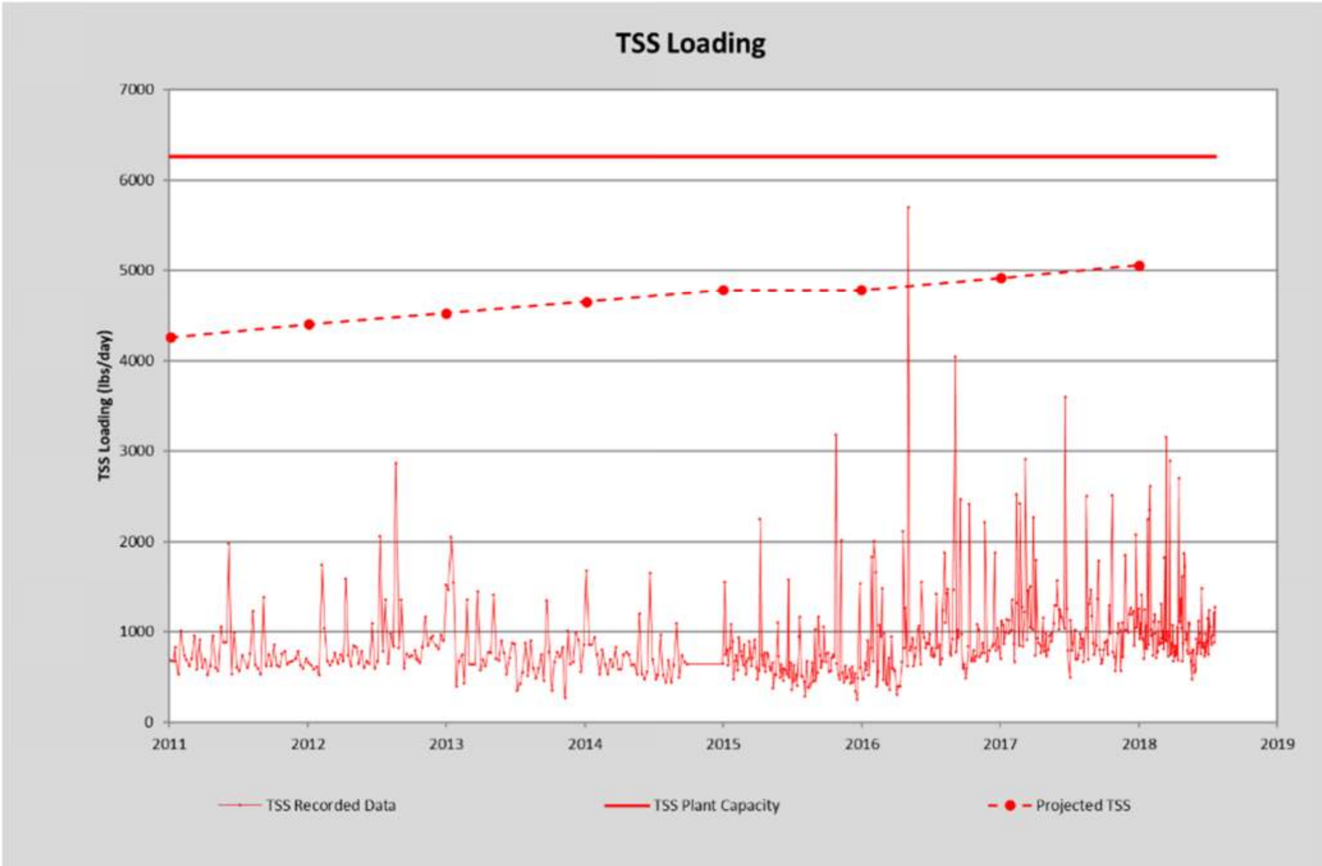


Figure 2-6 TSS Loading

Based on the data provided from the facility, yearly average of Biochemical Oxygen Demand (BOD) was 162 mg/L for the last three years, which is equivalent to a loading of 1666 lbs/day with the average flow of 1.7 MGD. Based on the population, BOD loading for this facility is 0.07 lbs/day/capita for 2018. Total Suspended Solid (TSS) data was averaging to be 77 mg/L, that is, total loading of 746 lbs/day and 0.03 lbs/day/capita. Typically, the residential sewer systems shall be designed on the basis of the BOD loading of 0.17 lbs per capita per day and the TSS loading of 0.20 lbs per capita per day (Utah Admin. Code R317-4-3). Consequently, the design basis of 0.17 lbs per capita for BOD and 0.20 lbs per capita for TSS were used in this report when projecting the city's future BOD and TSS loadings.

It is expected to reach the current BOD capacity of the plant, 5,836 lbs/day, by 2035 with per capita loading of 0.17 lbs/day/capita if population grows as projected. Also it will take the WRF fourteen (14) years to reach the plant's TSS capacity of 6,255 lbs/day assuming that the per capita loading of 0.20 lbs/day/capita by 2030. The value presented in this report may be conservative since current loading is significantly lower than the design basis loading values and will be used in this analysis throughout.

With the design future flow of 5 MGD on a year of 2058, BOD and TSS Loadings are anticipated to be 8,474 lb BOD/day and 9,969 lb TSS/day.

2.2.5 Influent Ammonia

The average ammonia concentration at the water reclamation facility is 25.4 mg/L which gives a current loading of 340 lbs per day with the flow of 1.7 MGD. Typically, municipal influent concentrations for total nitrogen, reported as Total Kjeldahl Nitrogen (TKN) is 40 mg/L. Based on the typical TKN value of 40 mg/L, influent ammonia loading will be 1000 lbs per day when plant reaches influent loading of 3.0 MGD. At the design influent flow rate of 5 MGD, anticipated TKN Loading to be treated in this plant is 1,617 lb/day.

2.2.6 Influent Phosphorus

Influent total phosphorus data was not included in the data provided by the City, however, typical influent concentration of phosphorus, 10 mg/L, will be used in this analysis. Currently the State is working on nutrient pollutants. It looks like in the near future there will be limits on phosphorus and nitrogen. The limits that are currently being discussed are Total Phosphorus (TP) 1 mg/l. It will be assumed that the new facility will be designed to meet the nutrient requirements.

Phosphorus can be removed both chemically and biologically. For this facility it will be assumed that the biological phosphorus removal will be used.

There is a potential that the phosphorus limit may be reduced below 1 mg/l and that is the typical threshold for biological phosphorus removal. If that happens in the future chemical precipitation may be required. However, using biological phosphorus removal will substantially reduce the amount of coagulants that will be needed to meet lower limits in the future.

2.2.7 Payson Fruit Growers

Payson Fruit Growers is the largest industries discharging wastewater to the reclamation facility, and it is the only future industrial growth expected for the facility. Its peak discharge is approximately 130,000 gallons per day. The current permit allows them to discharge 1,400 lbs BOD/day. They now would like to discharge total of 2,000 lbs BOD/day. It will be discussed how to treat the additional 600 lbs/day and corresponding cost for the additional treatment capacity it will require.

2.3 Expansion Parameters Summary

Assuming the population growth rates of 3.4 % for Payson and 5.1 % for Elk Ridge for next 20 years, the following parameters are predicted for 2040.

- Population 37,433
- Influent 3.75 MGD
- BOD 6,363 lb/day
- TSS 7,486 lb/day
- TKN 1,251 lb/day
- TP 312 lb/day

2.3.1 Effluent Requirement

Below is the effluent requirement that is anticipated for the facility with the expansion.

- BOD 25mg/l
- TSS 25 mg/l
- E Coli 126 / 158 CFU
- pH 6.5-9.0
- DO 5 mg/l min
- TRC 1.8 mg/l max
- TIN 10 mg/l
- TP 1 mg/l

CHAPTER 3 - REVIEW OF EXISTING FACILITY

3.1 Introduction

The current facility was last updated in 2010 and over the last few years of operation a better understanding of the facility has been gained. This review will evaluate the existing facilities and address limitations and improvements. Summary of the overall design capacity of the current facility can be found in Table 3-1 below. The WRF currently holds three UPDES permits, UT0020427, UTL0020427, UTR020427 and the facility has been in compliance with all the permits. Currently there is no onsite system service, nor combined sewer system within the area. There is no flow reduction programs in effect for the area served by this facility.

Table 3-1 Current Capacity

Flow	3 MGD
BOD	5,836 lbs/day
TSS	6,255 lbs/day
Ammonia	686 lbs/day

One of the items that will be addressed in this chapter is redundancy. There is different equipment that is critical to the facility and when those items fail the results may cause permit violations. Current permits for the City of Payson and the overall site plan is attached at the end of this report, as Appendix D and Appendix E.

3.2 Headworks

3.2.1 Primary Screens

There are two primary screens. The screening size is ¼" and the screen manufacturer is Huber. The screens are as shown in Figure 3-1. The design capacity of each of the screens is a peak flow of 3 MGD. The two screens are redundant to each

Figure 3-1 Primary Screen

other so if one screen is out of service the second screen should have the capacity to allow the peak flow to pass through the screen. However, during a large storm event in 2014 the flow entering the treatment facility exceeded the peak design flow and wastewater overtopped the channels in the headworks.

3.2.2 Washpactors

Each of the primary screens has a washpactor to collect the screenings and clean the organic material. The washpactors are functioning but in the near future it is anticipated that they will need additional maintenance as they get closer to their design life.

3.2.3 Grit System

The grit system consists of a cyclone grit trap shown in Figure 3-2. The solenoid valves are starting to wear out and need to be replaced. The solenoid valves control the air for the air lift pump and the air that agitates the grit on the bottom of the grit trap prior to the air lift pump operating. The agitation increases the efficiency of grit removal from the grit trap. The air lift pump sends the grit slurry to a grit washer shown in Figure 3-3. The grit trap's capacity is 6.4 MGD and appears to be in good working order and should work for the plant flow for several additional years. The grit washer shown in Figure 3-3 appears to show wear in the stainless steel tub. It is recommended that this be upgraded.

Figure 3-2 Grit Trap

3.2.4 Headworks Building

The headworks building is constructed of block and is in generally good condition. One limitation of the building is the electrical controls that are in a separate room within the building. Hydrogen sulfide that off gasses as it enters

Figure 3-3 Grit Washer

the screens is entering the electrical room and causing corrosion in the electrical gear. The corrosion may be minimized using a twofold approach. First the wood framed wall can seal the room better to prevent the gases from entering the room. The second issue is the ventilation in the building. The exhaust fan in the headworks area has failed. Birds have nested in the fan and rendered it inoperable. The exhaust fan should be upgraded which will help with the corrosion in the electrical room. Originally the electrical room was designed with a positive pressure ventilation system. This fan has also failed and is not providing the positive pressure. Updating both of the ventilation system is necessary to protect the electrical gear in the future.

3.3 Splitter Box

A structure was installed in the previous upgrade that would allow for the plant to expand the flow capacity by adding a second primary pump station near the headworks building. The existing wet well is only sized for the current design flow, 3 MGD. This structure will split the flow to a new wet well and pumping station. The wastewater flow also leaves this splitter box and is piped to the primary wet well.

Figure 3-4 Splitter Box

3.4 Primary Pumps

The primary pumps are located in the basement of the digester building as shown in Figure 3-5. The pumps seem to be working adequately. They are sized for the current design flow of the facility with one pump acting as a redundant unit for the other two. One difficulty with the pumps is access when doing maintenance. A crane rail needs to be installed which will allow the

Figure 3-5 Primary Pumps

pumps to be removed from their location with less effort. A temporary crane rail has been installed but it interferes with the disconnect switches for the pumps.
The crane rail and electrical gear is shown in Figure 3-6. The electrical gear should be relocated to allow for better access to the pumps. In addition to the crane rail shown, an additional method will be needed to move the pumps outside the building. Currently the pumps need to be moved across the floor and manually crried up the stairs from the basement.

Figure 3-6 Crane Rail

3.5 Primary Clarifier

The primary clarifier was taken off-line and recoated as part of the last upgrade. The coating should have another ten years of life before it requires another coating. At that time it may be necessary to replace the mechanism. One of the major limitations of the primary clarifier is that there is no redundancy unit, in other words, if one is taken down the facility cannot treat full capacity. It is recommended to install an additional primary clarifier of the same size and operate two during normal conditions. This operation allows additional solid removal because of the lower overflow rate, and provides redundancy.

Figure 3-7 Primary Clarifier

3.6 Trickling Filter

The trickling filter is shown in Figure 3-8 and is filled with rock media. The filter was installed in the 1980 upgrade. The mechanism bearings were recently changed. However, it appears the process has reached its design life. In addition with the new nutrient

Figure 3-8 Converted Trickling Filter Tanks

limits this unit process will no longer be effective in removing the required nutrients. The location and elevation of the trickling filter will be a good place to install a new primary clarifier.

Figure 3-9 Trickling Filter

Losing this unit process results in need of additional treatment capacity to replace this unit. In addition to the trickling filter there are two additional old tanks that at one time were trickling filters. They were installed in the early 1960's as part of the original plant as seen in Figure 3-9. The configuration of these tanks is not optimal for an activated sludge process. Therefore, they should be demolished and a new concrete basin should be installed to replace the trickling filter.

3.7 Intermediate Clarifiers

Figure 3-10 Intermediate Clarifiers

There are two intermediate clarifiers that were originally final clarifiers in the 1960 upgrade. They currently remove some of the solids generated in the trickling filter and direct them to the front of the treatment facility. The solids are then removed along with the primary sludge in the primary clarifiers. There has been a problem with these clarifiers where they are somehow capturing the solids from the activated sludge system and transferring them to the primary clarifier which has reduced the solids inventory in the STM Aerotors. To remedy this problem one of the clarifiers has been inactivated and the solids are allowed to overflow the weirs and transfer back to the STM Aerotors. Therefore, it is recommended that the clarifiers be abandoned. The area where they are located can be used for new tanks for nutrient removal. By installing the nutrient removal tanks in this area there should be enough slope to have the wastewater flow from the primary clarifiers through the tanks and to the STM Aerotors, which eliminates the need for the intermediate pump station.

3.8 Activated Sludge (STM Aerotors)

Figure 3-11 STM Aerotors

There have been mechanical problems with the STM Aerotors. The chains have broken more times than originally anticipated and the drives have needed replacement. Because of these problems it is anticipated that the tank will be converted to another method such as fine bubble diffusion system at some time in the future. The tank is shown in Figure 3-11. This conversion will require a blower building and diffusers in the tank. With this assumption it is anticipated that the activated sludge basins will be constructed with fine bubble diffusers to supply air.

One of the redundancy issues associated with the STM Aerotor is if one wheel is not functioning half of the basin has to be shut down to repair the wheel. It was anticipated that each wheel would be redundant for the system. However, experience has dictated that half of the aeration system is lost when repairs are being done. With a new aeration basin this will allow for better redundancy in the system because there will be additional flow trains that can be isolated from each other.

3.9 Final Clarifiers

Currently there are two final clarifiers. One of the clarifiers was installed as part of the last upgrade. The other clarifier is an older clarifier that was installed in an earlier upgrade. The older clarifier only has an 8-foot side water depth with makes it less efficient than the newer clarifier. The mechanism is getting close to its design life of 30 years and should be replaced in the near future. The mechanism was sandblasted and recoated in the last upgrade and should be good for a few more years. A new final clarifier should be installed which would be a redundant clarifier. It would allow for any single clarifier to be taken off-line for repairs and allow the other two clarifiers to meet the flow demands. The newest clarifier is having problems with the drive mechanism and should be replaced.

Figure 3-12 Filter Bridges

3.10 Final Filters

The bridges in the filter building are getting old and have reached their design life. They need to be replaced. To expand the capacity of the treatment facility the filters will need to be expanded. Expanding the building and lengthen the sand filters is one alternative, but the other alternative would be to install the diamond filters from Aqua Aerobics. This system would fit in the existing building and allow for additional flow to pass through the system using the existing building foot print.

3.11 RAS / WAS Building

Figure 3-13 RAS Pumps

The sump pump in the RAS/WAS building needs to be replaced. In addition, all of the flow meters need to be replaced in the building. The VFD's are not functioning reliably so they need to be replaced also.

3.12 RAS Pumps

The RAS pumps are shown in Figure 3-13 and they are currently working. However, they will need to be rebuilt in the near future with new impellers. The pumps and piping are in need of a new paint job.

3.13 WAS System

The WAS pumps are not used unless the newest clarifier is not in operation. The water surface in the new clarifier allows the WAS to flow to the DAF thickener without using the pumps. The pumps have seen little use due to this operation. The plug valve shown in Figure 3-14 is not operating as it should and will need to be replaced.

Figure 3-14 WAS Plug Valve

3.14 DAF

The DAF Air Panel shown in Figure 3-15 is not functioning correctly and needs to be rebuilt. The DAF Pumps shown in Figure 3-16 are in need of a rebuild also. The DAF is susceptible to freezing in the winter time because of the intermittent use. Therefore, it is recommended that a new structure is placed over the DAF.

Figure 3-15 DAF Air Panel

3.15 Chlorine Contact Basin

The chlorine contact basin is currently functioning. However, the new discharge permit will require dechlorination prior to discharge. It is recommended that UV disinfection be installed at the facility to replace the chlorine contact basin. The risk management plan that the City currently is required to have would be eliminated by removing chlorine from the site. The UV bulbs may be installed in the existing chlorine contact basin or a new basin could be installed to house the lights. The existing chlorine contact basin is shown in Figure 3-17.

Figure 3-17 Chlorine Contact Basin

3.16 Sludge Recirculation Pumps

The sludge recirculation pumps transfer the sludge through the heat exchanger to keep the digesters heated. The rotary lobe pumps have not lasted as well as expected. It is recommended that when they need to be replaced, a different type of pump will be used.

3.17 Waste Pumps

Figure 3-18 Sludge Recirculation Pumps

The waste pumps pump the thickened sludge from the DAF to the digesters. Currently they are air diaphragm pumps as shown in Figure 3-19. The limitation with these pumps is they require large air compressors and dryers to function properly. If the compressors need to be replaced in the future the pumps could be changed to a different type of pump that would not require the compressors and dryers.

Figure 3-19 Waste Pumps

3.18 Digesters

The existing digesters have the capacity for the current design of the treatment facility. However, if a tank needs to be taken off-line for service, the remaining digesters do not have the capacity necessary to take care of the solids handling at the plant. It is recommended that a new digester to be installed that allows for future growth and adds redundancy to the existing system. The gas hoses on the digesters have reached their design life and should be replaced.

3.19 Digester Mixers

The digester mixers are currently operating properly and should be adequate for a few more years.

3.20 Boiler

There is only a single boiler for the treatment plant at this time shown in Figure 3-20. At times, the digesters cannot

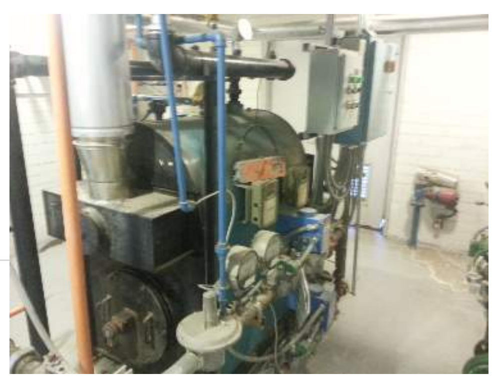


Figure 3-20 Boiler

reach the needed temperature for the digestion process. It is recommended that two new boilers be installed that will increase the heat capacity for the facility. They should be sized for the new digester and the existing digesters.

Figure 3-21 Heat Exchanger

3.21 Heat Exchanger

Currently there is a tube in tube heat exchanger as shown in Figure 3-21. The heat exchanger is sized to match the boiler and is functioning as anticipated. When larger boilers are installed, heat exchangers need to be upsized also. It is recommended that an additional heat exchanger be paired with the redundant boiler so there is redundancy in the boiler and heat exchanger.

3.22 Dewatering Facility

The dewatering facility was constructed recently. The dewatering unit is a Huber screw press and there is room for an additional press in the building. An additional unit would provide redundancy and additional capacity for future growth. In addition, a crane rail in the dewatering building would help with maintenance on the equipment.

3.23 Reuse Pump Station

The reuse pump station stores water in a bolted tank and currently the tank is only used if there is demand beyond what the wastewater plant can supply. This allows the water to become stagnant in the tank and the water quality is degrading. It is recommended to install additional pumps within the system that will cause the flow to continue through the tank, so it is recirculated. This will allow the tank to act as a equalization tank instead of just a storage tank.

3.24 Generator

The existing generator is at design capacity and is reaching its design life. It should be replaced and increased in size to meet the new electrical demands.

3.25 SCADA System

The SCADA system has reached its useful life and should be upgraded with new PLC's and HMI.

CHAPTER 4 - PROCESS SELECTION

4.1 Introduction

At the time of this facility plan, the existing permit has expired and the new permit has not been released. It is anticipated that there will be several changes in the new permit that will be either introduced in the new permit or added to future permits. The following constituents will be included permit limits in the near future:

4.1.1 Ammonia

The ammonia standard was changed in the water quality standards and it is anticipated that ammonia limits will be at most 1 mg/l.

4.1.2 Chlorine

A new model is being used for waste load allocations. This new model is showing that much lower chlorine limits are required in all new permits.

4.1.3 Phosphorus

Utah had adopted a new secondary standard for Phosphorus. In 2020 all discharging mechanical plants are required to meet a limit of 1 mg/l.

4.1.4 Total Inorganic Nitrogen (TIN)

It is anticipated that that a new rule will be implemented through the State which will require a TIN limit from mechanical plants to be 10 mg/l.

4.2 Process Requirements

The ammonia will require additional oxygen in the treatment system and reduce the effectiveness of the old trickling filter. Due to this change, the trickling filter should be replaced with additional activated sludge capacity.

The reduction in chlorine limits will require either dechlorination or UV to be used for disinfection. Converting to UV will remove the need for chlorine and eliminate the need for a risk management plan.

The phosphorus requirements can be either removed using chemical addition or through a biological process. The capital cost for the biological process is much more than the chemical capital costs. However, the biological operating costs are much less expensive than the chemical process. The existing facility has anaerobic digesters so if biological processes are used to remove phosphorus it will be released in the digester. This will require a side stream process to remove the phosphorus before either the decant or the pressate is sent back to the treatment facility. There are several new processes being used for this but they typically require chemical removal of the phosphorus. Therefore, installing chemical phosphorus removal at this time is the best solution until better side stream processes are developed. In the future it is recommended to install biological phosphorus removal assuming the side stream treatment processes become better proven. At this time the chemical phosphorus system can be used if the biological process becomes upset.

The TIN requirement will require anoxic basins to be installed to reduce the nitrogen biologically.

CHAPTER 5 - FACILITY UPGRADE ALTERNATIVES

In this section, the following alternatives were considered for the City of Payson; Do Nothing, 5 MGD with Biological Nutrient Removal (BNR) with redundant chemical nutrient removal, 5 MGD with Advanced Biological Nutrient Removal (ABNR), 5 MGD with ABNR and aerobic stabilization , 5 MGD with BNR and aerobic sludge stabilization, 3 MGD with BNR with redundant chemical nutrient removal, 3 MGD with Advanced Biological Nutrient Removal (ABNR), and 3 MGD with ABNR and aerobic stabilization. 3 MGD with BNR and aerobic sludge stabilization. Each option was evaluated in regard to site layout, installation cost, and operation and maintenance cost.

Statepoint Engineering evaluated strictly chemical phosphorus removal and the chemical dosing caused several process problems. Therefore, chemical precipitation is only being used as a backup to BNR. The Memo can be found in Appendix F.

Total containment, Rapid Infiltration Basins, nor land application options were considered for this report because of the treatment capacity of the existing facility and area each of those would require. The flows from the City of Payson are quite large and regionalization for this quantity of wastewater would be very difficult. Due to the distance and costs associated with regionalization in comparison to the magnitude of the required improvements, regionalization was not considered feasible at this time.

The area that is served by the facility would not change due to this capital facility plan and the only known industrial user for the facility is Payson Fruit Growers, as discussed previously. None of these alternatives described below will have impacts on groundwater since the treatment is closed system and treated water will enter surface water as it is discharged from the facility.

Payson City currently is carrying a total debt of $6,299,932 that they are making a payment of $1,004,674 on 2018. Among that debt, about $110,000 will be paid off by the end of 2018 and another debt of $530,000 should be paid off by 2022, the rest of the existing debt is around

$340,000 per year and should be paid off by the year of 2027. It is the City's plan to have this plan in effect by the year of 2023, thus, existing debt service of $340,000 is included in the fee calculation for each option.

5.1 Do Nothing

The current facility at City of Payson is functional and has additional capacity for some future growth of the community. No major modification would be done to the facility with this alternative. Because there will be no redundant equipment with this alternative, it may be difficult to maintain the effluent standard when maintenance is needed to one of the larger equipment. This option does not include any further treatment for the anticipated nutrient removal regulation. Furthermore, once Payson Fruit Grower uses their permitted 1,400 lbs/day limit, the facility will not only reach its nutrient capacity, but additional 400 lbs/day will not be treated unless some additional treatment system will be installed.

5.1.1 Probable Cost of Do Nothing Option

There will not be any additional debt for this option. Payson City currently is carrying a total debt of $6,299,932 that they made a payment of $1,004,674 in 2018. Among that debt, about $110,000 will be paid off by the end of 2018 and another debt of $530,000 should be paid off by 2022. The rest of the existing debt is around $340,000 and should be paid off by the year of 2027. Anticipated annual operation cost for the Do Nothing option is estimated based on Payson's current annual cost of operation and is shown in Table 5-1 below.

Table 5-1 Do Nothing Option

1.5 MGD	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 4 staff)	$529,065
Professional Services	$102,267
Operating	$534,669
Maintenance	$330,162
Existing Debt Service as of 2023	$340,000
Transfer	$186,982
Total Probable Cost	**$2,023,145**

The annual cost for the Do Nothing option including O&M and debt payment is expected to be $2.0 million, which yields to a minimum monthly user fee of $25.75 with 6,547 ERUs.

5.2 5 MGD Expansion with Redundancy – Chemical Nutrient Removal

The influent is anticipated to reach 5 MGD by 2035. To accommodate extra 2 MGD, significant modifications will be needed for the Payson wastewater treatment plant. Some permit changes are anticipated before this 5 MGD upgrade including following: anoxic/aerobic basin due to anticipated more stringent nutrient requirement, a blower building to accommodate the air requirement for the anoxic/aerobic basin, and UV system to replace the chlorine contact basin.

5.2.1 Headworks Upgrades

The primary pump station needs to be upgraded with a larger pump to transfer a greater influent flow. To accommodate the additional 2 MGD to the current 3 MGD, it is necessary to expand the existing headworks, unless water level on the downstream can be modified 16 inches. It is anticipated that an additional trench and screen will be installed on the south side of the existing headworks structure.

5.2.2 Anaerobic Basin

The existing trickling filter has been nearly reaching its maximum capacity, and it is recommended to be replaced with more efficient biological treatment system. The facility will need three (3) anaerobic basin trains consists of 20 ft x 200 ft x 17 ft deep basin to treat 5 MGD. It will operate with two duty trains with the third train as standby. The fine bubble diffusers will be installed within each basin. Small bubbles released near the floor of the basin, rise to the surface providing enough air for the growth of the microorganisms. A Blower building will be necessary for this process as it will require significant increase in volume of air compared to the trickling filter.

5.2.3 Anoxic/Aerobic Basin

There will be two (2) anoxic basins with recycle lines from the aerobic basins. While there are many types of mixing systems that could be implemented in anoxic basins, it is recommended to use a simple educator tube mixer for this application. The mixer is a simple design, consists of an 18 inch standpipe, installed at the bottom of the basin with the top of the pipe right below the water surface. An airline connects near the bottom of the mixer and creates an air bubble which rises to the surface within the vertical pipe. The bubble displaces a volume of water, creating mixing currents in the basin. The educator tube does not have any submerged moving parts, which reduces the complexity and frequency of maintenance. Additionally, educator tubes require a relatively small amount of process air that excess air produced from process air blower can be used in the application. The fine bubble diffusers will be installed within the aerobic section of the basin. Small bubbles released near the floor of the basin rise to the surface providing sufficient air to the wastewater for BOD and ammonia reduction as well as complete mixing within a basin.

5.2.4 Chemical Addition for Phosphorus Removal

Some coagulant will likely be added to the water stream at the point between anoxic/aerobic basin and aerobic basin for Phosphorus removal. The coagulant will be pumped into the water stream at a certain rate for dissolved phosphorus to form particulates that can be removed later in the process. This process will require two chemical storage tanks and two metering pumps inside of a building. It is recommended to install an air conditioned/heated building on the south end of the STM aerotor. THe foot print is expected to be approximately 30 ft x40 ft.

5.2.5 Digester (40 ft. diameter)

An additional digester is required for the 5 MGD upgrade expansion. This allows one of the existing digesters to be taken off line when maintenance is needed, while keeping the capacity of digesting 5 MGD.

5.2.6 Blower Building

A blower building will store several blowers that are needed for aerobic basins as well as the anoxic/aerobic basin. There will be a standby blower so that when one of the units is down, the maintenance work can take place without shutting down the treatment system.

5.2.7 DAF Building

Currently, their existing DAF is located outdoor at the facility. Cold weather during winter in Utah County has been interfering the effectiveness of the DAF unit. Also, as it was mentioned in chapter 3, the panel needs to be rebuilt. It is recommended that a building be retrofit over the existing DAF unit to store the DAF unit and its panel within a heated enclosure during winter.

5.2.8 Boiler Building

The existing boiler will be too small for the 5 MGD digesting process. It is recommended that the facility will install at least two new boilers inside of a building that will be heated during winter time. It can be part of the DAF building by extending the structure approximately 30 ft on the south end.

5.2.9 Primary Pump Station

The existing primary pump station is not sufficient for the additional influent volume. A new primary pump station will be required for 5 MGD expansion. The new primary pump station will be located on the North side of the existing primary pump station.

5.2.10 Primary Clarifier (70 ft. diameter)

Two primary clarifiers will be installed in addition to the existing 70-ft primary clarifier. There will be three primary clarifiers total. The new primary clarifiers will be placed where the trickling filter is currently located. Once installed, the facility will be able to perform regular maintenance, inspection, and any repairs on one of the primary clarifiers without disturbing the treatment capacity.

5.2.11 Final Clarifier

An additional final clarifier with a diameter of 70 ft will be required for the 5 MGD expansion. It will be located on the North side of the existing two final clarifiers. This will allow one of the final clarifiers to be down for maintenance or repair while keeping the 5 MGD treatment capacity.

5.2.12 Additional Screw Press

The chemical addition will increase the solid production of the facility. Consequently, an additional screw press should be installed in the existing dewatering building to accommodate the excess solid production.

5.2.13 UV Basin

As previously discussed in chapter 3, it is recommended to convert the existing chlorine contact basin to the UV contact basin. The UV lights can be retrofitted into the existing channel. A building will need to be installed for the UV contact basin.

5.2.14 Filter Building Expansion

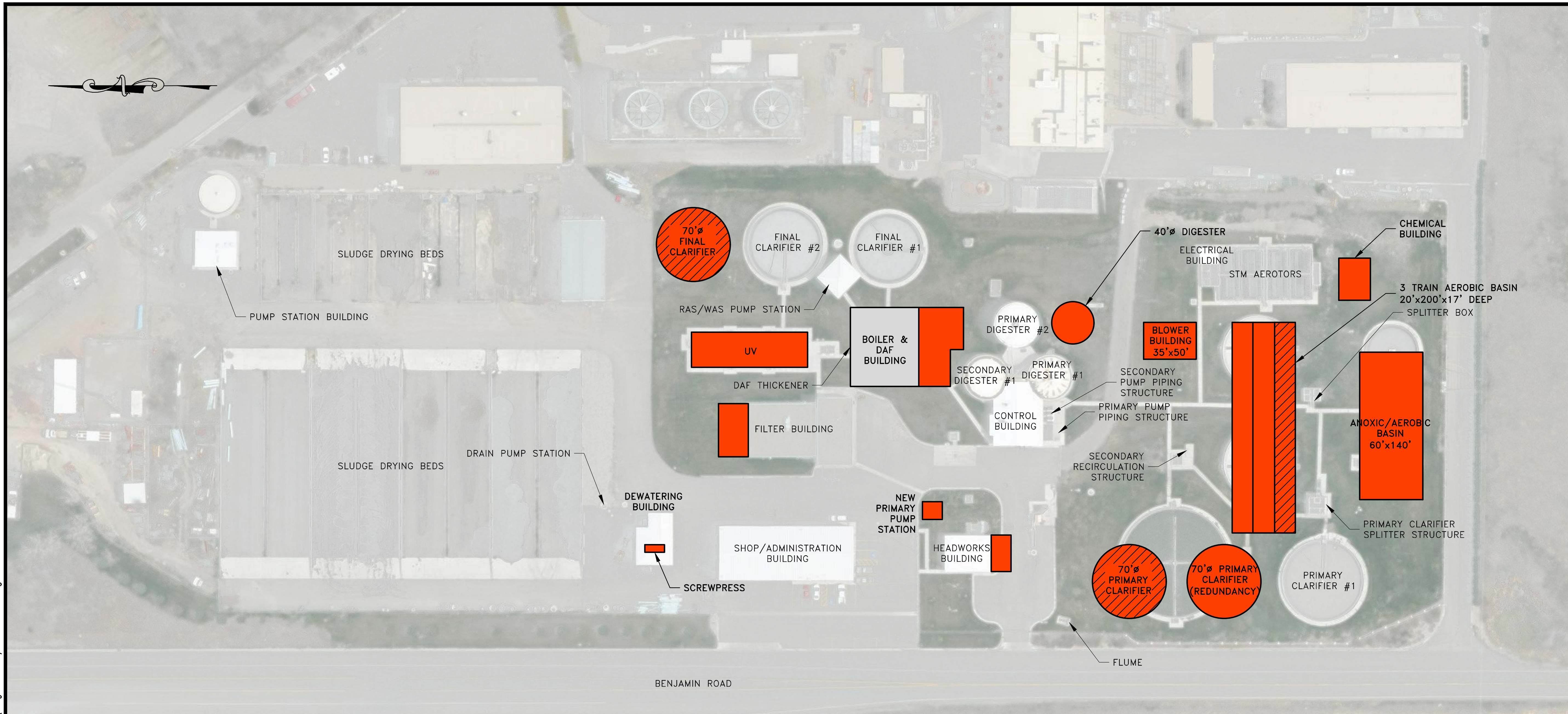
The existing sand filter will need to be replaced with cloth filters to accommodate additional volume of influent for the 5 MGD expansion. The footprint of the basin is likely to stay the same if it is decided to utilize the diamond cloth filters. However, the foot print of the building will expand for additional equipment and controls for the 5 MGD option.

5.2.15 Upgrade Effluent Pipe

Currently the facility has 24 inch diameter discharge from the chlorine contact basin and the Beer Creek Slough. With average design flow of 5 MGD, velocity of the discharge will be 2.5 ft/s. Design peak flow is to be determined at the time of the actual design of the facility, however, it is likely for the peak hourly flow to be at least 8 MGD or larger. The velocity of the outfall will be 4 ft/s once the peak flow is 8 MGD, and that is too rapid for the outfall structure and the existing pipe. It is recommended to increase the discharge pipe line to be minimum of 30 inch diameter line to accommodate the additional flow volume.

5.2.16 Site Layout

The following is the proposed layout for the 5 MGD expansion.



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Scale in Feet

LEGEND

= NEW STRUCTURES IN UPGRADE

= REDUNDANCY IN UPGRADE

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CITY OF PAYSON

WASTEWATER TREATMENT FACILITY UPGRADE

5 MGD SITE LAYOUT

AQUA ENGINEERING
533 W 2600 S, SUITE 275, BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

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DRAWING IS TO SCALE IF BAR MEASURES:
1" = FULL SCALE
1/2" = HALF SCALE

FIGURE
FIG 5-1

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5.2.17 5 MGD Expansion Probable Cost

The following cost estimate was developed for the proposed project. Detailed cost estimate can be found in Appendix G.

Table 5-2 Cost 5MGD

DESCRIPTION	COST
Site Work and Yard Piping	$ 300,000
Plant Repairs	$ 150,000
Demolition	$ 124,500
Headworks	$ 182,500
Primary Lift Station	$ 323,750
Anoxic Basin	$ 816,000
Aerobic Basin	$ 2,180,000
Primary Clarifier	$ 1,930,000
Final Clarifier	$ 1,150,000
Digester	$ 1,056,000
Solid Handling	$ 360,000
Chemical Storage	$ 254,400
UV Basin	$ 2,400,000
Reuse Pump Station Remodel	$ 910,000
Filter Building Upgrade	$ 910,000
Boiler & DAF Building	$ 1,360,000
Electrical	$ 2,721,430
Construction Cost Subtotal	$ 16,328,580
Contingency 20%	$ 3,265,716
Construction Cost Total	$ 19,594,296
Engineering, Construction Observation 10%	$ 1,959,430
Legal & Permitting 5%	$ 979,715
Total Probable Cost	$ 22,533,440

The estimated cost for the 5 MGD Expansion Upgrade is approximately $22.5 million. Assuming that the total amount is borrowed with 3% interest, the new debt payment would be $1,514,601 a year for next 20 years. Operation and maintenance cost for the 5 MGD option was estimated based on Payson's current annual cost of operation and is shown in Table 5-3 below.

Table 5-3 5 MGD

5 MGD	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 5 staff)	$ 661,331
Professional Services	$ 122,720
Operating	$ 1,336,673
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 1,514,601
Chemical Cost (4.4 mg/L P Removed)	$ 97,723
Total Probable Cost	**$ 4,590,192**

The annual cost for the 5 MGD option including Operation and Maintenance and debt payment is expected to be $4.6 million, which yields to a minimum monthly user fee of $58.43 with 6,547 ERUs, which is an increase of over $26 per ERU per month compared to the monthly fee of the current system.

5.3 - 5 MGD Expansion with Advanced Biological Nutrient Removal System

This option is similar to the 5 MGD Expansion that was previously discussed in Section 5.2. However, it uses Advanced Biological Nutrient Removal (ABNR) system in place of a conventional nutrient removal method such as aerobic basin. The majority of the upgrades to the current facility stays the same as the option discussed in Section 5.2, except for the following.

5.3.1 ABNR System

ABNR uses a patented system by Clearas that harnesses microbiology in a photobioreactor environment to accelerate photosynthesis, the consumption of carbon dioxide, and excess nutrients. Following the system, advanced microfiltration is used to filter out high quality water from return activated algae. The return activated algae can then either flow back to the beginning of the ABNR process or removed from the process, dried, then sold as animal supplements or feedstock, or converted into green bio-oil such as transportation fuels, or high-value chemicals used in the manufacturing of nutraceutical, pharmaceutical, and/or cosmetic products. For this option, the ABNR will be able to treat 3 MGD. The effluent from the system will have a total phosphorus concentration of 0.035 mg/L and can be blended with the other 2 MGD to have 0.95 mg/L.

ABNR system will require area for the greenhouse as well as the harvesting facility. It is anticipated that those two facilities will take up half of the existing sludge drying beds area.

5.3.2 Anaerobic Basin

Having the ABNR system will require more nutrients in its influent, to be specific, more ammonia, thus, the aerobic basin will be significantly smaller than the one designed for the 5 MGD Option discussed in Section 5.2. If the existing trickling filter is to be replaced with a more efficient biological treatment system, the facility will need three (3) anaerobic basin trains consisting of a 20 ft x 140 ft x 17 ft deep basin. Since less nutrient is required to be removed from its stream, this option will require a basin that is 40 % shorter than the 5 MGD option discussed in section 5.2. It will operate with two duty trains, with the third one as standby. The fine bubble diffusers will be installed within each basin. Small bubbles released near the floor of the basin rise to the surface providing sufficient air for the growth of the microorganisms. A blower building will be required for this process as it will require significant volume of air compared to the trickling filter; the blower size will be discussed later in this section.

5.3.3 Anoxic/Aerobic Basin

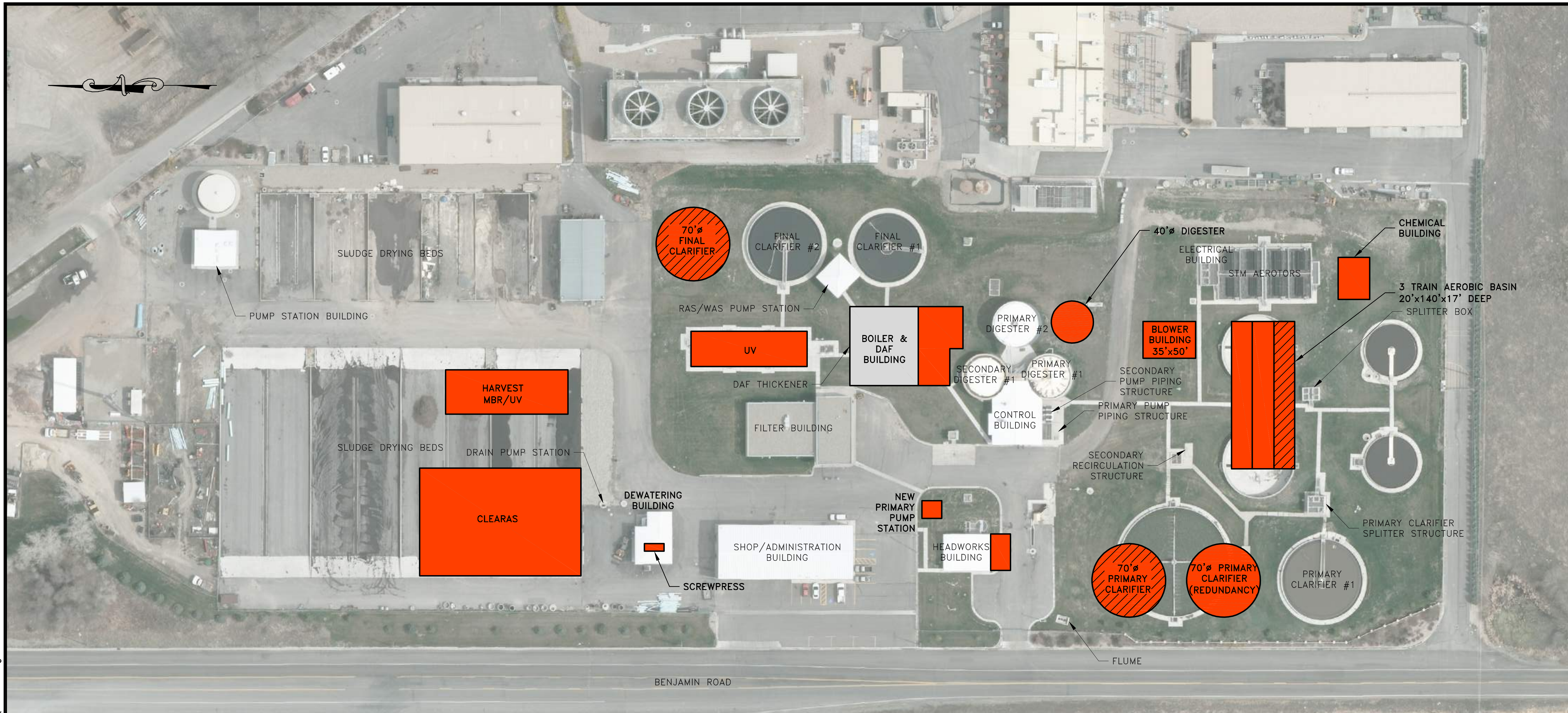
Since both Phosphorus and Ammonia will be removed by the ABNR, there will be no need for the additional Anoxic/Aerobic Basin for this Option.

5.3.4 Chemical Addition for Phosphorus Removal

As previously mentioned, Phosphorus will be removed by the ABNR system so there will not be any chemical addition for the 5MGD with ABNR Option.

5.3.5 Site Layout

The following is the proposed layout for the 5 MGD expansion with ABNR.



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CITY OF PAYSON

WASTEWATER TREATMENT FACILITY UPGRADE

5 MGD SITE LAYOUT / 3 MGD CLEARAS

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DRAWING IS TO SCALE IF BAR MEASURES:
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FIGURE
FIG 5-2

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5.3.6 5 MGD with ABNR Probable Cost

The following cost estimate was developed for the proposed project. Although the capital expense for this option is significantly higher than that of 5 MGD expansion with conventional nutrient removal system, potential sales of algae from this system could offset the cost and pay itself off quicker and bring revenue from the sales.

Table 5-4 Cost for 5 MGD with ABNR

DESCRIPTION	COST
Site Work and Yard Piping	$ 300,000
Plant Repairs	$ 150,000
Demolition	$ 116,250
Headworks	$ 170,000
Primary Lift Station	$ 312,500
Aerobic Basin	$ 1,640,000
Primary Clarifier	$ 1,895,000
Final Clarifier	$ 1,150,000
Digester	$ 1,056,000
Solid Handling	$ 360,000
Advanced Biological Nutrient Removal (3MGD Bended Flow Treatment)	$ 15,200,000
UV Basin	$ 1,800,000
Reuse Pump Station Remodel	$ 110,000
Boiler & DAF Building	$ 1,120,000
Electrical	$ 3,806,963
Construction Cost Subtotal	**$ 29,186,713**
Contingency 20%	$ 5,837,343
Construction Cost Total	$ 35,024,055
Engineering, Construction Observation 10%	$ 3,502,406
Legal & Permitting 5%	$ 1,751,203
Total Probable Cost	**$ 40,277,663**

The estimated cost for the 5 MGD Expansion with ABNR Upgrade is approximately $40 million. Assuming that the total amount is borrowed with 3% interest, the new debt payment would be $2,690,224 a year for next 20 years. Operation and maintenance cost for the 5 MGD with ABNR option was estimated based on Payson's current annual cost of operation and is shown in Table 5-5 and Table 5-6 below.

Table 5-5 5 MGD with ABNR without Algae Revenue

5 MGD with ABNR	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 5 staff)	$ 661,331
Professional Services	$ 122,720
ABNR O&M	$ 1,732,000
Operating	$ 1,336,673
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 2,707,292
Revenue from Algae ($0.5 to $2 per lb, $0 used)	$0
Total Probable Cost	**$ 7,417,160**

Table 5-6 5 MGD with ABNR with Algae Revenue ($0.75/lb)

5 MGD with ABNR	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 5 staff)	$ 661,331
Professional Services	$ 122,720
ABNR O&M	$ 1,732,000
Operating	$ 1,336,673
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 2,707,292
Revenue from Algae ($0.5 to $2 per lb, $.75 used)	($1,595,415)
Total Probable Cost	**$ 5,821,745**

Table 5-6 is the cost of annual fee if there is no revenue from the algae sales. The expected fee including O&M, debt payment is approximately $7.4 million per year. The annual probable cost yields to a minimum monthly user fee of $94.41 with 6,547 ERUs, which is over $62 increase per ERU per month compared to the current system.

In Table 5-7, the assumption of the revenue from algae, $.75 per pound was used for the cost analysis. The revenue of the algae sales can vary depending on the market for the algae. The annual fee for the 5 MGD with ABNR option is expected to be $5.8 million including the revenue from algae expected to be $1.6 million per year. The annual probable cost yields to a minimum monthly user fee of $74.10 with 6,547 ERUs, which is an increase of over $42 per ERU per month compared to the anticipated monthly fee of the current system. At this time, it is anticipated that the loans would need to be guaranteed with user fees so the algae sales would not be credited until the sales were established in the future.

5.4 5 MGD Expansion with ABNR, Aerobic Stabilization

This option is similar to the 5 MGD Expansion with ABNR that was previously discussed in Section 5.3. This option utilizes as many of the existing structures as possible to reduce the overall cost of the installment yet have the efficiency to remove more nutrients than the current system. Following includes the elimination and additional equipment and/or structures needed for this option.

5.4.1 Convert Anaerobic Digesters to Aerobic Stabilization Tanks

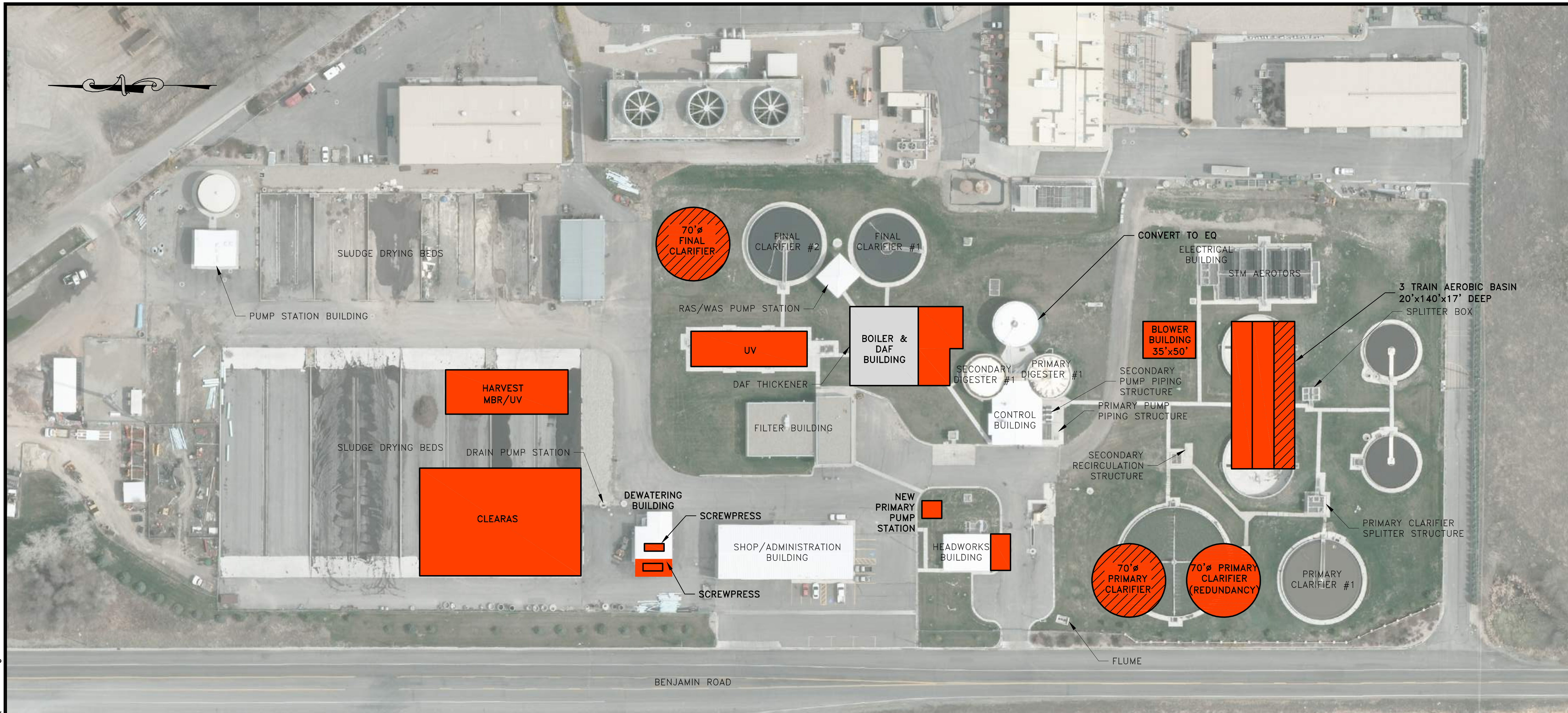
The anaerobic digesters will be aerated and used as equalization tanks for dewatering.

5.4.2 Solid Handling Equipment

It is anticipated that this option will produce more sludge off of digestion when compared to the 5 MGD with ABNR option. Therefore, it requires two (2) more dewatering equipment. It will operate with two duty units and one standby.

5.4.3 Site Layout

The following is the proposed layout for the 5 MGD with ABNR and aerobic stabilization.



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5 MGD SITE LAYOUT / 3 MGD CLEARAS/AEROBIC STABILIZATION

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DRAWING IS TO SCALE IF BAR MEASURES: 1" = FULL SCALE 1/2" = HALF SCALE

FIGURE
FIG 5-3

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5.4.4 5 MGD with ABNR Probable Cost

The following cost estimate was developed for the proposed project. Since this option does not include constructions of aerobic basins, primary clarifiers, the DAF building, and a digester, when compared to the 5MGD with ABNR option, it is slightly less expensive than the previous option discussed. However, the production of the algae depends on the influent volume, therefore, the anticipated revenue will be the same for both options. Below is the expected capital cost for this option.

Table 5-7 Cost for 5 MGD with ABNR, Aerobic Stabilization

DESCRIPTION	COST
Site Work and Yard Piping	$ 300,000
Plant Repairs	$ 150,000
Demolition	$ 36,000
Headworks	$ 195,000
Primary Lift Station	$ 312,500
Aerobic Basin	$ 2,038,000
Primary Clarifier	$ 1,895,000
Final Clarifier	$ 1,150,000
Convert Anaerobic Digester to Aerobic Eq Tanks	$ 380,000
Solid Handling	$ 850,000
Advanced Biological Nutrient Removal (3MGD Bended Flow Treatment)	$ 15,200,000
UV Basin	$ 840,000
Reuse Pump Station Remodel	$ 110,000
Electrical	$ 3,518,475
Construction Cost Subtotal	**$ 26,974,975**
Contingency 20%	$ 5,394,995
Construction Cost Total	$ 32,369,970
Engineering, Construction Observation 10%	$ 3,236,997
Legal & Permitting 5%	$ 1,618,499
Total Probable Cost	**$ 37,225,466**

The estimated cost for the 5 MGD Expansion with ABNR, Anaerobic Digestion Upgrade is approximately $37 million. Assuming that the total amount is borrowed with 3% interest, the new debt payment would be $2,502,136 a year for next 20 years. Operation and maintenance cost for the 5 MGD with ABNR, Anaerobic Digestion option was estimated based on Payson's current annual cost of operation and is shown in Table 5-8 and Table 5-9 below.

Table 5-8 5 MGD Aerobic Stabilization with ABNR without Algae Revenue

5 MGD Aerobic Stabilization with ABNR	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 5 staff)	$ 661,331
Professional Services	$ 122,720
ABNR O&M	$ 1,732,000
Operating	$ 1,336,673
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 2,502,136
Revenue from Algae ($0.5 to $2 per lb, $0 used)	$0
Total Probable Cost	**$ 7,212,004**

Table 5-9 5 MGD Aerobic Stabilization with ABNR with Algae Revenue ($0.75/lb)

5 MGD Aerobic Stabilization with ABNR	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 5 staff)	$ 661,331
Professional Services	$ 122,720
ABNR O&M	$ 1,732,000
Operating	$ 1,336,673
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 2,502,136
Revenue from Algae ($0.5 to $2 per lb, $.75 used)	($1,595,415)
Total Probable Cost	**$ 5,616,589**

Table 5-8 is the cost of operation if there is no revenue from the algae sales. The expected fee is approximately $7.2 million per year. The annual probable cost yields to a minimum monthly user fee of $91.80 with 6,547 ERUs, which is $60 increase per ERU per month compared to the current system.

In Table 5-9, the assumption of the revenue from algae, $0.75 per pound was used for the cost analysis. The revenue of the algae sales can vary depending on the market for the algae. The annual fee for the 5 MGD with ABNR option is expected to be $5.6 million including the revenue from algae expected to be $1.6 million per year. The annual probable cost yields to a minimum monthly user fee of $71.49 with 6,547 ERUs, which is an increase of over $39 per ERU per month compared to the anticipated monthly fee of the current system.

5.5 5 MGD Expansion with Aerobic Stabilization

This option is similar to the 5 MGD Expansion in Section 5.2. This option utilizes as many of the existing structures as possible to reduce the overall cost of the installment yet have the efficiency to remove more nutrients than the current system. Following includes the elimination and additional equipment and/or structures needed for this option.

5.5.1 Convert anaerobic digesters to aerobic stabilization tanks

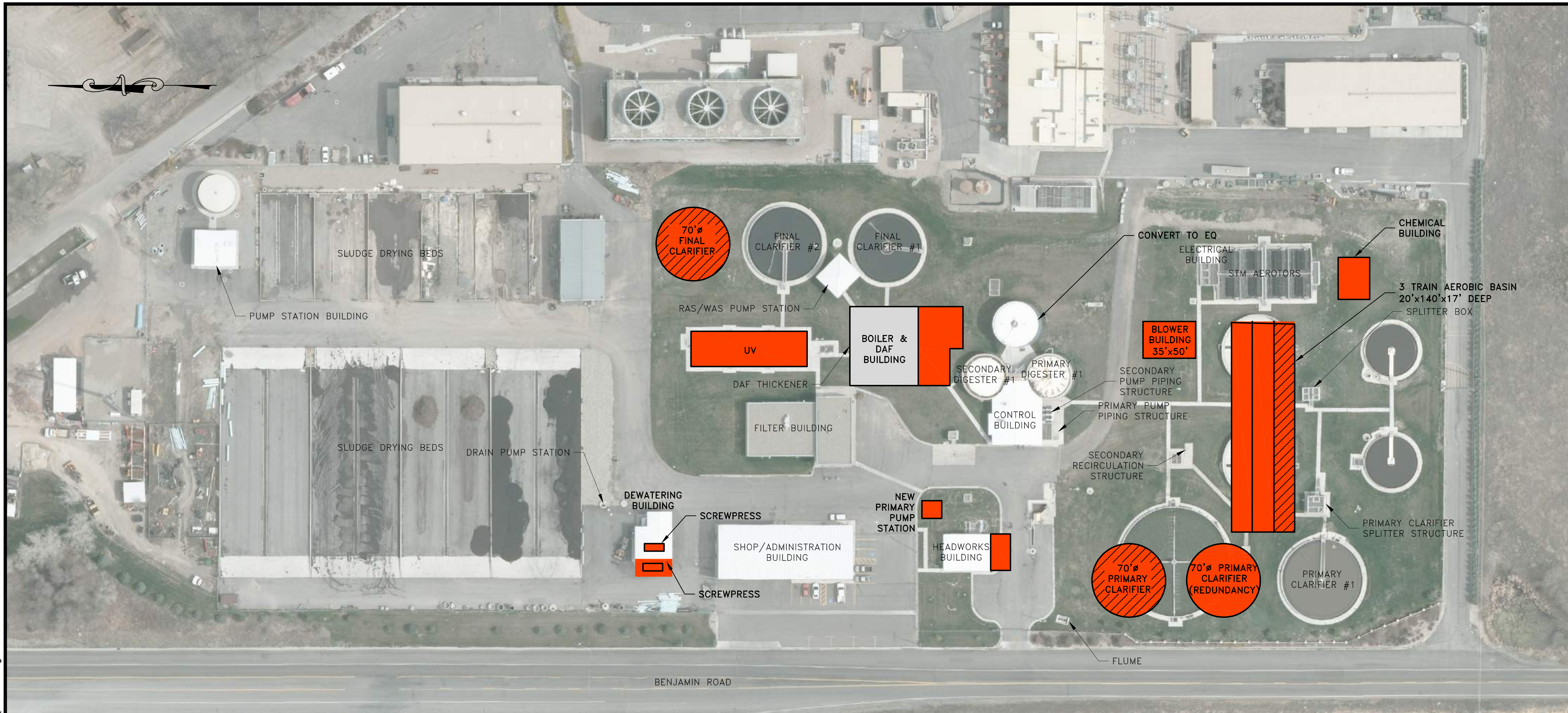
The anaerobic digesters will be aerated and used as equalization tanks for dewatering.

5.5.2 Solid Handling Equipment

It is anticipated that this option will produce more sludge off of digestion when compared to the 5 MGD with ABNR option. Therefore, it requires two (2) more dewatering equipment. It will operate with two duty units and one standby.

5.5.3 Site Layout

The following is the proposed layout for the 5 MGD expansion.



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Scale in Feet

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= REDUNDANCY IN UPGRADE

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CITY OF PAYSON

WASTEWATER TREATMENT FACILITY UPGRADE

5 MGD SITE LAYOUT /AEROBIC STABILIZATION

AQUA ENGINEERING
533 W. 2600 S. SUITE 275, BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

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DRAWING IS TO SCALE IF BAR MEASURES:
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FIGURE
FIG 5-4

5.5.4 5 MGD with ABNR Probable Cost

The following cost estimate was developed for the proposed project. Since this option does not include constructions of aerobic basins, primary clarifiers, the DAF building, and a digester, when compared to the 5MGD with ABNR option, it is slightly less expensive than the previous option discussed. However, the production of the algae depends on the influent volume, therefore, the anticipated revenue will be the same for both options. Below is the expected capital cost for this option.

Table 5-10 Cost for 5 MGD with Aerobic Stabilization

DESCRIPTION	COST
Site Work and Yard Piping	$ 300,000
Plant Repairs	$ 150,000
Demolition	$ 124,500
Headworks	$ 182,500
Primary Lift Station	$ 323,750
Anoxic Basin	$ 816,000
Aerobic Basin	$ 2,180,000
Primary Clarifier	$ 1,930,000
Final Clarifier	$ 1,150,000
Solid Handling	$ 720,000
Chemical Storage	$ 254,400
UV Basin	$ 2,400,000
Reuse Pump Station Remodel	$ 110,000
Filter Building Upgrade	$ 910,000
Convert Anaerobic Digester to Aerobic Eq Tanks	$ 380,000
Electrical	$ 2,386,230
Construction Cost Subtotal	$ 14,317,380
Contingency 20%	$ 2,863,476
Construction Cost Total	$ 17,180,856
Engineering, Construction Observation 10%	$ 1,718,086
Legal & Permitting 5%	$ 859,043
Total Probable Cost	**$ 19,757,984**

The estimated cost for the 5 MGD Expansion with Aerobic Stabilization Upgrade is approximately $19.7 million. Assuming that the total amount is borrowed with 3% interest, the new debt payment would be $2,318,661 a year for next 20 years. Operation and maintenance cost for the 5 MGD with ABNR, Anaerobic Digestion option was estimated based on Payson's current annual cost of operation and is shown in Table 5-8 below.

Table 5-11 5 MGD with Aerobic Stabilization

5 MGD With Aerobic Stabilization	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 5 staff)	$ 661,331
Professional Services	$ 122,720
Operating	$ 1,336,673
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 1,328,047
Chemical Cost (4.4 mg/L P Removed)	$ 97,723
Total Probable Cost	**$ 4,403,638**

Table 5-8 is the annual cost for the 5 MGD with aerobic stabilization including Operation and Maintenance and debt payment is expected to be $4.4 million, which yields to a minimum monthly user fee of $56.05 with 6,547 ERUs, which is an increase of over $24 per ERU per month compared to the monthly fee of the current system.

5.6 3 MGD Expansion with Redundancy

The overall capacity of the existing plant is 3 MGD. At the capacity of 3 MGD, the plant should be able to operate until about 2022 based on the population growth. However, the changes in the permit require several upgrades prior to 2022. To be specific, the chemical addition for the phosphorus removal will have to be installed by January of 2020 as required by Utah DEQ. In addition, it is recommended to have redundancy on some of the major treatment equipment in case of maintenance and/or major repair on the equipment. This alternative would upgrade the treatment facility to meet the new requirements in the permit and add redundancy for the main process.

5.6.1 Primary Clarifier (70 ft. diameter)

A primary clarifier will be installed to duplicate the treatment of the existing 70-ft primary clarifier. The primary clarifier will be placed where the existing trickling filter is located. Once installed, the facility will be able to perform regular maintenance, inspection, and any repairs on the primary clarifier without disturbing the treatment capacity.

5.6.2 Anaerobic Basin

The existing trickling filter has almost reached its maximum capacity, and it is recommended to be replaced with more efficient biological treatment system. The 3 MGD upgrade will require one (1) train with a dimension of 20 ft x 100 ft x 17 ft deep basin, therefore, two (2) trains are recommended to be installed for redundancy. The fine bubble diffusers will be installed within each basin. This process requires significantly greater volume of air compared to the trickling filter. It is anticipated that there will be a heated building with blowers inside; approximate area is 35 ft x 50 ft.

5.6.3 Blower Building

The blower building will store several blowers that are needed for aerobic basins. It is recommended a standby blower be installed so that when one of the units is taken off-line, the facility can still treat the full capacity without disturbance.

5.6.4 Chemical Addition for Phosphorus Removal

Some coagulant will likely to be added to the water stream after aerobic basin for Phosphorus removal. This process will require two chemical storage tanks and two metering pumps inside of a heated building. The coagulant will be pumped into the water stream at a certain rate for dissolved phosphorus to form particulates that can be removed later on in the process.

These chemicals will need to be stored indoors with a heater during winter months. A building approximately 30 ft x30 ft is required for the chemical storage and other equipment that will be required.

5.6.5 DAF Building

Currently the DAF is located outdoor at the Payson wastewater treatment facility. As a result, cold weather during winter time seems to reduce the effectiveness of the DAF unit. Also, the panel has not been functioning correctly and needs to be rebuilt. It is recommended that the building be retrofitted over the existing DAF unit to protect both the unit and the panel from cold winter weather.

5.6.6 Boiler Building

The existing boiler is undersized for the current digesters. It is recommended that the facility will install at least two new boilers inside of a building that will be heated during winter time. It can be part of the DAF building by extending the structure approximately 30 ft on the south end.

5.6.7 Heat Exchangers

Along with the additional boiler, two new heat exchangers need to be installed to work with the boilers to heat the digesters. Those heat exchangers can be in the same building as the boilers.

5.6.8 Final Clarifier

A final clarifier with a diameter of 70 feet is recommended to be installed at the Payson wastewater treatment facility. The new final clarifier will be placed on the north side of the existing final clarifiers. Having three final clarifiers will allow the maximum treatment capacity of 4.95 MGD for the final clarifying process. This will allow the facility to run two final clarifiers to meet the capacity of 3 MGD, but gives ability to take one of the final clarifiers off line when needed.

5.6.9 Additional Screw Press

The chemical addition will increase the solid production of the facility. An additional screw press should be installed in the existing dewatering building to dewater the additional solids.

5.6.10 UV Basin

The chlorine contact basin should be converted to UV lights for disinfection process. The UV lights can be retrofitted into the existing channel. A building will also need to be installed over the existing chlorine contact basin for the UV contact basin conversion.

5.6.11 Old Drying Bed Pump Station

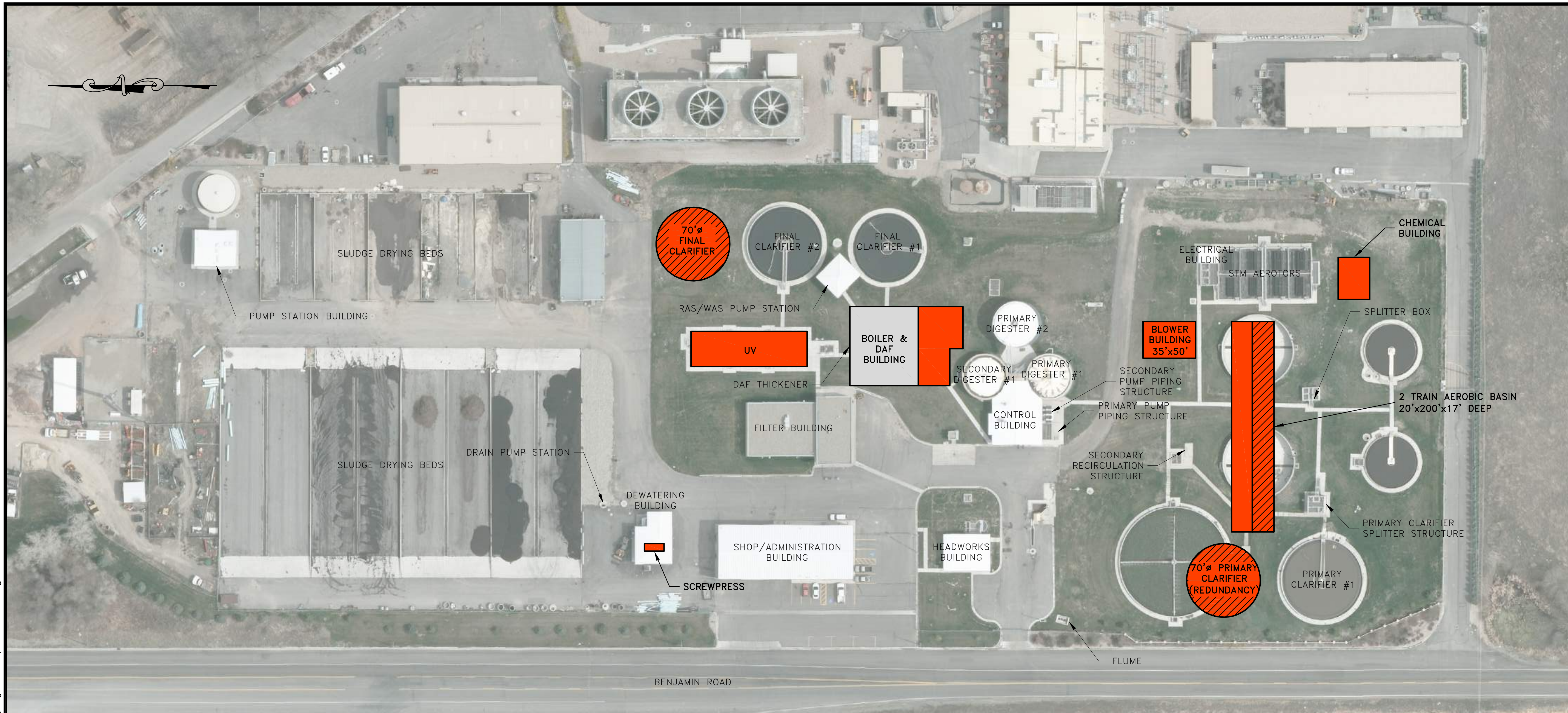
The pump station located near the old drying beds needs to be upgraded. It is currently pumping water from the power plant and needs to be upgraded.

5.6.12 Digester Piping

The piping in the digester building is old and needs to be replaced.

5.6.13 Site Layout

The proposed layout for the 3 MGD expansion is shown in Figure 5-5.



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Scale in Feet

LEGEND

= NEW STRUCTURES IN UPGRADE

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CITY OF PAYSON
WASTEWATER TREATMENT FACILITY UPGRADE
3 MGD SITE LAYOUT

AQUA ENGINEERING

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FIGURE
FIG 5-5

05/26/2019 X:\Payson\2014 Payson Facility Plan\Drafting\General\3mgd Site Layout 5-9-16.dwg

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5.6.14 3MGD Expansion Probable Cost

The following cost estimate was developed for the proposed project.

Table 5-12 Cost 3MGD

DESCRIPTION		COST
Site Work and Yard Piping	$	320,000
Plant Repairs	$	150,000
Demolition	$	94,500
Aerobic Basin	$	1,560,000
Primary Clarifier	$	1,115,000
Final Clarifier	$	1,150,000
Solid Handling	$	360,000
Chemical Storage	$	314,400
UV Basin	$	1,320,000
Reuse Pump Station Remodel	$	110,000
Filter Building	$	660,000
Boiler & DAF Building	$	960,000
Electrical	$	1,622,780
Construction Cost Subtotal	**$**	**9,736,680**
Contingency 20%	$	1,947,336
Construction Cost Total	$	11,684,016
Engineering, Construction Observation 10%	$	1,168,402
Legal & Permitting 5%	$	584,201
Total Probable Cost	**$**	**13,436,618**

The estimated cost for the 3 MGD Expansion Upgrade is approximately $13.4 million. Assuming that the total amount is borrowed with 3% interest, the debt payment would be $903,723 a year for next 20 years. Running cost for the 3 MGD option was estimated based on Payson's current annual cost of operation and is shown in Table 5-13 below.

Table 5-13 3 MGD

3 MGD	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 4 staff)	$ 529,065
Professional Services	$ 102,267
Operating	$ 668,336
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 903,152
Chemical Cost (4.4 mg/L P Removed)	$ 97,723
Total Probable Cost	**$ 3,157,687**

The annual fee for the 3 MGD option including O&M and debt payment is expected to be $3.1 million, which yields to a minimum monthly user fee of $40.19 with 6,547 ERUs, which is an increase of $8.30 per ERU per month compared to the anticipated monthly fee of the current system.

5.7 3 MGD Expansion with Advanced Biological Nutrient Removal System

This option is similar to the 3 MGD Expansion that was previously discussed in Section 5.4. However, it uses Advanced Biological Nutrient Removal (ABNR) system in place of conventional nutrient removing method such as aerobic basin. Majority of the upgrades to the current facility stays the same as the option discussed in Section 5.4, except for the following.

5.7.1 ABNR System

For this option, the ABNR will be able to treat 2 MGD, expected total phosphorus concentration of 0.035 mg/L will be the effluent.

5.7.2 Aerobic Basin

Having the ABNR system will require more nutrients in its influent, to be specific, more ammonia, thus, aerobic basin will be significantly smaller than the one designed for the 5 MGD

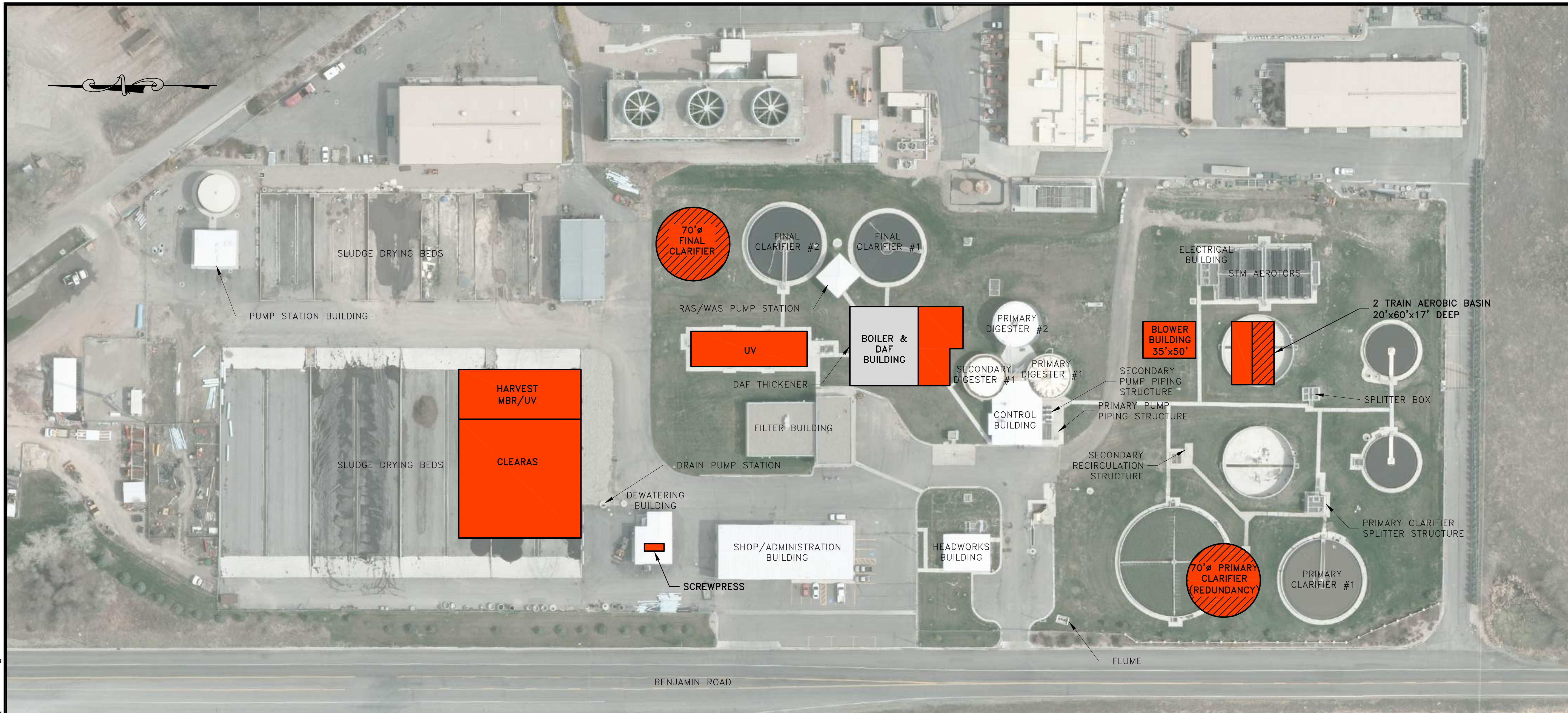
Option discussed in Section 5.4. If the existing trickling filter is to be replaced with more efficient biological treatment system, the facility will need three (3) anaerobic basin trains consists of 20 ft x 60 ft x 17 ft deep basin. Which is 40 % reduction in the length of the basin from 3 MGD Option. It is expected to operate as discussed for 3 MGD Option previously in Section 5.4.2.

5.7.3 Chemical Addition for Phosphorus Removal

As previously mentioned, Phosphorus will be removed by the ABNR system, there will not be any chemical addition for the 3 MGD with ABNR Option.

5.7.4 Site Layout

The proposed layout for the 3 MGD expansion with ABNR Option is shown in Figure 5-6.



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Scale in Feet

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WASTEWATER TREATMENT FACILITY UPGRADE

3 MGD SITE LAYOUT / 2 MGD CLEARAS

AQUA ENGINEERING
533 W. 2600 S. SUITE 275, BOUNTIFUL, UT 84010
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DRAWING IS TO SCALE IF BAR MEASURES:
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1/2" = HALF SCALE

FIGURE
FIG 5-6

05/26/2019 X:\Payson\2014 Payson Facility Plan\Drafting\General\FIG 5-6.dwg
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5.7.5 3 MGD with ABNR Probable Cost

The following cost estimate was developed for the proposed project. Although the capital expense for this option is significantly higher than that of the 3 MGD expansion with conventional nutrient removal system, potential sales of algae from this system could offset the cost and pay itself off quicker and bring revenue from the sales of the dried algae.

Table 5-14 Cost 3 MGD with ABNR

DESCRIPTION		COST
Site Work and Yard Piping	$	320,000
Plant Repairs	$	150,000
Demolition	$	68,750
Aerobic Basin	$	745,000
Primary Clarifier	$	1,115,000
Final Clarifier	$	1,150,000
Solid Handling	$	360,000
Advanced Biological Nutrient Removal (2MGD Blended Flow Treatment)	$	10,970,000
UV Basin	$	720,000
Reuse Pump Station Remodel	$	110,000
Boiler & DAF Building	$	960,000
Electrical	$	2,500,313
Construction Cost Subtotal	**$**	**19,169,063**
Contingency 20%	$	3,833,813
Construction Cost Total	$	23,002,875
Engineering, Construction Observation 10%	$	2,300,288
Legal & Permitting 5%	$	1,150,144
Total Probable Cost	**$**	**26,453,306**

The estimated cost for the 3 MGD Expansion with ABNR Upgrade is approximately $26.5 million. Assuming that the total amount is borrowed with 3% interest, the debt payment would be $1,778,078 a year for next 20 years. User cost for the 3 MGD with ABNR option was estimated based on Payson's current annual cost of operation and is shown in Table 5-15 below.

Table 5-15 3 MGD with ABNR without Algae Revenue

3 MGD with ABNR	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 4 staff)	$ 529,065
Professional Services	$ 102,267
ABNR O&M	$ 604,646
Operating	$ 668,336
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 1,778,078
Revenue from Algae ($0.5 to $2 per lb, $0 used)	$0
Total Probable Cost	**$ 4,539,536**

Table 5-15 is the cost of operation if there is no revenue from the algae sales. The expected fee is approximately $4.5 million per year. The annual probable cost yields to a minimum monthly user fee of $57.78 with 6,547 ERUs, which is a $26 increase per ERU per month compared to the current system.

Table 5-16 3 MGD with ABNR with Algae Revenue

3 MGD with ABNR	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 4 staff)	$ 529,065
Professional Services	$ 102,267
ABNR O&M	$ 604,646
Operating	$ 668,336
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 1,778,078
Revenue from Algae ($0.5 to $2 per lb, $.75 used)	($1,595,415)
Total Probable Cost	**$ 2,944,121**

In Table 5-16, the assumption of the revenue from algae, $0.75 per pound was used for the cost analysis. The revenue of the algae sales can vary depending on the market for the algae. The annual for the 3 MGD with ABNR option is expected to be $2.9 million including the revenue from algae expected to be $1.6 million per year. The annual probable cost yields to a minimum monthly user fee of $37.47 with 6,547 ERUs, which is an increase of $5.58 per ERU per month compared to the anticipated monthly fee of the current system.

5.8 3 MGD Expansion with ABNR, Aerobic Stabilization

This option is similar to the 3 MGD Expansion with ABNR that was previously discussed in Section 5.6. This option utilizes as many of the existing structures as possible to reduce the overall cost of the installment yet has the efficiency to remove more nutrients than the current system. The following includes the elimination and additional equipment and/or structures needed for this option.

5.8.1 Primary Clarifier

In this option, the existing two (2) primary clarifiers will be kept. One of the clarifiers will need a new clarifier mechanism as it was discussed in Section 3.

5.8.2 Anaerobic Basin

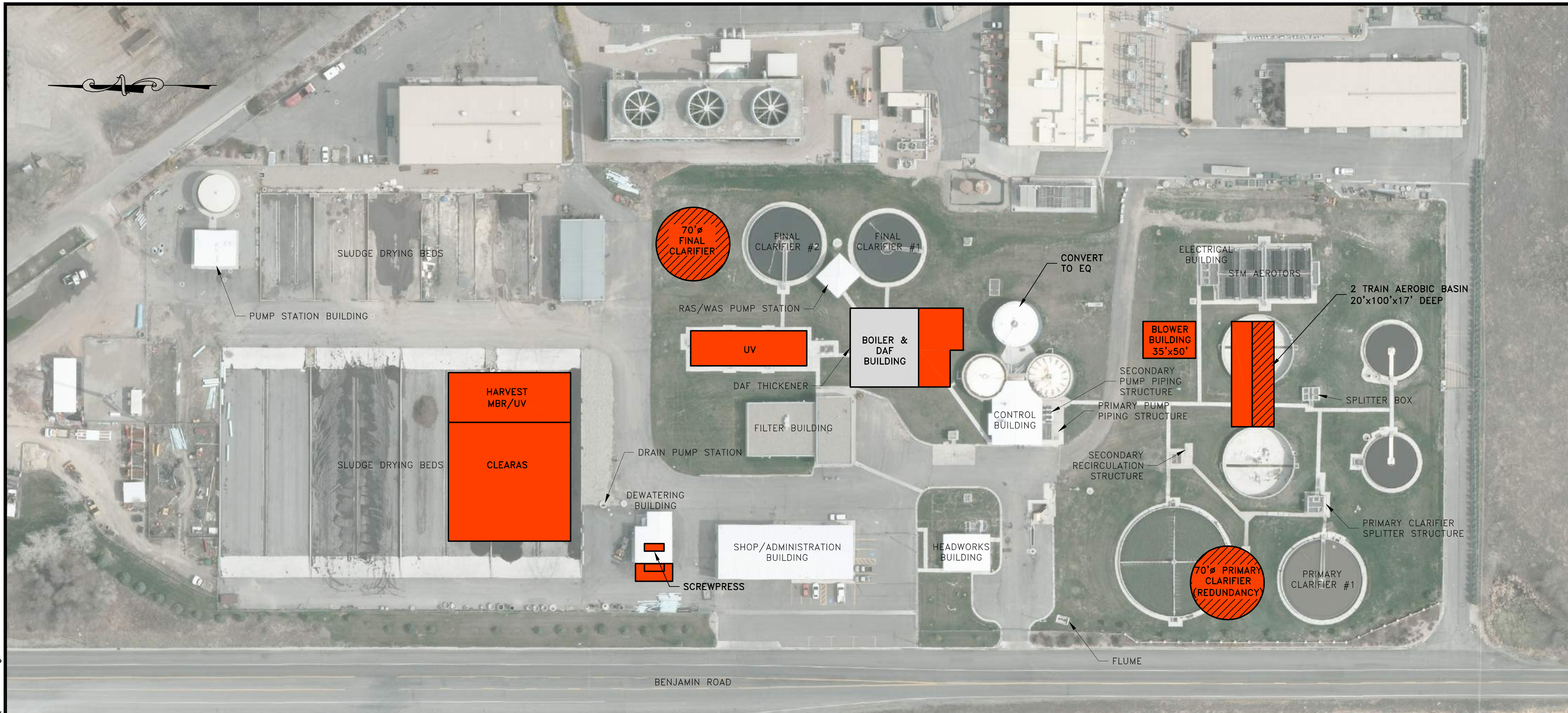
The existing trickling filter has been reaching its maximum capacity, and it is recommended to be replaced with a more efficient biological treatment system. The facility will need three (3) anaerobic basin trains consisting of a 20 ft x 80 ft x 17 ft deep basin. This basin is larger than what is required in the previous option; this is due to its longer duration of the digestion, however, it is still smaller than what is required for the Anaerobic-Anoxic- Aerobic basin options discussed in Section 5.5.

5.8.3 Solid Handling Equipment

It is anticipated that this option will produce more sludge off of digestion when compared to the 5 MGD with ABNR option. Therefore, it requires two (2) more dewatering equipment. It will operate with two duty units and one standby.

5.8.4 Site Layout

The following is the proposed layout for the 3 MGD with ABNR and Aerobic Stabilization expansion.



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Scale in Feet

LEGEND

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NO.	DATE	DESIGN	DRAWN	CHECKED
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WASTEWATER TREATMENT FACILITY UPGRADE

3 MGD SITE LAYOUT / 2 MGD CLEARAS, AEROBIC STABILIZATION

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DRAWING IS TO SCALE IF BAR MEASURES:
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FIGURE
FIG 5-7

05/26/2019 X:\Payson\2014 Payson Facility Plan\Drafting\General\FIG 5-7.dwg

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5.8.5 3 MGD with ABNR Probable Cost

The following cost estimate was developed for the proposed project. Since this option does not include constructions of aerobic basins, primary clarifiers, the DAF building and a digester, when compared to the 3 MGD with ABNR option, it is slightly less expensive than the previous option discussed. However, the production of the algae depends on the influent volume, therefore, the anticipated revenue will be the same for both options. Below is the expected capital cost for this option.

Table 5-17 Cost for 3 MGD with ABNR, Aerobic Stabilization

DESCRIPTION	COST
Site Work and Yard Piping	$ 220,000
Plant Repairs	$ 150,000
Demolition	$ 36,000
Aerobic Basin	$ 878,000
Primary Clarifier	$ 335,000
Final Clarifier	$ 1,150,000
Solid Handling	$ 950,000
Advanced Biological Nutrient Removal (2MGD Blended Flow Treatment)	$ 10,970,000
UV Basin	$ 660,000
Reuse Pump Station Remodel	$ 110,000
Electrical	$ 2,375,850
Construction Cost Subtotal	**$ 18,214,850**
Contingency 20%	$ 3,642,970
Construction Cost Total	$ 21,857,820
Engineering, Construction Observation 10%	$ 2,185,782
Legal & Permitting 5%	$ 1,092,891
Total Probable Cost	**$ 25,136,493**

The estimated cost for the 3 MGD Expansion with ABNR, Aerobic Stabilization Upgrade is approximately $25.1 million. Assuming that the total amount is borrowed with 3% interest, the debt payment would be $1,689,415 a year for next 20 years. The annual running cost for the 3 MGD with ABNR, Anaerobic Digestion option was estimated based on Payson's current annual cost of operation and is shown in below.

Table 5-18 3 MGD with ABNR without Algae Revenue

3 MGD Aerobic Stabilization with ABNR	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 4 staff)	$ 529,065
Professional Services	$ 102,267
ABNR O&M	$ 604,646
Operating	$ 668,336
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 1,689,567
Revenue from Algae ($0.5 to $2 per lb, $0 used)	$0
Total Probable Cost	**$ 4,451,025**

Table 5-18 is the cost of operation if there is no revenue from the algae sales. The expected fee is approximately $4.5 million per year. The annual probable cost yields to a minimum monthly user fee of $56.65 with 6,547 ERUs, which is $25 increase per ERU per month compared to the current system.

Table 5-19 3 MGD with ABNR Aerobic Digestion with Algae Revenue

3 MGD Aerobic Stabilization with ABNR	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 4 staff)	$ 529,065
Professional Services	$ 102,267
ABNR O&M	$ 604,646
Operating	$ 668,336
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 1,689,567
Revenue from Algae ($0.5 to $2 per lb, $.75 used)	($1,595,415)
Total Probable Cost	**$ 2,855,610**

In Table 5-19, the assumption of the revenue from algae, $0.75 per pound was used for the cost analysis. The revenue of the algae sales can vary depending on the market for the algae. The annual cost for the 3 MGD Aerobic Stabilization with ABNR option is expected to be $2.9 million including the revenue from algae which is expected to be $1.6 million per year. The annual probable cost yields to a minimum monthly user fee of $36.35 with 6,547 ERUs, which is a increase of $4.45 per ERU per month compared to the anticipated monthly fee of the current system.

5.9 3 MGD Expansion with Aerobic Stabilization

This option is similar to the 3 MGD Expansion in Section 5.2. This option utilizes as many of the existing structures as possible to reduce the overall cost of the installment, yet have the efficiency to remove more nutrients than the current system. The following includes the elimination and additional equipment and/or structures needed for this option.

5.9.1 Convert Anaerobic Digesters to Aerobic Stabilization Tanks

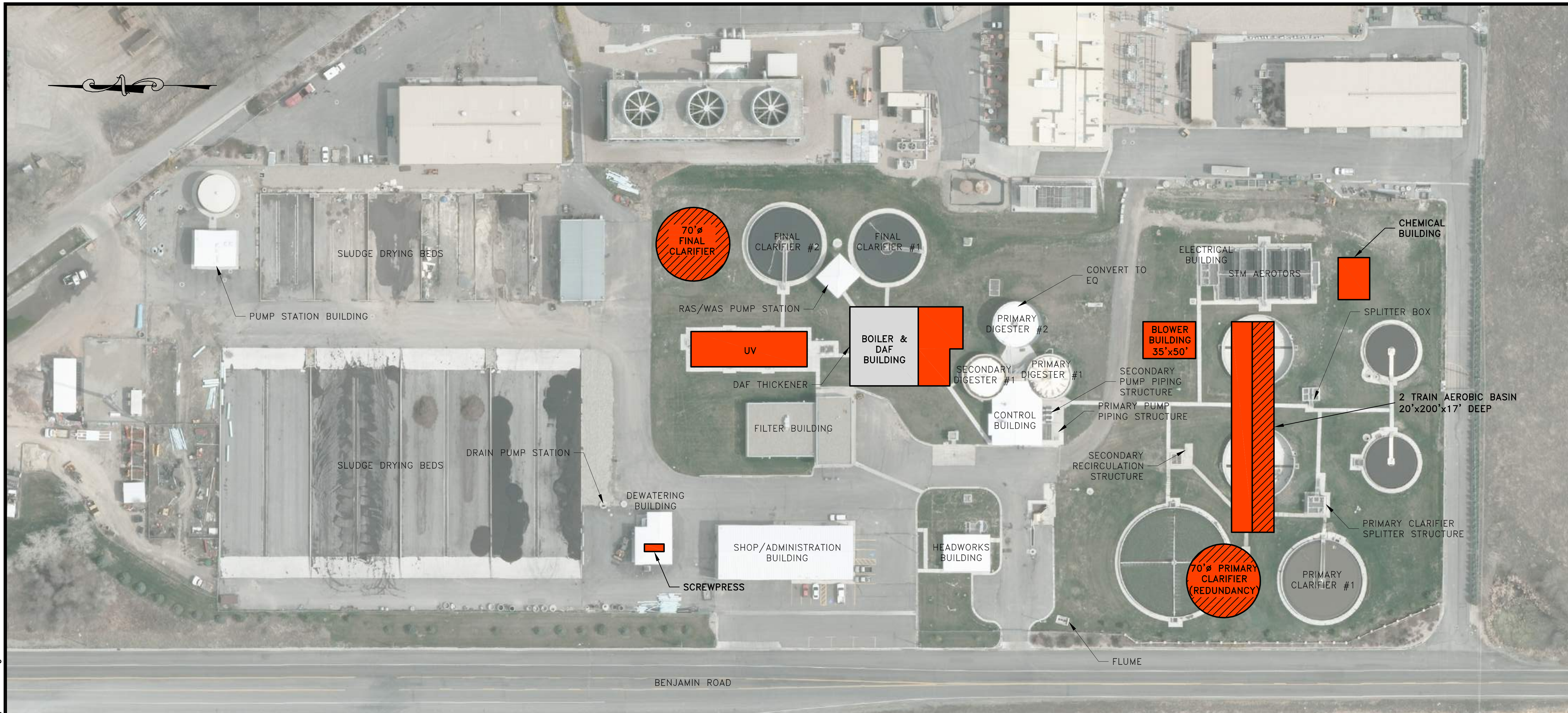
The anaerobic digesters will be aerated and used as equalization tanks for dewatering.

5.9.2 Solid Handling Equipment

It is anticipated that this option will produce more sludge off of digestion when compared to the 5 MGD with ABNR option. Therefore, it requires two (2) more dewatering equipment. It will operate with two duty units and one standby.

5.9.3 Site Layout

The following is the proposed layout for the 3 MGD expansion.



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Scale in Feet

LEGEND

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NO.	DATE	DESIGN	DRAWN	CHECKED	REVISIONS
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WASTEWATER TREATMENT FACILITY UPGRADE

3 MGD SITE LAYOUT / AEROBIC STABILIZATION

AQUA ENGINEERING
533 W. 2600 S. SUITE 275, BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

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DRAWING IS TO SCALE IF BAR MEASURES:
1" = FULL SCALE
1/2" = HALF SCALE

FIGURE
FIG 5-8

05/26/2019 X:\Payson\2014 Payson Facility Plan\Drafting\General\FIG 5-8.dwg

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5.9.4 3 MGD with ABNR Probable Cost

The following cost estimate was developed for the proposed project. Since this option does not include constructions of aerobic basins, primary clarifiers, the DAF building, and a digester, when compared to the 3MGD with ABNR option, it is slightly less expensive than the previous option discussed. However, the production of the algae depends on the influent volume, therefore, the anticipated revenue will be the same for both options. Below is the expected capital cost for this option.

Table 5-20 Cost for 3 MGD with Aerobic Stabilization

DESCRIPTION		COST
Site Work and Yard Piping	$	320,000
Plant Repairs	$	150,000
Demolition	$	94,500
Aerobic Basin	$	1,560,000
Primary Clarifier	$	1,115,000
Final Clarifier	$	1,150,000
Solid Handling	$	360,000
Chemical Storage	$	314,400
UV Basin	$	1,320,000
Reuse Pump Station Remodel	$	110,000
Filter Building	$	660,000
Convert Anaerobic Digester to Aerobic Eq Tanks	$	380,000
Electrical	$	1,506,780
Construction Cost Subtotal	**$**	**9,040,680**
Contingency 20%	$	1,808,136
Construction Cost Total	$	10,848,816
Engineering, Construction Observation 10%	$	1,084,882
Legal & Permitting 5%	$	542,441
Total Probable Cost	**$**	**12,476,138**

The estimated cost for the 3 MGD Expansion with Aerobic Stabilization Upgrade is approximately $12.4 million. Assuming that the total amount is borrowed with 3% interest, the new debt payment would be $838,592 a year for next 20 years. Operation and maintenance cost for the 3 MGD with ABNR, Anaerobic Digestion option was estimated based on Payson's current annual cost of operation and is shown in Table 5-8 below.

Table 5-21 3 MGD with Aerobic Stabilization

3 MGD Aerobic Stabilization	
DESCRIPTION	**Annual Cost**
Employee Related (assuming 4 staff)	$ 529,065
Professional Services	$ 102,267
Operating	$ 668,336
Maintenance	$ 330,162
Transfer	$ 186,982
Existing Debt Service as of 2023	$ 340,000
New Debt Service	$ 838,592
Total Probable Cost	**$ 2,995,405**

Table 5-8 is the annual cost for the 3 MGD with aerobic stabilization including Operation and Maintenance and debt payment is expected to be $3.0 million, which yields to a minimum monthly user fee of $38.13 with 6,547 ERUs, which is an increase of over $6.23 per ERU per month compared to the monthly fee of the current system.

5.10 Additional BOD for the Payson Fruit Growers

The overall capacity of the plant will be either 3 MGD or 5 MGD as desired, however, some of the significant upgrades needs to be made to receive additional 600 lb BOD per day from the Payson Fruit Growers. With this upgrade, the water treatment facility will be able to operate until the maximum capacity is reached by all of the municipal influent based on the anticipated population growth. This alternative would upgrade the treatment facility to meet the new requirements in the permit and add redundancy for the main process.

5.10.1 Aerobic Basin

To treat the additional 600 lb BOD per day, the aeration basin, previously discussed in Section 5.2.2 and 5.3.2, needs to be expanded. It will require 10 % more capacity when compared to the 3 MGD option, and all of the components including diffuser, piping, blower, and a larger building for the blowers.

5.10.2 Screw Press

Additional BOD loading will result in increased solid production of the facility. An additional screw press should be installed in a building. Some additional space will be required for the additional screw press and thus the solid handling building needs to be expanded.

5.10.3 Additional BOD Treatment Probable Cost

The cost estimate for the additional BOD removal is shown in Table 5-22.

Table 5-22 Cost Payson Fruit Growers

AQUA ENGINEERING 533 W 2600 S Suite 275 Bountiful, UT 84010 Phone (801) 299-1327 Fax (801) 299-0153		Engineer's Opinion of Probable Cost			
		Client:	Payson		
		600 lbs Additional Capacity			
ITEM	**DESCRIPTION**	**Qty**	**Unit**	**Each**	**COST**
Aerobic Basin					
1	Concrete Basin	100	cu.yd.	$1,100	$110,000
2	Diffuser	1	lump	$5,000	$5,000
3	Air Piping	1	lump	$10,000	$10,000
4	Blower Up-sizing	1	lump	$30,000	$30,000
5	Installation	1	lump	$10,000	$10,000
				Subtotal	$165,000
Solid Handling					
7	Dewatering Mechanism Up-sizing	1	lump	$40,000	$40,000
				Subtotal	$40,000
Electrical					
8	Electrical and Instrumentation	15	%	$30,750.00	$30,750
				Subtotal	$30,750
				Construction Cost Subtotal	**$235,750**
				Contingency 20%	$51,865
				Construction Cost Total	$287,615
				Engineering, Construction Observation 10%	$28,762
				Legal & Permitting 5%	$14,381
				Total Probable Cost	**$330,757**

5.11 Alternative Summary

The capital cost, operation and maintenance, and anticipated monthly bill per ERU are summarized in Table 5-23. Although the capital cost is high for the options with ABNR, operations and maintenance could be less than other options because they will have some revenue from the algae sales. The price of dried algae is anticipated to be between $0.50 and $2.00 per pound, depending on the market. The cost estimate table was developed under the assumption of $0.75 per pound of dried algae.

Table 5-23 Summary Alternative

		5 MGD				3 MGD			
	Do Nothing	Conventional Treatment	ABNR	ABNR +Aerobic Stabalization	Conventional +Aerobic Stabalization	Conventional Nut. Removal	ABNR	ABNR +AD	Conventional +Aerobic Stabalization
Capital Cost	-	$ 22,533,440	$40,277,663	$37,225,466	$ 19,757,984	$ 13,436,618	$26,453,306	$25,136,493	$12,476,138
O&M (annual)	$2,023,145	$ 4,590,192	$ 7,417,160	$ 7,212,004	$ 4,403,638	$ 3,157,687	$ 4,539,536	$ 4,451,025	$ 2,995,405
Monthly Bill (per ERU)	$ 25.75	$ 58.43	$ 94.41	$ 91.80	$ 56.05	$ 40.19	$ 57.78	$ 56.65	$ 38.13

CHAPTER 6 - RECOMMENDATION

6.1 Historical Review

6.1.1 Flow

The treatment facility was upgraded about 20 years ago and the anticipated growth at that time projected the design flow to be 3 MGD now. However, the current flow is only about 1.8 MGD so the anticipated growth in flow was not as much as originally predicted. Therefore, the treatment facility has additional hydraulic capacity. Figure 2-4 shows that the capacity will be reached in about 2027 based on the conservative design assumptions. However, the actual flow is lower than the design assumptions so it may be 2030 before the design flow is actually reached.

6.1.2 BOD and TSS loading

The loadings from BOD and TSS have grown closer to anticipated. However, there is still additional capacity for growth in the current system.

6.2 Current Needs

The primary needs for the treatment plant are:

1. Repair existing equipment that is reaching its anticipated life.
2. Redundancy
3. Meet the new nutrient standards

6.3 User Costs

6.3.1 5 MGD Expansion

The 5 MGD alternatives would accommodate future growth until about 2058. However, the current residents would be paying a higher monthly bill to pay for the future growth. This would reduce the need for a facility upgrade for a longer time but would burden the current residents.

6.3.2 3 MGD Expansion

The 3 MGD alternatives do not extend the life of the plant as long as the 5 MGD alternatives. It is estimated that the 3 MGD alternative will add an additional 10 years of life. At that time a new addition would be required to account for growth in the City. This would reduce the cost burden on the existing residents until the expansion was needed.

6.4 Preferred Plan: 3 MGD Expansion with Aerobic Stabilization

With the 3 MGD Expansion with Redundancy the City will be able to extend the operation for about 10 more years. This option will include several upgrades to the facility to meet the regulation updates including Phosphorus limits for the State of Utah as well as other nutrient limits for the tributaries of the Utah Lake. Anticipated capital cost of the project is $12.5 million and annual operational cost is expected to be about $3.0 million. With the ERU of 6,457, monthly bill should be $38.13.

6.5 Future Expansion

There are several different things that will trigger the future expansion.

1. Growth – As the City grows the plant will reach capacity.
2. Permit Changes – The discharge permit is renewed every 5 years. There are new regulations that are coming down from EPA all the time and as the permit requirements change the plant may need modifications to meet the new requirements.

6.5.1 Expansion timing

The timing is shown in dates that are estimated by population growth. However, the treatment facility has several design parameters that each have a design capacity. Flow, BOD, TSS, Nitrogen, and Phosphorus. Each of these parameters could change differently than anticipated over time. Once any of the parameters reach 80% of design capacity this should trigger a planning process to determine the best alternative for the future.

6.6 Net Present Value

Table 6-1 NPV

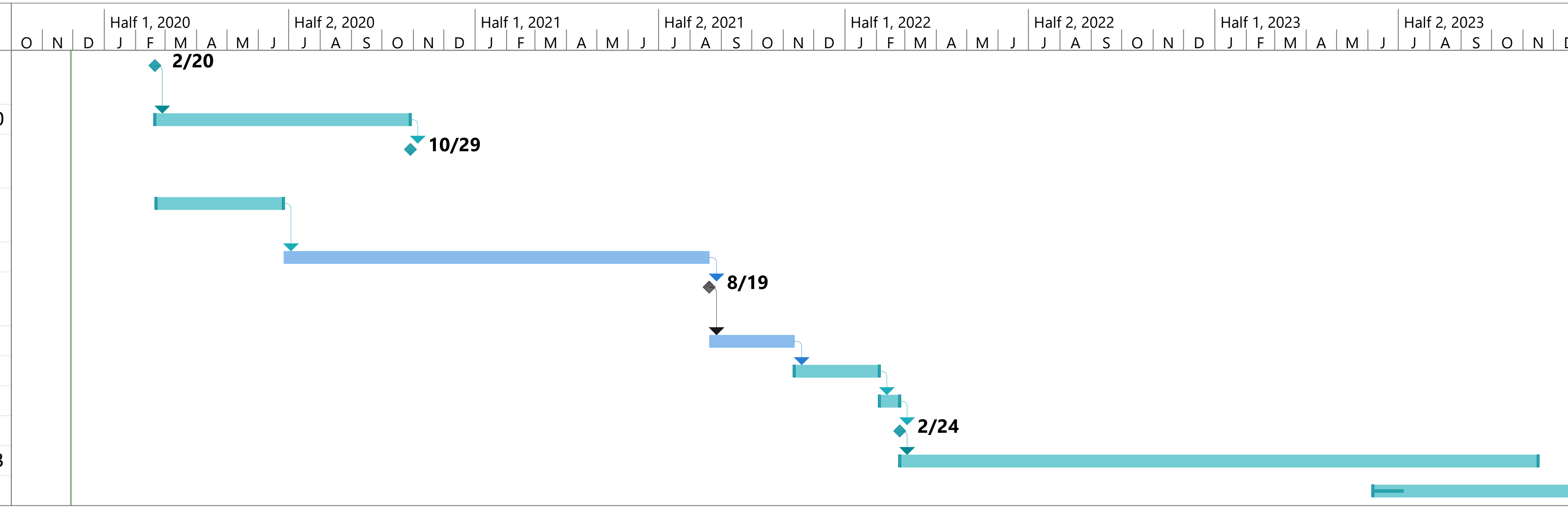
3 MGD 20 Year NPV				
Year	Capital Expense	Current Debt Service	Operational Cost	Net Annual Cost
2020	$12,476,138	$891,892	$1,816,812	$15,184,843
2021		$890,526	$1,871,317	$2,761,842
2022		$897,292	$1,927,456	$2,824,748
2023		$339,375	$1,985,280	$2,324,655
2024		$340,888	$2,044,838	$2,385,726
2025		$351,108	$2,106,183	$2,457,291
2026		$344,734	$2,169,369	$2,514,103
2027		$347,820	$2,234,450	$2,582,270
2028			$2,301,483	$2,301,483
2029			$2,370,528	$2,370,528
2030	$10,922,769		$2,441,644	$13,364,413
2031			$2,514,893	$2,514,893
2032			$2,590,340	$2,590,340
2033			$2,668,050	$2,668,050
2034			$2,748,092	$2,748,092
2035			$2,830,534	$2,830,534
2036			$2,915,450	$2,915,450
2037			$3,002,914	$3,002,914
2038			$3,093,001	$3,093,001
2039			$3,185,791	$3,185,791
NET Present Value				$59,252,476
Discount Rate				3%

Table 6-1 shows the cost for the 3MGD upgrade with the anticipated cost to expand the facility to 5MGD in 2030. The NPV for the project would be almost $60 million. This alternative will help keep the monthly user fees as low as possible. However, it will require an additional expansion sometime in the near future.

6.7 Schedule

The schedule is shown on the next page. This schedule will allow the plant to be operating and meet the nutrient removal requirements

ID	Task Name	Duration	Start	Finish
1	Facility Plan Approval	0 days	Thu 2/20/20	Thu 2/20/20
2	Financial Planning	180 days	Thu 2/20/20	Wed 10/28/20
3	Submit Financial Plan To DWQ	0 days	Thu 10/29/20	Thu 10/29/20
4	Design Grant Application	90 days	Fri 2/21/20	Thu 6/25/20
5	Design Engineering	300 days	Fri 6/26/20	Thu 8/19/21
6	Submit Drawings To DWQ For Review	0 days	Thu 8/19/21	Thu 8/19/21
7	DWQ Plan Review	60 days	Fri 8/20/21	Thu 11/11/21
8	Project Bidding	60 days	Fri 11/12/21	Thu 2/3/22
9	Award Bid	14 days	Fri 2/4/22	Wed 2/23/22
10	Notice to Proceed	0 days	Thu 2/24/22	Thu 2/24/22
11	Project Construction	450 days	Thu 2/24/22	Wed 11/15/23
12	Project Startup	150 days	Tue 6/6/23	Sun 12/31/23



Project: Project1
Date: Fri 11/29/19

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

Appendix A

Soil Resource Report

United States Department of Agriculture

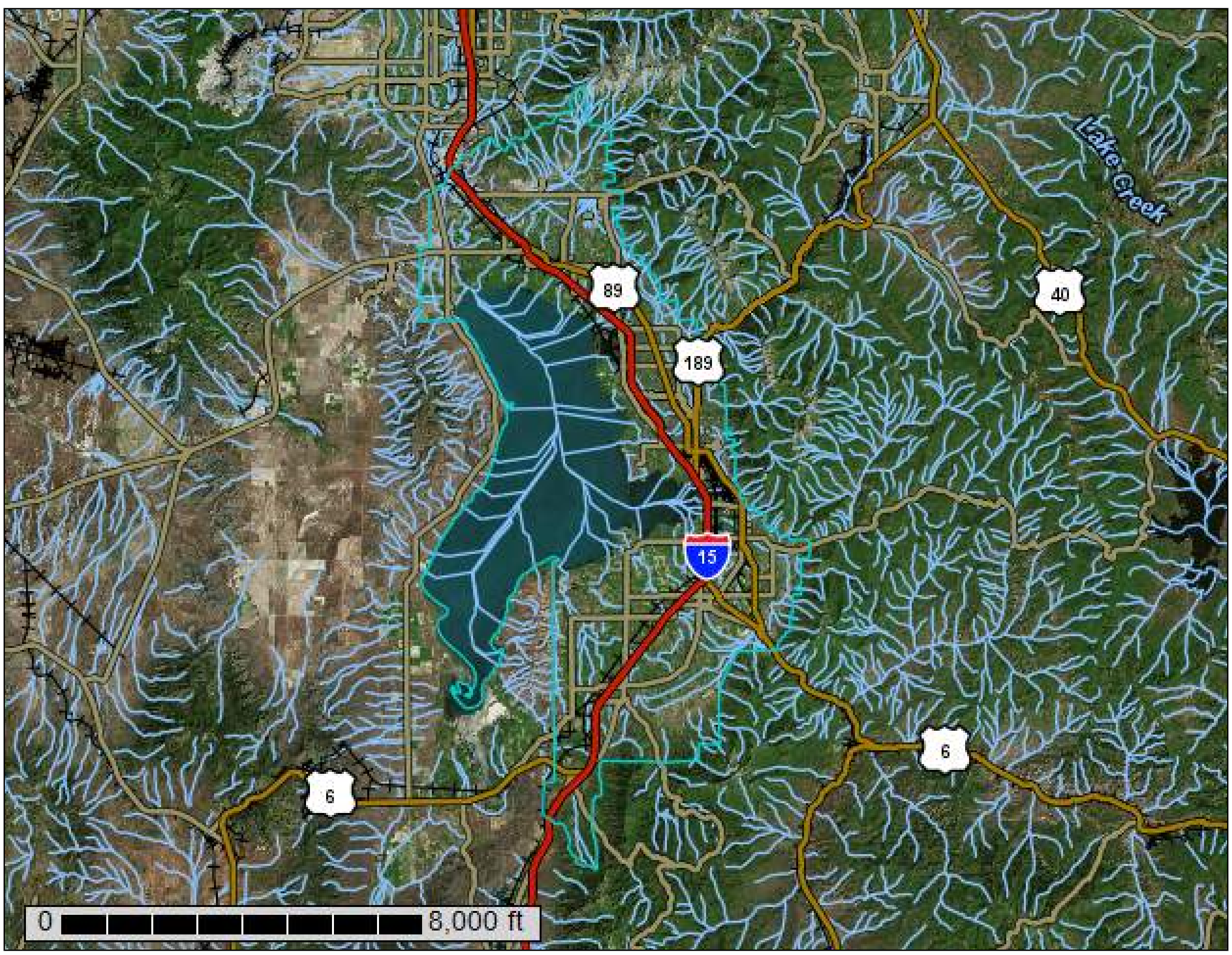
NRCS

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

Utah County, Utah - Central Part



August 16, 2016

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

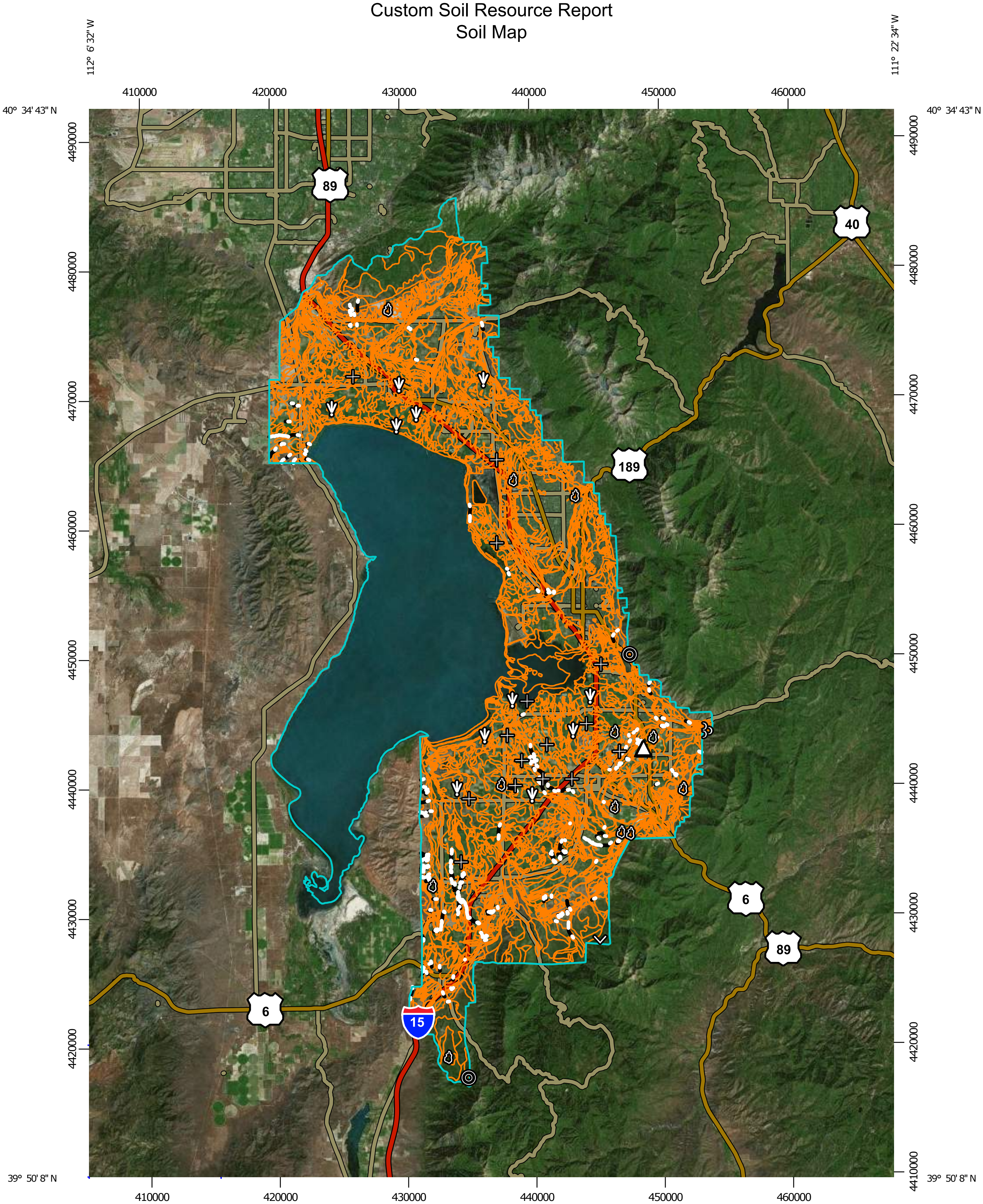
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:402,000 if printed on A portrait (8.5" x 11") sheet.

N

0 5000 10000 20000 30000 Meters

0 15000 30000 60000 90000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N 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.

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: Utah County, Utah - Central Part
Survey Area Data: Version 8, Sep 23, 2015

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

Date(s) aerial images were photographed: Jan 1, 1999—Dec 31, 2003

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

Utah County, Utah - Central Part (UT621)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AR	Arave silt loam, 0 to 1 percent slopes	1,216.5	0.4%
BC	Beaches	826.0	0.3%
Bd	Benjamin silty clay	3,820.0	1.3%
Be	Benjamin silty clay, moderately alkali	2,978.5	1.0%
Bf	Benjamin silty clay, strongly alkali	1,067.6	0.4%
Bg	Benjamin silty clay, sandy substratum	1,589.0	0.5%
BhB	Bingham loam, 1 to 3 percent slopes	3,456.4	1.2%
BkB	Bingham gravelly loam, 1 to 3 percent slopes	8,765.5	3.0%
BmC	Bingham cobbly loam, 3 to 6 percent slopes	773.6	0.3%
BmD	Bingham cobbly loam, 6 to 10 percent slopes	358.1	0.1%
Br	Bramwell silty clay loam	2,489.2	0.9%
Bs	Bramwell silty clay loam, drained	2,529.7	0.9%
Ch	Chipman loam	394.3	0.1%
Ck	Chipman silty clay loam	4,845.0	1.7%
Cm	Chipman silty clay loam, moderately deep water table	2,594.4	0.9%
Cn	Chipman silty clay loam, moderately saline	1,616.7	0.6%
Co	Chipman silty clay loam, strongly saline	716.8	0.2%
Cp	Chipman-McBeth complex	1,063.5	0.4%
CrD	Cleverly cobbly sandy loam, 6 to 15 percent slopes	1,813.6	0.6%
CsB	Cleverly gravelly fine sandy loam, 1 to 3 percent slopes	109.9	0.0%
CsC	Cleverly gravelly fine sandy loam, 3 to 6 percent slopes	1,005.3	0.3%
CsD	Cleverly gravelly fine sandy loam, 6 to 15 percent slopes	1,129.2	0.4%
CU	Cobbly alluvial land	954.9	0.3%
Da	Dagor loam	977.4	0.3%
Db	Dagor silt loam	239.2	0.1%
DCF	Dry Creek cobbly loam, 10 to 30 percent slopes	1,967.8	0.7%

Utah County, Utah - Central Part (UT621)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
DEF	Dry Creek extremely stony loam, stony subsoil variant, 6 to 30 percent slopes	514.5	0.2%
DRG2	Dry Creek cobbly loam, thin surface variant, 30 to 60 percent slopes, eroded	1,716.7	0.6%
GAG	Gappmayer cobbly loam, 50 to 70 percent slopes	976.2	0.3%
HEG	Henefer loam, 35 to 70 percent slopes	203.0	0.1%
HFF	Henefer-McPhie association, 5 to 30 percent slopes	1,961.0	0.7%
HFG2	Henefer-McPhie association, 30 to 60 percent slopes	2,700.1	0.9%
HKG	Henefer-Rake association, 35 to 70 percent slopes	2,304.0	0.8%
HmE	Hillfield silt loam, 10 to 20 percent slopes	622.6	0.2%
HmF	Hillfield silt loam, 20 to 30 percent slopes	248.9	0.1%
HNG	Hillfield-Layton complex, 30 to 60 percent slopes	704.0	0.2%
HOF	Hillfield-Sterling complex, 20 to 35 percent slopes	1,482.0	0.5%
HpF	Hillfield-Welby silt loams, 6 to 35 percent slopes	852.1	0.3%
Hr	Holdaway silt loam	3,283.1	1.1%
Hs	Holdaway silt loam, strongly saline-alkali	791.0	0.3%
Ir	Ironton loam	260.7	0.1%
Is	Ironton loam, moderately saline-alkali	350.8	0.1%
Jo	Jordan silt loam	385.2	0.1%
KeA	Keigley silty clay loam, 0 to 1 percent slopes	1,001.4	0.3%
KeB	Keigley silty clay loam, 1 to 3 percent slopes	395.9	0.1%
KgA	Keigley silty clay loam, extended season, 0 to 2 percent slopes	767.4	0.3%
KmA	Kidman very fine sandy loam, 0 to 1 percent slopes	637.3	0.2%
KmB	Kidman very fine sandy loam, 1 to 3 percent slopes	1,678.2	0.6%
KmC	Kidman very fine sandy loam, 3 to 6 percent slopes	346.8	0.1%
KNG2	Kilburn very gravelly sandy loam, 30 to 50 percent slopes, eroded	1,991.2	0.7%

Utah County, Utah - Central Part (UT621)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
KOD	Kilburn stony sandy loam, 3 to 15 percent slopes	917.7	0.3%
KRE2	Kilburn gravelly fine sandy loam, 15 to 30 percent slopes, eroded	592.9	0.2%
Ks	Kirkham silty clay loam	4,196.2	1.4%
Kt	Kirkham silty clay loam, moderately saline-alkali	1,580.5	0.5%
Ku	Kirkham silty clay loam, strongly saline-alkali	628.2	0.2%
LaC	Lakewin gravelly fine sandy loam, 1 to 6 percent slopes	3,360.1	1.2%
LaD	Lakewin gravelly fine sandy loam, 6 to 15 percent slopes	760.8	0.3%
LcE	Lakewin cobbly fine sandy loam, 15 to 30 percent slopes	623.2	0.2%
LeD	Layton loamy fine sand, 6 to 15 percent slopes	434.5	0.1%
LfC	Layton fine sandy loam, 1 to 6 percent slopes	1,660.6	0.6%
LmA	Layton fine sandy loam, slowly permeable substratum, 0 to 1 percent slopes	343.3	0.1%
LnB	Layton fine sandy loam, water table, 1 to 3 percent slopes	1,258.7	0.4%
Lo	Logan silty clay loam	1,287.3	0.4%
Ls	Logan silty clay loam, heavy variant	1,230.7	0.4%
MAF	Manila silt loam, 10 to 30 percent slopes	1,504.2	0.5%
Mf	Martini fine sandy loam	471.9	0.2%
Mh	McBeth silt loam	4,415.1	1.5%
Mn	McBeth silt loam, moderately saline	562.3	0.2%
MrC	McMurdie silt loam, 3 to 6 percent slopes	269.6	0.1%
MtE2	McMurdie-Taylorsville complex, 6 to 20 percent slopes, eroded	390.2	0.1%
MU	Mixed alluvial land	3,398.2	1.2%
MX	Mixed alluvial land, saline	915.4	0.3%
PaB	Parleys loam, 0 to 4 percent slopes	3,178.4	1.1%
PaC	Parleys loam, 3 to 8 percent slopes	1,092.7	0.4%
PbC	Parleys gravelly loam, overwashed, 3 to 6 percent slopes	238.8	0.1%

Utah County, Utah - Central Part (UT621)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
PcB	Parleys silty clay loam, 0 to 3 percent slopes	1,887.6	0.7%
Pd	Payson silty clay loam	824.4	0.3%
PEE	Payson-Terrace escarpments complex, 1 to 20 percent slopes, eroded	1,133.0	0.4%
Pf	Peteetneet peat	1,296.7	0.4%
Pg	Peteetneet-Holdaway complex	535.8	0.2%
PHG2	Picayune cobbly silt loam, 35 to 70 percent slopes, eroded	1,183.8	0.4%
PIF	Picayune cobbly loam, red variant, 30 to 60 percent slopes	887.5	0.3%
PJG2	Picayune-Rake association, 35 to 70 percent slopes, eroded	576.3	0.2%
PK	Pits and dumps	1,639.4	0.6%
PlC	Pleasant Grove gravelly loam, 3 to 6 percent slopes	2,071.3	0.7%
PlD	Pleasant Grove gravelly loam, 6 to 10 percent slopes	2,069.9	0.7%
PmE2	Pleasant Grove stony loam, 10 to 25 percent slopes, eroded	4,449.9	1.5%
PnA	Pleasant Vale loam, 0 to 2 percent slopes	2,342.5	0.8%
PNG2	Pleasant Grove-Terrace escarpments complex, 30 to 60 percent slopes, eroded	2,357.9	0.8%
PoA	Pleasant Vale loam, extended season, 0 to 2 percent slopes	920.4	0.3%
PoC	Pleasant Vale loam, extended season, 3 to 6 percent slopes	446.2	0.2%
PpB	Pleasant Vale gravelly loam, extended season, 1 to 3 percent slopes	651.6	0.2%
PrD	Pleasant Vale gravelly sandy loam, extended season, 6 to 10 percent slopes	554.1	0.2%
PsB	Pleasant Vale silty clay loam, 1 to 3 percent slopes	596.2	0.2%
PtB	Pleasant View fine sandy loam, 1 to 3 percent slopes	944.3	0.3%
PuD	Preston fine sand, 1 to 10 percent slopes	572.0	0.2%
Pv	Preston loamy fine sand, high water table variant	284.6	0.1%
Pw	Provo gravelly fine sandy loam	224.4	0.1%
Px	Provo-Sunset complex	1,359.6	0.5%
PY	Provo Bay peaty silt loam	301.9	0.1%

Utah County, Utah - Central Part (UT621)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Pz	Provo Bay silty clay loam	2,668.6	0.9%
RAG2	Rake extremely stony loam, 20 to 70 percent slopes, eroded	2,735.7	0.9%
RdA	Redola loam, 0 to 3 percent slopes	1,710.1	0.6%
ReC	Redola gravelly loam, 3 to 6 percent slopes	709.7	0.2%
RV	Riverwash	552.3	0.2%
RW	Rock land	3,506.8	1.2%
Sd	Steed sandy loam	999.6	0.3%
Se	Steed gravelly sandy loam	3,134.9	1.1%
SgB	Sterling gravelly fine sandy loam, 1 to 3 percent slopes	1,077.1	0.4%
SgC	Sterling gravelly fine sandy loam, 3 to 6 percent slopes	732.9	0.3%
SgD	Sterling gravelly fine sandy loam, 6 to 10 percent slopes	1,106.7	0.4%
SNG	Sterling-Terrace escarpments complex, 30 to 70 percent slopes	1,531.6	0.5%
So	Sunset loamy fine sand	205.1	0.1%
Sr	Sunset loam	6,426.6	2.2%
Ss	Sunset loam, gravelly substratum	1,518.9	0.5%
St	Sunset loam, clay substratum	697.2	0.2%
Su	Sunset loam, moderately saline	846.5	0.3%
TaA	Taylorsville silty clay loam, 0 to 1 percent slopes	2,507.7	0.9%
TaB	Taylorsville silty clay loam, 1 to 3 percent slopes	3,646.7	1.3%
TcA	Taylorsville silty clay loam, extended season, 0 to 1 percent slopes	384.5	0.1%
TcB	Taylorsville silty clay loam, extended season, 1 to 3 percent slopes	1,148.5	0.4%
TcC2	Taylorsville silty clay loam, extended season, 3 to 6 percent slopes, eroded	1,553.9	0.5%
TmB	Timpanogos loam, 0 to 3 percent slopes	4,575.2	1.6%
TmC	Timpanogos loam, 3 to 6 percent slopes	748.2	0.3%
ToB	Timpanogos loam, water table, 0 to 3 percent slopes	607.2	0.2%
UL	Urban land	4,129.0	1.4%

Utah County, Utah - Central Part (UT621)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
VnA	Vineyard fine sandy loam, 0 to 2 percent slopes	2,800.3	1.0%
VsA	Vineyard fine sandy loam, moderately saline, 0 to 2 percent slopes	1,083.8	0.4%
W	Water	85,940.3	29.6%
WbA	Welby silt loam, 0 to 1 percent slopes	1,002.9	0.3%
WbB	Welby silt loam, 1 to 3 percent slopes	2,362.6	0.8%
WbC	Welby silt loam, 3 to 6 percent slopes	498.4	0.2%
WeA	Welby silt loam, extended season, 0 to 1 percent slopes	612.1	0.2%
WeB	Welby silt loam, extended season, 1 to 3 percent slopes	1,400.7	0.5%
WeC	Welby silt loam, extended season, 3 to 6 percent slopes	1,417.6	0.5%
WeD2	Welby silt loam, extended season, 6 to 10 percent slopes	736.1	0.3%
WhD	Welby-Hillfield silt loams, 6 to 10 percent slopes	1,215.4	0.4%
WhE	Welby-Hillfield silt loams, 10 to 30 percent slopes	955.4	0.3%
Totals for Area of Interest		**290,382.3**	**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.

Utah County, Utah - Central Part

AR—Arave silt loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: j6wb
Elevation: 4,450 to 4,500 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 45 to 51 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Arave and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Arave

Setting

Landform: Beach plains
Landform position (three-dimensional): Talf, rise
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

A11 - 0 to 2 inches: silt loam
A12 - 2 to 5 inches: silt loam
B2tca - 5 to 9 inches: silty clay loam
B3ca - 9 to 13 inches: silty clay loam
C1ca - 13 to 28 inches: silty clay loam
A11b - 28 to 32 inches: silt loam
A12b - 32 to 42 inches: silt loam
C2 - 42 to 60 inches: loamy very fine sand

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Strongly saline (16.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 100.0
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): 7w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

BC—Beaches

Map Unit Setting

National map unit symbol: j6wc
Elevation: 4,490 to 4,510 feet
Farmland classification: Not prime farmland

Map Unit Composition

Beaches: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beaches

Setting

Landform: Beach plains
Landform position (three-dimensional): Talf, rise
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

H1 - 0 to 60 inches: fine sand

Properties and qualities

Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Frequent
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Low (about 3.6 inches)

Bd—Benjamin silty clay

Map Unit Setting

National map unit symbol: j6wd
Elevation: 4,700 to 5,000 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Benjamin and similar soils: 85 percent
Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Benjamin

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone and shale

Typical profile

Ap1 - 0 to 1 inches: silty clay
Ap2 - 1 to 4 inches: silty clay
A1 - 4 to 17 inches: silty clay
C1 - 17 to 25 inches: silty clay
C2G - 25 to 38 inches: silty clay
C3 - 38 to 46 inches: silty clay loam
C4 - 46 to 52 inches: silty clay
IIC5 - 52 to 60 inches: sandy 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Minor Components

Pleasant vale

Percent of map unit: 5 percent

Kirkham

Percent of map unit: 5 percent

Depressional soils

Percent of map unit: 3 percent
Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Strongly saline-alkali soils

Percent of map unit: 2 percent

Be—Benjamin silty clay, moderately alkali

Map Unit Setting

National map unit symbol: j6wf
Elevation: 4,700 to 5,000 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Benjamin and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Benjamin

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone and shale

Typical profile

Ap1 - 0 to 1 inches: silty clay
Ap2 - 1 to 4 inches: silty clay
A1 - 4 to 17 inches: silty clay
C1 - 17 to 25 inches: silty clay
C2g - 25 to 38 inches: silty clay
C3 - 38 to 46 inches: silty clay loam
C4 - 46 to 52 inches: silty clay
IIC5 - 52 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 60.0

Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Minor Components

Depressional soils

Percent of map unit: 3 percent
Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Strongly saline-alkali soils

Percent of map unit: 2 percent

Bf—Benjamin silty clay, strongly alkali

Map Unit Setting

National map unit symbol: j6wg
Elevation: 4,700 to 5,000 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Benjamin and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Benjamin

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone and shale

Typical profile

Ap1 - 0 to 1 inches: silty clay
Ap2 - 1 to 4 inches: silty clay
A1 - 4 to 17 inches: silty clay
C1 - 17 to 25 inches: silty clay
C2G - 25 to 38 inches: silty clay

C3 - 38 to 46 inches: silty clay loam
C4 - 46 to 52 inches: silty clay
IIC5 - 52 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): 7w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Minor Components

Depressional soils

Percent of map unit: 3 percent
Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Bg—Benjamin silty clay, sandy substratum

Map Unit Setting

National map unit symbol: j6wh
Elevation: 4,700 to 5,000 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Benjamin and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Benjamin

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone and shale

Typical profile

Ap1 - 0 to 1 inches: silty clay
Ap2 - 1 to 4 inches: silty clay
A1 - 4 to 17 inches: silty clay
C1 - 17 to 25 inches: silty clay
C2G - 25 to 38 inches: silty clay
C3 - 38 to 60 inches: sand

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Minor Components

Depressional soils

Percent of map unit: 3 percent
Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Strongly saline-alkali soils

Percent of map unit: 2 percent

BhB—Bingham loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6wj
Elevation: 4,700 to 5,200 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Bingham and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bingham

Setting

Landform: Terraces, alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Linear, convex
Parent material: Alluvium and/or lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 6 inches: gravelly loam
B21t - 6 to 12 inches: gravelly sandy clay loam
B22t - 12 to 18 inches: gravelly fine sandy loam
IIIB3ca - 18 to 27 inches: very gravelly sandy loam
IICca - 27 to 60 inches: very gravelly sand

Properties and qualities

Slope: 1 to 3 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

BkB—Bingham gravelly loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2tjsk
Elevation: 4,320 to 5,350 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 49 to 51 degrees F
Frost-free period: 150 to 180 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Bingham and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bingham

Setting

Landform: Lake terraces, fan remnants
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, side slope, tread
Down-slope shape: Linear, concave
Across-slope shape: Convex
Parent material: Fine-loamy slope alluvium derived from quartzite and/or limestone over sandy and gravelly lacustrine deposits derived from quartzite and/or limestone

Typical profile

Ap - 0 to 6 inches: gravelly loam
Bt1 - 6 to 12 inches: gravelly sandy clay loam
Bt2 - 12 to 18 inches: gravelly fine sandy loam
2Btk - 18 to 27 inches: very gravelly sandy loam
2Ck - 27 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: 20 to 34 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 3.0
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4s

Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

BmC—Bingham cobbly loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6wl
Elevation: 4,700 to 5,200 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Bingham and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bingham

Setting

Landform: Alluvial fans, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Convex, linear
Parent material: Alluvium and/or lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 6 inches: cobbly loam
B21t - 6 to 12 inches: gravelly sandy clay loam
B22t - 12 to 18 inches: gravelly fine sandy loam
IIIB3ca - 18 to 27 inches: very gravelly sandy loam
IICca - 27 to 60 inches: very gravelly sand

Properties and qualities

Slope: 3 to 6 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

BmD—Bingham cobbly loam, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: j6wm
Elevation: 4,700 to 5,200 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Bingham and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bingham

Setting

Landform: Alluvial fans, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Convex, linear
Parent material: Alluvium and/or lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 6 inches: cobbly loam
B21t - 6 to 12 inches: gravelly sandy clay loam
B22t - 12 to 18 inches: gravelly fine sandy loam
IIIB3ca - 18 to 27 inches: very gravelly sandy loam
IICca - 27 to 60 inches: very gravelly sand

Properties and qualities

Slope: 6 to 10 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

Br—Bramwell silty clay loam

Map Unit Setting

National map unit symbol: j6wn
Elevation: 4,320 to 4,600 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Bramwell and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bramwell

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 6 inches: silty clay loam
A1 - 6 to 11 inches: silty clay loam
C1 - 11 to 20 inches: silty clay loam
C2ca - 20 to 31 inches: silty clay loam
C3ca - 31 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Minor Components

Chipman

Percent of map unit: 5 percent

Strongly saline soils

Percent of map unit: 3 percent

Taylorsville

Percent of map unit: 3 percent

Depressional soils

Percent of map unit: 2 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Hardpan soils

Percent of map unit: 2 percent

Bs—Bramwell silty clay loam, drained

Map Unit Setting

National map unit symbol: j6wp
Elevation: 4,320 to 4,600 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Bramwell and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bramwell

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 6 inches: silty clay loam
A1 - 6 to 11 inches: silty clay loam
C1 - 11 to 20 inches: silty clay loam
C2ca - 20 to 31 inches: silty clay loam

C3ca - 31 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 36 to 48 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Minor Components

Taylorsville

Percent of map unit: 5 percent

Depressional soils

Percent of map unit: 3 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Ch—Chipman loam

Map Unit Setting

National map unit symbol: j6wr
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Chipman and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chipman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Apca - 0 to 8 inches: loam
Alg - 8 to 16 inches: silty clay loam
C1cag - 16 to 20 inches: silty clay loam
C2ca - 20 to 27 inches: silty clay loam
C3ca - 27 to 44 inches: loam
C4cag - 44 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Minor Components

Depressional soils

Percent of map unit: 3 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Ck—Chipman silty clay loam

Map Unit Setting

National map unit symbol: j6ws
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Chipman and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chipman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Apca - 0 to 8 inches: silty clay loam
Alg - 8 to 16 inches: silty clay loam
C1cag - 16 to 20 inches: silty clay loam
C2ca - 20 to 27 inches: silty clay loam
C3ca - 27 to 44 inches: loam
C4cag - 44 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C

Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Minor Components

Mcbeth

Percent of map unit: 5 percent
Landform: Lake terraces, alluvial fans, flood plains
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, convex, concave
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Ironton

Percent of map unit: 5 percent
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Bramwell

Percent of map unit: 5 percent

Cm—Chipman silty clay loam, moderately deep water table

Map Unit Setting

National map unit symbol: j6wt
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chipman and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chipman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Apca - 0 to 8 inches: silty clay loam
Alg - 8 to 16 inches: silty clay loam
C1cag - 16 to 20 inches: silty clay loam

C2ca - 20 to 27 inches: silty clay loam
C3ca - 27 to 44 inches: loam
C4cag - 44 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Minor Components

Depressional soils

Percent of map unit: 5 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Cn—Chipman silty clay loam, moderately saline

Map Unit Setting

National map unit symbol: j6wv
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chipman and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chipman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Apca - 0 to 8 inches: silty clay loam
Alg - 8 to 16 inches: silty clay loam
C1cag - 16 to 20 inches: silty clay loam
C2ca - 20 to 27 inches: silty clay loam
C3ca - 27 to 44 inches: loam
C4cag - 44 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Minor Components

Depressional soils

Percent of map unit: 3 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Strongly saline-alkali soils

Percent of map unit: 2 percent

Co—Chipman silty clay loam, strongly saline

Map Unit Setting

National map unit symbol: j6ww
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Chipman and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chipman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Apca - 0 to 8 inches: silty clay loam
Alg - 8 to 16 inches: silty clay loam
C1cag - 16 to 20 inches: silty clay loam
C2ca - 20 to 27 inches: silty clay loam
C3ca - 27 to 44 inches: loam
C4cag - 44 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Strongly saline (16.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 60.0
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D

Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Minor Components

Depressional soils

Percent of map unit: 3 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Cp—Chipman-McBeth complex

Map Unit Setting

National map unit symbol: j6wx
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chipman and similar soils: 60 percent
Mcbeth and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chipman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Apca - 0 to 8 inches: silty clay loam
Alg - 8 to 16 inches: silty clay loam
C1cag - 16 to 20 inches: silty clay loam
C2ca - 20 to 27 inches: silty clay loam
C3ca - 27 to 44 inches: loam
C4cag - 44 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches

Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Description of Mcbeth

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from mixed sources

Typical profile

Ap - 0 to 8 inches: silt loam
A1 - 8 to 12 inches: silt loam
C1g - 12 to 18 inches: silt loam
C2g - 18 to 24 inches: very fine sandy loam
C3g - 24 to 53 inches: silt loam
C4g - 53 to 68 inches: silt loam

Properties and qualities

Slope: 0 to 1 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 to high (0.60 to 2.00 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B/D
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

CrD—Cleverly cobbly sandy loam, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: j6wy
Elevation: 4,650 to 5,580 feet
Mean annual precipitation: 14 to 20 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Cleverly and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cleverly

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Slope alluvium derived from quartzite and/or sandstone

Typical profile

Ap - 0 to 7 inches: cobbly sandy loam
A1 - 7 to 16 inches: gravelly loam
B21 - 16 to 29 inches: gravelly loam
B3 - 29 to 42 inches: gravelly loam
Cca - 42 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 6 to 15 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

CsB—Cleverly gravelly fine sandy loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6wz
Elevation: 4,650 to 5,580 feet
Mean annual precipitation: 14 to 20 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Cleverly and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cleverly

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Slope alluvium derived from quartzite and/or sandstone

Typical profile

Ap - 0 to 7 inches: gravelly fine sandy loam
A1 - 7 to 16 inches: gravelly loam
B21 - 16 to 28 inches: gravelly loam
B3 - 28 to 42 inches: gravelly loam
Cca - 42 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 1 to 3 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

CsC—Cleverly gravelly fine sandy loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6x0
Elevation: 4,650 to 5,580 feet
Mean annual precipitation: 14 to 20 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Cleverly and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cleverly

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Slope alluvium derived from quartzite and/or sandstone

Typical profile

Ap - 0 to 7 inches: gravelly fine sandy loam
A1 - 7 to 16 inches: gravelly loam
B21 - 16 to 29 inches: gravelly loam
B3 - 29 to 42 inches: gravelly loam
Cca - 42 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 3 to 6 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

CsD—Cleverly gravelly fine sandy loam, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: j6x1
Elevation: 4,650 to 5,580 feet
Mean annual precipitation: 14 to 20 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Cleverly and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cleverly

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Slope alluvium derived from quartzite and/or sandstone

Typical profile

Ap - 0 to 7 inches: gravelly fine sandy loam
A1 - 7 to 16 inches: gravelly loam
B21 - 16 to 29 inches: gravelly loam
B3 - 29 to 42 inches: gravelly loam
Cca - 42 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 6 to 15 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

Minor Components

Kilburn

Percent of map unit: 5 percent

CU—Cobbly alluvial land

Map Unit Setting

National map unit symbol: j6wq
Elevation: 4,200 to 4,600 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 120 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Aquic xerofluvents and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Aquic Xerofluvents

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

H1 - 0 to 60 inches: extremely cobbly coarse sandy loam

Properties and qualities

Slope: 1 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): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B

Minor Components

Depressional soils

Percent of map unit: 5 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Da—Dagor loam

Map Unit Setting

National map unit symbol: j6x5
Elevation: 4,800 to 5,200 feet
Mean annual precipitation: 14 to 17 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Dagor and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dagor

Setting

Landform: Alluvial fans, flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Concave, linear
Across-slope shape: Convex, concave
Parent material: Alluvium derived from granite, quartzite and schist

Typical profile

Ap - 0 to 6 inches: loam
C1 - 6 to 24 inches: loam
C2 - 24 to 36 inches: loam
C3 - 36 to 60 inches: loam

Properties and qualities

Slope: 1 to 3 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Db—Dagor silt loam

Map Unit Setting

National map unit symbol: j6x6
Elevation: 4,800 to 5,200 feet
Mean annual precipitation: 14 to 17 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Dagor and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dagor

Setting

Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Concave, convex
Parent material: Alluvium derived from granite, quartzite and schist

Typical profile

Ap - 0 to 6 inches: silt loam
C1 - 6 to 24 inches: loam
C2 - 24 to 36 inches: loam
C3 - 36 to 60 inches: loam

Properties and qualities

Slope: 1 to 3 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 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

DCF—Dry Creek cobbly loam, 10 to 30 percent slopes

Map Unit Setting

National map unit symbol: j6x2
Elevation: 5,200 to 5,700 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Dry creek and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dry Creek

Setting

Landform: Hills, alluvial fans
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, concave
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from mixed sources

Typical profile

A1 - 0 to 5 inches: cobbly loam
A3 - 5 to 9 inches: cobbly loam
B21t - 9 to 15 inches: cobbly clay
B22t - 15 to 26 inches: cobbly clay
B3ca - 26 to 29 inches: very cobbly clay loam
Cca - 29 to 60 inches: very cobbly clay loam

Properties and qualities

Slope: 10 to 30 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 50 percent
Available water storage in profile: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Picayune

Percent of map unit: 5 percent

DEF—Dry Creek extremely stony loam, stony subsoil variant, 6 to 30 percent slopes

Map Unit Setting

National map unit symbol: j6x3
Elevation: 5,200 to 6,000 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Dry creek variant and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dry Creek Variant

Setting

Landform: Lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and/or slope alluvium derived from mixed sources

Typical profile

A1 - 0 to 4 inches: extremely stony loam
B1 - 4 to 10 inches: very cobbly clay loam
B21t - 10 to 14 inches: extremely cobbly clay loam
B22t - 14 to 20 inches: extremely cobbly clay loam
B3 - 20 to 30 inches: extremely cobbly sandy clay loam
C1ca - 30 to 43 inches: extremely cobbly sandy loam
C2 - 43 to 60 inches: extremely cobbly sandy loam

Properties and qualities

Slope: 6 to 30 percent
Percent of area covered with surface fragments: 20.0 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 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

DRG2—Dry Creek cobbly loam, thin surface variant, 30 to 60 percent slopes, eroded

Map Unit Setting

National map unit symbol: j6x4
Elevation: 5,200 to 5,700 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Dry creek and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dry Creek

Setting

Landform: Ridges, mountain slopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountainflank, interfluve, crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from mixed sources

Typical profile

A1 - 0 to 5 inches: cobbly loam
B21t - 5 to 15 inches: cobbly clay
B22t - 15 to 26 inches: cobbly clay
B3ca - 26 to 29 inches: very cobbly clay loam
Cca - 29 to 60 inches: very cobbly clay loam

Properties and qualities

Slope: 30 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 50 percent
Available water storage in profile: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Mountain Gravelly Loam (Oak) (R047XA410UT)

Minor Components

Picayune

Percent of map unit: 5 percent

GAG—Gappmayer cobbly loam, 50 to 70 percent slopes

Map Unit Setting

National map unit symbol: j6x7
Elevation: 5,500 to 7,100 feet
Mean annual precipitation: 18 to 25 inches
Mean annual air temperature: 41 to 45 degrees F
Frost-free period: 80 to 90 days
Farmland classification: Not prime farmland

Map Unit Composition

Gappmayer and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gappmayer

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from mixed sources

Typical profile

A1 - 0 to 6 inches: cobbly loam
A12 - 6 to 10 inches: very cobbly loam
A21 - 10 to 19 inches: very cobbly loam
A22 - 19 to 30 inches: very cobbly loam
B1 - 30 to 44 inches: very cobbly loam
B2t - 44 to 56 inches: extremely cobbly loam
B3 - 56 to 63 inches: extremely cobbly loam

Properties and qualities

Slope: 50 to 70 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: Mountain Gravelly Loam (Oak) (R047XA410UT)

Minor Components

Shallow soils

Percent of map unit: 8 percent

Rock outcrop

Percent of map unit: 7 percent

HEG—Henefer loam, 35 to 70 percent slopes

Map Unit Setting

National map unit symbol: j6x8
Elevation: 5,500 to 7,100 feet
Mean annual precipitation: 18 to 25 inches
Mean annual air temperature: 41 to 45 degrees F
Frost-free period: 80 to 90 days
Farmland classification: Not prime farmland

Map Unit Composition

Henefer and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Henefer

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from mixed sources

Typical profile

A11 - 0 to 3 inches: loam
A12 - 3 to 7 inches: loam
B11 - 7 to 15 inches: clay loam

B21t - 15 to 25 inches: cobbly clay
B22t - 25 to 33 inches: cobbly clay
B23t - 33 to 43 inches: cobbly clay
B3 - 43 to 58 inches: extremely cobbly clay
C - 58 to 65 inches: extremely cobbly clay

Properties and qualities

Slope: 35 to 70 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 low to moderately high (0.06 to 0.20 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 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Mountain Loam (Mountain Big Sagebrush) (R047XA430UT)

HFF—Henefer-McPhie association, 5 to 30 percent slopes

Map Unit Setting

National map unit symbol: j6x9
Elevation: 5,500 to 7,100 feet
Mean annual precipitation: 18 to 25 inches
Mean annual air temperature: 41 to 46 degrees F
Frost-free period: 80 to 90 days
Farmland classification: Not prime farmland

Map Unit Composition

Henefer and similar soils: 60 percent
Mcphie and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Henefer

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from mixed sources

Typical profile

A11 - 0 to 3 inches: loam
A12 - 3 to 7 inches: loam
B11 - 7 to 15 inches: clay loam
B21t - 15 to 25 inches: cobbly clay

B22t - 25 to 33 inches: cobbly clay
B23t - 33 to 43 inches: cobbly clay
B3 - 43 to 58 inches: extremely cobbly clay
C - 58 to 65 inches: extremely cobbly clay

Properties and qualities

Slope: 5 to 30 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 low to moderately high (0.06 to 0.20 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 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Mountain Loam (Mountain Big Sagebrush) (R047XA430UT)

Description of Mcphie

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from granite

Typical profile

A11 - 0 to 7 inches: sandy loam
A12 - 7 to 12 inches: loam
A2 - 12 to 24 inches: gravelly sandy loam
B&A - 24 to 30 inches: cobbly sandy loam
B21t - 30 to 38 inches: cobbly loam
B22t - 38 to 55 inches: cobbly loam
B3 - 55 to 60 inches: very cobbly sandy loam

Properties and qualities

Slope: 5 to 30 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 (0.60 to 2.00 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 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Mountain Gravelly Loam (Oak) (R047XA410UT)

HFG2—Henefer-McPhie association, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: j6xb
Elevation: 5,500 to 7,100 feet
Mean annual precipitation: 18 to 25 inches
Mean annual air temperature: 41 to 46 degrees F
Frost-free period: 80 to 90 days
Farmland classification: Not prime farmland

Map Unit Composition

Henefer and similar soils: 80 percent
Mcphie and similar soils: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Henefer

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from mixed sources

Typical profile

A11 - 0 to 3 inches: loam
A12 - 3 to 7 inches: loam
B11 - 7 to 15 inches: clay loam
B21t - 15 to 25 inches: cobbly clay
B22t - 25 to 33 inches: cobbly clay
B23t - 33 to 43 inches: cobbly clay
B3 - 43 to 58 inches: extremely cobbly clay
C - 58 to 65 inches: extremely cobbly clay

Properties and qualities

Slope: 30 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 low to moderately high (0.06 to 0.20 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 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Mountain Loam (Mountain Big Sagebrush) (R047XA430UT)

Description of Mcphie

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from granite

Typical profile

A12 - 0 to 7 inches: cobbly sandy loam
A11 - 7 to 12 inches: cobbly sandy loam
A2 - 12 to 24 inches: gravelly sandy loam
B&A - 24 to 30 inches: cobbly sandy loam
B21t - 30 to 38 inches: cobbly loam
B22t - 38 to 55 inches: cobbly loam
B3 - 55 to 60 inches: very cobbly sandy loam

Properties and qualities

Slope: 30 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: Mountain Gravelly Loam (Oak) (R047XA410UT)

HKG—Henefer-Rake association, 35 to 70 percent slopes

Map Unit Setting

National map unit symbol: j6xc
Elevation: 5,100 to 7,100 feet
Mean annual precipitation: 15 to 25 inches
Mean annual air temperature: 41 to 47 degrees F
Frost-free period: 80 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Rake and similar soils: 35 percent
Henefer and similar soils: 30 percent
Henefer and similar soils: 30 percent
Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rake

Setting

Landform: Ridges, mountain slopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountainflank, interfluve, crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from limestone and quartzite

Typical profile

A1 - 0 to 6 inches: stony loam
B2t - 6 to 13 inches: extremely cobbly clay loam
C1cam - 13 to 32 inches: indurated
C2ca - 32 to 37 inches: extremely stony sandy loam

Properties and qualities

Slope: 35 to 70 percent
Percent of area covered with surface fragments: 6.0 percent
Depth to restrictive feature: 10 to 20 inches to petrocalcic
Natural drainage class: Well 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: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 70 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: Mountain Shallow Loam (Mountain Big Sagebrush) (R047XA446UT)

Description of Henefer

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve, crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from mixed sources

Typical profile

A11 - 0 to 3 inches: loam
A12 - 3 to 7 inches: loam
B11 - 7 to 15 inches: clay loam
B21t - 15 to 25 inches: cobbly clay
B22t - 25 to 33 inches: cobbly clay
B23t - 33 to 43 inches: cobbly clay
B3 - 43 to 58 inches: very cobbly clay, extremely cobbly clay

B3 - 43 to 58 inches: very cobbly clay, extremely cobbly clay
C - 58 to 65 inches:
C - 58 to 65 inches:

Properties and qualities

Slope: 35 to 70 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Mountain Loam (Mountain Big Sagebrush) (R047XA430UT)

Description of Henefer

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve, crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from mixed sources

Typical profile

A11 - 0 to 3 inches: cobbly loam
A11 - 3 to 7 inches: cobbly loam
B11 - 7 to 15 inches: cobbly clay loam
B21t - 15 to 25 inches: cobbly clay
B22t - 25 to 33 inches: cobbly clay
B23t - 33 to 43 inches: cobbly clay
B3 - 43 to 58 inches: extremely cobbly clay
C - 58 to 65 inches: extremely cobbly clay

Properties and qualities

Slope: 35 to 50 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 low to moderately high (0.06 to 0.20 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 7.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Mountain Loam (Mountain Big Sagebrush) (R047XA430UT)

Minor Components

Picayune

Percent of map unit: 5 percent

HmE—Hillfield silt loam, 10 to 20 percent slopes

Map Unit Setting

National map unit symbol: j6xg
Elevation: 4,700 to 5,200 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Hillfield and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hillfield

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 4 inches: silt loam
AC - 4 to 12 inches: silt loam
C1ca - 12 to 26 inches: silt loam
C2ca - 26 to 35 inches: loam
C3ca - 35 to 40 inches: loam
IIC4 - 40 to 60 inches: sandy loam

Properties and qualities

Slope: 10 to 20 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 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 50 percent

Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Taylorsville

Percent of map unit: 5 percent

Welby

Percent of map unit: 5 percent

HmF—Hillfield silt loam, 20 to 30 percent slopes

Map Unit Setting

National map unit symbol: j6xh
Elevation: 4,700 to 5,200 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Hillfield and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hillfield

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 4 inches: silt loam
AC - 4 to 12 inches: silt loam
C1ca - 12 to 26 inches: silt loam
C2ca - 26 to 35 inches: loam
C3ca - 35 to 40 inches: loam
IIC4 - 40 to 60 inches: sandy loam

Properties and qualities

Slope: 20 to 30 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 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 50 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

HNG—Hillfield-Layton complex, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: j6xd
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 12 to 17 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Hillfield and similar soils: 60 percent
Layton and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hillfield

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 4 inches: silt loam
AC - 4 to 12 inches: silt loam
C1ca - 12 to 26 inches: silt loam
C2ca - 26 to 35 inches: loam

C3ca - 35 to 40 inches: loam
IIC4 - 40 to 60 inches: sandy loam

Properties and qualities

Slope: 30 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 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 50 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Description of Layton

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from sandstone and quartzite

Typical profile

A11 - 0 to 2 inches: loamy fine sand
A12 - 2 to 7 inches: loamy fine sand
AC - 7 to 14 inches: loamy fine sand
C1 - 14 to 26 inches: loamy fine sand
C2ca - 26 to 39 inches: loamy fine sand
C3ca - 39 to 60 inches: fine sand

Properties and qualities

Slope: 30 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): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e

Hydrologic Soil Group: A
Ecological site: Upland Sand (Black Greasewood, Indian Ricegrass) (R028AY330UT)

HOF—Hillfield-Sterling complex, 20 to 35 percent slopes

Map Unit Setting

National map unit symbol: j6xf
Elevation: 4,600 to 5,200 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Sterling and similar soils: 50 percent
Hillfield and similar soils: 50 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hillfield

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 4 inches: silt loam
AC - 4 to 12 inches: silt loam
C1ca - 12 to 26 inches: silt loam
C2ca - 26 to 35 inches: loam
C3ca - 35 to 40 inches: loam
IIC4 - 40 to 60 inches: sandy loam

Properties and qualities

Slope: 20 to 30 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 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 50 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Description of Sterling

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 5 inches: gravelly fine sandy loam
A1 - 5 to 11 inches: gravelly sandy loam
C1ca - 11 to 16 inches: gravelly sandy loam
C2ca - 16 to 21 inches: very gravelly sandy loam
C3ca - 21 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 20 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: Upland Stony Loam (Wyoming Big Sagebrush) (R028AY334UT)
Other vegetative classification: Upland Stony Loam (Mountain Big Sagebrush) (028AY334UT)

HpF—Hillfield-Welby silt loams, 6 to 35 percent slopes

Map Unit Setting

National map unit symbol: j6xj
Elevation: 4,500 to 5,200 feet

Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition
Hillfield and similar soils: 60 percent
Welby and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hillfield

Setting
Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile
Ap - 0 to 4 inches: silt loam
AC - 4 to 12 inches: silt loam
C1ca - 12 to 26 inches: silt loam
C2ca - 26 to 35 inches: loam
C3ca - 35 to 40 inches: loam
IIC4 - 40 to 60 inches: sandy loam

Properties and qualities
Slope: 20 to 30 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 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 50 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Description of Welby

Setting
Landform: Lake terraces, escarpments
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
AC - 12 to 22 inches: silt loam
C1ca - 22 to 40 inches: silt loam
C2ca - 40 to 54 inches: silt loam
C3 - 54 to 65 inches: silt loam

Properties and qualities

Slope: 6 to 10 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Hr—Holdaway silt loam

Map Unit Setting

National map unit symbol: j6xk
Elevation: 4,400 to 4,500 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Holdaway and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holdaway

Setting

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

Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 13 inches: silt loam
C1cag - 13 to 20 inches: silt loam
C2camg - 20 to 28 inches: indurated
C3cag - 28 to 32 inches: silt loam
C4cam-C6camg - 32 to 67 inches: cemented material

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 40 inches to petrocalcic
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 75 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 15.0
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: Wet Fresh Meadow (R028AY020UT)

Hs—Holdaway silt loam, strongly saline-alkali

Map Unit Setting

National map unit symbol: j6xl
Elevation: 4,400 to 4,500 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Holdaway and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holdaway

Setting

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

Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 13 inches: silt loam
C1cag - 13 to 20 inches: silt loam
C2camg - 20 to 28 inches: indurated
C3cag - 28 to 32 inches: silt loam
C4cam-C6camg - 32 to 67 inches: cemented material

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 40 inches to petrocalcic
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 75 percent
Salinity, maximum in profile: Strongly saline (16.0 to 40.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Ir—Ironton loam

Map Unit Setting

National map unit symbol: j6xm
Elevation: 4,500 to 4,550 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ironton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ironton

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 8 inches: loam
C1,2,3,cag - 8 to 32 inches: loam
IIC4g - 32 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 1 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 to high (0.60 to 2.00 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Is—Ironton loam, moderately saline-alkali

Map Unit Setting

National map unit symbol: j6xn
Elevation: 4,500 to 4,550 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Ironton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ironton

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 8 inches: loam
C1,2,3cag - 8 to 32 inches: loam
IIC4g - 32 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 1 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 to high (0.60 to 2.00 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B/D
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Jo—Jordan silt loam

Map Unit Setting

National map unit symbol: j6xp
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 48 degrees F
Farmland classification: Not prime farmland

Map Unit Composition

Jordan and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jordan

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

A1,A2 - 0 to 7 inches: silt loam
B2tsaca - 7 to 15 inches: clay
C1saca,C2ca - 15 to 55 inches: silty clay loam
C3 - 55 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 1 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): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 30 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Strongly saline (16.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 90.0
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Minor Components

Payson

Percent of map unit: 5 percent

KeA—Keigley silty clay loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: j6xt
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Keigley and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Keigley

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silty clay loam
A12,A13 - 7 to 27 inches: silty clay loam
C1,C2 - 27 to 65 inches: silty clay loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): 2c
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

KeB—Keigley silty clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6xv
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Keigley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Keigley

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silty clay loam
A12,A13 - 7 to 27 inches: silty clay loam
C1,C2 - 27 to 65 inches: silty clay loam

Properties and qualities

Slope: 1 to 3 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Pleasant vale

Percent of map unit: 5 percent

Taylorsville

Percent of map unit: 5 percent

Strongly saline soils

Percent of map unit: 5 percent

KgA—Keigley silty clay loam, extended season, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: j6xw
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Keigley and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Keigley

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silty clay loam
A12,A13 - 7 to 27 inches: silty clay loam
C1,C2 - 27 to 65 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

KmA—Kidman very fine sandy loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: j6xx
Elevation: 4,700 to 5,100 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Kidman and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kidman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from quartzite and/or sandstone

Typical profile

Ap - 0 to 8 inches: very fine sandy loam

B2 - 8 to 20 inches: very fine sandy loam
C1,C2 - 20 to 44 inches: very fine sandy loam
C3ca - 44 to 60 inches: loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: A
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Layton

Percent of map unit: 5 percent

Timpanogos

Percent of map unit: 5 percent

KmB—Kidman very fine sandy loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6xy
Elevation: 4,700 to 5,100 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Kidman and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kidman

Setting

Landform: Lake terraces

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from quartzite and/or sandstone

Typical profile

Ap - 0 to 8 inches: very fine sandy loam
B2 - 8 to 20 inches: very fine sandy loam
C1,C2 - 20 to 44 inches: very fine sandy loam
C3ca - 44 to 60 inches: loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

KmC—Kidman very fine sandy loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6xz
Elevation: 4,700 to 5,100 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Kidman and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kidman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from quartzite and/or sandstone

Typical profile

Ap - 0 to 8 inches: very fine sandy loam
B2 - 8 to 20 inches: very fine sandy loam
C1,C2 - 20 to 44 inches: very fine sandy loam
C3ca - 44 to 60 inches: loam

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Layton

Percent of map unit: 5 percent

KNG2—Kilburn very gravelly sandy loam, 30 to 50 percent slopes, eroded

Map Unit Setting

National map unit symbol: j6xq
Elevation: 4,600 to 5,700 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Kilburn and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kilburn

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from granite and quartzite

Typical profile

A11 - 0 to 8 inches: very gravelly sandy loam
A12 - 8 to 15 inches: very gravelly sandy loam
B2,B3 - 15 to 36 inches: very gravelly sandy loam
C1 - 36 to 40 inches: extremely gravelly sandy loam
C2ca - 40 to 60 inches: extremely gravelly sandy loam

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

Minor Components

Cleverly

Percent of map unit: 5 percent

Rock outcrop

Percent of map unit: 5 percent

KOD—Kilburn stony sandy loam, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: j6xr
Elevation: 4,600 to 5,700 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Kilburn and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kilburn

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from granite and quartzite

Typical profile

A11 - 0 to 8 inches: stony sandy loam
A12 - 8 to 15 inches: very stony sandy loam
A12 - 15 to 36 inches: very stony sandy loam
C1 - 36 to 40 inches: extremely stony sandy loam
C2ca - 40 to 60 inches: extremely stony sandy loam

Properties and qualities

Slope: 3 to 15 percent
Percent of area covered with surface fragments: 12.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

KRE2—Kilburn gravelly fine sandy loam, 15 to 30 percent slopes, eroded

Map Unit Setting

National map unit symbol: j6xs
Elevation: 4,600 to 5,700 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Kilburn and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kilburn

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from granite and quartzite

Typical profile

A11 - 0 to 8 inches: gravelly fine sandy loam
A12 - 8 to 15 inches: very gravelly sandy loam
B2,B3 - 15 to 36 inches: very gravelly sandy loam
C1 - 36 to 40 inches: extremely gravelly sandy loam
C2ca - 40 to 60 inches: extremely gravelly sandy loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

Ks—Kirkham silty clay loam

Map Unit Setting

National map unit symbol: j6y0
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Kirkham and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kirkham

Setting

Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Talf, dip

Down-slope shape: Linear, concave
Across-slope shape: Concave, convex
Parent material: Alluvium derived from sandstone, quartzite and granite

Typical profile

Ap - 0 to 11 inches: silty clay loam
C1,C2 - 11 to 28 inches: silty clay loam
C3 - 28 to 42 inches: silty clay
C4,C5 - 42 to 65 inches: silt loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Minor Components

Benjamin

Percent of map unit: 5 percent

Pleasant vale

Percent of map unit: 5 percent

Kt—Kirkham silty clay loam, moderately saline-alkali

Map Unit Setting

National map unit symbol: j6y1
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Kirkham and similar soils: 95 percent
Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kirkham

Setting

Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Concave, convex
Parent material: Alluvium derived from sandstone, quartzite and granite

Typical profile

Ap - 0 to 11 inches: silty clay loam
C1,C2 - 11 to 28 inches: silty clay loam
C3 - 28 to 42 inches: silty clay
C4,C5 - 42 to 65 inches: silt loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Minor Components

Strongly saine soils

Percent of map unit: 5 percent

Ku—Kirkham silty clay loam, strongly saline-alkali

Map Unit Setting

National map unit symbol: j6y2
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 150 to 170 days

Farmland classification: Not prime farmland

Map Unit Composition

Kirkham and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kirkham

Setting

Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Concave, convex
Parent material: Alluvium derived from sandstone, quartzite and granite

Typical profile

Ap - 0 to 11 inches: silty clay loam
C1,C2 - 11 to 28 inches: silty clay loam
C3 - 28 to 42 inches: silty clay
C4,C5 - 42 to 65 inches: silt loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 60.0
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Minor Components

Depressional soils

Percent of map unit: 5 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

LaC—Lakewin gravelly fine sandy loam, 1 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6y3
Elevation: 4,600 to 5,100 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Lakewin and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lakewin

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

A11,A12 - 0 to 10 inches: gravelly fine sandy loam
B21 - 10 to 17 inches: gravelly fine sandy loam
B22 - 17 to 27 inches: very gravelly sandy loam
IIC1&IIC2ca - 27 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

Minor Components

Sterling

Percent of map unit: 5 percent

Bingham

Percent of map unit: 5 percent

LaD—Lakewin gravelly fine sandy loam, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: j6y4
Elevation: 4,600 to 5,100 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Lakewin and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lakewin

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

A11,A12 - 0 to 8 inches: gravelly fine sandy loam
B21 - 8 to 17 inches: gravelly fine sandy loam
B22 - 17 to 27 inches: very gravelly sandy loam
IIC1&C2ca - 27 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

LcE—Lakewin cobbly fine sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: j6y5
Elevation: 4,600 to 5,100 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Lakewin and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lakewin

Setting

Landform: Lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

A11,A12 - 0 to 10 inches: cobbly fine sandy loam
B21 - 10 to 17 inches: gravelly fine sandy loam
B22 - 17 to 27 inches: very gravelly sandy loam
IIC1&C2ca - 27 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: A
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

Minor Components

Sterling

Percent of map unit: 5 percent

LeD—Layton loamy fine sand, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: j6y6
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Layton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Layton

Setting

Landform: Escarpments, terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from sandstone and quartzite

Typical profile

A11,A12,AC - 0 to 12 inches: loamy fine sand
C1 - 12 to 26 inches: loamy fine sand
C2ca - 26 to 39 inches: loamy fine sand
C3ca - 39 to 60 inches: fine sand

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): 4s

Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: Upland Sand (Black Greasewood, Indian Ricegrass) (R028AY330UT)

LfC—Layton fine sandy loam, 1 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6y7
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Layton and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Layton

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from sandstone and quartzite

Typical profile

A11,A12,AC - 0 to 7 inches: fine sandy loam
C1 - 7 to 26 inches: loamy fine sand
C2CA - 26 to 39 inches: loamy fine sand
C3CA - 39 to 60 inches: fine sand

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: Upland Sand (Black Greasewood, Indian Ricegrass) (R028AY330UT)

Minor Components

Preston

Percent of map unit: 5 percent

Kidman

Percent of map unit: 5 percent

LmA—Layton fine sandy loam, slowly permeable substratum, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: j6y8
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Layton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Layton

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from sandstone and quartzite

Typical profile

A11,A12,AC - 0 to 14 inches: fine sandy loam
C1 - 14 to 36 inches: loamy fine sand
C2ca - 36 to 48 inches: sandy clay loam
C3ca - 48 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 1 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 0.60 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Ecological site: Upland Sand (Black Greasewood, Indian Ricegrass) (R028AY330UT)

LnB—Layton fine sandy loam, water table, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6y9
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 42 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Layton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Layton

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from sandstone and quartzite

Typical profile

A11,A12,AC - 0 to 14 inches: fine sandy loam
C1 - 14 to 36 inches: loamy fine sand
C2ca - 36 to 48 inches: sandy clay loam
C3ca - 48 to 60 inches: fine sand

Properties and qualities

Slope: 1 to 3 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 0.60 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C

Ecological site: Upland Sand (Black Greasewood, Indian Ricegrass) (R028AY330UT)

Lo—Logan silty clay loam

Map Unit Setting

National map unit symbol: j6yb
Elevation: 4,450 to 4,550 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Logan and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Logan

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

O2 - 0 to 8 inches: peat
A11g,12g&O - 8 to 21 inches: silty clay loam
C123cag - 21 to 44 inches: silty clay loam
C4cag - 44 to 64 inches: silt loam
C5g - 64 to 85 inches: silty clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 50 percent
Salinity, maximum in profile: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Available water storage in profile: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C/D
Ecological site: Wet Fresh Meadow (R028AY020UT)

Minor Components

Chipman

Percent of map unit: 5 percent

Ironton

Percent of map unit: 5 percent
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Ls—Logan silty clay loam, heavy variant

Map Unit Setting

National map unit symbol: j6yc
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Logan variant and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Logan Variant

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silty clay loam
A12 - 7 to 16 inches: silty clay loam
ACca, C1ca - 16 to 39 inches: silty clay
A1b - 39 to 46 inches: silty clay loam
C2 - 46 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches

Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups
Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C/D
Ecological site: Wet Saline Meadow (Saltgrass) (R028AY024UT)

MAF—Manila silt loam, 10 to 30 percent slopes

Map Unit Setting
National map unit symbol: j6yd
Elevation: 5,000 to 6,000 feet
Mean annual precipitation: 18 to 25 inches
Mean annual air temperature: 41 to 45 degrees F
Frost-free period: 80 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition
Manila and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manila

Setting
Landform: Mountain slopes, fans
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex, concave
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from mixed sources

Typical profile
H1 - 0 to 6 inches: silt loam
H2 - 6 to 17 inches: clay loam
H3 - 17 to 42 inches: silty clay
H4 - 42 to 63 inches: cobbly clay loam
H5 - 63 to 73 inches: cobbly loam

Properties and qualities
Slope: 10 to 30 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.8 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Mountain Loam (Mountain Big Sagebrush) (R047XA430UT)

Minor Components

Henefer
Percent of map unit: 5 percent

Mf—Martini fine sandy loam

Map Unit Setting
National map unit symbol: j6yh
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Martini and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Martini

Setting
Landform: Alluvial fans, flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Concave, linear
Across-slope shape: Convex, concave
Parent material: Alluvium derived from mixed sources

Typical profile
Ap - 0 to 9 inches: fine sandy loam
A1 - 9 to 12 inches: fine sandy loam
C1 - 12 to 17 inches: fine sandy loam
C2 - 17 to 50 inches: sandy loam
C3 - 50 to 60 inches: loamy fine sand

Properties and qualities
Slope: 0 to 1 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): High (2.00 to 6.00 in/hr)

Depth to water table: About 42 to 60 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: Moderate (about 6.1 inches)

Interpretive groups
Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Minor Components

Depressional soils
Percent of map unit: 4 percent
Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Sunset
Percent of map unit: 3 percent

Strongly saline-alkali soils
Percent of map unit: 3 percent

Mh—McBeth silt loam

Map Unit Setting
National map unit symbol: j6yj
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Mcbeth and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mcbeth

Setting
Landform: Lake terraces, alluvial fans, flood plains
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, convex, concave

Parent material: Alluvium derived from mixed sources

Typical profile

Ap - 0 to 8 inches: silt loam
A1 - 8 to 12 inches: silt loam
C1g - 12 to 18 inches: silt loam
C2g - 18 to 24 inches: very fine sandy loam
C3g,C4g - 24 to 68 inches: silt loam

Properties and qualities

Slope: 0 to 1 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 to high (0.60 to 2.00 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B/D
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Minor Components

Chipman

Percent of map unit: 5 percent

Mn—McBeth silt loam, moderately saline

Map Unit Setting

National map unit symbol: j6yk
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Mcbeth and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mcbeth

Setting

Landform: Lake terraces, alluvial fans, flood plains
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, convex, concave
Parent material: Alluvium derived from mixed sources

Typical profile

Ap - 0 to 8 inches: silt loam
A1 - 8 to 12 inches: silt loam
C1g - 12 to 18 inches: silt loam
C2g - 18 to 24 inches: very fine sandy loam
C3g,C4g - 24 to 68 inches: silt loam

Properties and qualities

Slope: 0 to 1 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 to high (0.60 to 2.00 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: B/D
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

MrC—McMurdie silt loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6yl
Elevation: 4,800 to 5,100 feet
Mean annual precipitation: 16 to 20 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Mcmurdie and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mcmurdie

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silt loam
B1 - 7 to 11 inches: silt loam
B2t - 11 to 25 inches: silty clay
B3ca&C1ca - 25 to 47 inches: silty clay
C2ca - 47 to 63 inches: silty clay loam

Properties and qualities

Slope: 3 to 6 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Mountain Loam (Mountain Big Sagebrush) (R047XA430UT)

Minor Components

Parleys

Percent of map unit: 5 percent

MtE2—McMurdie-Taylorsville complex, 6 to 20 percent slopes, eroded

Map Unit Setting

National map unit symbol: j6ym
Elevation: 4,500 to 5,100 feet
Mean annual precipitation: 14 to 20 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Taylorsville and similar soils: 50 percent
Mcmurdie and similar soils: 50 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mcmurdie

Setting

Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silt loam
B1 - 7 to 11 inches: silt loam
B2t - 11 to 25 inches: silty clay
B3ca&C1ca - 25 to 47 inches: silty clay
C2ca - 47 to 63 inches: silty clay loam

Properties and qualities

Slope: 6 to 10 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Mountain Loam (Mountain Big Sagebrush) (R047XA430UT)

Description of Taylorsville

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve, crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Lacustrine deposits derived from limestone and shale

Typical profile

Ap - 0 to 7 inches: silty clay loam
AC - 7 to 13 inches: silty clay loam
C1,C2 - 13 to 36 inches: silty clay loam
C3ca - 36 to 56 inches: silty clay loam

C4 - 56 to 62 inches: silty clay loam

Properties and qualities

Slope: 6 to 20 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 25.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

MU—Mixed alluvial land

Map Unit Setting

National map unit symbol: j6yf
Elevation: 4,450 to 4,550 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Mixed alluvial land and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mixed Alluvial Land

Setting

Landform: Channels, streams
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from mixed sources

Typical profile

H1 - 0 to 6 inches: loam

H2 - 6 to 60 inches: gravelly clay loam

Properties and qualities

Slope: 0 to 10 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: Wet Fresh Streambank (R028AY022UT)

Minor Components

Depressional soils

Percent of map unit: 5 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

MX—Mixed alluvial land, saline

Map Unit Setting

National map unit symbol: j6yg
Elevation: 4,450 to 4,550 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Mixed alluvial land saline and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mixed Alluvial Land Saline

Setting

Landform: Channels, streams
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from mixed sources

Typical profile

H1 - 0 to 6 inches: sandy loam
H2 - 6 to 60 inches: gravelly clay loam

Properties and qualities

Slope: 0 to 10 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: D
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Minor Components

Depressional soils

Percent of map unit: 5 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

PaB—Parleys loam, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 2tjtg
Elevation: 4,210 to 5,400 feet
Mean annual precipitation: 12 to 18 inches

Mean annual air temperature: 49 to 51 degrees F
Frost-free period: 160 to 190 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Parleys and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Parleys

Setting

Landform: Lake terraces, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits and/or alluvium derived from igneous and sedimentary rock

Typical profile

Ap - 0 to 6 inches: loam
A - 6 to 15 inches: loam
Bt - 15 to 26 inches: clay loam
Bk - 26 to 33 inches: silty clay loam
CBk - 33 to 48 inches: silt loam
C - 48 to 60 inches: stratified fine sand to silty clay loam

Properties and qualities

Slope: 0 to 4 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 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 35 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

PaC—Parleys loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tjsx

Elevation: 4,210 to 5,910 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 49 to 51 degrees F
Frost-free period: 160 to 190 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Parleys and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Parleys

Setting

Landform: Lake terraces, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Lacustrine deposits and/or alluvium derived from igneous and sedimentary rock

Typical profile

Ap - 0 to 6 inches: loam
A - 6 to 11 inches: loam
Bt1 - 11 to 15 inches: silty clay loam
Bt2 - 15 to 19 inches: silty clay loam
Btk - 19 to 26 inches: silty clay loam
Bk - 26 to 30 inches: silty clay loam
CBk - 30 to 42 inches: silty clay loam
C1 - 42 to 52 inches: silty clay loam
C2 - 52 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: High (about 11.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

PbC—Parleys gravelly loam, overwashed, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6yy
Elevation: 4,650 to 5,000 feet
Mean annual precipitation: 15 to 20 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Parleys and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Parleys

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 10 inches: gravelly loam
B2t - 10 to 20 inches: silty clay loam
B3ca - 20 to 35 inches: silty clay loam
C1ca&C2 - 35 to 67 inches: silt loam

Properties and qualities

Slope: 3 to 6 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

PcB—Parleys silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6yz
Elevation: 4,650 to 5,000 feet
Mean annual precipitation: 15 to 20 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Parleys and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Parleys

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silty clay loam
B2t - 7 to 20 inches: silty clay loam
B3ca - 20 to 35 inches: silty clay loam
C1ca&C2 - 35 to 67 inches: silt loam

Properties and qualities

Slope: 0 to 3 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Pd—Payson silty clay loam

Map Unit Setting

National map unit symbol: j6z0
Elevation: 4,550 to 4,600 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Payson and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Payson

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone and shale

Typical profile

A21,A22 - 0 to 9 inches: silty clay loam
B1 - 9 to 14 inches: silty clay
B2t - 14 to 21 inches: clay
B3ca&C1ca - 21 to 33 inches: clay
C2ca - 33 to 48 inches: clay
C3 - 48 to 68 inches: clay

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 36 to 54 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 90.0
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

PEE—Payson-Terrace escarpments complex, 1 to 20 percent slopes, eroded

Map Unit Setting

National map unit symbol: j6yn
Elevation: 4,550 to 4,600 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 45 to 47 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Payson and similar soils: 45 percent
Terrace escarpments: 30 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Payson

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone and shale

Typical profile

A21,A22 - 0 to 9 inches: silty clay loam
B1 - 9 to 14 inches: silty clay
B2t - 14 to 21 inches: clay
B3ca&c1ca - 21 to 33 inches: clay
C2ca - 33 to 48 inches: clay
C3 - 48 to 68 inches: clay

Properties and qualities

Slope: 1 to 3 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 36 to 54 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 90.0
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w

Hydrologic Soil Group: C
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Description of Terrace Escarpments

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Minor Components

Saline-alkali soils

Percent of map unit: 25 percent

Pf—Peteetneet peat

Map Unit Setting

National map unit symbol: j6z1
Elevation: 4,450 to 4,500 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Peteetneet and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peteetneet

Setting

Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Organic material

Typical profile

011,012,021 - 0 to 15 inches: peat
022,023 - 15 to 60 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 13.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B/D
Ecological site: Wet Fresh Meadow (R028AY020UT)

Minor Components

Logan

Percent of map unit: 5 percent
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Wet Fresh Meadow (R028AY020UT)

Ironton

Percent of map unit: 5 percent
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Pg—Peteetneet-Holdaway complex

Map Unit Setting

National map unit symbol: j6z2
Elevation: 4,400 to 4,500 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Peteetneet and similar soils: 55 percent
Holdaway and similar soils: 40 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peteetneet

Setting

Landform: Depressions
Landform position (three-dimensional): Dip

Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Organic material

Typical profile

011,012,021 - 0 to 15 inches: peat
022,023 - 15 to 60 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 13.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B/D
Ecological site: Wet Fresh Meadow (R028AY020UT)

Description of Holdaway

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 13 inches: silt loam
C1cag - 13 to 20 inches: silt loam
C2camg - 20 to 28 inches: indurated
C3cag - 28 to 32 inches: silt loam
C4cam-C6camg - 32 to 67 inches: cemented material

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 40 inches to petrocalcic
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 75 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 15.0
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: Wet Fresh Meadow (R028AY020UT)

Minor Components

Logan

Percent of map unit: 5 percent
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Wet Fresh Meadow (R028AY020UT)

PHG2—Picayune cobbly silt loam, 35 to 70 percent slopes, eroded

Map Unit Setting

National map unit symbol: j6yp
Elevation: 5,500 to 7,500 feet
Mean annual precipitation: 18 to 24 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 80 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Picayune and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Picayune

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from limestone and quartzite

Typical profile

A1 - 0 to 6 inches: cobbly silt loam
B2 - 6 to 12 inches: cobbly silty clay loam
B31ca - 12 to 23 inches: cobbly silt loam
B32ca - 23 to 29 inches: cobbly clay loam
C1ca - 29 to 60 inches: cobbly silt loam

Properties and qualities

Slope: 35 to 70 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Mountain Loam (Mountain Big Sagebrush) (R047XA430UT)

Minor Components

Rake

Percent of map unit: 5 percent

PIF—Picayune cobbly loam, red variant, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: j6yq
Elevation: 5,500 to 7,500 feet
Mean annual precipitation: 18 to 24 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 80 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Picayune and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Picayune

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from limestone and quartzite

Typical profile

A1&B2 - 0 to 10 inches: cobbly loam
B3ca - 10 to 16 inches: cobbly clay loam
C1ca - 16 to 24 inches: clay loam

Cr - 24 to 28 inches: unweathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Mountain Loam (Mountain Big Sagebrush) (R047XA430UT)

Minor Components

Rake

Percent of map unit: 5 percent

Picayune

Percent of map unit: 5 percent

PJG2—Picayune-Rake association, 35 to 70 percent slopes, eroded

Map Unit Setting

National map unit symbol: j6yr
Elevation: 5,100 to 7,500 feet
Mean annual precipitation: 15 to 24 inches
Mean annual air temperature: 43 to 48 degrees F
Frost-free period: 80 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Picayune and similar soils: 60 percent
Rake and similar soils: 35 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Picayune

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Convex

Across-slope shape: Convex
Parent material: Colluvium derived from limestone and quartzite

Typical profile

A1 - 0 to 6 inches: cobbly silt loam
B2 - 6 to 12 inches: cobbly silty clay loam
B31ca - 12 to 23 inches: cobbly silt loam
B32ca - 23 to 29 inches: cobbly clay loam
C1ca - 29 to 60 inches: cobbly silt loam

Properties and qualities

Slope: 35 to 70 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Mountain Loam (Mountain Big Sagebrush) (R047XA430UT)

Description of Rake

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from limestone and quartzite

Typical profile

A1 - 0 to 6 inches: extremely stony loam
B2t - 6 to 13 inches: extremely cobbly clay loam
C1cam - 13 to 32 inches: indurated
C2ca - 32 to 37 inches: extremely stony sandy loam

Properties and qualities

Slope: 20 to 70 percent
Percent of area covered with surface fragments: 12.0 percent
Depth to restrictive feature: 10 to 20 inches to petrocalcic
Natural drainage class: Well 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: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 70 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water storage in profile: Very low (about 0.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: Mountain Shallow Loam (Mountain Big Sagebrush) (R047XA446UT)

Minor Components

Rock outcrop

Percent of map unit: 5 percent

PK—Pits and dumps

Map Unit Setting

National map unit symbol: j6ys
Elevation: 4,490 to 4,900 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pits: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

PIC—Pleasant Grove gravelly loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6z3
Elevation: 4,600 to 5,700 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pleasant grove and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pleasant Grove

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex

Parent material: Colluvium and/or slope alluvium derived from limestone, quartzite and shale

Typical profile

A11,A12 - 0 to 6 inches: gravelly loam
A13 - 6 to 21 inches: cobbly loam
C1ca - 21 to 38 inches: very cobbly loam
C2ca - 38 to 49 inches: very cobbly fine sandy loam
C3ca - 49 to 60 inches: very cobbly loam

Properties and qualities

Slope: 3 to 6 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

PlD—Pleasant Grove gravelly loam, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: j6z4
Elevation: 4,600 to 5,700 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pleasant grove and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pleasant Grove

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from limestone, quartzite and shale

Typical profile

A11&A12 - 0 to 6 inches: gravelly loam
A13 - 6 to 21 inches: cobbly loam
C1ca - 21 to 38 inches: very cobbly loam
C2ca - 38 to 49 inches: very cobbly fine sandy loam
C3ca - 49 to 60 inches: very cobbly loam

Properties and qualities

Slope: 6 to 10 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

PmE2—Pleasant Grove stony loam, 10 to 25 percent slopes, eroded

Map Unit Setting

National map unit symbol: j6z5
Elevation: 4,600 to 5,700 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Pleasant grove and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pleasant Grove

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from limestone, quartzite and shale

Typical profile

A11&A12 - 0 to 2 inches: stony loam

A13 - 2 to 21 inches: cobbly loam
C1ca - 21 to 38 inches: very cobbly loam
C2ca - 38 to 49 inches: very cobbly fine sandy loam
C3ca - 49 to 60 inches: very cobbly loam

Properties and qualities

Slope: 10 to 25 percent
Percent of area covered with surface fragments: 10.0 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

PnA—Pleasant Vale loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: j6z6
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pleasant vale and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pleasant Vale

Setting

Landform: Alluvial fans, flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Concave, linear
Across-slope shape: Convex, concave
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

Ap - 0 to 6 inches: loam
A1 - 6 to 17 inches: loam

C1 - 17 to 24 inches: very fine sandy loam
C2 - 24 to 40 inches: very fine sandy loam
C3&C4 - 40 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 2 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 2c
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

PNG2—Pleasant Grove-Terrace escarpments complex, 30 to 60 percent slopes, eroded

Map Unit Setting

National map unit symbol: j6yt
Elevation: 4,600 to 5,700 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Pleasant grove and similar soils: 80 percent
Terrace escarpments: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pleasant Grove

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Colluvium and/or slope alluvium derived from limestone, quartzite and shale

Typical profile

A11&A12 - 0 to 2 inches: stony loam
A13 - 2 to 21 inches: cobbly loam
C1ca - 21 to 38 inches: very cobbly loam
C2ca - 38 to 49 inches: very cobbly fine sandy loam
C3ca - 49 to 60 inches: very cobbly loam

Properties and qualities

Slope: 30 to 60 percent
Percent of area covered with surface fragments: 10.0 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: Upland Gravelly Loam (Bonneville Big Sagebrush) (R028AY306UT)

Description of Terrace Escarpments

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

PoA—Pleasant Vale loam, extended season, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: j6z7
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pleasant vale and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pleasant Vale

Setting

Landform: Alluvial fans, flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Concave, linear
Across-slope shape: Convex, concave
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

Ap - 0 to 6 inches: loam
A1 - 6 to 17 inches: loam
C1 - 17 to 24 inches: very fine sandy loam
C2 - 24 to 40 inches: very fine sandy loam
C3,C4 - 40 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 2 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

PoC—Pleasant Vale loam, extended season, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6z8
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pleasant vale and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pleasant Vale

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

Ap - 0 to 6 inches: loam
A1 - 6 to 12 inches: loam
C1 - 12 to 24 inches: very fine sandy loam
C2 - 24 to 40 inches: very fine sandy loam
C3,C4 - 40 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 3 to 6 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

PpB—Pleasant Vale gravelly loam, extended season, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6z9
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pleasant vale and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pleasant Vale

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

Ap - 0 to 6 inches: gravelly loam
A1 - 6 to 17 inches: gravelly sandy loam
C1 - 17 to 24 inches: very fine sandy loam
C2 - 24 to 40 inches: very fine sandy loam
C3,C4 - 40 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 1 to 3 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: Moderate (about 8.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

PrD—Pleasant Vale gravelly sandy loam, extended season, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: j6zb
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Pleasant vale and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pleasant Vale

Setting

Landform: Hills, lake terraces
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

Ap - 0 to 6 inches: gravelly sandy loam
A1 - 6 to 17 inches: gravelly sandy loam
C1 - 17 to 24 inches: very fine sandy loam
C2 - 24 to 40 inches: very fine sandy loam
C3,C4 - 40 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

PsB—Pleasant Vale silty clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6zc
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pleasant vale and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pleasant Vale

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

Ap - 0 to 8 inches: silty clay loam
A1 - 8 to 14 inches: loam
C1 - 14 to 24 inches: very fine sandy loam
C2 - 24 to 40 inches: very fine sandy loam
C3,C4 - 40 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 1 to 3 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

PtB—Pleasant View fine sandy loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6zd
Elevation: 4,800 to 5,100 feet
Mean annual precipitation: 17 to 20 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days

Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pleasant view and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pleasant View

Setting

Landform: Channels
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from mixed sources

Typical profile

Ap - 0 to 6 inches: fine sandy loam
C1,C2 - 6 to 23 inches: fine sandy loam
IIC3ca - 23 to 30 inches: gravelly sandy loam
IIC4ca - 30 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: Semimoist Streambank (Narrowleaf Cottonwood) (R047XA002UT)

PuD—Preston fine sand, 1 to 10 percent slopes

Map Unit Setting

National map unit symbol: j6zf
Elevation: 4,500 to 4,750 feet
Mean annual precipitation: 14 to 19 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Preston and similar soils: 95 percent
Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Preston

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind worked lacustrine deposits derived from sandstone and quartzite

Typical profile

A11 - 0 to 3 inches: fine sand
A12 - 3 to 17 inches: fine sand
C2,A1b.C2 - 17 to 60 inches: fine sand

Properties and qualities

Slope: 1 to 10 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to strongly saline (0.0 to 20.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: Upland Sand (Black Greasewood, Indian Ricegrass) (R028AY330UT)

Minor Components

Layton

Percent of map unit: 5 percent

Pv—Preston loamy fine sand, high water table variant

Map Unit Setting

National map unit symbol: j6zg
Elevation: 4,500 to 4,650 feet
Mean annual precipitation: 14 to 19 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Preston, wet, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Preston, Wet

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind worked lacustrine deposits derived from sandstone and quartzite

Typical profile

A1 - 0 to 3 inches: loamy fine sand
C1 - 3 to 8 inches: fine sand
A1b - 8 to 15 inches: loamy fine sand
C2,C3,C4 - 15 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Pw—Provo gravelly fine sandy loam

Map Unit Setting

National map unit symbol: j6zh
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 11 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Provo and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Provo

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

Ap - 0 to 7 inches: gravelly fine sandy loam
A1g - 7 to 15 inches: gravelly fine sandy loam
C1g - 15 to 25 inches: extremely gravelly sand
IIC2 - 25 to 40 inches: extremely gravelly loamy sand
IIC3 - 40 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 1 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): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B
Ecological site: Semiwet Fresh Streambank (R028AY014UT)

Minor Components

Sunset

Percent of map unit: 5 percent

Px—Provo-Sunset complex

Map Unit Setting

National map unit symbol: j6zj
Elevation: 4,500 to 4,900 feet

Mean annual precipitation: 11 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Provo and similar soils: 70 percent
Sunset and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Provo

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

Ap - 0 to 7 inches: gravelly fine sandy loam
Alg - 7 to 15 inches: gravelly fine sandy loam
C1g - 15 to 25 inches: extremely gravelly sand
IIC2 - 25 to 40 inches: extremely gravelly loamy sand
IIC3 - 40 to 60 inches: extremely gravelly sand

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): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B
Ecological site: Semiwet Fresh Streambank (R028AY014UT)

Description of Sunset

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, granite and shale

Typical profile

Ap - 0 to 7 inches: loam
A1 - 7 to 14 inches: loam

C1,C2,C3 - 14 to 41 inches: stratified very fine sandy loam to loam
C4,C5 - 41 to 60 inches: stratified loam to silty clay loam

Properties and qualities

Slope: 0 to 3 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 to high (0.60 to 2.00 in/hr)
Depth to water table: About 30 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: C
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

PY—Provo Bay peaty silt loam

Map Unit Setting

National map unit symbol: j6yv
Elevation: 4,450 to 5,000 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 120 to 130 days
Farmland classification: Not prime farmland

Map Unit Composition

Provo bay and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Provo Bay

Setting

Landform: Valley floors, flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from mixed sources

Typical profile

A11ca,A12gca - 0 to 8 inches: peaty silt loam
A13gca - 8 to 13 inches: silty clay loam
A14gca - 13 to 22 inches: clay loam

C1 - 22 to 33 inches: loam
C2 - 33 to 60 inches: silt loam

Properties and qualities
Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: C/D
Ecological site: Wet Fresh Meadow (R028AY020UT)

Pz—Provo Bay silty clay loam

Map Unit Setting
National map unit symbol: j6zk
Elevation: 4,450 to 5,000 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 120 to 130 days
Farmland classification: Not prime farmland

Map Unit Composition
Provo bay and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Provo Bay

Setting
Landform: Depressions on valley floors
Landform position (three-dimensional): Dip, talf
Down-slope shape: Concave, linear
Across-slope shape: Concave
Parent material: Alluvium derived from mixed sources

Typical profile
A11ca,A12gca - 0 to 8 inches: silty clay loam
A13gca - 8 to 13 inches: silty clay loam
A14gca - 13 to 22 inches: clay loam
C1 - 22 to 33 inches: loam
C2 - 33 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Ecological site: Wet Fresh Meadow (R028AY020UT)

RAG2—Rake extremely stony loam, 20 to 70 percent slopes, eroded

Map Unit Setting

National map unit symbol: j6zl
Elevation: 5,100 to 6,500 feet
Mean annual precipitation: 15 to 18 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Rake and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rake

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from limestone and quartzite

Typical profile

A1 - 0 to 6 inches: extremely stony loam
B2t - 6 to 13 inches: extremely cobbly clay loam
C1cam - 13 to 32 inches: indurated
C2ca - 32 to 37 inches: very stony sandy loam, extremely stony sandy loam
C2ca - 32 to 37 inches:

Properties and qualities

Slope: 20 to 70 percent
Percent of area covered with surface fragments: 13.0 percent
Depth to restrictive feature: 10 to 20 inches to petrocalcic
Natural drainage class: Well 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: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 70 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 0.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: Mountain Shallow Loam (Mountain Big Sagebrush) (R047XA446UT)

Minor Components

Rock outcrop

Percent of map unit: 3 percent

RdA—Redola loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6zp
Elevation: 4,600 to 5,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Redola and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Redola

Setting

Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Concave, convex
Parent material: Alluvium derived from limestone and sandstone

Typical profile

Ap - 0 to 8 inches: loam
C1,C2 - 8 to 30 inches: loam
C3 - 30 to 50 inches: stratified gravelly coarse sand to very fine sandy loam
IIC4 - 50 to 60 inches: gravelly coarse sand

Properties and qualities

Slope: 0 to 3 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.1 inches)

Interpretive groups

Land capability classification (irrigated): 2c
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: Loamy Bottom (Great Basin Wildrye) (R028AY006UT)
Other vegetative classification: Loamy Bottom (Great Basin Wildrye) (028AY006UT)

Minor Components

Martin

Percent of map unit: 5 percent

ReC—Redola gravelly loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6zq
Elevation: 4,600 to 5,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Redola and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Redola

Setting

Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Talf, dip

Down-slope shape: Linear, concave
Across-slope shape: Concave, convex
Parent material: Alluvium derived from limestone and sandstone

Typical profile

Ap - 0 to 8 inches: gravelly loam
C1,C2 - 8 to 30 inches: loam
C3 - 30 to 50 inches: stratified gravelly coarse sand to very fine sandy loam
IIC4 - 50 to 60 inches: gravelly coarse sand

Properties and qualities

Slope: 3 to 6 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy Bottom (Great Basin Wildrye) (R028AY006UT)
Other vegetative classification: Loamy Bottom (Great Basin Wildrye) (028AY006UT)

RV—Riverwash

Map Unit Setting

National map unit symbol: j6zm
Elevation: 4,500 to 4,800 feet
Farmland classification: Not prime farmland

Map Unit Composition

Riverwash: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverwash

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from sandstone and quartzite

Typical profile

H1 - 0 to 60 inches: extremely cobbly coarse sandy loam

Properties and qualities

Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 13 to 24 inches
Frequency of flooding: Frequent
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: Low (about 3.6 inches)

RW—Rock land

Map Unit Setting

National map unit symbol: j6zn
Elevation: 4,500 to 4,800 feet
Farmland classification: Not prime farmland

Map Unit Composition

Rock land: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rock Land

Setting

Landform: Cliffs, ledges
Down-slope shape: Linear
Across-slope shape: Linear

Minor Components

Rake

Percent of map unit: 5 percent

Pleasant grove

Percent of map unit: 5 percent

Sd—Steed sandy loam

Map Unit Setting

National map unit symbol: j6zs
Elevation: 4,550 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Steed and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Steed

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

A1 - 0 to 7 inches: sandy loam
C1 - 7 to 31 inches: extremely gravelly loamy sand
C2,C3 - 31 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: Semiwet Fresh Streambank (R028AY014UT)

Se—Steed gravelly sandy loam

Map Unit Setting

National map unit symbol: j6zt
Elevation: 4,550 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Steed and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Steed

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

A1 - 0 to 7 inches: gravelly sandy loam
C1 - 7 to 31 inches: extremely gravelly loamy sand
C2,C3 - 31 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: Semiwet Fresh Streambank (R028AY014UT)

Minor Components

Provo

Percent of map unit: 5 percent

SgB—Sterling gravelly fine sandy loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6zv
Elevation: 4,600 to 5,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sterling and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sterling

Setting

Landform: Benches, lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 5 inches: gravelly fine sandy loam
A1 - 5 to 11 inches: gravelly sandy loam
C1ca - 11 to 16 inches: gravelly sandy loam
C2ca - 16 to 21 inches: very gravelly sandy loam
C3ca - 21 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: Upland Stony Loam (Wyoming Big Sagebrush) (R028AY334UT)
Other vegetative classification: Upland Stony Loam (Mountain Big Sagebrush) (028AY334UT)

SgC—Sterling gravelly fine sandy loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6zw
Elevation: 4,600 to 5,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sterling and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sterling

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 5 inches: gravelly fine sandy loam
A1 - 5 to 11 inches: gravelly sandy loam
C1ca - 11 to 16 inches: gravelly sandy loam
C2ca - 16 to 21 inches: very gravelly sandy loam
C3ca - 21 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: Upland Stony Loam (Wyoming Big Sagebrush) (R028AY334UT)
Other vegetative classification: Upland Stony Loam (Mountain Big Sagebrush) (028AY334UT)

SgD—Sterling gravelly fine sandy loam, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: j6zx
Elevation: 4,600 to 5,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sterling and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sterling

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 5 inches: gravelly fine sandy loam
A1 - 5 to 11 inches: gravelly sandy loam
C1ca - 11 to 16 inches: gravelly sandy loam
C2ca - 16 to 21 inches: very gravelly sandy loam
C3ca - 21 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: Upland Stony Loam (Wyoming Big Sagebrush) (R028AY334UT)
Other vegetative classification: Upland Stony Loam (Mountain Big Sagebrush) (028AY334UT)

SNG—Sterling-Terrace escarpments complex, 30 to 70 percent slopes

Map Unit Setting

National map unit symbol: j6zr
Elevation: 4,600 to 5,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Sterling and similar soils: 60 percent
Terrace escarpments: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sterling

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 5 inches: cobbly fine sandy loam
A1 - 5 to 11 inches: gravelly sandy loam
C1ca - 11 to 16 inches: gravelly sandy loam
C2ca - 16 to 21 inches: very gravelly sandy loam
C3ca - 21 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 30 to 70 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: Upland Stony Loam (Wyoming Big Sagebrush) (R028AY334UT)
Other vegetative classification: Upland Stony Loam (Mountain Big Sagebrush) (028AY334UT)

Description of Terrace Escarpments

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

So—Sunset loamy fine sand

Map Unit Setting

National map unit symbol: j6zy

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Sunset and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sunset

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, granite and shale

Typical profile

Ap - 0 to 7 inches: loamy fine sand
A1 - 7 to 14 inches: loam
C1,C2,C3 - 14 to 41 inches: stratified very fine sandy loam to loam
C4,C5 - 41 to 60 inches: stratified loam to silty clay loam

Properties and qualities

Slope: 0 to 1 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 to high (0.60 to 2.00 in/hr)
Depth to water table: About 42 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Sr—Sunset loam

Map Unit Setting

National map unit symbol: j6zz
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sunset and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sunset

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, granite and shale

Typical profile

Ap - 0 to 7 inches: loam
A1 - 7 to 14 inches: loam
C1,C2,C3 - 14 to 41 inches: stratified very fine sandy loam to loam
C4,C5 - 41 to 60 inches: stratified loam to silty clay loam

Properties and qualities

Slope: 0 to 3 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 to high (0.60 to 2.00 in/hr)
Depth to water table: About 30 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: C
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Ss—Sunset loam, gravelly substratum

Map Unit Setting

National map unit symbol: j700
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days

Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sunset and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sunset

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, granite and shale

Typical profile

Ap - 0 to 7 inches: loam
A1 - 7 to 14 inches: loam
C1,C2,C3 - 14 to 20 inches: very fine sandy loam
C4,C5 - 20 to 60 inches: stratified gravelly loamy sand to gravelly sandy loam

Properties and qualities

Slope: 0 to 1 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 to high (0.60 to 2.00 in/hr)
Depth to water table: About 42 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: B
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Minor Components

Sunset

Percent of map unit: 25 percent

St—Sunset loam, clay substratum

Map Unit Setting

National map unit symbol: j701

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sunset and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sunset

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, granite and shale

Typical profile

Ap - 0 to 7 inches: loam
A1 - 7 to 14 inches: loam
C1,C2,C3 - 14 to 20 inches: very fine sandy loam
C4,C5 - 20 to 60 inches: clay

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 42 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Su—Sunset loam, moderately saline

Map Unit Setting

National map unit symbol: j702
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F

Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Sunset and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sunset

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, granite and shale

Typical profile

Ap - 0 to 7 inches: loam
A1 - 7 to 14 inches: loam
C1,C2,C3 - 14 to 41 inches: stratified very fine sandy loam to loam
C4,C5 - 41 to 60 inches: stratified loam to silty clay loam

Properties and qualities

Slope: 0 to 1 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 to high (0.60 to 2.00 in/hr)
Depth to water table: About 42 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

Minor Components

Strongly saline-alkali soils

Percent of map unit: 5 percent

Kirkham

Percent of map unit: 5 percent

TaA—Taylorsville silty clay loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: j703
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Taylorsville and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Taylorsville

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone and shale

Typical profile

Ap - 0 to 7 inches: silty clay loam
AC - 7 to 13 inches: silty clay loam
C1,C2 - 13 to 36 inches: silty clay loam
C3ca - 36 to 56 inches: silty clay loam
C4 - 56 to 62 inches: silty clay loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 25.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C

Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Bramwell
Percent of map unit: 5 percent

TaB—Taylorsville silty clay loam, 1 to 3 percent slopes

Map Unit Setting
National map unit symbol: j704
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Taylorsville and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Taylorsville

Setting
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone and shale

Typical profile
Ap - 0 to 7 inches: silty clay loam
AC - 7 to 13 inches: silty clay loam
C1,C2 - 13 to 36 inches: silty clay loam
C3ca - 36 to 56 inches: silty clay loam
C4 - 56 to 62 inches: silty clay loam

Properties and qualities
Slope: 1 to 3 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent

Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 25.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Bramwell

Percent of map unit: 5 percent

TcA—Taylorsville silty clay loam, extended season, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: j705
Elevation: 4,530 to 4,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Taylorsville and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Taylorsville

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone and shale

Typical profile

Ap - 0 to 7 inches: silty clay loam
AC - 7 to 13 inches: silty clay loam
C1,C2 - 13 to 36 inches: silty clay loam
C3ca - 36 to 56 inches: silty clay loam
C4 - 56 to 62 inches: silty clay loam

Properties and qualities

Slope: 0 to 1 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 25.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

TcB—Taylorsville silty clay loam, extended season, 1 to 3 percent slopes

Map Unit Setting
National map unit symbol: j706
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Taylorsville and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Taylorsville

Setting
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone and shale

Typical profile
Ap - 0 to 7 inches: silty clay loam
AC - 7 to 13 inches: silty clay loam
C1,C2 - 13 to 36 inches: silty clay loam
C3ca - 36 to 56 inches: silty clay loam
C4 - 56 to 62 inches: silty clay loam

Properties and qualities
Slope: 1 to 3 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 25.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

TcC2—Taylorsville silty clay loam, extended season, 3 to 6 percent slopes, eroded

Map Unit Setting

National map unit symbol: j707
Elevation: 4,530 to 4,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Taylorsville and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Taylorsville

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone and shale

Typical profile

Ap - 0 to 7 inches: silty clay loam
AC - 7 to 13 inches: silty clay loam
C,C2 - 13 to 36 inches: silty clay loam
C3ca - 36 to 56 inches: silty clay loam
C4 - 56 to 62 inches: silty clay loam

Properties and qualities

Slope: 3 to 6 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 25.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

TmB—Timpanogos loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: j708
Elevation: 4,700 to 4,900 feet
Mean annual precipitation: 15 to 18 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Timpanogos and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Timpanogos

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, quartzite and granite

Typical profile

Ap - 0 to 9 inches: loam
B2t - 9 to 14 inches: loam
B3ca - 14 to 18 inches: loam

C1ca,C2ca - 18 to 48 inches: silt loam
IIC3 - 48 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 0 to 3 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Parleys

Percent of map unit: 5 percent

Kidman

Percent of map unit: 5 percent

TmC—Timpanogos loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j709
Elevation: 4,700 to 4,900 feet
Mean annual precipitation: 15 to 18 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Timpanogos and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Timpanogos

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, quartzite and granite

Typical profile

Ap - 0 to 9 inches: loam
B2t - 9 to 14 inches: loam
B3ca - 14 to 18 inches: loam
C1ca,C2ca - 18 to 48 inches: silt loam
IIC3 - 48 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 3 to 6 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Welby

Percent of map unit: 5 percent

Parleys

Percent of map unit: 5 percent

ToB—Timpanogos loam, water table, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: j70b
Elevation: 4,700 to 4,900 feet

Mean annual precipitation: 15 to 18 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Timpanogos and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Timpanogos

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, quartzite and granite

Typical profile

Ap - 0 to 9 inches: loam
B2t - 9 to 14 inches: loam
B3ca - 14 to 18 inches: loam
C1ca,C2ca - 18 to 48 inches: silt loam
IIC3 - 48 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 0 to 3 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 to high (0.60 to 2.00 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): 2c
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Welby

Percent of map unit: 5 percent

UL—Urban land

Map Unit Setting

National map unit symbol: j6w9
Elevation: 4,480 to 4,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

VnA—Vineyard fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: j70c
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Vineyard and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Vineyard

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: fine sandy loam
AC - 7 to 13 inches: fine sandy loam
C1ca,C2ca - 13 to 35 inches: fine sandy loam
C3ca - 35 to 42 inches: very fine sandy loam
C4 - 42 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 2 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): High (2.00 to 6.00 in/hr)

Depth to water table: About 30 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 7.6 inches)

Interpretive groups
Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A
Ecological site: Semiwet Fresh Meadow (R028AY012UT)

Minor Components

Timpanogos
Percent of map unit: 5 percent

Welby
Percent of map unit: 5 percent

VsA—Vineyard fine sandy loam, moderately saline, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: j70d
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition
Vineyard and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Vineyard

Setting
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile
Ap - 0 to 7 inches: fine sandy loam
B2t - 7 to 13 inches: fine sandy loam
B3ca - 13 to 35 inches: fine sandy loam
C1ca,C2ca - 35 to 42 inches: very fine sandy loam
IIC3 - 42 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 2 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): High (2.00 to 6.00 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: Alkali Bottom (Alkali Sacaton) (R028AY001UT)

W—Water

Map Unit Setting

National map unit symbol: j70s
Elevation: 4,470 to 4,720 feet
Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

WbA—Welby silt loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: j70f
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Welby and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
Ac - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 0 to 1 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2c
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Taylorsville

Percent of map unit: 5 percent

Vineyard

Percent of map unit: 5 percent

WbB—Welby silt loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j70g
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Welby and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
AC - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 1 to 3 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

WbC—Welby silt loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j70h
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F

Frost-free period: 130 to 170 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Welby and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
AC - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 3 to 6 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Taylorsville

Percent of map unit: 5 percent

WeA—Welby silt loam, extended season, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: j70j
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Welby and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
AC - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 0 to 1 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)

Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Timpanogos

Percent of map unit: 5 percent

WeB—Welby silt loam, extended season, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j70k
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Welby, c3, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby, C3

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
AC - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 1 to 3 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Timpanogos

Percent of map unit: 5 percent

WeC—Welby silt loam, extended season, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j70l
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Welby and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
AC - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 3 to 6 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

WeD2—Welby silt loam, extended season, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: j70m
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Welby and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
AC - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 6 to 10 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Minor Components

Hillfield
Percent of map unit: 5 percent

Timpanogos
Percent of map unit: 5 percent

WhD—Welby-Hillfield silt loams, 6 to 10 percent slopes

Map Unit Setting
National map unit symbol: j70n
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Welby and similar soils: 60 percent
Hillfield and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby

Setting
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile
Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
AC - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 6 to 10 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Description of Hillfield

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 4 inches: silt loam
AC - 4 to 12 inches: silt loam
C1ca - 12 to 26 inches: silt loam
C2ca - 26 to 35 inches: loam
C3ca - 35 to 40 inches: loam
IIC4 - 40 to 60 inches: sandy loam

Properties and qualities

Slope: 6 to 10 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 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 50 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

WhE—Welby-Hillfield silt loams, 10 to 30 percent slopes

Map Unit Setting

National map unit symbol: j70p
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Welby and similar soils: 60 percent
Hillfield and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby

Setting

Landform: Lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
AC - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 10 to 20 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 (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

Description of Hillfield

Setting

Landform: Lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 4 inches: silt loam
AC - 4 to 12 inches: silt loam
C1ca - 12 to 26 inches: silt loam
C2ca - 26 to 35 inches: loam
C3ca - 35 to 40 inches: loam
IIC4 - 40 to 60 inches: sandy loam

Properties and qualities

Slope: 20 to 30 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 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 50 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Upland Loam (Bonneville Big Sagebrush) North (R028AY310UT)
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)

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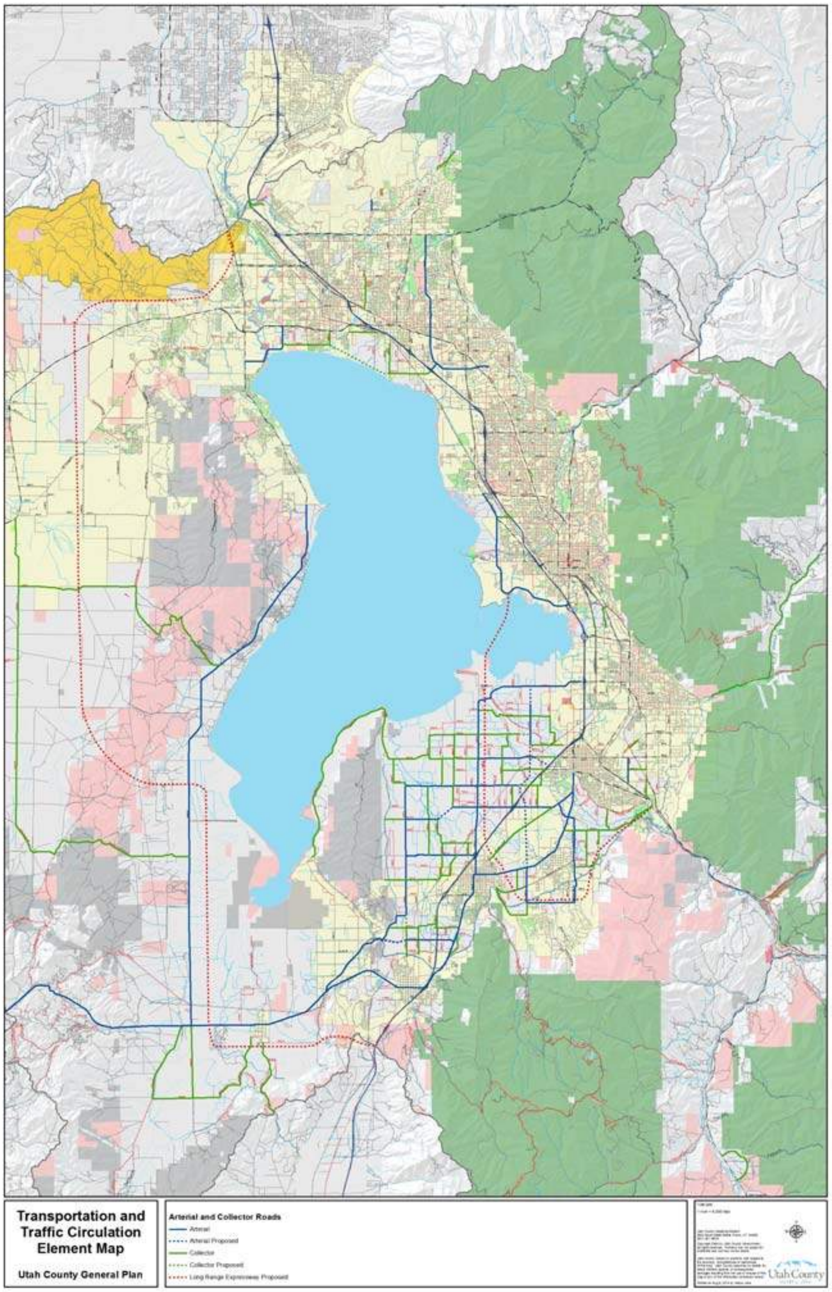
Appendix B

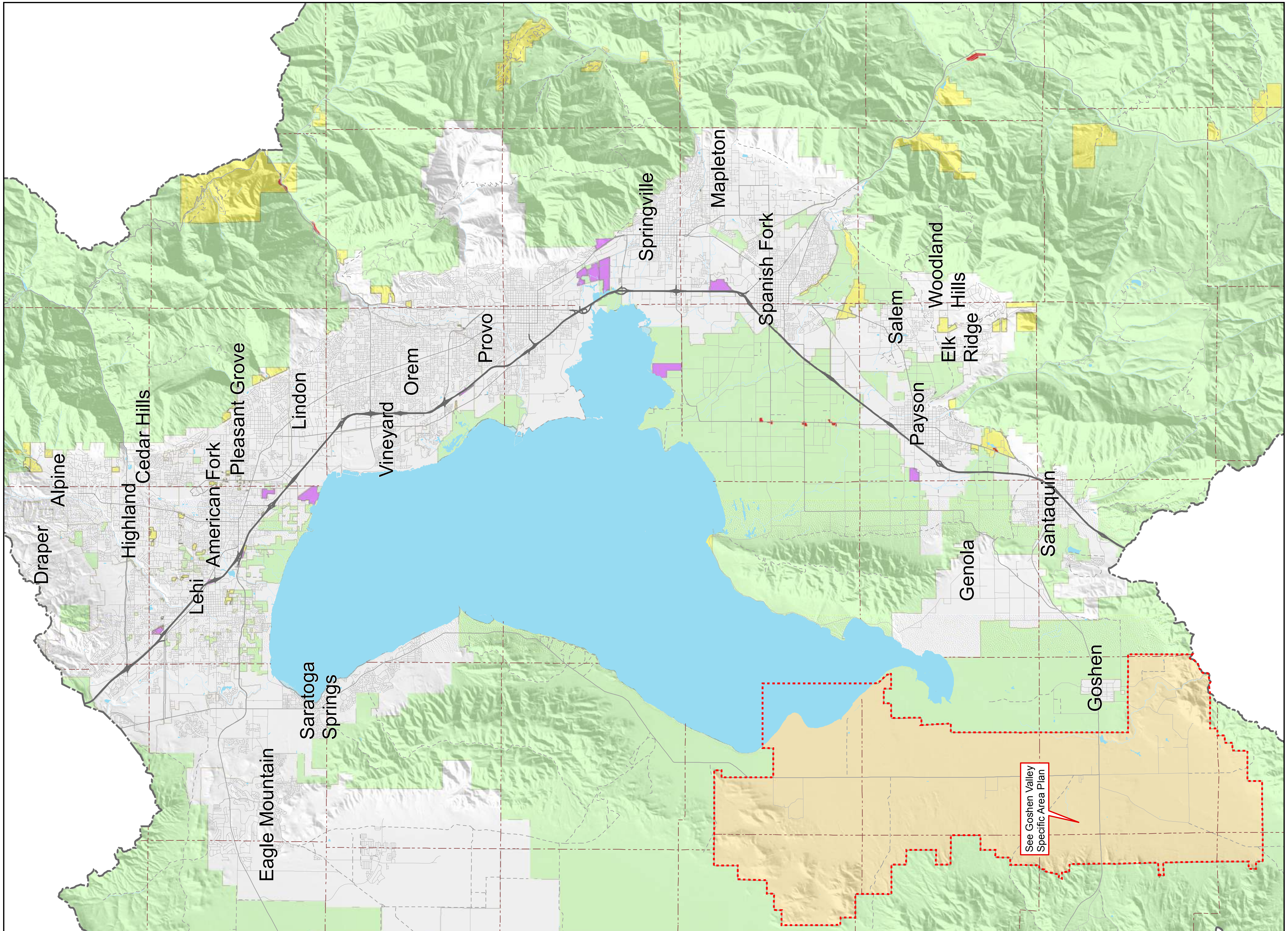
Utah County Land Use

General Plan, Land Use Element Map

The Utah County General Plan, *Land Use Element Map*, illustrates the five areas of the Utah County General Plan, *Land Use Element Plan*. This land use plan and land use map, along with the goals, objectives and policies element; the moderate income housing element; the transportation and traffic circulation element; and the environmental element; make up the advisory guidelines for the comprehensive development and long-range land use planning for the unincorporated lands of Utah County, Utah.


Transportation and Traffic Circulation Element Map
Utah County General Plan
Arterial and Collector Roads
Arterial
Arterial Proposed
Collector
Collector Proposed
Long Range Expressway Proposed
Utah County

Land Use Element Map



Utah County General Plan

N

1:197,871
1 inch = 3.12 miles

County Boundary
Township Lines
Stream or River

Roads
I-15
Highway or State Road
Paved Roads
Dirt Roads
Gravel Roads

County Land Use
Agricultural/Watershed
Commercial
Incorporated
Manufacturing
Residential
Utah Lake
Goshen Valley Area Plan

Utah County
HEART of UTAH

Utah County Information Systems GIS Division
2855 South State Street
Provo, UT 84606
(801) 851-8626

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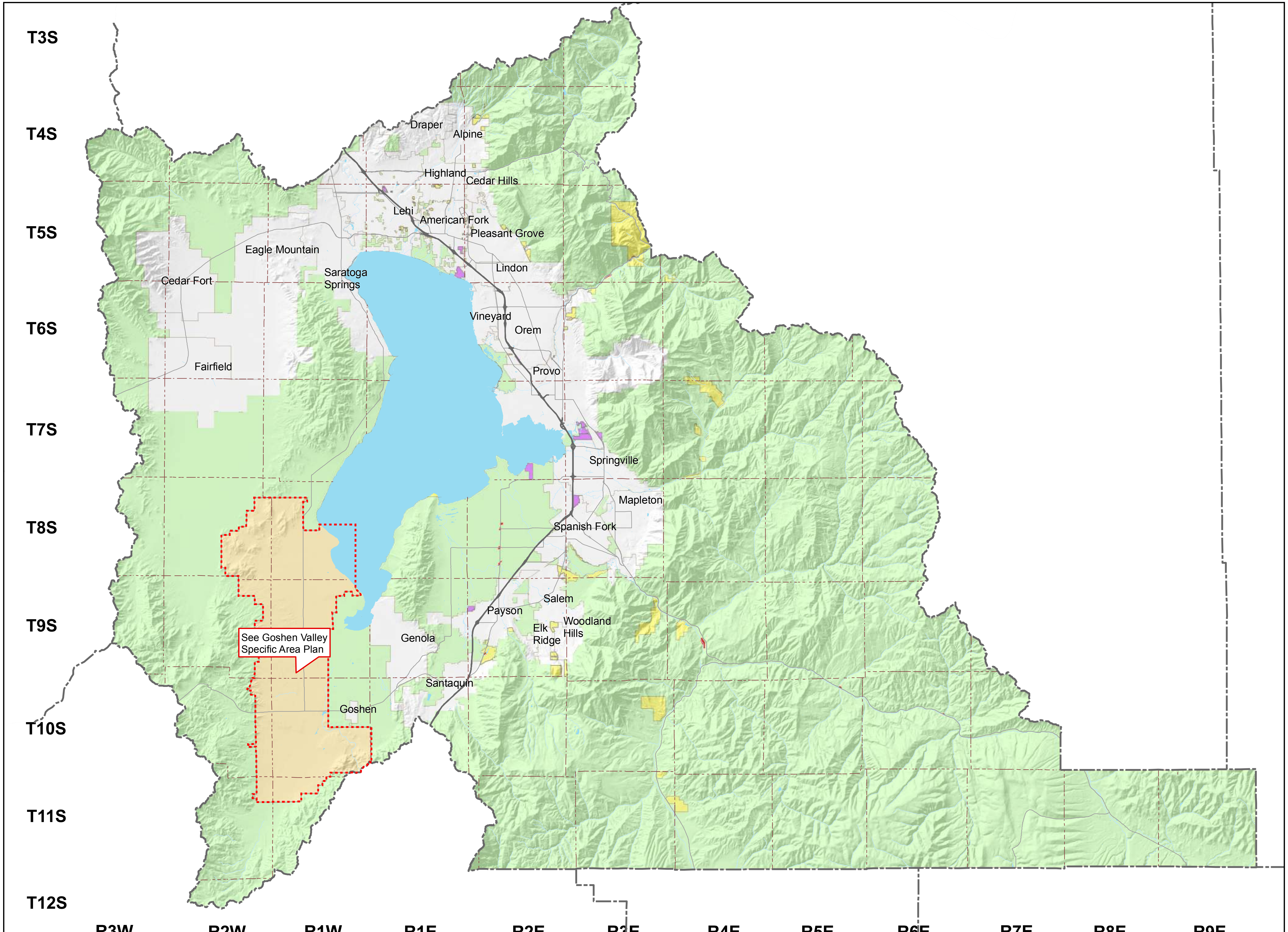
Land Use Element Map

Utah County General Plan



N

1:356,944
1 inch = 5.63 miles

- County Boundary
- Township Lines
- Stream or River

Roads

- I-15
- Highway or State Road

County Land Use

- Agricultural/Watershed
- Commercial
- Incorporated
- Manufacturing
- Residential
- Utah Lake
- Goshen Valley Area Plan

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Appendix C

Water Conservation and Management Plan

Water Conservation Plan
For
Payson City, Utah

November 4, 2015

TABLE OF CONTENTS

1. INTRODUCTION

In response to the rapid growth occurring throughout the state of Utah, Payson City citizens and leaders are becoming concerned for the future cost and availability of the water supply. A similar concern has been demonstrated by the state legislature in the Water Conservation Plan Act (House Bill 153) passed and revised in the 1999 legislative session (Section 73-10-32 Utah Code Annotated). This water conservation plan is written to address the concerns of leaders and citizens of both Payson City and the state of Utah.

2. DESCRIPTION OF PAYSON CITY AND ITS WATER SYSTEM

Located in at the southern end of Utah County, and in the second driest state in the nation, Payson City's 2010 population was approximately 18,295. Payson City's current service area is approximately 7,192 acres. Providing water to meet the needs of its citizens has always been a top priority of city leaders and planners. As a result, Payson's well-maintained and operated water system provides the citizens of Payson City with water when and where needed. Currently, the water system provides water to 5,430 residential, 350 combined commercial, industrial, and institutional (public) connections.

Payson City residents and their leaders place a high value on open space. Consequently, 220 acres of land in the city have been set aside as parks and a cemetery. The golf course and landscaped areas around schools, churches and major industries occupy approximately another 230 acres. Payson City still has approximately 1,200 acres of vacant land in agricultural zones, more than 200 vacant acres in industrial zones, and more than 180 acres in undeveloped residential zones.

Payson City is presently receiving a small portion of the county's residential, commercial and industrial growth. This growth is causing small changes in the way the land within the city limits is being utilized, but as of now we are able with our present water supply and delivery system to meet demands. Through careful planning and efficient utilization of available water supplies these increased needs can and will be met.

Payson City's culinary water system is owned and operated by Payson City Corporation. The system serves the residents of Payson City and a small number of the residents in the adjoining unincorporated areas of the county. Water from Peteetneet Creek and/or nearby springs has been used since the settling of the City in the 1850s. It is estimated that the first modern water storage tank was constructed sometime in the 1940s. The distribution system throughout the City has been added to, since the early 1900s. The water sources consist of 9 springs located in Payson Canyon to the south-east of the City and 5 underground wells located within the City limits. Water storage is contained in three storage tanks, (2) 2.5 MG and (1) 0.6 MG, located at the mouth of Payson Canyon.

Significant water conservation was achieved in 1991-2 by installing a pressurized irrigation system throughout the City. The pressurized irrigation system is a completely separate system from the culinary system and is saving close to 4500 acre-feet of culinary water per year over flood irrigation. This system provides pressurized irrigation water to each residence for lawn and garden watering so that culinary water is not needed or used for those purposes. As an addition to the pressurized irrigation a process of implementing a sewer effluent reuse project which has the potential to reuse up to 4,700 acre-feet of culinary water per year has been accomplished. This is done by pumping effluent water into both the Nebo Power Plant and Payson City's pressurized irrigation system. For more information on the reuse plan please refer to Payson City's January 26, 2004 "Sewer Effluent Reuse Project Plan".

2.1. Inventory of Water Resources

Payson City has been withdrawing approximately 1,200 acre-feet of culinary water annually from an underlying aquifer through wells. This has supplied about half of the total water required to meet demands on the culinary system which provides for both indoor water uses. The remaining water need of the city's 18,295 people comes from the 9 springs in Payson Canyon.

Potable water for future city residents will, for the most part come from our current sources and shares turned over to Payson City Corporation by land developers as part of development agreements. For planning purposes the amount withdrawn from the 5 wells will be held below 7,000 acre-feet.

The city owns 266.2 acre feet in South Utah Valley Municipal Water Association (SUVMWA). SUVMWA is an association made up of ten cities in South Utah County for the purpose of helping provide for the member cities' water needs. Water provided under these shares is, and will continue to be, used for irrigation of city owned parks and open spaces.

Under current water rights the city is entitled to withdraw 7,119 acre-feet of culinary water annually from wells as shown below. This amount of water shares should be enough to supply Payson City's culinary needs until the population exceeds 35,000. Furthermore current irrigation water rights entitle Payson City to use 6,322 acre-feet of annually from canyon springs and wells as shown below. This amount of irrigation water shares should be enough to supply Payson City's irrigation needs until the population exceeds 31,000.

Table 1 City-Owned Water Rights

WR #	*POINT OF DIVERSION*	*Quantity Acft*	*USES OF WATER RIGHT*
51-1053	Underground Water Wells	5.4	Irrigation Water
51-1063	Peteetneet Creek, Streams & Springs	11 cfs	Hydro-Electric Power Plant
51-1266	Surface Runoff Water	1400	Spring Lake
51-1313	Underground Water Wells	3608	Culinary Water
51-1711	Dixon Spring	96	Culinary Water
51-1762	Underground Water Wells	0.37	Culinary Water
51-1763	Underground Water Wells	27	Culinary Water
51-2694	Underground Water Wells	122.1	Irrigation Water
51-2868	Underground Water Wells	724	Irrigation Water
51-3781	Underground Water Wells	52	Irrigation Water
51-4766	Underground Water Wells	33.9	Culinary Water
51-5402	Peteetneet Creek, Streams & Springs	50 cfs	Hydro-Electric Power Plant
51-6055	Underground Water Wells	152	Culinary Water
51-6272	Peteetneet Creek, Streams & Springs	3260	Irrigation Water
51-7052	Underground Water Wells	29.6	Culinary Water
51-7113	Underground Water Wells	186.3	Culinary Water
51-7114	Underground Water Wells	101.6	Culinary Water
51-7146	Underground Water Wells	69	Culinary Water
51-7161	Underground Water Wells	31.5	Culinary Water
51-7170	Underground Water Wells	266.2	Irrigation Water
51-7173	Underground Water Wells	327	Culinary Water
51-7191	Utah Lake and Jordan River	41.31	Irrigation Water
51-7192	Underground Water Wells	135.5	Culinary Water

51-7194	Underground Water Wells	9.68	Culinary Water
51-7197	Utah Lake and Jordan River	163.3	Irrigation Water
51-7198	Utah Lake and Jordan River	224.8	Irrigation Water
51-7203	Underground Water Wells	48.4	Culinary Water
51-7224	Underground Water Wells	48.4	Culinary Water
51-7228	Underground Water Wells	28	Culinary Water
51-7241	Underground Water Wells	48.4	Culinary Water
51-7244	Underground Water Wells	4.9	Culinary Water
51-7247	Underground Water Wells	72.6	Culinary Water
51-7250	Underground Water Wells	103.7	Culinary Water
51-7251	Underground Water Wells	51.9	Culinary Water
51-7268	Underground Water Wells	4.8	Culinary Water
51-7277	Underground Water Wells	151	Culinary Water
51-7278	Underground Water Wells	96.8	Culinary Water
51-7294	Underground Water Wells	9.7	Culinary Water
51-7303	Underground Water Wells	9.7	Culinary Water
51-7314	Underground Water Wells	53.2	Culinary Water
51-7315	Underground Water Wells	203.3	Culinary Water
51-7316	Underground Water Wells	4.8	Culinary Water
51-7328	Underground Water Wells	27.5	Culinary Water
51-7336	Underground Water Wells	203.3	Culinary Water
51-7388	Underground Water Wells	0.5	Culinary Water
51-7400	Underground Water Wells	27.5	Culinary Water
51-7403	Underground Water Wells	48.4	Culinary Water
51-7551	Underground Water Wells	212.95	Culinary Water
51-7555	Underground Water Wells	47.2	Culinary Water
51-7572	Underground Water Wells	3.8	Culinary Water
51-7580	Underground Water Wells	4.8	Culinary Water
51-7614	Underground Water Wells	24.2	Culinary Water
51-7615	Underground Water Wells	47.2	Culinary Water
55-9505	Utah Lake and Jordan River	62.9	Irrigation Water
	Total Culinary Water	7119	Acre-Feet
	Total Irrigation Water	6322	Acre-Feet

2.2. Water Budgets

The following table shows the amount of water delivered into the water system and the metered outflows to end-users for the years 2011 to 2015.

Table 2 City Water Budget - 2011 through 2015

Inflow (AF)				***Outflow (AF)***				
Year	Springs	Wells	Total	Residential	Commercial	Industrial	Total	Difference
2011	638,266	279,312	2815.94	N/A	N/A	N/A	2139.24	-24%
2012	565,977	412,051	3001.45	N/A	N/A	N/A	2361.03	-21%
2013	445,975	565,071	3102.78	N/A	N/A	N/A	2257.61	-27%
2014	485,683	685,575	3594.45	N/A	N/A	N/A	2695.84	-25%
2015	513,272	578,604	3350.84	N/A	N/A	N/A	2580.15	-23%

Average annual losses from the system are about 24 percent for the five years of record.

2.3. Present Water Use and Future Water Needs

When all uses of culinary grade water are compared with the number of people living in Payson City over the last 5 years, residents use 154.8 gallons of treated water per capita per day (gpcd) compared to the statewide average of 185 gpcd.

The un-metered secondary irrigation system installed in 1991-2 is saving close to an average of 178.0 gpcd of culinary water.

Payson City Culinary Water system consists of nine springs located in Payson Canyon and four deep wells located in the City limits. The total combined water right from these sources is 13,441 acre-ft/year. Since the installation of the PI system in 1991-2, the culinary water usage has increased together with the population of Payson.

The extent of the city's estimated future population growth through the year 2050 is shown in Figure 1. Many factors influence this projection, and the estimates shown may vary substantially from the actual population experienced.

The UAMPS Nebo Power Plant has recently been constructed in the city and is using large volumes of treated city water and effluent in its production process. Payson City also has an active Economic Development Plan that is targeting industrial users to occupy our business park. Furthermore, there is a large cherry processing operation that requires a significant amount of high quality production water.

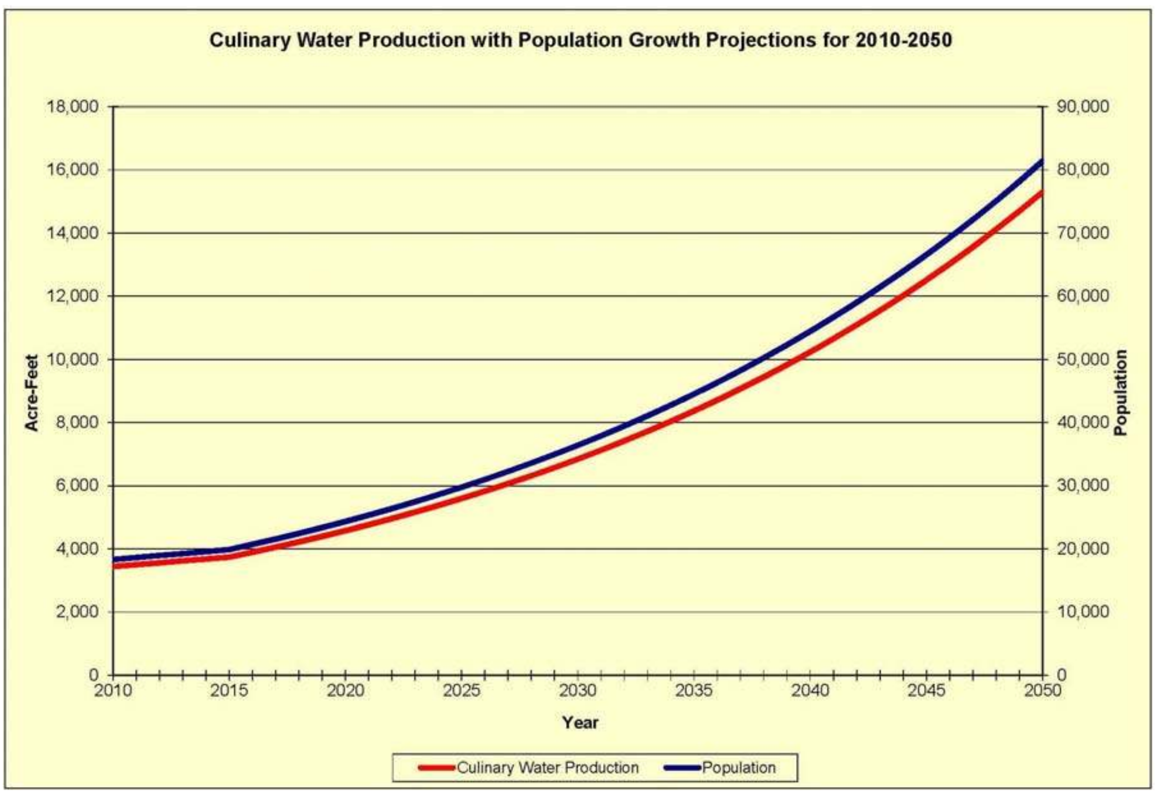

Figure 1 Culinary water production graphed with population growth projected through 2050. Projections are based on maintaining an average Payson City goal of 140 gpcd culinary water usage. Payson city has also made it a goal to reduce the irrigation water usage form 178 gpcd to 169 gpcd as part of the 5% reduction goal.

3. WATER PROBLEMS, CONSERVATION MEASURES AND GOALS

Problems Identified

The Water Conservation Committee, in its recent report, identified and prioritized several problems during the investigative phase of their work. The following are the items identified:

- The current water pricing and billing system, while currently being adjusted to adequately cover expenses in the water enterprise account, lacks incentives and sufficient information for residents and businesses to use water more efficiently.
- Citizens lack information and understanding of landscaping water requirements and efficient water-use habits and practices: Very few residents know how much water is required to maintain healthy landscaped areas and how to consistently use water efficiently indoors. Most citizens' irrigation and indoor practices are based on convenience rather than plant needs and water supply considerations.
- Existing meters are providing inaccurate data due to age and obsolescence. Many meters have been in service for more than 10 years and need to be replaced. Furthermore many of the well meters need to be replaced with automatic read meters.
- Many trees and shrubs on the city's acceptable plants list are high water users. Trees and shrubs on the city's list are preferred because they have non-intrusive root systems.
- Political consequences prevent water rates from keeping up with increasing costs: With the currently available methods for setting water rates, city council action is required for each adjustment. Raising rates often is deferred as long as possible because of political risks to members of the city council.
- Haskellville (an unincorporated area of Utah County east of Payson City) has 25 connections on Salem cannel Road which have low flow and pressure.
- Payson City's water system has several outdated lines that have been in service for more than 40 years and are in need of replacement. These lines are most likely the largest source of system water losses. ***We estimate that 20-25% of our loss may be due to inaccurate meters and leaking lines.***
- Some residents are not changed over to the pressurized irrigation system for outdoor watering.

Each problem represents an opportunity. Aside from replacement of meters, replacement of old lines and high water-use landscaping, the opportunity exists to solve the above problems through a well-thought-out water pricing program.

In addition to a new pricing and billing system, the opportunity exists to prepare a new generation of wise-water users. This can be assisted with a strong sustained water education program in the public and private schools.

Additional opportunities can be found in two of the remaining problems. Old meters may provide an opportunity for the city to begin a program to replace old meters with modern remote-read meters that can create substantial savings through reduced labor. High water using plants on an "acceptable plants list" could provide an opportunity for the Urban Forestry Committee to undertake research to find additional water thrifty plants that do not have intrusive root systems, and may improve landscape quality and appearance. Landscaping along existing and future roads in the city could be more easily maintained if low water-use shrubs and mulches were used instead of Kentucky blue grass. All this will help solve the last problem identified by reducing peak demands and the need for expensive water system upgrades.

3.1. Water Conservation Goals

In pursuit of solutions to the problems identified previously, and in light of the variety of conservation measures available to solve these problems, the following goals have been identified:

- GOAL #1

  Reduce the city's per capita water use rate by at least 5 percent in five years, 147 gallons of treated water and 169 gallons of untreated water per capita per day (gpcd). The 10 year average water-use rate goal is 140 gallons of treated water and 148 gallons of untreated water per capita per day (gpcd). The ultimate long term goal is to bring these down to a combined 280 gpcd.

- GOAL #2

  Maintain a financially viable water system. The water pricing system should encourage customers to reduce use without creating a revenue shortfall.

- GOAL #3

  Maintain or improve the appearance of street landscapes, open spaces and yards. Improved irrigation practices and water efficient landscapes can enhance the beauty of the city. Annual surveys of citizen attitudes will measure satisfaction, or lack thereof, with landscapes on city-owned properties and rights-of-way.

- GOAL #4

  Installation of Secondary Irrigation Meters. Payson City has actively pursued irrigation meter grant and funding opportunities. With the installation of irrigation meters, it is believed that water conservation will be obtained. As users are held financial responsible for individual water usage, unwanted, disregarded waste and use of water will be avoided.

4. CURRENT CONSERVATION PRACTICES

In order to solve the problems identified above and take advantage of the many associated opportunities, specific water conservation measures must be identified and evaluated. Payson City has already implemented several water conservation measures; these, along with additional measures that will effectively solve Payson City's water problems, are discussed below.

Payson City's current water conservation program is directed primarily at managing water shortages and providing useful material to assist residents to use water more efficiently. Current measures include a water conservation contingency plan, water education program for outdoor and indoor water use, and a conservation oriented water rate structure.

4.1. Water Conservation Contingency Plan

The city has a "Water Conservation Contingency Plan" dated December 2004, which spells out climate and political realities related to water use during drought or other water supply shortages. Also addressed in this report are the conservation measures that may be implemented during times of emergency. They are as follows:

4.1.1. Level 1 – Normal Years

- Eliminate watering on city property from 10 a.m. to 6 p.m.
- Initiate voluntary public conservation measures.
- Issue information to all customers on conservation procedures each can accomplish around their own property and within their own homes.

4.1.2. Level 2 – 75% of Normal

- Minimize watering of city property.
- Educate the public on the water supply decreases.
- Initiate mandatory public conservation measure.
- Enforce outside watering restrictions including watering times and quantities.

4.1.3. Level 3 – 50% of Normal

Strictly enforce all conservation policies with significant fines for non-compliance.
Physically restrict water supplies to (in order of priority):

- All outside irrigation systems
- Park properties and other non-essential support facilities
- Commercial businesses, restricting largest users first
- Residential areas
- Any other "non-life support" areas, insuring water supplies to hospitals, hospices, and all other heath care facilities, and controlled designated area water facilities.

Additional non-emergency water conservation measures are listed below.

4.2. Water Education Program

The following information on efficient outdoor and indoor water use is available to the citizens of Payson City through the city and county libraries and is occasionally disseminated with the water bill.

4.2.1. Outdoor Water Use:

- Do not irrigate landscaping with culinary water at any time. Take advantage of the pressurized irrigation system. Irrigation of landscaping is not needed before or after the pressurized irrigation system is turned on or shut off.
- Water landscape only as much as required by the type of landscape, and the specific weather patterns of your area, including cutting back on watering times in the spring and fall.
- Do not water on hot, sunny, and/or windy days. You may actually end up doing more harm than good to your landscape, as well as wasting a significant amount of water.
- Sweep sidewalks and driveways instead of using the hose to clean them off.

- Wash your car from a bucket of soapy (biodegradable) water and rinse while parked on or near the grass or landscape so that all the water running off goes to beneficial use instead of running down the gutter to waste.
- Check for and repair leaks in all pipes, hoses, faucets, couplings, valves, etc. Verify there are no leaks by turning everything off and checking your water meter to see if it is still running. Some underground leaks may not be visible due to draining off into storm drains, ditches, or traveling outside your property.
- Use mulch around trees and shrubs, as well as in your garden to retain as much moisture as possible. Areas with drip systems will use much less water, particularly during hot, dry and windy conditions.
- Keep your lawn well trimmed and all other landscaped areas free of weeds to reduce overall water needs of your yard.
- For new development it is mandatory for all landscaped areas to be water by an automated irrigation system.

4.2.2. Indoor Water Use:

About two-thirds of the total water used in a household is used in the bathroom. Concentrate on reducing your bathroom use. Following are suggestions for this specific area:

- Do not use your toilet as a wastebasket. Put all tissues, wrappers, diapers, cigarette butts, etc. in the trashcan.
- Check the toilet for leaks. Is the water level too high? Put a few drops of food coloring in the tank. If the bowl water becomes colored without flushing, there is a leak.
- If you do not have a low volume flush toilet, put a plastic bottle full of sand and water to reduce the amount of water used per flush. However, be careful not to over conserve to the point of having to flush twice to make the toilet work. Also, be sure the containers used do not interfere with the flushing mechanism.
- Take short showers with the water turned up only as much as necessary. Turn the shower off while soaping up or shampooing. Install low flow showerheads and/or other flow restriction devices.
- Do not let the water run while shaving or brushing your teeth. Fill the sink or a glass instead.
- When doing laundry, make sure you always wash a full load or adjust the water level appropriately if your machine will do that. Most machines use 40 gallons or more for each load, whether it is two socks or a week’s worth of clothes.
- Repair any leak within the household. Even a minor slow drip can waste up to 15 to 20 gallons of water a day.
- Know where your main shutoff valve is and make sure that it works. Shutting the water off yourself when a pipe breaks or a leak occurs will not only save water, but also eliminate or minimize damage to your personal property.
- Keep a jar of water in the refrigerator for a cold drink instead of running water from the tap until it gets cold. You are putting several glasses of water down the drain for one cold drink.
- Plug the sink when rinsing vegetables, dishes, or anything else; use only a sink full of water instead of continually running water down the drain.

5. CURRENT WATER RATES

Designing an appropriate rate schedule is a complex task. Rate design is a process of matching the costs of operating the water system to the unique economic, political and social environments in which the city provides its service. The cost of delivering the service must be evaluated and understood. Each water system has unique assets and constraints. Based on the characteristics of the system, and past capital and operating costs, revenue requirements can be estimated.

City staff has estimated the cost of providing water service and proposed a rate schedule designed to cover such costs. Although this rate schedule shown below has recently been adopted by the City Council, it still contains some flaws that could be improved upon with a more conservation oriented rate schedule.

Table 3 Current Water Rates

Type:	***Block Rate***
Service Charge:	$16.02/month
Base Allocation:	0 Kgal/month
Amount of Water	Rate
0+ Kgal	$0.86/Kgal

This rate schedule was raised from $.83/Kgal in the old rate schedule to $.86/Kgal in the new.

6. ADDITIONAL CONSERVATION MEASURES

In order to effectively meet Payson City's future water needs and solve all the water problems identified, additional and more specific water conservation measures will be required. These include more stringent water rates, meter replacement and leak repair, improved efficiency of irrigation at city parks and other open spaces, education, and plumbing fixture replacement.

1. More Stringent Water Rate Structure
   The Water Conservation Committee, using revenue requirements estimated by the city staff, investigated a different rate schedule designed to meet those requirements, provide additional price incentives for efficient water use, show the customer how much water is needed each month and provide funding for water conservation assistance and education. This rate schedule is called "Target Billing". We feel that a rate structure like the target billing water rate will need the benefit of remote read meters to get accurate monthly readings for each of our customers. Therefore we recommend that the meter replacement program be completed before a target billing water rate could be instituted.

   Table 4 Proposed Target Billing Rates

Type:	***Target Billing***
Base Charge:	$16.020/month
Base Allocation:	0 Kgal/month
% of Target	Rate
0 – 50%	$0.71/Kgal
51 – 100%	$0.95/Kgal
101 – 150%	$1.50
151 – 200%	$3.00
201% +	$6.00/Kgal

   This rate schedule is designed to meet revenue requirements while creating funding for the water conservation program from fees paid by those who waste water. The water user who uses water indiscriminately and falls into the most expensive tier experiences a volume charge of $6.00/Kgal for the last block.

2. Meter Replacement and Leak Detection Program
   Over time, all meters become less accurate in recording actual flows. This leads to lost revenue to the city and inaccurate data to citizens. A recent survey of meters revealed that nearly 34 percent of the water delivered to the city is not being registered on the meters.

   It is anticipated that a meter replacement program would pay for itself in two to three years with enhanced revenues continuing for five to ten years after that. Meter replacement does not result directly in lower water use since the rate in this plan is based on total inflow of potable water. Once meters are upgraded however, leak detection programs that do reduce water purchases and the use rate, will be more effective.

3. Improved Efficiency in Irrigating City Parks and Other Open Spaces
   A recent water audit of parks and open spaces for a nearby city indicated that most large turf areas were being over irrigated by up to 50 percent. Payson City presently has 230 acres in groomed parks, cemeteries and sports fields.

   As part of our water conservation plan Payson City has made it our 5 year goal to have all city parks and open spaces irrigation systems integrated into our computer automated control system. Our automated system will allow us to better control and monitor or city irrigation water system. We estimate that we may see as much as a 10 % reduction in water usage by implementing better management practices alone.

4. Education
   Educating residents and businesses that irrigate landscapes to use water more efficiently will enhance the likelihood that Payson water use goals will be met. The Water Conservation Committee is preparing to launch the initial phase of such an education program in September. Benefits and costs of a strong education program are difficult to enumerate but will be tracked and accounted for as it unfolds.

5. Plumbing Fixture Replacement
   Incentives to exchange old high water-use toilets and shower heads for new more efficient ones can be provided through city cost sharing using revenues generated by penalty tiers in future rate schedules. While it is difficult to calculate meaningful estimates of the benefits and costs of such programs on the water-use rate, there is ample evidence in the literature that such programs are effective. The Division of Water Resource estimated in 1995 that such programs could reduce residential indoor water use by 33 percent.

7. IMPLEMENTING AND UPDATING THE WATER CONSERVATION PLAN

To insure the goals outlined above are reached, appropriate tasks must be determined, responsibility fixed with the logical person or department, and a time line set for completion of each task. We recommended that Brent Arns be appointed as the water conservation coordinator to supervise and lead the water conservation program. The city council has authorized this position and will have responsibility for providing funding for the measures outlined in this plan. The city manager and their staff will be responsible, under the supervision of the water conservation coordinator, to carry out the necessary task within the appropriate time constraints.

It was also recommended the water conservation coordinator make quarterly reports on progress toward goals to the city council. The water conservation plan will be revised and updated as required to meet changing conditions and needs. This plan will also be updated and resubmitted to the Utah Division of Water Resource in April of 2020, as required by legislative House Bill 153.

APPENDIX A – WORKSHEETS

8. Current Conservation Practices

Please list current water conservation measures and their estimated water savings. Copy this page to add more measures. One completed, use this information to write the Current Conservation Practices section of your Water Conservation Plan (see Sample Plan, pages 7 - 10).

8.1. Measure 1

Description:
The Pressurized irrigation system (PI) supplies irrigation water to each customer in Payson City.
Implemented: 3/15/1991 Still active? Yes/No
Estimated Annual Savings: 4500 Ac Ft
Comments:
Additional savings can be made if we meter the PI system, but we are restricted by the water quality of the irrigation water. New technology is becoming available that appears may provide us with a dirty water meter in the future. Until there is a proven dirty water meter on the market we are not looking into metering the PI system. Furthermore, the PI rates need to be adjusted to compensate for the required system maintenance.

8.2. Measure 2

Description:
The City has implemented a computerized Osmac control system for the City that is tied into a weather station and controls most of the city's irrigation practices.
Implemented: 6/15/2003 Still active? Yes /No
Estimated Annual Savings: 220 Ac Ft
Comments:

____
____

8.3. Measure 3

Description: City Ordinance 10.08.11and 10.10.2 Wasting Water, 10.8.13 Use and Regulation of Fire hydrants and Valves, 10.10.7 Prohibitions, 10.10.11Use of culinary Water for Irrigation
Implemented: 8/7/2002 Still active? Yes /No
Estimated Annual Savings: __________ Ac Ft
Comments:
These ordinances are written to limit the use of culinary water and promote the use of irrigation water for all irrigation purposes.

8.4. Measure 4

Description: Public Notice on watering days.
Implemented: 3/15/1991 Still active? Yes/ No
Estimated Annual Savings: __________ Ac Ft
Comments:
During drought years Payson City's current policy is to publicly notice watering days and to restrict watering to three times a week and only on certain days based on your address.

9. Additional Conservation Measures

Please list additional conservation measures your entity may consider, enhancing conservation efforts and results. The following is a list of Best Management Practices (BMPs) recommended to water providers by the Division of Water Resource. One completed, use this information to write the Additional Conservation Measures section of your Water Conservation Plan (see Sample Plan, pages 11 - 14).

9.1. BMP 1 – Comprehensive Water Conservation Plans

- Develop a water management and conservation plan as required by law.
- Plans are to be adopted by the water agency authority (city council, board of directors, etc.) and updated no less than every five years.

9.2. BMP 2 – Universal Metering

- Install meters on all residential, commercial, institutional and industrial water connections. Meters should be read on a regular basis.
- Establish a maintenance and replacement program for existing meters.
- Meter secondary water at the most specific level possible, somewhere below Source water metering. Individual secondary connection metering should be done as soon as technology permits.

9.3. BMP 3 – Incentive Water Conservation Pricing

- Implement a water pricing policy that promotes water conservation.
- Charge for secondary water based on individual use levels as soon as technology permits.

9.4. BMP 4 – Water Conservation Ordinances

- Adopt an incentive water rate structure.
- Adopt a time-of-day watering ordinance.
- Adopt an ordinance requiring water-efficient landscaping in all new commercial development. This should include irrigation system efficiency standards and an acceptable plant materials lists.
- Adopt an ordinance prohibiting the general waste of water.

9.5. BMP 5 – Water Conservation Coordinator

- Designate a water conservation coordinator to facilitate water conservation programs.

9.6. BMP 6 – Public Information Program

- Implement a public information program consistent with the recommendations of the Governor's Water Conservation Team. Such programs can be adapted to meet the specific needs of the local area and may use the "Slow the Flow" logo with approval of the division.

9.7. BMP 7 – System Water Audits, Leak Detection and Repair

- Set specific goals to reduce unaccounted for water to an acceptable level.
- Set standards for annual water system accounting that will quantify system losses and trigger repair and replacement programs, using methods consistent with American Water Works Association's Water Audit and Leak Detection Guidebook.

9.8. BMP 8 – Large Landscape Conservation Programs and Incentives

- Promote a specialized large landscape water conservation program for all schools, parks and businesses.
- Encourage all large landscape facility managers and workers to attend specialized training in water conservation.
- Provide outdoor water audits to customers with large amenity landscapes.

9.9. BMP 9 – Water Survey Programs for Residential Customers

- Implement residential indoor and outdoor water audits to educate residents on how to save water.

9.10. BMP 10 – Plumbing Standards

- Review existing plumbing codes and revise them as necessary to ensure water-conserving measures in all new construction.
- Identify homes, office building and other structures built prior to 1992 and develop a strategy to distribute or install high-efficiency plumbing fixtures such as ultra low-flow toilets, showerheads, faucet aerators, etc.

9.11. BMP 11 – School Education Programs

- Support state and local water education programs for the elementary school system.

9.12. BMP 12 – Conservation Programs for Commercial, Industrial and Institutional Customers

- Change business license requirements to require water reuse and recycling in new commercial and industrial facilities where feasible.
- Provide comprehensive site water audits to those customers known to be large water users.
- Identify obstacles and benefits of installing separate meters for landscapes.

9.13. BMP 13 – Reclaimed Water Use

- Use reclaimed or recycled water where feasible.

10. Cost Analysis

Please perform a cost analysis on conservation programs you hope to implement in your organization. Once completed, use this information to write the Cost Analysis section of your Water Conservation Plan (see Sample Plan, pages 15 - 17).

10.1. Description

Give a brief description of the proposed program. Example: "Toilet Distribution and Retrofit Program for Customers Targeted for Older Housing Developments".

10.2. Capital Costs

Capital costs are usually one-time purchases, such as equipment or computers, used throughout the life of the program. If you plan to do a showerhead distribution program, the one-time purchase of 5,000 showerheads would be included as a capital cost.

10.3. Annual Costs

Annual costs are those costs that will occur on an on-going basis. These costs include salary for personnel devoted to the program and any rentals that may be necessary.

10.4. Avoided Costs

Avoided costs are costs that will become unnecessary due directly to the efforts of this program. If it is projected that the program will save 2,000 acre-feet of water, then the cost of purchasing 2,000 additional acre-feet of water each year in the future must be considered an avoided cost.

For instance, if the program saves 2,000 acre-feet and water is valued at $400 per acre-foot, the avoided costs for water purchases is $800,000.

10.5. Net Cost / Benefit

The Net Benefit of a program can be derived by adding the capital costs to the annual costs (projected over the duration of the program), and then subtracting the program cost from any avoided costs (benefits) this conservation will produce. Example:

Avoided Costs $178,434

Capital Costs		$54,757
Annual Costs		$12,847
TOTAL	$67,604	

Program Duration 5 years

178,434 - (54,757 + (12,847*5)) = $59,442 (total benefit of program)

This example has a Net Benefit of **$59,442** over the life of the program.

10.6. Program

Description____

______ minus (__________ plus (__________ times ______) = __________

Avoided Costs	**Capital Costs**	**Annual Costs**	**Program Duration**	**Total Benefit**

11. Implementation, Monitoring and Evaluation

Please describe the process for plan implementation, the monitoring of the plan, and evaluation of the success of the program(s) selected. One completed, use this information to write the Implementing and Updating section of your Water Conservation Plan (see Sample Plan, page 17).

11.1. Implementation Procedure

Assign Responsibility ____

Budget Projected Costs ___________ **Fund** ___________

Schedule Begin Date ___________ End Date ___________

Public Involvement ____

11.2. Monitoring & Evaluation

Evaluation Schedule Monthly Quarterly Annually Other ______________

Data to Be Gathered ____

Evaluation Process ____

____

11.3. Plan Update

Describe the procedure for updating the water conservation plan:

____

____

____

12. Resolution Water Conservation Plan

Official Resolution

Be it Resolved: This resolution is the adoption of a the Payson City Water Conservation Plan. WHEREAS, the Payson City Council understands the pressing need to use water in a more efficient manner to allow for future sustained growth of the community. The plan will be amended no less than every five years and will continue to play a vital role in the future development of Payson City, Utah

Owner's signature: ____

(Signature of City Manager)

Acknowledgement

State of _____________)
) ss.
County of ___________)

The foregoing instrument was acknowledged before me this ______________ , _______

____
Notary's signature

____
Residing at

____
My commission expires:

Notary's seal

Appendix D

Current Permits

Utah Division of Water Quality
Statement of Basis
ADDENDUM
Wasteload Analysis and Antidegradation Level I Review

Date: **April 10, 2017**

Facility: **Payson City Wastewater Treatment Facility**
Payson, UT
UPDES No. UT0020427

Receiving water: **Beer Creek (2B, 3C, 4)**

This addendum summarizes the wasteload analysis that was performed to determine water quality based effluent limits (WQBEL) for this discharge. Wasteload analyses are performed to determine point source effluent limitations necessary to maintain designated beneficial uses by evaluating projected effects of discharge concentrations on in-stream water quality. The wasteload analysis also takes into account downstream designated uses (UAC R317-2-8). Projected concentrations are compared to numeric water quality standards to determine acceptability. The numeric criteria in this wasteload analysis may be modified by narrative criteria and other conditions determined by staff of the Division of Water Quality.

<u>Discharge</u>
Outfall 001: Irrigation Ditch → Beer Creek → Benjamin Slough → Utah Lake

The maximum daily design discharge is 5.0 MGD and the maximum monthly design discharge is 3.0 MGD for the facility.

<u>Receiving Water</u>
The receiving water for Outfall 001 is an unnamed irrigation ditch, which is tributary to Beer Creek, which drains to Benjamin Slough and then to Utah Lake.

Per UAC R317-2-13.5.c, the designated beneficial uses for Beer Creek (Utah County) from 4850 West (in NE1/4NE1/4 sec. 36, T.8 S., R.1 E.) to headwaters are 2B, 3C, and 4.

- *Class 2B - Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing.*
- *Class 3C - Protected for nongame fish and other aquatic life, including the necessary aquatic organisms in their food chain*
- *Class 4 - Protected for agricultural uses including irrigation of crops and stock watering.*

Typically, the critical flow for the wasteload analysis is considered the lowest stream flow for seven consecutive days with a ten year return frequency (7Q10). Due to a lack of flow records for Beer Creek, the 20th percentile of flow measurements was calculated to estimate seasonal critical flow in the receiving water (Table 1). No flow records were found for the irrigation ditch and it was assumed the ditch has no flow during critical conditions.

Payson Power (UPDES UT0025518) also discharges to the same irrigation ditch and has the potential to discharge concurrently with the Payson City Wastewater Treatment Plant discharge; however, based on information provided by the permittee, Payson Power would not discharge when the wastewater treatment plant discharge is at the maximum (AQUA Engineering 2017a).

Table 1: Annual critical low flow

Season	**Flow (cfs)**			
	Payson Power Discharge During Chronic Conditions	Payson Power Discharge During Acute Conditions	Irrigation Ditch above WWTP	Beer Creek above confluence with Irrigation Ditch
Summer	0.0	0.0	0.0	4.0
Fall	0.0	0.0	0.0	10.0
Winter	0.0	0.0	0.0	13.2
Spring	0.0	0.0	0.0	10.0

TMDL

Beer Creek from confluence with Spring Creek to headwaters is listed as impaired for total ammonia and O/E bioassessment according to the 303(d) list in the *Utah's Final 2016 Integrated Report* (UDWQ 2017). Benjamin Slough from confluence with Utah Lake to Beer Creek confluence is listed as impaired for total ammonia. Utah Lake is listed as impaired for total phosphorus and total dissolved solids.

Mixing Zone

The maximum allowable mixing zone is 15 minutes of travel time for acute conditions, not to exceed 50% of stream width, and 2,500 feet for chronic conditions, per UAC R317-2-5. Water quality standards must be met at the end of the mixing zone.

The actual length of the mixing zone was not determined; however, it was presumed to remain within the maximum allowable mixing zone dimensions. Acute limits were calculated using 50% of the seasonal critical low flow.

Parameters of Concern

The potential parameters of concern identified for the discharge/receiving water were total suspended solids (TSS), dissolved oxygen (DO), BOD_5, total phosphorus (TP), total nitrogen (TN), total ammonia (TAN), E. coli, pH, and total residual chlorine (TRC) as determined in consultation with the UPDES Permit Writer.

Water Quality Modeling

A QUAL2Kw model of the receiving water was built and calibrated to synoptic survey data collected in October of 2013 by DWQ staff using standard operating procedures (UDWQ 2012). The model of Beer Creek extends 4 kilometers downstream from the confluence with the unnamed irrigation ditch to near the crossing with South 4850 West.

Receiving water quality data were obtained from monitoring site 4995420 Beer Creek above Payson WWTP at U-115 Crossing. The average seasonal value was calculated for each constituent with available data in the receiving water. Effluent parameters were characterized using data from monitoring site 4995410 Payson WWTP and 4995480 Payson Power.

The QUAL2Kw model was used for determining the WQBELs. Effluent concentrations were adjusted so that water quality standards were not exceeded in the receiving water. Where WQBELs exceeded secondary standards or categorical limits, the concentration in the model was set at the secondary standard or categorical limit.

The calibration and wasteload models are available for review by request.

WET Limits

The percent of effluent in the receiving water in a fully mixed condition, and acute and chronic dilution in a not fully mixed condition are calculated in the WLA in order to generate WET limits. The LC_{50} (lethal concentration, 50%) percent effluent for acute toxicity and the IC_{25} (inhibition concentration, 25%) percent effluent for chronic toxicity, as determined by the WET test, needs to be below the WET limits, as determined by the WLA. The WET limit for LC_{50} is typically 100% effluent and does not need to be determined by the WLA.

Table 2: WET Limits for IC_{25}

Season	Percent Effluent
Summer	54%
Fall	32%
Winter	26%
Spring	32%

Effluent Limits

The effect of the effluent on the DO in the receiving water was evaluated using the QUAL2Kw model. A DO sag downstream resulting from the plant discharge was predicted by the model in Beer Creek. However, the DO recovered and limits beyond secondary standards are not required for DO and BOD_5 (Table 3). QUAL2Kw rates, input and output for DO and eutrophication related constituents are summarized in Appendix A.

The ammonia limits for both acute and chronic toxicity were determined. The previous permit only had limits for ammonia resulting from acute toxicity (max. daily limit). In 2008, the chronic ammonia criteria were extended to 3C and 3D waters.

The limits for total residual chlorine were determined assuming an average decay rate of 42 /day (at 20 Cº) and a travel time in the unnamed irrigation ditch of 107 minutes prior to discharge to Beer Creek (AQUA Engineering 2017b). The analysis for TRC is summarized in Appendix B.

A mass balance mixing analysis was conducted for conservative constituents such as dissolved metals. The WQBELs for conservative constituents are summarized in Appendix C.

Table 3: Water Quality Based Effluent Limits Summary

Effluent Constituent	Acute			Chronic		
	Standard	Limit	Averaging Period	Standard	Limit	Averaging Period
Flow (MGD)		5.0	1 day		3.0	30 days
Ammonia (mg/L)[1]	Varies		1 hour	Varies		30 days
Summer (Jul-Sep)		7.0			4.0	
Fall (Oct-Dec)		9.0			6.0	
Winter (Jan-Mar)		12.0			8.0	
Spring (Apr-Jun)		11.0			8.0	
Min. Dissolved Oxygen (mg/L)	3.0	4.0	Instantaneous	5.0	5.0	30 days
BOD_5 (mg/L)	None	35	7 days	None	25	30 days
Total Residual Chlorine (mg/L)	0.019		1 hour	0.011		4 days
Summer (Jul-Sep)		0.84			0.72	
Fall (Oct-Dec)		0.49			0.54	
Winter (Jan-Mar)		0.29			0.35	
Spring (Apr-Jun)		0.48			0.53	

1: Ammonia limit due to toxicity requirements.

Models and supporting documentation are available for review upon request.

Antidegradation Level I Review

The objective of the Level I ADR is to ensure the protection of existing uses, defined as the beneficial uses attained in the receiving water on or after November 28, 1975. No evidence is known that the existing uses deviate from the designated beneficial uses for the receiving water. Therefore, the beneficial uses will be protected if the discharge remains below the WQBELs presented in this wasteload.

A Level II Antidegradation Review (ADR) is not required for this discharge since the pollutant concentration and load is not increasing under this permit renewal.

Prepared by: **Nicholas von Stackelberg, P.E.**
Standards and Technical Services Section

Documents:

WLA Document: *payson_potw_wla_2017-04-10.docx*
QUAL2Kw Calibration Model: *payson_potw_cal_2013.xlsm*
QUAL2Kw Wasteload Model: *payson_wla_2017.xlsm*

References:

AQUA Engineering. 2017a. *Discharge Flows to Beer Creek from Payson City and UAMPS*.

AQUA Engineering. 2017b. *Payson Chlorine Decay Rates*.

Neilson, B.T., A.J. Hobson, N. von Stackelberg, M. Shupryt, and J.D. Ostermiller. 2012. *Using QUAL2K Modeling to Support Nutrient Criteria Development and Wasteload Analyses in Utah*.

Utah Division of Water Quality. 2012a. *Utah Wasteload Analysis Procedures Version 1.0*.

Utah Division of Water Quality. 2012b. *Field Data Collection for QUAL2Kw Model Build and Calibration Standard Operating Procedures Version 1.0*.

Utah Division of Water Quality. 2017. *Utah's Final 2016 Integrated Report.*

WASTELOAD ANALYSIS [WLA] Date: 4/10/2017
Appendix A: QUAL2Kw Analysis for Eutrophication

Discharging Facility:	Payson WWTP		
UPDES No:	UT-0020427		
Permit Flow [MGD]:	1.00	Maximum Monthly Flow	
	3.00	Maximum Daily Flow	
Receiving Water:	Beer Creek		
Stream Classification:	2B, 3C, 4		
Stream Flows [cfs]:	4.00	Summer (July-Sept)	Critical Low Flow
	10.00	Fall (Oct-Dec)	
	13.20	Winter (Jan-Mar)	
	10.00	Spring (Apr-June)	
Fully Mixed:	NO		
Acute River Width:	50%		
Chronic River Width:	100%		

Modeling Information

A QUAL2Kw model was used to determine these effluent limits.

Model Inputs

The following is upstream and discharge information that was utilized as inputs for the analysis.
Dry washes are considered to have an upstream flow equal to the flow of the discharge.

Headwater/Upstream Information	Summer	Fall	Winter	Spring
Flow (cfs)	4.0	10.0	13.2	10.0
Temperature (deg C)	21.2	12.1	5.0	12.6
Specific Conductance (μmhos)	1125	1125	1125	1125
Inorganic Suspended Solids (mg/L)	28.0	37.3	29.5	27.3
Dissolved Oxygen (mg/L)	6.7	8.2	10.4	8.5
$CBOD_5$ (mg/L)	2.6	2.7	5.1	3.6
Organic Nitrogen (mg/L)	1.500	1.500	1.500	1.500
NH4-Nitrogen (mg/L)	0.080	0.185	0.399	0.250
NO3-Nitrogen (mg/L)	1.125	1.327	1.430	1.255
Organic Phosphorus (mg/L)	0.035	0.110	0.119	0.077
Inorganic Ortho-Phosphorus (mg/L)	0.169	0.145	0.186	0.190
Phytoplankton (μg/L)	0.0	0.0	0.0	0.0
Detritus [POM] (mg/L)	3.1	4.1	3.3	3.0
Alkalinity (mg/L)	235	235	235	235
pH	7.8	8.2	8.3	8.0

Discharge Information - Payson POTW

Chronic	Summer	Fall	Winter	Spring
Flow (MGD)	3.0	3.0	3.0	3.0
Temperature (deg C)	22.7	17.1	11.4	16.9
Specific Conductance (µmhos)	1450	1450	1450	1450
Inorganic Suspended Solids (mg/L)	6.0	4.0	5.3	5.0
Organic Nitrogen (mg/L)	5.000	5.000	5.000	5.000
NO3-Nitrogen (mg/L)	21.700	22.875	28.820	28.500
Organic Phosphorus (mg/L)	0.000	0.000	0.000	0.000
Inorganic Ortho-Phosphorus (mg/L)	5.000	5.000	5.000	5.000
Phytoplankton (µg/L)	0.000	0.000	0.000	0.000
Detritus [POM] (mg/L)	0.0	0.0	0.0	0.0
Alkalinity (mg/L)	235	235	235	235
pH	7.6	7.6	7.5	7.5

Acute	Summer	Fall	Winter	Spring
Flow (MGD)	5.0	5.0	5.0	5.0
Temperature (deg C)	22.7	17.1	11.4	16.9
Specific Conductance (µmhos)	1450	1450	1450	1450
Inorganic Suspended Solids (mg/L)	6.0	4.0	5.3	5.0
Organic Nitrogen (mg/L)	10.000	10.000	10.000	10.000
NO3-Nitrogen (mg/L)	21.700	22.875	28.820	28.500
Organic Phosphorus (mg/L)	0.000	0.000	0.000	0.000
Inorganic Ortho-Phosphorus (mg/L)	10.000	10.000	10.000	10.000
Phytoplankton (µg/L)	0.000	0.000	0.000	0.000
Detritus [POM] (mg/L)	0.0	0.0	0.0	0.0
Alkalinity (mg/L)	235	235	235	235
pH	8.0	8.2	7.9	8.1

Discharge Information - Payson Power

Chronic	Summer	Fall	Winter	Spring
Flow (MGD)	0.0	0.0	0.0	0.0

Acute	Summer	Fall	Winter	Spring
Flow (MGD)	0.0	0.0	0.0	0.0

All model numerical inputs, intermediate calculations, outputs and graphs are available for discussion, inspection and copy at the Division of Water Quality.

Effluent Limitations

Current State water quality standards are required to be met under a variety of conditions including in-stream flows targeted to the 7-day, 10-year low flow (R317-2-9).

Other conditions used in the modeling effort reflect the environmental conditions expected at low stream flows.

Effluent Limitations based upon Water Quality Standards for DO, and Ammonia and Total Residual Chlorine Toxicity

In-stream criteria of downstream segments for Dissolved Oxygen will be met with an effluent limitation as follows:

Chronic	Standard	Summer	Fall	Winter	Spring
Flow (MGD)	N/A	3.00	3.00	3.00	3.00
NH4-Nitrogen (mg/L)	Varies	6.0	9.0	9.5	12.0
$CBOD_5$ (mg/L)	N/A	25.0	25.0	25.0	25.0
Dissolved Oxygen [30-day Ave] (mg/L)	5.0	5.0	5.0	5.0	5.0

Acute	Standard	Summer	Fall	Winter	Spring
Flow (MGD)	N/A	5.0	5.0	5.0	5.0
NH4-Nitrogen (mg/L)	Varies	10.0	12.0	13.0	12.0
$CBOD_5$ (mg/L)	N/A	35.0	35.0	35.0	35.0
Dissolved Oxygen [Minimum] (mg/L)	3.0	4.0	4.0	4.0	4.0

Summary Comments

The mathematical modeling and best professional judgement indicate that violations of receiving water beneficial uses with their associated water quality standards, including important down-stream segments, will not occur for the evaluated parameters of concern as discussed above if the effluent limitations indicated above are met.

Coefficients and Other Model Information

Parameter	*Value*	*Units*
Stoichiometry:		
Carbon	40	gC
Nitrogen	7.2	gN
Phosphorus	1	gP
Dry weight	100	gD
Chlorophyll	1	gA
Inorganic suspended solids:		
Settling velocity	0.001	m/d
Oxygen:		
Reaeration model	Thackston-Dawson	
Temp correction	1.024	
Reaeration wind effect	None	
O2 for carbon oxidation	2.69	gO2/gC
O2 for NH4 nitrification	4.57	gO2/gN
Oxygen inhib model CBOD oxidation	Exponential	
Oxygen inhib parameter CBOD oxidation	0.60	L/mgO2
Oxygen inhib model nitrification	Exponential	
Oxygen inhib parameter nitrification	0.60	L/mgO2
Oxygen enhance model denitrification	Exponential	
Oxygen enhance parameter denitrification	0.60	L/mgO2
Oxygen inhib model phyto resp	Exponential	
Oxygen inhib parameter phyto resp	0.60	L/mgO2
Oxygen enhance model bot alg resp	Exponential	
Oxygen enhance parameter bot alg resp	0.60	L/mgO2
Slow CBOD:		
Hydrolysis rate	0	/d
Temp correction	1.047	
Oxidation rate	0.103	/d
Temp correction	1.047	
Fast CBOD:		
Oxidation rate	10	/d
Temp correction	1.047	
Organic N:		
Hydrolysis	0.88120891	/d
Temp correction	1.07	
Settling velocity	0.099218	m/d
Ammonium:		
Nitrification	0.2064034	/d
Temp correction	1.07	
Nitrate:		
Denitrification	0.28353818	/d
Temp correction	1.07	
Sed denitrification transfer coeff	0.053355	m/d
Temp correction	1.07	
Organic P:		
Hydrolysis	0.79805215	/d
Temp correction	1.07	
Settling velocity	0.096605	m/d
Inorganic P:		
Settling velocity	0.04793	m/d
Sed P oxygen attenuation half sat constant	0.53889	mgO2/L

Phytoplankton:		
Max Growth rate	2.8944	/d
Temp correction	1.07	
Respiration rate	0.480803	/d
Temp correction	1.07	
Death rate	0.86518	/d
Temp correction	1	
Nitrogen half sat constant	15	ugN/L
Phosphorus half sat constant	2	ugP/L
Inorganic carbon half sat constant	1.30E-05	moles/L
Phytoplankton use HCO3- as substrate	Yes	
Light model	Smith	
Light constant	57.6	langleys/d
Ammonia preference	25.4151	ugN/L
Settling velocity	0.468545	m/d
Bottom Plants:		
Growth model	Zero-order	
Max Growth rate	10.8314	gD/m2/d or /d
Temp correction	1.07	
First-order model carrying capacity	100	gD/m2
Basal respiration rate	0.2458802	/d
Photo-respiration rate parameter	0.01	unitless
Temp correction	1.07	
Excretion rate	0.046004	/d
Temp correction	1.07	
Death rate	0.036896	/d
Temp correction	1.07	
External nitrogen half sat constant	711.113	ugN/L
External phosphorus half sat constant	123.473	ugP/L
Inorganic carbon half sat constant	7.44E-05	moles/L
Bottom algae use HCO3- as substrate	Yes	
Light model	Smith	
Light constant	41.6646	mgO^2/L
Ammonia preference	28.99375	ugN/L
Subsistence quota for nitrogen	31.0379	mgN/gD
Subsistence quota for phosphorus	2.26157	mgP/gD
Maximum uptake rate for nitrogen	770.252	mgN/gD/d
Maximum uptake rate for phosphorus	36.4362	mgP/gD/d
Internal nitrogen half sat ratio	1.468463	
Internal phosphorus half sat ratio	3.2861345	
Nitrogen uptake water column fraction	1	
Phosphorus uptake water column fraction	1	
Detritus (POM):		
Dissolution rate	2.318491	/d
Temp correction	1.07	
Settling velocity	0.08897	m/d
pH:		
Partial pressure of carbon dioxide	370	ppm
TRC:		
Decay rate	0.8	/d

Atmospheric Inputs:	Summer	Fall	Winter	Spring
Min. Air Temperature, F	57.7	29.5	24.0	45.0
Max. Air Temperature, F	90.5	51.0	44.9	74.2
Dew Point, Temp., F	58.6	35.0	30.3	48.5
Wind, ft./sec. @ 21 ft.	9.8	7.5	7.6	9.2
Cloud Cover, %	10%	10%	10%	10%

Other Inputs:	
Bottom Algae Coverage	75%
Bottom SOD Coverage	100%
Prescribed SOD, gO_2/m^2/day	0

WASTELOAD ANALYSIS [WLA]
Appendix B: Total Residual Chlorine

Date: 4/10/2017

Discharging Facility: Payson WWTP
UPDES No: UT-0020427

CHRONIC

	Season	Receiving Water	Standard	Payson WWTP Effluent	Payson Power Effluent	Total Effluent	Mixing Zone Boundary	Dilution Factor	Effluent Limit Without Decay	Temperature (°C)	Decay Rate @ 20 ℃	Decay Rate @ T ℃	Travel Time (min)	Decay Coefficient	Effluent Limit
Discharge (cfs)	Summer	4.0		4.6	0.0	4.6	8.6	0.9							
	Fall	10.0		4.6	0.0	4.6	14.6	2.2							
	Winter	13.2		4.6	0.0	4.6	17.8	2.8							
	Spring	10.0		4.6	0.0	4.6	14.6	2.2							
Temperature (℃)	Summer			22.7	30.0	22.7									
	Fall			17.1	25.9	17.1									
	Winter			11.4	27.5	11.4									
	Spring			16.9	23.6	16.9									
TRC (mg/L)	Summer	0.000	0.011						0.020	22.7	42	47.6	107.568	0.03	0.716
	Fall	0.000	0.011						0.035	17.1	42	36.8	107.568	0.06	0.541
	Winter	0.000	0.011						0.042	11.4	42	28.3	107.568	0.12	0.350
	Spring	0.000	0.011						0.035	16.9	42	36.5	107.568	0.07	0.530

ACUTE

	Season	Receiving Water	Standard	Payson WWTP Effluent	Payson Power Effluent	Total Effluent	Mixing Zone Boundary	Dilution Factor	Effluent Limit Without Decay	Temperature (°C)	Decay Rate @ 20 ℃	Decay Rate @ T ℃	Travel Time (min)	Decay Coefficient	Effluent Limit
Discharge (cfs)	Summer	2.0		7.7	0.0	7.7	9.7	0.3							
	Fall	5.0		7.7	0.0	7.7	12.7	0.6							
	Winter	6.6		7.7	0.0	7.7	14.3	0.9							
	Spring	5.0		7.7	0.0	7.7	12.7	0.6							
Temperature (℃)	Summer			22.7	30.0	22.7									
	Fall			17.1	25.9	17.1									
	Winter			11.4	27.5	11.4									
	Spring			16.9	23.6	16.9									
TRC (mg/L)	Summer	0.000	0.019						0.024	22.7	42	47.6	107.568	0.03	0.836
	Fall	0.000	0.019						0.031	17.1	42	36.8	107.568	0.06	0.487
	Winter	0.000	0.019						0.035	11.4	42	28.3	107.568	0.12	0.291
	Spring	0.000	0.019						0.031	16.9	42	36.5	107.568	0.07	0.478

124.66667

WASTELOAD ANALYSIS [WLA] Date: 4/10/2017
Appendix C: Mass Balance Mixing Analysis for Conservative Constituents

Discharging Facility:	Payson WWTP		
UPDES No:	UT-0020427		
Permit Flow [MGD]:	3.00	Maximum Monthly Discharge	
	5.00	Maximum Daily Discharge	
Payson Power:	0.00	Discharge	
Receiving Water:	Beer Creek		
Stream Classification:	2B, 3C, 4		
Stream Flows [cfs]:	4.00	Summer (July-Sept)	Critical Low Flow
Fully Mixed:	NO		
Acute River Width:	50%		
Chronic River Width:	100%		
Mixed Flow [cfs]:	8.6	Chronic	
	9.7	Acute	

Modeling Information

A mass balance mixing analysis was used to determine these effluent limits.

All model numerical inputs, intermediate calculations, outputs and graphs are available for discussion, inspection and copy at the Division of Water Quality.

Effluent Limitations

Current State water quality standards are required to be met under a variety of conditions including in-stream flows targeted to the 7-day, 10-year low flow (R317-2-9).

Other conditions used in the modeling effort reflect the environmental conditions expected at low stream flows.

Effluent Limitations for Protection of Recreation (Class 2B Waters)

Physical Parameter	Maximum Concentration
pH Minimum	6.5
pH Maximum	9.0

Bacteriological		
E. coli (30 Day Geometric Mean)	206	(#/100 mL)
E. coli (Maximum)	668	(#/100 mL)

Effluent Limitations for Protection of Aquatic Wildlife (Class 3C Waters)

Physical Parameter	Maximum Concentration
Temperature (deg C)	27
Temperature Change (deg C)	4

Inorganics	Chronic Standard (4 Day Average)	Acute Standard (1 Hour Average)
Parameter	Standard	Standard
Phenol (mg/L)		0.010
Hydrogen Sulfide (Undissociated) [mg/L]		0.002

Total Recoverable Metals	Chronic Standard (4 Day Average)[1]			Acute Standard (1 Hour Average)[1]		
Parameter	Standard	Background[2]	Limit	Standard	Background[2]	Limit
Aluminum (µg/L)	N/A[3]	5.4	NONE	750	5.4	1,001
Arsenic (µg/L)	150	7.7	273	340	7.7	452
Cadmium (µg/L)	0.7	0.5	1.0	8.5	0.5	11.2
Chromium VI (µg/L)	11.0	2.5	18.3	16.0	2.5	20.7
Chromium III (µg/L)	263	2.5	487	5,497	2.5	7,344
Copper (µg/L)	29.8	5.3	51.0	50.5	5.3	66.0
Cyanide (µg/L)	5.2	3.5	6.7	22.0	3.5	28.4
Iron (µg/L)				1,000	6.7	1,334
Lead (µg/L)	18.0	0.3	33.2	462	0.3	617
Mercury (µg/L)	0.012	0.008	0.015	2.4	0.0	3.2
Nickel (µg/L)	165	0.5	307	1,484	0.5	1,983
Selenium (µg/L)	4.6	1.9	6.9	18.4	1.9	24.1
Silver (µg/L)				39.3	0.1	52.5
Tributylin (µg/L)	0.072	0.048	0.092	0.46	0.05	0.60
Zinc (µg/L)	380	10.0	698	380	10.0	505

1: Based upon a Hardness of 390 mg/l as CaCO3

2: Background concentration average of monitoring data

3: Where the pH is equal to or greater than 7.0 and the hardness is equal to or greater than 50 ppm as $CaC0_3$ in the receiving water after mixing, the 87 ug/L chronic criterion (expressed as total recoverable) will not apply, and aluminum will be regulated based on compliance with the 750 ug/L acute aluminum criterion (expressed as total recoverable).

Organics [Pesticides]	Chronic Standard (4 Day Average)			Acute Standard (1 Hour Average)		
Parameter	Standard	Background[1]	Limit	Standard	Background[1]	Limit
Aldrin (µg/L)				1.5	1.0	1.7
Chlordane (µg/L)	0.0043	0.0029	0.0055	1.2	0.0	1.6
DDT, DDE (µg/L)	0.001	0.001	0.001	0.55	0.00	0.73
Diazinon (µg/L)	0.17	0.11	0.22	0.17	0.11	0.20
Dieldrin (µg/L)	0.0056	0.0038	0.0072	0.24	0.00	0.32
Endosulfan, a & b (µg/L)	0.056	0.038	0.072	0.11	0.04	0.14
Endrin (µg/L)	0.036	0.024	0.046	0.086	0.024	0.108
Heptachlor & H. epoxide (µg/L)	0.0038	0.0025	0.0049	0.26	0.00	0.35
Lindane (µg/L)	0.08	0.05	0.10	1.0	0.1	1.3
Methoxychlor (µg/L)				0.03	0.02	0.03
Mirex (µg/L)				0.001	0.001	0.001
Nonylphenol (µg/L)	6.6	4.4	8.5	28.0	4.4	36.2
Parathion (µg/L)	0.0130	0.0087	0.0167	0.066	0.009	0.086
PCB's (µg/L)	0.014	0.009	0.018			
Pentachlorophenol (µg/L)	15.0	10.1	19.3	19.0	10.1	22.6
Toxephene (µg/L)	0.0002	0.0001	0.0003	0.73	0.00	0.98

1: Background concentration assumed 67% of chronic standard

Radiological	Maximum Concentration		
Parameter	Standard	Background[1]	Limit
Gross Alpha (pCi/L)	15	10.1	17.3

1: Background concentration assumed 67% of chronic standard; TDS is based on observed ambient data

Effluent Limitation for Protection of Agriculture (Class 4 Waters)

	Maximum Concentration		
Parameter	Standard	Background[1]	Limit
Total Dissolved Solids (mg/L)	1,200	754	1,585
Boron (mg/L)	0.75	0.2	1.2
Arsenic, Dissolved (µg/L)	100	7.7	180
Cadmium, Dissolved (µg/L)	10	0.5	18.2
Chromium, Dissolved (µg/L)	100	2.5	184
Copper, Dissolved (µg/L)	200	5.3	368
Lead, Dissolved (µg/L)	100	0.3	186
Selenium, Dissolved (µg/L)	50	1.9	91.5
Gross Alpha (pCi/L)	15	10.1	19.3

1: Background concentration assumed 67% of chronic standard; TDS is based on observed ambient data

FILE COPY

STATE OF UTAH
DIVISION OF WATER QUALITY
DEPARTMENT OF ENVIRONMENTAL QUALITY
SALT LAKE CITY, UTAH

UTAH POLLUTANT DISCHARGE ELIMINATION SYSTEM (UPDES) PERMITS

Major Municipal Permit No. **UT0020427**
Biosolids Permit No. **UTL0020427**
Storm Water Permit No. **UTR020427**

In compliance with provisions of the Utah *Water Quality Act, Title 19, Chapter 5, Utah Code Annotated ("UCA") 1953, as amended* (the *"Act"*),

PAYSON CITY WASTEWATER TREATMENT FACILITY

is hereby authorized to discharge from its wastewater treatment facility to receiving waters unnamed irrigation ditch to **BEER CREEK**,

to dispose of biosolids,

and to discharge storm water,

in accordance with specific limitations, outfalls, and other conditions set forth herein.

This permit shall become effective on April 1, 2008

This permit expires at midnight on March 31, 2013.

Signed this 25th day of March, 2008.

Walter L. Baker
Executive Secretary
Utah Water Quality Board

Table of Contents

I. DISCHARGE LIMITATIONS AND REPORTING REQUIREMENTS

A. Description of Discharge Point. The authorization to discharge wastewater provided under this part is limited to those outfalls specifically designated below as discharge locations. Discharges at any location not authorized under a UPDES permit are violations of the *Act* and may be subject to penalties under the *Act*. Knowingly discharging from an unauthorized location or failing to report an unauthorized discharge may be subject to criminal penalties as provided under the *Act*.

Outfall Number	Location of Discharge Outfall
001	Located at latitude 40°03'41" and longitude 111°43'49". The discharge is through a concrete pipe to an unnamed irrigation return drainage ditch to Beer Creek then Benjamin Slough to Utah Lake.

B. Narrative Standard. It shall be unlawful, and a violation of this permit, for the permittee to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum, or other nuisances such as color, odor or taste, or cause conditions which produce undesirable aquatic life or which produce objectionable tastes in edible aquatic organisms; or result in concentrations or combinations of substances which produce undesirable physiological responses in desirable resident fish, or other desirable aquatic life, or undesirable human health effects, as determined by a bioassay or other tests performed in accordance with standard procedures.

C. Specific Limitations and Self-Monitoring Requirements.

1. Effective April 1, 2008 and lasting through the life of this permit, there shall be no acute or chronic toxicity in Outfall 001 as defined in *Part VIII*, and determined by test procedures described in *Part I. C. 3.a* of this permit.

2. Effective immediately and lasting the duration of this permit, the permittee is authorized to discharge from Outfall 001. Such discharges shall be limited and monitored by the permittee as specified below:

Parameter	Effluent Limitations			
	Maximum Monthly Average	Maximum Weekly Average	Daily Minimum	Daily Maximum
BOD_5, mg/L	25	35	NA	NA
BOD_5 Min. % Removal	85	NA	NA	NA
TSS, mg/L	25	35	NA	NA
TSS Min. % Removal	85	NA	NA	NA
E. Coli, no./100mL	126	158	NA	NA
Dissolved Oxygen, mg/l	NA	NA	4.0	NA

Ammonia, mg/l December – February March – May June – August September – November	 NA NA NA NA	 NA NA NA NA	 NA NA NA NA	 14.1 13.1 12.5 13.1
TRC, mg/L December – February March – May June – August September – November	 NA NA NA NA	 NA NA NA NA	 NA NA NA NA	 2.4 1.6 1.1 1.6
WET, Acute Biomonitoring	NA	NA	NA	Pass/Fail
Oil & Grease, mg/L	NA	NA	NA	10
pH, Standard Units	NA	NA	6.5	9.0

NA – Not Applicable

Self-Monitoring and Reporting Requirements, a*			
Parameter	Frequency	Sample Type	Units
Total Flow, b*, c*	Continuous	Recorder	MGD
BOD_5, Influent, d* Effluent	2 x Weekly 2 x Weekly	Composite Composite	mg/L mg/L
TSS, Influent, d* Effluent	2 x Weekly 2 x Weekly	Composite Composite	mg/L mg/L
Dissolved Oygen	2 x Weekly	Grab	mg/L
Ammonia	2 x Weekly	Grab	No./100mL
E. Coli	2 x Weekly	Grab	No./100mL
TRC	Daily	Grab	mg/L
WET, Acute Biomonitoring Ceriodaphnia dubia Pimephales promelas	Quarterly 1st & 3rd Quarters 2nd & 4th Quarters	 Composite Composite	 Pass/Fail Pass/Fail
Oil & Grease, e*	Monthly	Grab	mg/L
pH	2 x Weekly	Grab	SU
Metals, Influent Effluent	Quarterly Quarterly	Composite Composite	mg/L mg/L
Organic Toxics	Yearly	Grab	mg/L

a* See Definitions, *Part VIII*, for definition of terms.

b* Flow measurements of influent/effluent volume shall be made in such a manner that the permittee can affirmatively demonstrate that representative values are being obtained.

c* If the rate of discharge is controlled, the rate and duration of discharge shall be reported.

d* In addition to monitoring the final discharge, influent samples shall be taken and analyzed for this constituent at the same frequency as required for this constituent in the discharge.

e* Sample when Sheen is Visible.

3. Acute/Chronic Whole Effluent Toxicity (WET) Testing.

   a. *Whole Effluent Testing – Acute Toxicity.* Starting on April 1, 2008, the permittee shall conduct quarterly acute static replacement toxicity tests on a composite sample of the final effluent. The sample shall be collected at Outfall 001.

   The monitoring frequency for acute tests shall be quarterly unless a sample is found to be acutely toxic during a routine test. If that occurs, the monitoring frequency shall become weekly (See *Part I.C. 3.b, Accelerated Testing*). Samples shall be collected on a two day progression; i.e., if the first sample is on a Monday, during the next sampling period, the sampling shall begin on a Wednesday, etc.

   The replacement static acute toxicity tests shall be conducted in general accordance with the procedures set out in the latest revision of *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. Fourth Edition. August 1993, EPA/600/4-90/027F* as per *40 CFR 136.3(a) TABLE 1A-LIST OF APPROVED BIOLOGICAL METHODS*, and the *Region VIII EPA NPDES Acute Test Conditions – Static Renewal Whole Effluent Toxicity Test (August, 1997)*. In the case of conflicts, the Region VIII procedures will prevail. The permittee shall conduct the 48-hour static replacement toxicity test using Ceriodaphnia dubia (water flea) and the acute 96-hour static replacement toxicity test using Pimephales promelas (fathead minnow). Tests will be conducted quarterly alternating between the Ceriodaphnia dubia and Pimephales promelas species replacement toxicity tests as appropriate. A CO_2 atmosphere may be used (in conjunction with an unmodified test) in order to account for pH drift.

   Acute toxicity occurs when 50 percent or more mortality is observed for either species at any effluent concentration. Mortality in the control must simultaneously be 10 percent or less for the results to be considered valid. If more than 10 percent control mortality occurs, the test shall be repeated until satisfactory control mortality is achieved. A variance to this requirement may be granted by the Executive Secretary if a mortality of less than 10 percent was observed in higher effluent dilutions.

   If the permit contains a total residual chlorine limitation greater than 0.20 mg/L, the permittee may request from the Executive Secretary approval to de-chlorinate the sample, or collect the sample prior to chlorination.

   Quarterly test results shall be reported along with the Discharge Monitoring Report (DMR) submitted for the end of the reporting calendar quarter e.g., biomonitoring results for the calendar quarter ending March 31 shall be reported with the DMR due April 28, with the remaining biomonitoring reports submitted with DMRs due each July 28, October 28, and January 28). All test results shall be reported along with the DMR submitted for that reporting period. The format for the report shall be consistent with the latest revision of the *Region VIII Guidance for Acute Whole Effluent Reporting (August, 1997)* and shall include all chemical and physical data as specified.

If the results for one year of testing indicate no acute toxicity, the permittee may request a reduction in testing frequency and/or reduction to one species. The Executive Secretary may approve, partially approve, or deny the request based on results and other available information. If approval is given, the modification will take place without a public notice.

b. *Accelerated Testing.* When acute toxicity is indicated during routine biomonitoring as specified in this permit, the permittee shall notify the Executive Secretary in writing within five (5) days after becoming aware of the test result. The permittee shall perform an accelerated schedule of biomonitoring to establish whether a pattern of toxicity exists. Accelerated testing will begin within seven (7) days after the permittee becomes aware of the test result. Accelerated testing shall be conducted as specified under *Part I.C.3.c, Pattern of Toxicity*. If the accelerated testing demonstrates no pattern of toxicity, routine monitoring shall be resumed.

c. *Pattern of Toxicity.* A pattern of toxicity is defined by the results of a series of up to five (5) biomonitoring tests pursuant to the accelerated testing requirements using 100 percent effluent on the single species found to be more sensitive, once every week for up to five (5) consecutive weeks.

If two (2) consecutive tests (not including the scheduled quarterly or monthly test which triggered the search for a pattern of toxicity) do not result in acute toxicity, no further accelerated testing will be required and no pattern of toxicity will be found to exist. The permittee will provide written verification to the Executive Secretary within five (5) days, and resume routine monitoring.

A pattern of toxicity is established if one of the following occurs:

(1) If two (2) consecutive test results (not including the scheduled quarterly or monthly test, which triggered the search for a pattern of toxicity) indicate acute toxicity, this constitutes an established pattern of toxicity.

(2) If consecutive tests continue to yield differing results each time, the permittee will be required to conduct up to a maximum of five (5) acute tests (not including the scheduled quarterly or monthly test which triggered the search for a pattern of toxicity). If three out of five test results indicate acute toxicity, this will constitute an established pattern of toxicity.

d. *Preliminary Toxicity Investigation.*

(1) When a pattern of toxicity is detected the permittee will notify the Executive Secretary in writing within five (5) days and begin an

evaluation of the possible causes of the toxicity. The permittee will have fifteen (15) working days from demonstration of the pattern to complete a Preliminary Toxicity Investigation (PTI) and submit a written report of the results to the Executive Secretary. The PTI may include, but is not limited to, additional chemical and biological monitoring, examination of pretreatment program records, examination of discharge monitoring reports, a thorough review of the testing protocol, evaluation of treatment processes and chemical use, inspection of material storage and transfer areas to determine if a spill may have occurred, and similar procedures.

(2) If the PTI identifies a probable toxicant and/or a probable source of toxicity the permittee shall submit, as part of its final results written notification of that effect to the Executive Secretary. Within thirty (30) days of completing the PTI the permittee shall submit for approval a control program to control effluent toxicity and shall proceed to implement such a plan within seven (7) days following approval. The control program, as submitted to or revised by the Executive Secretary, may be incorporated into the permit.

(3) If no probable explanation for toxicity is identified in the PTI, the permittee shall notify the Executive Secretary as part of its final report, along with a schedule for conducting a Phase I Toxicity Reduction Evaluation (TRE) (See *Part I.C.3.f, Toxicity Reduction Evaluation*).

(4) If toxicity spontaneously disappears during the PTI, the permittee shall submit written notification to that effect to the Executive Secretary as part of the reporting requirements of paragraph a. of this section.

e. *Toxicity Reduction Evaluation (TRE).* If toxicity is detected during the life of this permit and it is determined by the Executive Secretary that a TRE is necessary, the permittee shall be so notified and shall initiate a TRE immediately thereafter. The purpose of the TRE will be to establish the cause of toxicity, locate the source(s) of the toxicity, and control or provide treatment for the toxicity.

A TRE may include but is not limited to one, all, or a combination of the following:

(1) Phase I – Toxicity Characterization

(2) Phase II – Toxicity Identification Procedures

(3) Phase III – Toxicity Control Procedures

(4) Any other appropriate procedures for toxicity source elimination and control.

If the TRE establishes that the toxicity cannot be immediately eliminated, the permittee shall submit a proposed compliance plan to the Executive

Secretary. The plan shall include the proposed approach to control toxicity and a proposed compliance schedule for achieving control. If the approach and schedule are acceptable to the Executive Secretary, this permit may be reopened and modified.

If the TRE shows that the toxicity is caused by a toxicant(s) that may be controlled with specific numerical limitations, the permittee may:

(a) Submit an alternative control program for compliance with the numerical requirements.

(b) If necessary, provide a modified biomonitoring protocol, which compensates for the pollutant(s) being controlled numerically.

If acceptable to the Executive Secretary, this permit may be reopened and modified to incorporate any additional numerical limitations, a modified compliance schedule if judged necessary by the Executive Secretary, and/or a modified biomonitoring protocol.

Failure to conduct an adequate TRE, or failure to submit a plan or program as described above, or the submittal of a plan or program judged inadequate by the Executive Secretary, shall be considered a violation of this permit.

D. <u>Reporting of Wastewater Monitoring Results</u>. Monitoring results obtained during the previous month shall be summarized for each month and reported on a Discharge Monitoring Report Form (EPA No. 3320-1), post-marked no later than the 28th day of the month following the completed reporting period. The first report is due on May 28, 2008. If no discharge occurs during the reporting period, "no discharge" shall be reported. Legible copies of these, and all other reports including whole effluent toxicity (WET) test reports required herein, shall be signed and certified in accordance with the requirements of *Signatory Requirements (see Part VII.G)*, and submitted to the Director, Division of Water Quality at the following address:

original to: Department of Environmental Quality
Division of Water Quality
288 North 1460 West
PO Box 144870
Salt Lake City, Utah 84114-4870

II. INDUSTRIAL PRETREATMENT PROGRAM

A. Pretreatment Program Delegation. The permittee has been delegated primary responsibility for enforcing against discharges prohibited by *40 CFR 403.5* and applying and enforcing any national Pretreatment Standards established by the United States Environmental Protection Agency in accordance with Section 307 (b) and (c) of *The Clean Water Act (CWA)*, as amended by *The Water Quality Act (WQA), of 1987.*

The permittee shall implement the Industrial Pretreatment Program in accordance with the legal authorities, policies, and procedures described in the permittee's approved Pretreatment Program submission. Such program commits the permittee to do the following:

1. Carry out inspection, surveillance, and monitoring procedures, which will determine, independent of information supplied by the industrial user, whether the industrial user is in compliance with the pretreatment standards. At a minimum, all significant industrial users shall be inspected and sampled by the permittee at least once per year;

2. Control through permit, order, or similar means, the contribution to the POTW by each industrial user to ensure compliance with applicable pretreatment standards and requirements;

3. Require development, as necessary, of compliance schedules by each industrial user for the installation of control technologies to meet applicable pretreatment standards;

4. Maintain and update industrial user information as necessary, to ensure that all IUs are properly permitted and/or controlled at all times;

5. Enforce all applicable pretreatment standards and requirements and obtain appropriate remedies for noncompliance by any industrial user;

6. Annually publish a list of industrial users that were determined to be in significant noncompliance during the previous year. The notice must be published before March 28 of the following year;

7. Maintain an adequate revenue structure and staffing level for continued implementation of the Pretreatment Program.

8. Evaluate all significant industrial users at least once every two years to determine if they need to develop a slug prevention plan. If a slug prevention plan is required, the permittee shall insure that the plan contains at least the minimum elements required in *40 CFR 403.8(f)(2)(v);*

9. Notify all significant industrial users of their obligation to comply with applicable requirements under *Subtitles C and D* of the *Resource* Conservation and Recovery Act (RCRA); and

10. Develop, implement, and maintain an enforcement response plan as required by *40 CFR 403.8(f)(5)* which shall, at a minimum,

    a. Describe how the POTW will investigate instances of noncompliance;

    b. Describe the types of escalating enforcement responses the POTW will take in response to all anticipated type of industrial user violations; and

    c. Describe the time periods within which such responses will be taken and identify the POTW staff position(s) responsible for pursuing these actions.

11. Establish and enforce specific local limits as necessary to implement the provisions of the *40 CFR Parts 403.5(a)* and *(b)*, and as required by *40 CFR Part 403.5(c)*.

B. Program Updates. The permittee is required to modify its pretreatment program, as necessary, to reflect changes in the regulations of *40 CFR 403*. Such modifications shall be completed within the time frame set forth by the applicable regulations. Modification of the approved pretreatment program must be done in accordance with the requirements of *40 CFR 403.18*. Modifications of the approved program which result in less stringent industrial user requirements shall not be effective until after approval has been granted by the Executive Secretary.

C. Annual Report. The permittee shall provide the Division of Water Quality and EPA with an annual report briefly describing the permittee's pretreatment program activities over the previous calendar year. Reports shall be submitted no later than March 28 of each year. These annual reports shall, at a minimum, include:

1. An updated listing of the permittee's industrial users.

2. A descriptive summary of the compliance activities including numbers of any major enforcement actions, i.e., administrative orders, penalties, civil actions, etc.

3. An assessment of the compliance status of the permittee's industrial users and the effectiveness of the permittee's Pretreatment Program in meeting its needs and objectives.

4. A summary of all sampling data taken of the influent and effluent for those pollutants listed in *Part II.H.*

5. A description of all substantive changes made to the permittee's pretreatment program referenced in *Section B* of this section. Substantive changes include, but are not limited to, any change in any ordinance, major modification in the program's administrative structure or operating agreement(s), a significant reduction in monitoring, or a change in the method of funding the program.

6. Other information as may be determined necessary by the Executive Secretary.

D. General and Specific Prohibitions. Pretreatment standards (*40 CFR 403.5*) specifically prohibit the introduction of the following pollutants into the waste treatment system from any source of non-domestic discharge:

1. Pollutants which create a fire or explosion hazard in the publicly owned treatment works (POTW), including, but not limited to, wastestreams with a closed cup flashpoint of less than 140oF (60oC);

2. Pollutants, which will cause corrosive structural damage to the POTW, but in no case, discharges with a pH lower than 5.0;

3. Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in interference;

4. Any pollutant, including oxygen demanding pollutants (BOD, etc.), released in a discharge at such volume or strength as to cause interference in the POTW;

5. Heat in amounts, which will inhibit biological activity in the POTW, resulting in interference, but in no case, heat in such quantities that the influent to the sewage treatment works exceeds 104°F (40°C);

6. Petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;

7. Pollutants, which result in the presence of toxic gases, vapor, or fumes within the POTW in a quantity that may cause worker health or safety problems;

8. Any trucked or hauled pollutants, except at discharge points designated by the POTW; or

9. Any pollutant that causes pass through or interference at the POTW.

10. Any specific pollutant which exceeds any local limitation established by the POTW in accordance with the requirement of *40 CFR 403.5(c)* and *40 CFR 403.5(d)*.

E. Categorical Standards. In addition to the general and specific limitations expressed in *Part A and D* of this section, applicable National Categorical Pretreatment Standards must be met by all industrial users of the POTW. These standards are published in the federal regulations at *40 CFR 405* et. seq.

F. Enforcement Notice. *UCA 19-5-104* provides that the State may issue a notice to the POTW stating that a determination has been made that appropriate enforcement action must be taken against an industrial user for noncompliance with any pretreatment requirements within 30 days. The issuance of such notice shall not be construed to limit the authority of the Executive Secretary.

G. Formal Action. The Executive Secretary retains the right to take legal action against any industrial user and/or POTW for those cases where a permit violation has occurred because of the failure of an industrial user to meet an applicable pretreatment standard.

H. Self-Monitoring and Reporting Requirements.

1. Influent and Effluent Monitoring and Reporting Requirements. The permittee shall sample and analyze both the influent and effluent quarterly, for the following parameters.

Metals Monitoring for Pretreatment Program				
Parameter	Sample Type	Frequency	Units	Test Limt a.*
Total Arsenic	Composite	Quarterly	ug/L	100.2
Total Cadmium				0.6
Total Chromium				11.0
Total Copper				23.9
Total Cyanide	Grab			5.2
Total Lead	Composite			12.9
Total Mercury	Composite/Grab			0.012
Total Molybdenum	Composite			n/a
Total Nickel				132
Total Selenium				4.6
Total Silver				25.1
Total Zinc				304.7

a.* The MDL of the test method used for analysis must be below this limit, if a test method is not available the permittee must submit documentation to the Executive Secretary regarding the method that will be used.

In addition, the permittee shall analyze the treatment facility influent and effluent for the presence of the toxic pollutants listed in *40 CFR 122 Appendix D Table II (Organic Toxic Pollutants)* yearly. The pesticides fraction of *Appendix D, Table II* is suspended unless pesticides are expected to be present.

The results of the analyses of metals, cyanide and toxic organics shall be submitted along with the Discharge Monitoring Report (DMR) at the end of the earliest possible reporting period.

2. In accordance with the requirements of *40 CFR Part 403.5(c)*, the permittee shall determine if there is a need to develop or revise its local limits in order to implement the general and specific prohibitions of *40 CFR Part 403.5 (a)* and *Part 403.5 (b)*. A technical evaluation of the need to develop or revise local limits shall be submitted to the Division within **12 months** of the effective date of this permit. This evaluation should be conducted in accordance with the latest revision of the *Utah Model industrial Pretreatment Program, Section 4, Local Limits*. If a technical evaluation, which may be based on the *Utah Model Industrial Pretreatment Program, Section 4, Local Limits*, reveals that development or revision of local limits is necessary, the permittee shall submit the

proposed local limits revision to the Division of Water Quality for approval, and after approval implement the new local limits, within **12 months** of the Division's determination that a revision is necessary.

III. BIOSOLIDS REQUIREMENTS

A. Description of Biosolids Treatment and Disposal.

The authorization to dispose of biosolids provided under this permit is limited to those biosolids produced from the treatment works owned and operated by the permittee. The treatment methods and disposal practices are specifically designated below.

1. Treatment.

   Biosolids produced at the PCWWTP **are stabilized in anaerobic digesters with a hydraulic retention time of approximately 40 days at an estimated average temperature of 95° F (29.4°C). The biosolids are de-watered with drying beds.**

2. Description of Biosolids Disposal Method.

   The biosolids are disposed in a landfill

3. Changes in Treatment Systems and Disposal Practices.

   Should the PCWWTP change their disposal methods or the biosolids generation and handling processes of the plant, the PCWWTP must notify the Executive Secretary at least 180 days in advance. This includes, but is not limited to, the addition or removal of any biosolids treatment units (e.g., digesters, drying beds, etc.) and/or any other change that would require a major modification of the permit.

   All biosolids land filled must meet the requirements of *40 CFR 258, Utah Administrative Code R315-301-5* and *Section 2.12* of the latest version of the *EPA Region VIII Biosolids Management Handbook.*

B. Specific Limitations and Monitoring Requirements.

All biosolids generated by this facility that are disposed shall meet the requirements of *Part III.B.1*and *2* listed below.

1. Vector Attraction Reduction Requirements.
   The vector attraction reduction must be met with a 38% volatile solids reduction prior to disposal in the landfill.

   a. There are additional vector attraction reduction alternatives available in *40 CFR 503.33*. If the permittee intends to use one of these alternatives, the Executive Secretary and the EPA must be informed at least thirty (30) days prior to its use. This change may be made without additional public notice.

2. Self-Monitoring Requirements.

At a minimum, upon the effective date of this permit, vector attraction reduction and paint filter tests requirements shall be monitored according to *40 CFR 503.16.*

Minimum Frequency of Monitoring

Amount of Biosolids Disposed Per Year	**Monitoring Frequency**
> 0 to < 290 DMT	**One Time Per Year**
> 290 to < 1500 DMT	**Four times Per Year**

Sample collection, preservation and analysis shall be performed in a manner consistent with the requirements of *40 CFR Part 503* and/or other criteria specified in this permit.

C. Special Conditions on Biosolids Storage.

For biosolids or material derived from biosolids that are stored in piles for one year or longer, measures shall be taken to ensure that erosion (whether by wind or water) does not occur. However, best management practices should also be used for piles used for biosolids treatment. If a treatment pile is considered to have caused a problem, best management practices could be added as a requirement in the next permit renewal.

Permanent storage of biosolids is prohibited. Biosolids shall not be temporarily stored for more than two years. Written permission to store biosolids for more than two years must be obtained from the Executive Secretary. Storage of biosolids for more than two years will be allowed only if it is determined that significant treatment is occurring.

D. Representative Sampling.

Biosolids samples used to measure compliance with Part II of this Permit shall be collected at locations representative of the quality of biosolids generated at the treatment works and immediately prior to land application.

E. Reporting of Monitoring Results.

1. The PCWWTP shall provide the results of all monitoring performed in accordance with *Part III.B.* of the permit and information on management practices, and certifications shall be provided no later than February 19 of each year. Each report is for the previous calendar year. If no biosolids were applied to the land during the reporting period, "no biosolids were applied" shall be reported. Legible copies of these, and all other reports required herein, shall be signed and certified in accordance with Record Keeping (see *Part III.G.*), and

submitted to the Utah Division of Water Quality and the EPA at the following addresses:

Original to: Biosolids Coordinator
Utah Division of Water Quality
P. O. Box 144870
Salt Lake City Utah, 84114-4870

Copy to: Biosolids Coordinator, 8P-W-P
U. S. Environmental Protection Agency
Region VIII
999 18th Street, Suite 500
Denver, Colorado 80202-2466

F. Additional Monitoring by the Permittee. If the PCWWTP monitors any pollutant more frequently than required by this permit, using test procedures approved under *40 CFR 503* or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted on the Biosolids Report form. Such increased frequency shall also be indicated

G. Record Keeping

1. If so notified by the Executive Secretary the PCWWTP may be required to add additional record keeping if information provided indicates that this is necessary to protect public health and the environment.

2. The PCWWTP is required to keep the following information for at least 5 years:

   "I certify under the penalty of law, that the vector attraction requirements in *Part III.B.1.*, have been met. This determination has been made under my direction and supervision in accordance with the system designed to assure that qualified personnel properly gathered and evaluated the information used to determine that the vector attraction reduction requirements have been met. I am aware that there are significant penalties for false certification including the possibility of imprisonment."

3. Records of monitoring information shall include:

   a. The date, exact place, and time of sampling or measurements;

   b. The initials or name(s) of the individual(s) who performed the sampling or measurements;

   c. The date(s) analyses were performed;

   d. The time(s) analyses were initiated;

   e. The initials or name(s) of individual(s) who performed the analyses;

f. References and written procedures, when available, for the analytical techniques or methods used; and,

g. The results of such analyses, including the bench sheets, instrument readouts, computer disks or tapes, etc., used to determine these results.

4. The PCWWTP shall retain records of all monitoring information, including all calibration and maintenance records and 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 for the life of the permit. Data collected on site, copies of Biosolids Report forms, and a copy of this UPDES biosolids-only permit must be maintained on site during the duration of activity at the permitted location.

H. Twenty-four Hour Notice of Noncompliance Reporting.

1. The shall report any noncompliance including transportation accidents and spills from the transfer of biosolids which may seriously endanger health or the environment as soon as possible, but no later than 24 hours from the time the PCWWTP first became aware of the circumstances. The report shall be made to the Division of Water Quality at (801) 538-6146 or (801) 536-4123 (24-hour answering machine).

2. A written submission shall also be provided within five days of the time that the PCWWTP becomes aware of the circumstances. The written submission shall 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.

3. The Executive Secretary may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Division of Water Quality, by phone, at (801) 538-6146.

4. Reports shall be submitted to the addresses in *Part III.E.1.*, Reporting of Monitoring Results.

I. Other Noncompliance Reporting. Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for *Part III.B.* are submitted. The reports shall contain the information listed in *Part III.F.*

IV. STORM WATER REQUIREMENTS.

A. Coverage of This Section. The requirements listed under this section shall apply to storm water discharges. Storm water discharges from the following portions of the facility may be eligible for coverage under this permit: biosolids drying beds, haul or access roads on which transportation of biosolids may occur, grit screen cleaning areas, chemical loading, unloading and storage areas, salt or sand storage areas, vehicle or equipment storage and maintenance areas, or any other wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage, including lands dedicated to the disposal of sewage sludge that are located within the confines of the facility that may have a reasonable expectation to contribute to pollutants in a storm water discharge.

B. Prohibition of Non-Storm Water Discharges. Except for discharges identified in *Part I.*, and discharges described below in this paragraph, non-storm water discharges are prohibited. The following non-storm water discharges may be authorized under this permit provided the non-storm water component of the discharge is in compliance with this section; discharges from fire fighting activities; fire hydrant flushing; potable water sources including waterline flushing; drinking fountain water; irrigation drainage and lawn watering; routine external building wash down water where detergents or other compounds have not been used in the process; pavement wash waters where spills or leaks of toxic or hazardous materials (including oils and fuels) have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; uncontaminated compressor condensate; uncontaminated springs; uncontaminated ground water; and foundation or footing drains where flows are not contaminated with process materials such as solvents.

C. Storm Water Pollution Prevention Plan Requirements. The permittee must have (on site) or develop and implement a storm water pollution prevention plan as a condition of this permit.

1. Contents of the Plan. The plan shall include, at a minimum, the following items:

   a. *Pollution Prevention Team.* Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team who are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

   b. *Description of Potential Pollutant Sources.* Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials, which may be reasonably expected to have the potential as a significant pollutant source. Each plan shall include, at a minimum:

(1) *Drainage*. A site map indicating drainage areas and storm water outfalls. For each area of the facility that generates storm water discharges associated with the waste water treatment related activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow and an identification of the types of pollutants that are likely to be present in storm water discharges associated with the activity. Factors to consider include the toxicity of the pollutant; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified. The site map shall include but not be limited to:

(a) Drainage direction and discharge points from all wastewater associated activities including but not limited to grit screen cleaning, bio-solids drying beds and transport, chemical/material loading, unloading and storage areas, vehicle maintenance areas, salt or sand storage areas.

(b) Location of any erosion and sediment control structure or other control measures utilized for reducing pollutants in storm water runoff.

(c) Location of bio-solids drying beds where exposed to precipitation or where the transportation of bio-solids may be spilled onto internal roadways or tracked off site.

(d) Location where grit screen cleaning or other routinely performed industrial activities are located and are exposed to precipitation.

(e) Location of any handling, loading, unloading or storage of chemicals or potential pollutants such as caustics, hydraulic fluids, lubricants, solvents or other petroleum products, or hazardous wastes and where these may be exposed to precipitation.

(f) Locations where any major spills or leaks of toxic or hazardous materials have occurred.

(g) Location of any sand or salt piles.

(h) Location of fueling stations or vehicle and equipment maintenance and cleaning areas that are exposed to precipitation.

(i) Location of receiving streams or other surface water bodies.

(j) Locations of outfalls and the types of discharges contained in the drainage areas of the outfalls.

(2) *Inventory of Exposed Materials.* An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the effective date of this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the effective date of this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(3) *Spills and Leaks.* A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the effective date of this permit. Such list shall be updated as appropriate during the term of the permit.

(4) *Sampling Data.* A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(5) *Summary of Potential Pollutant Sources and Risk Assessment.* A narrative description of the potential pollutant sources from the following activities associated with treatment works: access roads/rail lines; loading and unloading operations; outdoor storage activities; material handling sites; outdoor vehicle storage or maintenance sites; significant dust or particulate generating processes; and onsite waste disposal practices. Specific potential pollutants shall be identified where known.

(6) *Measures and Controls.* The permittee shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(7) *Good Housekeeping.* All areas that may contribute pollutants to storm waters discharges shall be maintained in a clean, orderly manner. These are practices that would minimize the generation of pollutants at the source or before it would be necessary to employ sediment ponds or other control measures at the discharge outlets. Where applicable, such measures or other equivalent measures would include the following: sweepers and covered storage to minimize dust generation and storm runoff; conservation of vegetation where possible to minimize erosion;

sweeping of haul roads, bio-solids access points, and exits to reduce or eliminate off site tracking; sweeping of sand or salt storage areas to minimize entrainment in storm water runoff; collection, removal, and proper disposal of waste oils and other fluids resulting from vehicle and equipment maintenance; other equivalent measures to address identified potential sources of pollution.

(8) *Preventive Maintenance.* A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(9) *Spill Prevention and Response Procedures.* Areas where potential spills that can contribute pollutants to storm water discharges can occur, and their accompanying drainage points, shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures and equipment for cleaning up spills shall be identified in the plan and made available to the appropriate personnel.

(10) *Inspections.* In addition to the comprehensive site evaluation required under paragraph *(Part IV.C.1.b.(16))* of this section, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility on a periodic basis. The following areas shall be included in all inspections: access roads/rail lines, equipment storage and maintenance areas (both indoor and outdoor areas); fueling; material handling areas, residual treatment, storage, and disposal areas; and wastewater treatment areas. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained. The use of a checklist developed by the facility is encouraged.

(11) *Employee Training.* Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify how often training will take place, but training should be held at least annually (once per calendar year). Employee training must, at a minimum, address the following areas when applicable to a facility: petroleum product management; process chemical management; spill prevention and control; fueling procedures; general good housekeeping

practices; proper procedures for using fertilizers, herbicides and pesticides.

(12) *Record keeping and Internal Reporting Procedures.* A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(13) *Non-storm Water Discharges.*

(a) *Certification.* The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with *Part VII.G* of this permit.

(b) *Exceptions.* Except for flows from fire fighting activities, sources of non-storm water listed in *Part IV.B.* (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(c) *Failure to Certify.* Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the *Executive Secretary* within 180 days after the effective date of this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the State, which are not, authorized by a *UPDES* permit are unlawful, and must be terminated.

(14) *Sediment and Erosion Control.* The plan shall identify areas, which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(15) *Management of Runoff.* The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity *Part IV.C.1.b* (Description of Potential Pollutant Sources) of this permit] shall be considered when determining reasonable and appropriate measures. Appropriate measures or other equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, wet detention/retention devices and discharging storm water through the waste water facility for treatment.

(16) *Comprehensive Site Compliance Evaluation.* Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with *Part IV.C.1.b* (Description of Potential Pollutant Sources) of this section and pollution prevention measures and controls identified in the plan in accordance with *Part IV.C.1.b.(6)* (Measures and Controls) of this section shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph *i.* (above) shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with *Part VII.G* (Signatory Requirements) of this permit.

(17) *Deadlines for Plan Preparation and Compliance.* The permittee shall prepare and implement a plan in compliance with the provisions of this section within 270 days of the effective date of this permit. If the permittee already has a plan, it shall be revised according to *Part IV.C.1.b.(16)*, Comprehensive Site Evaluation.

(18) *Keeping Plans Current.* The permittee shall amend the plan whenever there is a change in design, construction, operation, or maintenance, that has a significant effect on the potential for the discharge of pollutants to the waters of the state or if the storm water pollution prevention plan proves to be ineffective in eliminating or significantly minimizing pollutants from sources identified by the plan, or in otherwise achieving the general objective of controlling pollutants in storm water discharges associated with the activities at the facility.

D. Monitoring and Reporting Requirements.

1. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each of the following designated periods during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event: January through March; April through June; July through September; and October through December.

   a. *Sample and Data Collection.* Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

b. *Visual Storm Water Discharge Examination Reports.* Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

c. *Representative Discharge.* When the permittee has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the observation data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

d. *Adverse Conditions.* When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the results of the visual examination. Adverse weather conditions, which may prohibit the collection of samples, include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

e. *Inactive and Unstaffed Site.* When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

V. MONITORING, RECORDING & GENERAL REPORTING REQUIREMENTS

A. Representative Sampling. Samples taken in compliance with the monitoring requirements established under *Part I* shall be collected from the effluent stream prior to discharge into the receiving waters. Samples and measurements shall be representative of the volume and nature of the monitored discharge. Samples of biosolids shall be collected at a location representative of the quality of biosolids immediately prior to the use-disposal practice.

B. Monitoring Procedures. Monitoring must be conducted according to test procedures approved under *Utah Administrative Code ("UAC") R317-2-10 and 40CFR Part 503*, unless other test procedures have been specified in this permit.

C. Penalties for Tampering. The *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 shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

D. Compliance Schedules. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

E. Additional Monitoring by the Permittee. If the permittee monitors any parameter more frequently than required by this permit, using test procedures approved under *UAC R317-2-10* and *40 CFR 503* or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or the Biosolids Report Form. Such increased frequency shall also be indicated. Only those parameters required by the permit need to be reported.

F. Records Contents. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements:
2. The individual(s) who performed the sampling or measurements;
3. The date(s) and time(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and,
6. The results of such analyses.

G. Retention of Records. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and 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, for a period of at least five years from the date of the sample, measurement, report or application. This period may be extended by request of the Executive Secretary at any time. A copy of this UPDES permit must be maintained on site during the duration of activity at the permitted location

H. Twenty-four Hour Notice of Noncompliance Reporting.

1. The permittee shall (orally) report any noncompliance including transportation accidents, spills, and uncontrolled runoff from biosolids transfer or land application sites which may seriously endanger health or environment, as soon as possible, but no later than twenty-four (24) hours from the time the permittee first became aware of circumstances. The report shall be made to the Division of Water Quality, (801) 538-6146, or 24-hour answering service (801) 536-4123.

2. The following occurrences of noncompliance shall be reported by telephone (801) 536-4123 as soon as possible but no later than 24 hours from the time the permittee becomes aware of the circumstances:

    a. Any noncompliance which may endanger health or the environment;

    b. Any unanticipated bypass, which exceeds any effluent limitation in the permit (See *Part VI.G, Bypass of Treatment Facilities.)*;

    c. Any upset which exceeds any effluent limitation in the permit (See *Part VI.H, Upset Conditions*.);

    d. Violation of a maximum daily discharge limitation for any of the pollutants listed in the permit; or,

    e. Violation of any of the Table 3 metals limits, the pathogen limits, the vector attraction reduction limits or the management practices for biosolids that have been sold or given away.

3. A written submission shall also be provided within five days of the time that the permittee becomes aware of the circumstances. The written submission shall 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;

    d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance; and,

    e. Steps taken, if any, to mitigate the adverse impacts on the environment and human health during the noncompliance period.

4. The Executive Secretary may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Division of Water Quality, (801) 538-6146.

5. Reports shall be submitted to the addresses in *Part I.D, Reporting of Monitoring Results*.

I. Other Noncompliance Reporting. Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for *Part I.D* are submitted. The reports shall contain the information listed in *Part V.H.3*

J. Inspection and Entry The permittee shall allow the Executive Secretary, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

1. 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 the permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit, including but not limited to, biosolids treatment, collection, storage facilities or area, transport vehicles and containers, and land application sites;

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the *Act*, any substances or parameters at any location, including, but not limited to, digested biosolids before dewatering, dewatered biosolids, biosolids transfer or staging areas, any ground or surface waters at the land application sites or biosolids, soils, or vegetation on the land application sites; and,

5. The permittee shall make the necessary arrangements with the landowner or leaseholder to obtain permission or clearance, the Executive Secretary, or authorized representative, upon the presentation of credentials and other documents as may be required by law, will be permitted to enter without delay for the purposes of performing their responsibilities.

VI. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give advance notice to the Executive Secretary of any planned changes in the permitted facility or activity, which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions. The *Act* provides that any person who violates a permit condition implementing provisions of the *Act* is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions or the Act is subject to a fine not exceeding $25,000 per day of violation. Any person convicted under *UCA 19-5-115(2)* a second time shall be punished by a fine not exceeding $50,000 per day. Except as provided at *Part VI.G, Bypass of Treatment Facilities* and *Part VI.H, Upset Conditions*, nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense. It shall not be 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.

D. Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit, which has a reasonable likelihood of adversely affecting human health or the environment. The permittee shall also take all reasonable steps to minimize or prevent any land application in violation of this permit.

E. Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which 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 quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems, which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

F. Removed Substances. Collected screening, grit, solids, sludge, or other pollutants removed in the course of treatment shall be disposed of in such a manner so as to prevent any pollutant from entering any waters of the state or creating a health hazard. Sludge/digester supernatant and filter backwash shall not directly enter either the final effluent or waters of the state by any other direct route.

G. Bypass of Treatment Facilities.

1. Bypass Not Exceeding Limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to paragraph 2 and 3 of this section.

2. Prohibition of Bypass.

   a. Bypass is prohibited, and the Executive Secretary may take enforcement action against a permittee for bypass, unless:

      (1) Bypass was unavoidable to prevent loss of human life, personal injury, or severe property damage;

      (2) There were no feasible alternatives to 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 judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance, and

      (3) The permittee submitted notices as required under *section VI.G.3.*

   b. The executive Secretary may approve an anticipated bypass, after considering its adverse effects, if the Executive Secretary determines that it will meet the three conditions listed in *sections VI.G.2.a (1), (2) and (3).*

3. Notice.

   a. *Anticipated bypass.* Except as provided above in *section VI.G.2* and below in *section VI.G.3.b*, if the permittee knows in advance of the need for a bypass, it shall submit prior notice, at least ninety days before the date of bypass. The prior notice shall include the following unless otherwise waived by the Executive Secretary:

      (1) Evaluation of alternative to bypass, including cost-benefit analysis containing an assessment of anticipated resource damages:

(2) A specific bypass plan describing the work to be performed including scheduled dates and times. The permittee must notify the Executive Secretary in advance of any changes to the bypass schedule;

(3) Description of specific measures to be taken to minimize environmental and public health impacts;

(4) A notification plan sufficient to alert all downstream users, the public and others reasonably expected to be impacted by the bypass;

(5) A water quality assessment plan to include sufficient monitoring of the receiving water before, during and following the bypass to enable evaluation of public health risks and environmental impacts; and,

(6) Any additional information requested by the Executive Secretary.

b. *Emergency Bypass.* Where ninety days advance notice is not possible, the permittee must notify the Executive Secretary, and the Director of the Department of Natural Resources, as soon as it becomes aware of the need to bypass and provide to the Executive Secretary the information in *section VI.G.3.a.(1) through (6)* to the extent practicable.

c. *Unanticipated bypass.* The permittee shall submit notice of an unanticipated bypass to the Executive Secretary as required under *Part IV.H*, Twenty Four Hour Reporting. The permittee shall also immediately notify the Director of the Department of Natural Resources, the public and downstream users and shall implement measures to minimize impacts to public health and environment to the extent practicable.

H. Upset Conditions.

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with technology based permit effluent limitations if the requirements of paragraph 2 of this section are met. Executive Secretary's administrative determination regarding a claim of upset cannot be judiciously challenged by the permittee until such time as an action is initiated for noncompliance.

2. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate,

through properly signed, contemporaneous operating logs, or other relevant evidence that:

a. An upset occurred and that the permittee can identify the cause(s) of the upset;

b. The permitted facility was at the time being properly operated;

c. The permittee submitted notice of the upset as required under *Part V.H, Twenty-four Hour Notice of Noncompliance Reporting*; and,

d. The permittee complied with any remedial measures required under *Part VI.D, Duty to Mitigate*.

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

VII. GENERAL REQUIREMENTS

A. Planned Changes. The permittee shall give notice to the Executive Secretary as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when the alteration or addition could significantly change the nature or increase the quantity of parameters discharged or pollutant sold or given away. This notification applies to pollutants, which are not subject to effluent limitations in the permit. In addition, if there are any planned substantial changes to the permittee's existing sludge facilities or their manner of operation or to current sludge management practices of storage and disposal, the permittee shall give notice to the Executive Secretary of any planned changes at least 30 days prior to their implementation.

B. Anticipated Noncompliance. The permittee shall give advance notice to the Executive Secretary of any planned changes in the permitted facility or activity, which may result in noncompliance with permit requirements.

C. Permit Actions. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee shall apply for and obtain a new permit. The application shall be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information. The permittee shall furnish to the Executive Secretary, within a reasonable time, any information which the Executive Secretary may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Executive Secretary, upon request, copies of records required to be kept by this permit.

F. Other Information. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Executive Secretary, it shall promptly submit such facts or information.

G. Signatory Requirements. All applications, reports or information submitted to the Executive Secretary shall be signed and certified.

1. All permit applications shall be signed by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Executive Secretary shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Executive Secretary, and,

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. A duly authorized representative may thus be either a named individual or any individual occupying a named position.

3. Changes to authorization. If an authorization under *paragraph VII.G.2* is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of *paragraph VII.G.2.* must be submitted to the Executive Secretary prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports. The *Act* provides that 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 shall, upon conviction be punished by a fine of not more than

$10,000.00 per violation, or by imprisonment for not more than six months per violation, or by both.

I. Availability of Reports. Except for data determined to be confidential under *UAC R317-8-3.2*, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the office of Executive Secretary. As required by the *Act*, permit applications, permits and effluent data shall not be considered confidential.

J. Oil and Hazardous Substance Liability. Nothing in this permit shall be construed to preclude the permittee of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under the *Act*.

K. Property Rights. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

L. Severability. The provisions of this permit are severable, and if any provisions of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

M. Transfers. This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Executive Secretary at least 20 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittee's containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,

3. The Executive Secretary does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph *2* above.

N. State or Federal Laws. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by *UCA 19-5-117* and *Section 510* of the *Act* or any applicable Federal or State transportation regulations, such as but not limited to the Department of Transportation regulations.

O. Water Quality - Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include the appropriate effluent limitations and compliance schedule, if necessary, if one or more of the following events occurs:

1. Water Quality Standards for the receiving water(s) to which the permittee discharges are modified in such a manner as to require different effluent limits than contained in this permit.

2. A final wasteload allocation is developed and approved by the State and/or EPA for incorporation in this permit.

3. A revision to the current Water Quality Management Plan is approved and adopted which calls for different effluent limitations than contained in this permit.

P. Biosolids – Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include the appropriate biosolids limitations (and compliance schedule, if necessary), management practices, other appropriate requirements to protect public health and the environment, or if there have been substantial changes (or such changes are planned) in biosolids use or disposal practices; applicable management practices or numerical limitations for pollutants in biosolids have been promulgated which are more stringent than the requirements in this permit; and/or it has been determined that the permittees biosolids use or land application practices do not comply with existing applicable state of federal regulations.

Q. Toxicity Limitation - Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include, whole effluent toxicity (WET) limitations, a compliance date, a compliance schedule, a change in the whole effluent toxicity (biomonitoring) protocol, additional or modified numerical limitations, or any other conditions related to the control of toxicants if one or more of the following events occur;

1. Toxicity is detected, as per *Part I.C.4.a* of this permit, during the duration of this permit.

2. The TRE results indicate that compliance with the toxic limits will require an implementation schedule past the date for compliance and the Executive Secretary agrees with the conclusion.

3. The TRE results indicate that the toxicant(s) represent pollutant(s) that may be controlled with specific numerical limits, and the Executive

Secretary agrees that numerical controls are the most appropriate course of action.

4. Following the implementation of numerical control(s) of toxicant(s), the Executive Secretary agrees that a modified biomonitoring protocol is necessary to compensate for those toxicant that are controlled numerically.

5. The TRE reveals other unique conditions or characteristics, which in the opinion of the permit issuing authority justify the incorporation of unanticipated special conditions in the permit.

R. Storm Water-Reopener Provision. At any time during the duration (life) of this permit, this permit may be reopened and modified (following proper administrative procedures) as per *UAC R317.8*, to include, any applicable storm water provisions and requirements, a storm water pollution prevention plan, a compliance schedule, a compliance date, monitoring and/or reporting requirements, or any other conditions related to the control of storm water discharges to "waters-of-State".

S. Total Maximum Daily Load-Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include Total Maximum Daily Load (TMDL) monitoring, related effluent limits, a compliance schedule, a compliance date, additional or modified numerical limitations, or any other conditions related to the TMDL Process and activity in effected impaired water body

VIII. DEFINITIONS

A. Wastewater.

1. The "7-day (and weekly) average", other than for e-coli bacteria, fecal coliform bacteria, and total coliform bacteria, is the arithmetic average of all samples collected during a consecutive 7-day period or calendar week, whichever is applicable. Geometric means shall be calculated for e-coli bacteria, fecal coliform bacteria, and total coliform bacteria. The 7-day and weekly averages are applicable only to those effluent characteristics for which there are 7-day average effluent limitations. The calendar week, which begins on Sunday and ends on Saturday, shall be used for purposes of reporting self-monitoring data on discharge monitoring report forms. Weekly averages shall be calculated for all calendar weeks with Saturdays in the month. If a calendar week overlaps two months (i.e., the Sunday is in one month and the Saturday in the following month), the weekly average calculated for that calendar week shall be included in the data for the month that contains Saturday.

2. The "30-day (and monthly) average," other than for e-coli bacteria, fecal coliform bacteria and total coliform bacteria, is the arithmetic average of all samples collected during a consecutive 30-day period or calendar month, whichever is applicable. Geometric means shall be calculated for e-coli bacteria, fecal coliform bacteria and total coliform bacteria. The calendar month shall be used for purposes of reporting self-monitoring data on discharge monitoring report forms.

3. "Act," means the *Utah Water Quality Act.*

4. "Acute toxicity" occurs when 50 percent or more mortality is observed for either test species at any effluent concentration.

5. "Bypass," means the diversion of waste streams from any portion of a treatment facility.

6. "Chronic toxicity" occurs when the survival, growth, or reproduction for either test species exposed to a dilution of 25 percent effluent (or lower) is significantly less (at the 95 percent confidence level) than the survival, growth, or reproduction of the control specimens.

7. "Composite Samples" shall be flow proportioned. The composite sample shall, as a minimum, contain at least four (4) samples collected over the compositing period. Unless otherwise specified, the time between the collection of the first sample and the last sample shall not be less than six

(6) hours nor more than 24 hours. Acceptable methods for preparation of composite samples are as follows:

a. Constant time interval between samples, sample volume proportional to flow rate at time of sampling;

b. Constant time interval between samples, sample volume proportional to total flow (volume) since last sample. For the first sample, the flow rate at the time the sample was collected may be used;

c. Constant sample volume, time interval between samples proportional to flow (i.e., sample taken every "X" gallons of flow); and,

d. Continuous sample volume, with sample collection rate proportional to flow rate.

8. "CWA," means *The Federal Water Pollution Control Act*, as amended, by *The Clean Water Act of 1987.*

9. "Daily Maximum" (Daily Max.) is the maximum value allowable in any single sample or instantaneous measurement.

10. "EPA," means the United States Environmental Protection Agency.

11. "Executive Secretary," means Executive Secretary of the Utah Water Quality Board.

12. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

13. An "instantaneous" measurement, for monitoring requirements, is defined as a single reading, observation, or measurement.

14. "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 which 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.

15. "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 operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

B. Biosolids.

1. "Biosolids," means any material or material derived from sewage solids that have been biologically treated.

2. "Dry Weight-Basis," means 100 percent solids (i.e. zero percent moisture).

3. "Land Application" is the spraying or spreading of biosolids onto the land surface; the injection of biosolids below the land surface; or the incorporation of biosolids into the land so that the biosolids can either condition the soil or fertilize crops or vegetation grown in the soil. Land application includes distribution and marketing (i.e. the selling or giving away of the biosolids).

4. "Pathogen," means an organism that is capable of producing an infection or disease in a susceptible host.

5. "Pollutant" for the purposes of this permit is an organic substance, an inorganic substance, a combination of organic and inorganic substances, or pathogenic organisms that after discharge and upon exposure, ingestion, inhalation, or assimilation into an organism either directly from the environment or indirectly by ingestion through the food-chain, could on the basis of information available to the Administrator of EPA, cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunction in reproduction), or physical deformations in either organisms or offspring of the organisms.

6. "Runoff" is rainwater, leachate, or other liquid that drains over any part of a land surface and runs off the land surface.

7. "Similar Container" is either an open or closed receptacle. This includes, but is not limited to, a bucket, a box, a carton, and a vehicle or trailer with a load capacity of one metric ton or less.

8. "Total Solids" are the materials in the biosolids that remain as a residue if the biosolids are dried at 103^{o} or 105^{o} Celsius.

9. "Treatment Works" are either Federally owned, publicly owned, or privately owned devices or systems used to treat (including recycling and

reclamation) either domestic sewage or a combination of domestic sewage and industrial waste or liquid manure.

10. "Vector Attraction" is the characteristic of biosolids that attracts rodents, flies mosquito's or other organisms capable of transporting infectious agents.

11. "Animals" for the purpose of this permit are domestic livestock.

12. "Annual Whole Sludge Application Rate" is the amount of sewage sludge (dry-weight basis) that can be applied to a unit area of land during a cropping cycle.

13. "Agronomic Rate is the whole sludge application rate (dry-weight basis) designed to: (1) provide the amount of nitrogen needed by the crop or vegetation grown on the land; and (2) minimize the amount of nitrogen in the sewage sludge that passes below the root zone of the crop or vegetation grown on the land to the ground water.

14. "Annual Pollutant Loading Rate" is the maximum amount of a pollutant (dry-weight basis) that can be applied to a unit area of land during a 365-day period.

15. "Application Site or Land Application Site" means all contiguous areas of a users' property intended for sludge application.

16. "Cumulative Pollutant Loading Rate" is the maximum amount of an inorganic pollutant (dry-weight basis) that can be applied to a unit area of land.

17. "Grit and Screenings" are sand, gravel, cinders, other materials with a high specific gravity and relatively large materials such as rags generated during preliminary treatment of domestic sewage at a treatment works and shall be disposed of according to *40 CFR 258*.

18. "High Potential for Public Contact Site" is land with a high potential for contact by the public. The includes, but is not limited to, public parks, ball fields, cemeteries, plant nurseries, turf farms, and gold courses.

19. "Low Potential for Public Contact Site" is the land with a low potential for contact by the public. This includes, but is not limited to, farms, ranches, reclamation areas, and other lands which are private lands, restricted public lands, or lands which are not generally accessible to or used by the public.

20. "Monthly Average" is the arithmetic mean of all measurements taken during the month.

21. "Volatile Solids" is the amount of the total solids in sewage sludge lost when the sludge is combusted at 550 degrees Celsius for 15-20 minutes in the presence of excess air.

C. Storm Water

1. "Best Management Practices" ("BMPs") means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control facility site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

2. "Coal pile runoff" means the rainfall runoff from or through any coal storage pile.

3. "Co-located industrial activity" means when a facility has industrial activities being conducted onsite that are described under more than one of the coverage sections of *Appendix II* in the General Multi-Sector Permit for Storm Water Discharges Associated with Industrial Activity. Facilities with co-located industrial activities shall comply with all applicable monitoring and pollution prevention plan requirements of each section in which a co-located industrial activity is described.

4. "Commercial Treatment and Disposal Facilities" means facilities that receive, on a commercial basis, any produced hazardous waste (not their own) and treat or dispose of those wastes as a service to the generators. Such facilities treating and/or disposing exclusively residential hazardous wastes are not included in this definition.

5. "Landfill" means an area of land or an excavation in which wastes are placed for permanent disposal, and that is not a land application unit, surface impoundment, injection well, or waste pile.

6. "Land application unit" means an area where wastes are applied onto or incorporated into the soil surface (excluding manure spreading operations) for treatment or disposal.

7. "Municipal separate storm sewer system" (large and/or medium) means all municipal separate storm sewers that are either:

a. Located in an incorporated place (city) with a population of 100,000 or more as determined by the latest Decennial Census by the Bureau of Census (at the issuance date of this permit, Salt Lake City is the only city in Utah that falls in this category); or

b. Located in the counties with unincorporated urbanized populations of 100,000 or more, except municipal separate storm sewers that are located in the incorporated places, townships or towns within such counties (at the issuance date of this permit Salt Lake County is the only county that falls in this category); or

c. Owned or operated by a municipality other than those described in paragraph *a.* or *b.* (above) and that are designated by the *Executive Secretary* as part of the large or medium municipal separate storm sewer system.

8. "NOI" means "notice of intent", it is an application form that is used to obtain coverage under the General Multi-Sector Permit for Storm Water Discharges Associated with Industrial Activity.

9. "NOT" means "notice of termination", it is a form used to terminate coverage under the General Multi-Sector Permit for Storm Water Discharges Associated with Industrial Activity.

10. "Point source" means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

11. "Section 313 water priority chemical" means a chemical or chemical categories that:

a. Are listed at *40 CFR 372.65* pursuant to *Section 313* of the *Emergency Planning and Community Right-to-Know Act* (*EPCRA*) (also known as *Title III of the Superfund Amendments and Reauthorization Act* (*SARA*) of 1986);

b. Are present at or above threshold levels at a facility subject to *EPCRA Section 313* reporting requirements; and

c. Meet at least one of the following criteria:

(1) Are listed in *Appendix D* of *40 CFR Part 122* on either Table II (organic priority pollutants), Table III (certain metals, cyanides, and phenols) or Table V (certain toxic pollutants and hazardous substances);

(2) Are listed as a hazardous substance pursuant to *Section 311(b)(2)(A)* of the *CWA* at *40 CFR 116.4*; or

(3) Are pollutants for which EPA has published acute or chronic water quality criteria. See *Appendix III* of this permit. This appendix was revised based on final rulemaking EPA published in the *Federal Register* November 30, 1994.

12. "Significant materials" includes, but is not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under *Section 101(14)* of *CERCLA*; any chemical the facility is required to report pursuant to *EPCRA Section 313*; fertilizers; pesticides; and waste products such as ashes, slag and sludge that have the potential to be released with storm water discharges.

13. "Significant spills" includes, but is not limited to: releases of oil or hazardous substances in excess of reportable quantities under *Section 311 of the Clean Water Act* (see *40 CFR 110.10* and *CFR 117.21*) or *Section 102* of *CERCLA* (see *40 CFR 302.4*).

14. "Storm water" means storm water runoff, snowmelt runoff, and surface runoff and drainage.

15. "SWDMR" means "storm water discharge monitoring report", a report of the results of storm water monitoring required by the permit. The Division of Water Quality provides the storm water discharge monitoring report form.

16. "Storm water associated with industrial activity" (*UAC R317-8-3.8(6)(c) & (d)*) means the discharge from any conveyance that is used for collecting and conveying storm water and that is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. The term does not include discharges from facilities or activities excluded from the *UPDES* program. For the categories of industries identified in paragraphs *(a)* through *(j)* of this definition, the term includes, but is not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used

or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters (as defined in *40 CFR Part 401*); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water. For the categories of industries identified in paragraph *(k)* of this definition, the term includes only storm water discharges from all areas (except access roads and rail lines) listed in the previous sentence where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water. For the purposes of this paragraph, material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, finished product, by-product or waste product. The term excludes areas located on plant lands separate from the plant's industrial activities, such as office buildings and accompanying parking lots as long as the drainage from the excluded areas is not mixed with storm water drained from the above described areas. Industrial facilities (including industrial facilities that are Federally, State, or municipally owned or operated that meet the description of the facilities listed in paragraphs *(a)* to *(k)* of this definition) include those facilities designated under *UAC R317-8-3.8(1)(a)5.* The following categories of facilities are considered to be engaging in "industrial activity" for purposes of this subsection:

a. Facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards under *40 CFR Subchapter N* (except facilities with toxic pollutant effluent standards that are exempted under category (k) of this definition);

b. Facilities classified as Standard Industrial Classifications 24 (except 2434), 26 (except 265 and 267), 28 (except 283 and 285), 29, 311, 32 (except 323), 33, 3441, 373;

c. Facilities classified as Standard Industrial Classifications 10 through 14 (mineral industry) including active or inactive mining operations (except for areas of coal mining operations no longer meeting the definition of a reclamation area under *40 CFR 434.11(l)* because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or except for areas of non-coal mining operations that have been released from applicable State or Federal reclamation requirements after December 17, 1990) and oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations; inactive mining operations are mining sites that are not being actively mined, but that have an identifiable owner/operator;

d. Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under Subtitle C of RCRA;

e. Landfills, land application sites, and open dumps that have received any industrial wastes (waste that is received from any of the facilities described under this subsection) including those that are subject to regulation under *Subtitle D* of *RCRA*;

f. Facilities involved in the recycling of materials, including metal scrapyards, battery reclaimers, salvage yards, and automobile junkyards, including but limited to those classified as Standard Industrial Classification 5015 and 5093;

g. Steam electric power generating facilities, including coal handling sites;

h. Transportation facilities classified as Standard Industrial Classifications 40, 41, 42 (except 4221-25), 43, 44, 45 and 5171 that have vehicle maintenance shops, equipment cleaning operations, or airport deicing operations. Only those portions of the facility that are either involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, airport deicing operations, or that are otherwise identified under paragraphs (a) to (g) or (I) to (k) of this subsection are associated with industrial activity;

i. Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated to the disposal of sewage sludge that are located within the confines of the facility, with a design flow of 1.0 mgd or more, or required to have an approved pretreatment program under *40 CFR Part 403*. Not included are farm lands, domestic gardens or lands used for sludge management where sludge is beneficially reused and that are not physically located in the confines of the facility, or areas that are in compliance with *40 CFR Part 503*;

j. Construction activity including clearing, grading and excavation activities except: operations that result in the disturbance of less than 5 acres of total land area that are not part of a larger common plan of development or sale;

k. Facilities under Standard Industrial Classifications 20, 21, 22, 23, 2434, 25, 265, 267, 27, 283, 285, 30, 31 (except 311), 323, 34 (except 3441), 35, 36, 37 (except 373), 38, 39, 4221-25, (and that are not otherwise included within categories (a) to (j))

17. "Waste pile" means any non-containerized accumulation of solid, non-flowing waste that is used for treatment or storage.

STATEMENT OF BASIS
PAYSON CITY WASTEWATER TREATMENT PLANT
RENEWAL PERMIT: DISCHARGE, BIOSOLIDS & STORM WATER
UPDES PERMIT NUMBER: UT0020427
UPDES BIOSOLIDS PERMIT NUMBER: UTL-020427
UPDES MULTI-SECTOR STORM WATER GENERAL PERMIT NUMBER: UTR000000
MAJOR MUNICIPAL

FACILITY CONTACTS

Person Name:	Jeff Hiatt
Position:	Plant Superintendent
Facility Name:	Payson City Wastewater Treatment Plant
Mailing Address:	439 West Utah Ave Payson City, Utah 84651
Telephone:	(801) 465-5277
Actual Address:	1062 North Main

DESCRIPTION OF FACILITY

The Payson City Wastewater Treatment Plant (PCWWTP) is located at 1062 North Main, Payson City, Utah and serves the City of Payson. The State of Utah Data Base Storet number is 499541. The population of the City is approximately 20,000. The design flow of the facility is 3.0 MGD average daily flow with a peak flow of 4.5 MGD.

The influent enters the plant through a 30" Parmer Bowlus flume. The headworks contain two (2) 30" step screens followed by rag washers for each screen. The headworks also contain an 8 ft diameter vortex grit removal system with an air lift pump to a grit washer. The process water is then pumped to the 70 ft diameter Primary Clarifier followed by the102 ft diameter Primary Trickling Filter (Rock Media Volume = 57,200 ft^3). The primary pump station has a capacity of 0.5-7.0 MGD with one standby pump.

The flow then enters the secondary pump station where the wastewater is pumped to one of two 45 ft diameter Intermediate Clarifiers. The secondary pump station has a capacity of 0.5-6.5 MGD with one standby pump. After leaving the Intermediate Clarifiers, the flow enters the STM Aerotors. In July 2002, a rectangular tank (92.5 ft x 49.5 ft x 16 ft) fitted with eight (8) STM Aerotors were brought on line, replacing the Secondary Trickling Filters which were taken off line to be converted to Aeration Basins. The Aeration Basins were only to be used during the cherry processing season, July through September. The flow would leave the Intermediate Clarifiers, enter the Aeration Basins, and then flow back to the Aerotor tank. Throughout the remainder of the year, the Aeration Basins would be off line, and the flow leaving the Intermediate Clarifiers will directly enter the Aerotor tank. Currently the Aeration Basins are incomplete and off line, and the cherry processing is no longer done in Payson.

After leaving the Aerotor Tank, the process water will enter one of two Final Clarifiers with diameters of 45 ft and 60 ft. Following the Final Clarifiers, the flow is directed through 2-Shallow bed, Traveling Bridge Rapid Sand Filters followed by a Chlorine Contact Basin having a sixty (60) minute detention time in the Chlorine Contact Basin and then discharged through Outfall 001.

PCWWTP has three (3) anaerobic digesters. Each Digester is 40 ft in diameter with a total digester volume of 91,471 ft^3. Payson City has nine (9) drying beds. The first five drying beds have an area of 5000 ft^2 each. The remaining four drying beds have a combined area of 16,150 ft^2. The bio-solids are removed from the drying beds and sent to land fill. Approximately 250 metric tons of dry bio-solids are produced each year by the facility.

SUMMARY OF CHANGES FROM PREVIOUS PERMIT

In an effort to increase efficiency, the DWQ has recently begun consolidating permits. Therefore, in addition to the Discharge provisions, the renewal permit for PCWWTP will include provisions for storm water, biosolids, and pretreatment.

The Utah Water Quality Board had revised the bacteriological criteria in the Standards of Quality for Waters of the State effective June 1, 2005. Based, in part, on a long-standing recommendation from the Environmental Protection Agency, numeric criteria for E. coli bacteria were added to the standards. The new E. coli criteria is 126 (no.)/100 mL (30-day geometric mean) and 158 (no.)/100 mL (7-day geometric mean), which is considered equivalent to 200 (no.)/100 mL and 250 (no.)/100 mL fecal coliforms (*UAC R317-1-3.2*), respectively.

In March 2003, the Board agreed to adopt new standards that will have a significant effect on ammonia limits. The new ammonia standards were public noticed and approved in January 2004. The parameters affected were dissolved oxygen (DO), ammonia and total residual chlorine (TRC).

DISCHARGE

DESCRIPTION OF DISCHARGE

The PCWWTF discharges into an irrigation ditch which runs approximately one to two miles before entering Beer Creek. Beer Creek runs through Benjamin Slough and hence to Utah Lake. The PCWWTF has been reporting self-monitoring results on Discharge Monitoring Reports on a monthly basis. A summary of the last 3 years of data is attached and there were no significant violations.

Outfall	Description of Discharge Point
001	Located at latitude 40°03'41" and longitude 111°43'49". The discharge is through a concrete pipe to an unnamed irrigation return drainage ditch to Beer Creek then Benjamin Slough to Utah Lake.

RECEIVING WATERS AND STREAM CLASSIFICATION

The final discharge has been classified as 3C (Beer Creek) and 4 (unnamed ditch and Beer Creek) according to *Utah Administrative Code (UAC) R317-2-13.*

Class 3C	-Protected for nongame fish and other aquatic life, including the necessary aquatic organisms in their food chain.
Class 4	-Protected for agricultural uses including irrigation of crops and stock watering.

BASIS FOR EFFLUENT LIMITATIONS

Limitations on total suspended solids (TSS), biochemical oxygen demand (BOD_5), E-coli coliforms, pH and percent removal for BOD_5 and TSS are based on current Utah Secondary Treatment Standards, *UAC R317-1-3.2*. The Dissolved Oxygen, Ammonia and Total Residual Chlorine limits are based on the Waste Load Analysis attached. The oil and grease is based on best professional judgment (BPJ). The permit limitations are:

Parameter	Effluent Limitations			
	Maximum Monthly Average	Maximum Weekly Average	Daily Minimum	Daily Maximum
BOD_5, mg/L BOD_5 Min. % Removal	25 85	35 NA	NA NA	NA NA
TSS, mg/L TSS Min. % Removal	25 85	35 NA	NA NA	NA NA
E. Coli, no./100mL	126	158	NA	NA
Dissolved Oxygen, mg/l	NA	NA	4	NA
Ammonia, mg/l December – February March – May June – August September – November	 NA NA NA NA	 NA NA NA NA	 NA NA NA NA	 14.1 13.1 12.5 13.1
TRC, mg/L December – February March – May June – August September – November	 NA NA NA NA	 NA NA NA NA	 NA NA NA NA	 2.4 1.6 1.1 1.6
WET, Acute Biomonitoring	NA	NA	NA	Pass/Fail
Oil & Grease, mg/L	NA	NA	NA	10
pH, Standard Units	NA	NA	6.5	9.0

NA – Not Applicable.

SELF-MONITORING AND REPORTING REQUIREMENTS

The following self-monitoring requirements are the same as in the previous permit. The permit will require reports to be submitted monthly and quarterly, as applicable, on Discharge Monitoring Report (DMR) forms due 28 days after the end of the monitoring period. Lab sheets for biomonitoring must be attached to the biomonitoring DMR.

Self-Monitoring and Reporting Requirements			
Parameter	Frequency	Sample Type	Units
Total Flow	Continuous	Recorder	MGD
BOD_5, Influent Effluent	2 x Weekly 2 x Weekly	Composite Composite	mg/L mg/L
TSS, Influent Effluent	2 x Weekly 2 x Weekly	Composite Composite	mg/L mg/L
Dissolved Oygen	2 x Weekly	Grab	mg/L

Ammonia	2 x Weekly	Grab	No./100mL
E. Coli	2 x Weekly	Grab	No./100mL
TRC	Daily	Grab	mg/L
WET, Acute Biomonitoring Ceriodaphnia dubia Pimephales promelas	Quarterly 1st & 3rd Quarters 2nd & 4th Quarters	 Composite Composite	 Pass/Fail Pass/Fail
Oil & Grease	Monthly	Grab	mg/L
pH	2 x Weekly	Grab	SU
Metals, Influent Effluent	Quarterly Quarterly	Composite Composite	mg/L mg/L
Organic Toxics	Yearly	Grab	mg/L

BIOSOLIDS

The biosolids (sewage sludge) are stabilized in anaerobic digesters with a hydraulic retention time of 40 days at an average temperature of 95° F (35° C). Once a week the biosolids are drawn off the bottom of the primary digester and sent to the secondary digester that serves as a holding tank. The biosolids from the secondary digester are wasted to the drying beds. The typical drying time is 3 to 4 months depending on the weather. In 2006 the PWRF produced 477 dry metric tons (DMT) of biosolids, all of which was disposed in the Payson City landfill.

BIOSOLIDS MONITORING REQUIREMENTS

Under *40 CFR 503* biosolids are not required to be monitored for heavy metals content or pathogens if the biosolids are disposed in a landfill.

LANDFILL MONITORING

Paint Filter Test[1]
Under *40 CFR 258,* landfill monitoring requirements, the biosolids will need to pass a paint filter test before the biosolids are disposed of in a landfill. If the biosolids do not pass a paint filter test, the biosolids cannot be disposed in a landfill.

Vector Attraction Reduction Monitoring
The PWRF needs to meet a method of vector attraction reduction (VAR) if the biosolids are hauled to the landfill. The PWRF meets the VAR requirement by a 38% reduction in volatile solids through the anaerobic digesters and drying beds *(40 CFR 503.33(b)(1)).*

Minimum Frequency of Monitoring for the Paint Filter Test

Amount of Biosolids Disposed Per Year	Monitoring Frequency
> 0 to < 290 DMT	**One Time Per Year**
> 290 to < 1500 DMT	**Four times Per Year**

MONITORING DATA

The PWRF is not required to monitor for heavy metals or pathogens if the biosolids are disposed of in a landfill. Therefore, there is not any monitoring data for heavy metals or pathogens, however, the PWRF did sample for total solids content, for the paint filter test.

Paint Filter Tests, 2006		Total Solids, 2006
Dates Sampled	Results	Results
Sept. 28, 2006 - Sludge Pile West End	Pass	66.2 %
Sept. 28, 2006 - Sludge Pile East End	Pass	69.6 %

[1](Under *40 CFR 258*-Criteria for Municipal Solid Waste Landfills, the permittee must sample the biosolids to ensure the biosolids pass the paint filter test. When the biosolids are in "batches" each batch must be sampled to ensure compliance with *40 CFR, Part 258*).

RECORD KEEPING

The record keeping requirements from *40 CFR 503.17* are included under *Part III.G.* of the permit. Since the biosolids are disposed in a landfill the disposal records need to be retained for a minimum of five years.

REPORTING

The PWRF needs to report annually as required in *40 CFR 503.18.* This report is to include the results of all monitoring performed in accordance with *Part III.B.* of the permit, information on management practices, biosolids treatment, and certifications. This report is due no later than February 19 of each year. Each report is for the previous calendar year.

During the last permit cycle, the PWRF submitted all reports before the deadline of February 19. All reports were complete and accurate with the laboratory analysis attached.

STORM WATER

STORMWATER REQUIREMENTS

Storm water provisions are included in this combined UPDES permit.

The storm water requirements are based on the UPDES Multi-Sector General Permit for Storm Water Discharges for Industrial Activity, General Permit No. UTR000000 (MSGP). All sections of the MSGP that pertain to discharges from wastewater treatment plants have been included and sections which are redundant or do not pertain have been deleted.

The permit requires the preparation and implementation of a storm water pollution prevention plan for all areas within the confines of the plant. Elements of this plan are required to include: 1. The development of a pollution prevention team: 2. Development of drainage maps and materials stockpiles: 3. An inventory of exposed materials: 4. Spill reporting and response procedures: 5. A preventative maintenance program: 6. Employee training: 7. Certification that storm water discharges are not mixed with non-storm water discharges: 8. Compliance site evaluations and potential pollutant source identification, and: 9. Visual examinations of storm water discharges.

PCWWTP is currently covered under the UPDES Multi Sector General Permit for Industrial Activities.

PRETREATMENT REQUIREMENTS

The pretreatment requirements remain the same as in the current permit with the permittee administering an approved pretreatment program. Any substantial changes to the program must be submitted for approval to the Division of Water Quality. Authority to require a pretreatment program is provided for in *19-5-108 UCA, 1953 ann.* and *UAC R317-8-8.*

The permittee will be required to perform an annual evaluation of the need to revise or develop technically based local limits to implement the general and specific prohibitions of *40 CFR, Part 403.5(a)* and *Part 403.5(b)*. This evaluation may indicate that present local limits are sufficiently protective, or that they must be revised.

As part of this evaluation, the permit requires quarterly influent and effluent monitoring for metals and yearly organic toxics listed in *R317-8-7.5* and sludge monitoring for potential pollutants listed in *40 CFR 503.*

BIOMONITORING REQUIREMENTS

A nationwide effort to control toxic discharges where effluent toxicity is an existing or potential concern is regulated in accordance with the *State of Utah Permitting and Enforcement Guidance Document for Whole Effluent Toxicity Control (biomonitoring)*. Authority to require effluent biomonitoring is provided in *Permit Conditions, UAC R317-8-4.2, Permit Provisions, UAC R317-8-5.3* and *Water Quality Standards, UAC R317-2-5* and *R317 -2-7.2.*

Since the permittee is a major municipal discharger, the renewal permit will require whole effluent toxicity (WET) testing. Acute toxicity testing will be conducted using both species, Ceriodaphnia dubia quarterly and Pimephales promelas (fathead minnow) quarterly. The permit will contain the standard requirements for accelerated testing upon failure of a WET test and a PTI (Preliminary Toxicity Investigation) and TRE (Toxicity Reduction Evaluation) as necessary. (Description of monitoring frequency, species being monitored and Numerical Toxicity Limit if necessary)

The permit will contain the standard requirements for accelerated testing upon failure of a WET test and a PTI (Preliminary Toxicity Investigation) and TRE (Toxicity Reduction Evaluation) as necessary.

TOTAL MAXIMUM DAILY LOAD REQUIREMENTS

PCWWTP discharges wastewater into Utah Lake, which has been identified as impaired for total dissolved solids (TDS) and total phosphorus (TP) based on the 1998, 303(d) assessment process as defined in the Clean Water Act. As required under federal regulation a total maximum daily load (TMDL) will be developed for all impaired waters. The TMDL will focus on developing limitations for those parameters of concern (POC) that were identified during the 305(b) and 303(d) assessment process. POC's are parameters that are in violation of water quality standards or that contribute to impairment of a beneficial use (a major component of the water quality standards).

Currently, a TMDL evaluation is underway for the Utah Lake. If the results of the TMDL process establish effluent limits for any of the POC's, then it would be required by (40 CFR Part 130) to include these effluent limits in the UPDES permit. Therefore, it is strongly recommended that the facility staff participate in the TMDL development process. The staff at the Division of Water Quality will be responsible for scheduling and notifying appropriate facility personnel regarding TMDL meetings. Please contact your UPDES permit writer for information on scheduled TMDL meetings.

PERMIT DURATION

It is recommended that this permit be effective for a duration of five (5) years.

Drafted by
Daniel Griffin, Discharge
Mark Schmitz, Biosolids
Mike George, Storm Water
Utah Division of Water Quality

3/19/08

ADDENDUM TO FACT SHEET AND STATEMENT OF BASIS

The public notice e comment period started on February 15, 2008, and was advertised in The Daily Hearald. Comments were accepted through March 18, 2008. The Public Notice, Draft FSSOB, and Draft Permit were all posted on the Division of water quality web page. No comments were received. No changes have been made to the Permit or FSSOB.

REVISED MARCH 19, 2008

Division of Water Quality Wasteload Analysis Request Form

Original

Permit Writer:	**Daniel Griffin**		**/11/2007**
			/1/2007
WLA by:	[signature]		11/07 YYM
			18
WQM Manager:	**Ying Ying Macauley**	Approval Date:	
TMDL Manager:	**Carl Adams**	Approval Date:	1/18/08
Permit Writer:	**Daniel Griffin**	Date of Receiving WLA Results	

☐ New Permit ☑ Permit Renewal ☐ Permit Modification Permit Expiration Date: **3/31/2008**

Facility Name: **Payson City WWTP** UPDES #: **UT0020427**

Contact Person: **Jeff Hiatt** Telephone #: **(801) 465-5277**

Initial Elevation (ft.): **4505** Receiving Water: **Ditch to Beer Creek/UT Lake**

Does the facility discharge to a waterbody with an approved TMDL?: **Not at this time (Utah Lake)**

If yes, what are the parameters of concern (e.g., TDS, Total Phosphorous, Metals, etc.)?:

Does the facility discharge in the Colorado River Basin?: **No**

Does the facility have a State approved pre-treatment program?: **Yes**

Does the facility have any industrial contributors?: **Yes**

Latitude: **40 E 03' 41"** Longitude: **111E 43' 49"**

Other Location Information: **1062 North Main, Payson Utah**

☐ Attach a map showing facility and discharge locations Quad sheet map name:

Discharge Information	Temp. (°C)	BOD (mg/L)	Ammonia (mg/L)	TRC (mg/L)	Actual Flow (MGD)	Parameters of Concern	
Summer (Jul-Sept)		**6**	**14**	**1**	**1.4**		
Fall (Oct-Dec)		**6**	**1**	**1**	**1.4**		
Winter (Jan-Mar)		**6**	**1**	**1**	**1.4**		
Spring (Apr-Jun)		**6**	**1**	**1**	**1.4**		

(30-day averages in mg/L from DMR if available/applicable. If not applicable put NA in each box.)

Design Flow (MGD): **3**

Flow Projection	Population	Flow (MGD)
5 Years ago		
Current		
% increase in past 5 years		
5 year projection		
Safety of Factor	1.2	1.2
Projected Growth/Flow		

Permit writers have the option of choosing either the design flow or the projected flow for permit value calculations. Using the projected flow requires authorization by the respective UPDES section manager

Signature Date

Special Considerations:

Utah Division of Water Quality
Salt Lake City, Utah

WASTELOAD ANALYSIS [WLA]
Addendum: Statement of Basis
SUMMARY

Discharging Facility:	**Payson WWTP**		
UPDES No:	UT-0020427		
Current Flow:	1.40	MGD	
Projected Flow:	3.00	MGD	

Receiving Water:	**Irrigation Ditch -> Beer Creek -> Utah Lake**		
Stream Classification:	3C, 4		
Stream Flows [cfs]:	0.0	Summer (July-Sept)	20th Percentile
	0.0	Fall (Oct-Dec)	20th Percentile
	0.0	Winter (Jan-Mar)	20th Percentile
	0.0	Spring (Apr-June)	20th Percentile
	0.0	Average	
Stream TDS Values:	350.0	Summer (July-Sept)	80th Percentile
	350.0	Fall (Oct-Dec)	80th Percentile
	350.0	Winter (Jan-Mar)	80th Percentile
	350.0	Spring (Apr-June)	80th Percentile

Effluent Limits:				**WQ Standard:**
Flow, MGD:	3.00	MGD	Design Flow	
BOD, mg/l:	25.0	Summer	5.0	Indicator
Dissolved Oxygen, mg/l	5.0	Summer	5.0	30 Day Average
TNH3, Chronic, mg/l:	12.5	Summer	Varies	Function of pH and Temperature
TDS, mg/l:	1201.8	Summer	1200.0	

Modeling Parameters:

Acute River Width:	50.0%
Chronic River Width:	100.0%

Antidegradation Review Completed for: TDS
Antidegradation Level II Review is NOT Required

Special Considerations: Values are from combined Payson/Salem WLAs June 15-16, 2004.

Date: 1/14/2008

Utah Division of Water Quality
Salt Lake City, Utah

WASTELOAD ANALYSIS [WLA]
Addendum: Statement of Basis

14-Jan-08
10:00 AM

Facilities: **Payson WWTP** **UPDES No: UT-0020427**
Discharging to: **Irrigation Ditch -> Beer Creek -> Utah Lake**

I. Introduction

Wasteload analyses are performed to determine point source effluent limitations necessary to maintain designated beneficial uses by evaluating projected effects of discharge concentrations on in-stream water quality. The wasteload analysis also takes into account downstream designated uses [R317-2-8, UAC]. Projected concentrations are compared to numeric water quality standards to determine acceptability. The anti-degradation policy and procedures are also considered. The primary in-stream parameters of concern may include metals (as a function of hardness), total dissolved solids (TDS), total residual chlorine (TRC), un-ionized ammonia (as a function of pH and temperature, measured and evaluated interms of total ammonia), and dissolved oxygen.

Mathematical water quality modeling is employed to determine stream quality response to point source discharges. Models aid in the effort of anticipating stream quality at future effluent flows at critical environmental conditions (e.g., low stream flow, high temperature, high pH, etc).

The numeric criteria in this wasteload analysis may always be modified by narrative criteria and other conditions determined by staff of the Division of Water Quality.

II. Receiving Water and Stream Classification

Irrigation Ditch -> Beer Creek -> Utah	3C, 4
Antidegradation Review:	Antidegradation Level II Review is NOT Required

III. Numeric Stream Standards for Protection of Aquatic Wildlife

Total Ammonia (TNH3)	Varies as a function of Temperature and pH Rebound. See Water Quality Standards
Chronic Total Residual Chlorine (TRC)	0.011 mg/l (4 Day Average) 0.019 mg/l (1 Hour Average)
Chronic Dissolved Oxygen (DO)	5.00 mg/l (30 Day Average) N/A mg/l (7Day Average) 3.00 mg/l (1 Day Average
Maximum Total Dissolved Solids	1200.0 mg/l

Acute and Chronic Heavy Metals (Dissolved)

Parameter	4 Day Average (Chronic) Standard Concentration		Load*		1 Hour Average (Acute) Standard Concentration		Load*	
Aluminum	87.00	ug/l**	2.176	lbs/day	750.00	ug/l	18.761	lbs/day
Arsenic	190.00	ug/l	4.753	lbs/day	340.00	ug/l	8.505	lbs/day
Cadmium	0.61	ug/l	0.015	lbs/day	6.52	ug/l	0.163	lbs/day
Chromium III	211.98	ug/l	5.303	lbs/day	4435.01	ug/l	110.942	lbs/day
ChromiumVI	11.00	ug/l	0.275	lbs/day	16.00	ug/l	0.400	lbs/day
Copper	23.86	ug/l	0.597	lbs/day	39.43	ug/l	0.986	lbs/day
Iron					1000.00	ug/l	25.015	lbs/day
Lead	12.89	ug/l	0.322	lbs/day	330.75	ug/l	8.274	lbs/day
Mercury	0.0120	ug/l	0.000	lbs/day	2.40	ug/l	0.060	lbs/day
Nickel	132.17	ug/l	3.306	lbs/day	1188.80	ug/l	29.738	lbs/day
Selenium	4.60	ug/l	0.115	lbs/day	20.00	ug/l	0.500	lbs/day
Silver	N/A	ug/l	N/A	lbs/day	25.06	ug/l	0.627	lbs/day
Zinc	304.03	ug/l	7.605	lbs/day	304.03	ug/l	7.605	lbs/day

* Allowed below discharge

**Chronic Aluminum standard applies only to waters with a pH < 7.0 and a Hardness < 50 mg/l as CaCO

Metals Standards Based upon a Hardness of 300.11 mg/l as CaCO3

Organics [Pesticides]

Parameter	4 Day Average (Chronic) Standard Concentration		Load*		1 Hour Average (Acute) Standard Concentration		Load*	
Aldrin					1.500	ug/l	0.038	lbs/day
Chlordane	0.004	ug/l	0.108	lbs/day	1.200	ug/l	0.030	lbs/day
DDT, DDE	0.001	ug/l	0.025	lbs/day	0.550	ug/l	0.014	lbs/day
Dieldrin	0.002	ug/l	0.048	lbs/day	1.250	ug/l	0.031	lbs/day
Endosulfan	0.056	ug/l	1.404	lbs/day	0.110	ug/l	0.003	lbs/day
Endrin	0.002	ug/l	0.058	lbs/day	0.090	ug/l	0.002	lbs/day
Guthion					0.010	ug/l	0.000	lbs/day
Heptachlor	0.004	ug/l	0.095	lbs/day	0.260	ug/l	0.007	lbs/day
Lindane	0.080	ug/l	2.006	lbs/day	1.000	ug/l	0.025	lbs/day
Methoxychlor					0.030	ug/l	0.001	lbs/day
Mirex					0.010	ug/l	0.000	lbs/day
Parathion					0.040	ug/l	0.001	lbs/day
PCB's	0.014	ug/l	0.351	lbs/day	2.000	ug/l	0.050	lbs/day
Pentachlorophenol	13.00	ug/l	325.896	lbs/day	20.000	ug/l	0.500	lbs/day
Toxephene	0.0002	ug/l	0.005	lbs/day	0.7300	ug/l	0.018	lbs/day

IV. Numeric Stream Standards for Protection of Agriculture

	4 Day Average (Chronic) Standard Concentration	Load*	1 Hour Average (Acute) Standard Concentration		Load*	
Arsenic			100.0	ug/l		lbs/day
Boron			750.0	ug/l		lbs/day
Cadmium			10.0	ug/l	0.13	lbs/day
Chromium			100.0	ug/l		lbs/day
Copper			200.0	ug/l		lbs/day

Lead	100.0 ug/l	lbs/day
Selenium	50.0 ug/l	lbs/day
TDS, Summer	1200.0 mg/l	15.01 tons/day

V. Numeric Stream Standards for Protection of Human Health (Class 1C Waters)

	4 Day Average (Chronic) Standard		1 Hour Average (Acute) Standard	
Metals	**Concentration**	**Load***	**Concentration**	**Load***
Arsenic			ug/l	lbs/day
Barium			ug/l	lbs/day
Cadmium			ug/l	lbs/day
Chromium			ug/l	lbs/day
Lead			ug/l	lbs/day
Mercury			ug/l	lbs/day
Selenium			ug/l	lbs/day
Silver			ug/l	lbs/day
Fluoride (3)			ug/l	lbs/day
to			ug/l	lbs/day
Nitrates as N			ug/l	lbs/day
Chlorophenoxy Herbicides				
2,4-D			ug/l	lbs/day
2,4,5-TP			ug/l	lbs/day
Endrin			ug/l	lbs/day
ocyclohexane (Lindane)			ug/l	lbs/day
Methoxychlor			ug/l	lbs/day
Toxaphene			ug/l	lbs/day

VI. Numeric Stream Standards the Protection of Human Health from Water & Fish Consumption [Toxics]

	Maximum Conc., ug/l - Acute Standards					
	Class 1C		**Class 3A, 3B**			
Toxic Organics	[2 Liters/Day for 70 Kg Person over 70 Yr.]		[6.5 g for 70 Kg Person over 70 Yr.]			
Acenaphthene	ug/l	lbs/day	2700.0	ug/l	67.69	lbs/day
Acrolein	ug/l	lbs/day	780.0	ug/l	19.55	lbs/day
Acrylonitrile	ug/l	lbs/day	0.7	ug/l	0.02	lbs/day
Benzene	ug/l	lbs/day	71.0	ug/l	1.78	lbs/day
Benzidine	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Carbon tetrachloride	ug/l	lbs/day	4.4	ug/l	0.11	lbs/day
Chlorobenzene	ug/l	lbs/day	21000.0	ug/l	526.45	lbs/day
1,2,4-Trichlorobenzene						
Hexachlorobenzene	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
1,2-Dichloroethane	ug/l	lbs/day	99.0	ug/l	2.48	lbs/day
1,1,1-Trichloroethane						
Hexachloroethane	ug/l	lbs/day	8.9	ug/l	0.22	lbs/day
1,1-Dichloroethane						
1,1,2-Trichloroethane	ug/l	lbs/day	42.0	ug/l	1.05	lbs/day
1,1,2,2-Tetrachloroethai	ug/l	lbs/day	11.0	ug/l	0.28	lbs/day
Chloroethane			0.0	ug/l	0.00	lbs/day
Bis(2-chloroethyl) ether	ug/l	lbs/day	1.4	ug/l	0.04	lbs/day
2-Chloroethyl vinyl ether	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day

2-Chloronaphthalene	ug/l	lbs/day	4300.0	ug/l	107.80	lbs/day
2,4,6-Trichlorophenol	ug/l	lbs/day	6.5	ug/l	0.16	lbs/day
p-Chloro-m-cresol			0.0	ug/l	0.00	lbs/day
Chloroform (HM)	ug/l	lbs/day	470.0	ug/l	11.78	lbs/day
2-Chlorophenol	ug/l	lbs/day	400.0	ug/l	10.03	lbs/day
1,2-Dichlorobenzene	ug/l	lbs/day	17000.0	ug/l	426.17	lbs/day
1,3-Dichlorobenzene	ug/l	lbs/day	2600.0	ug/l	65.18	lbs/day
1,4-Dichlorobenzene	ug/l	lbs/day	2600.0	ug/l	65.18	lbs/day
3,3'-Dichlorobenzidine	ug/l	lbs/day	0.1	ug/l	0.00	lbs/day
1,1-Dichloroethylene	ug/l	lbs/day	3.2	ug/l	0.08	lbs/day
1,2-trans-Dichloroethyle	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
2,4-Dichlorophenol	ug/l	lbs/day	790.0	ug/l	19.80	lbs/day
1,2-Dichloropropane	ug/l	lbs/day	39.0	ug/l	0.98	lbs/day
1,3-Dichloropropylene	ug/l	lbs/day	1700.0	ug/l	42.62	lbs/day
2,4-Dimethylphenol	ug/l	lbs/day	2300.0	ug/l	57.66	lbs/day
2,4-Dinitrotoluene	ug/l	lbs/day	9.1	ug/l	0.23	lbs/day
2,6-Dinitrotoluene	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
1,2-Diphenylhydrazine	ug/l	lbs/day	0.5	ug/l	0.01	lbs/day
Ethylbenzene	ug/l	lbs/day	29000.0	ug/l	727.00	lbs/day
Fluoranthene	ug/l	lbs/day	370.0	ug/l	9.28	lbs/day
4-Chlorophenyl phenyl ether						
4-Bromophenyl phenyl ether						
Bis(2-chloroisopropyl) e	ug/l	lbs/day	170000.0	ug/l	4261.71	lbs/day
Bis(2-chloroethoxy) met	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Methylene chloride (HM	ug/l	lbs/day	1600.0	ug/l	40.11	lbs/day
Methyl chloride (HM)	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Methyl bromide (HM)	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Bromoform (HM)	ug/l	lbs/day	360.0	ug/l	9.02	lbs/day
Dichlorobromomethane	ug/l	lbs/day	22.0	ug/l	0.55	lbs/day
Chlorodibromomethane	ug/l	lbs/day	34.0	ug/l	0.85	lbs/day
Hexachlorobutadiene(c)	ug/l	lbs/day	50.0	ug/l	1.25	lbs/day
Hexachlorocyclopentadi	ug/l	lbs/day	17000.0	ug/l	426.17	lbs/day
Isophorone	ug/l	lbs/day	600.0	ug/l	15.04	lbs/day
Naphthalene						
Nitrobenzene	ug/l	lbs/day	1900.0	ug/l	47.63	lbs/day
2-Nitrophenol	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
4-Nitrophenol	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
2,4-Dinitrophenol	ug/l	lbs/day	14000.0	ug/l	350.96	lbs/day
4,6-Dinitro-o-cresol	ug/l	lbs/day	765.0	ug/l	19.18	lbs/day
N-Nitrosodimethylamine	ug/l	lbs/day	8.1	ug/l	0.20	lbs/day
N-Nitrosodiphenylamine	ug/l	lbs/day	16.0	ug/l	0.40	lbs/day
N-Nitrosodi-n-propylami	ug/l	lbs/day	1.4	ug/l	0.04	lbs/day
Pentachlorophenol	ug/l	lbs/day	8.2	ug/l	0.21	lbs/day
Phenol	ug/l	lbs/day	4.6E+06	ug/l	1.15E+05	lbs/day
Bis(2-ethylhexyl)phthala	ug/l	lbs/day	5.9	ug/l	0.15	lbs/day
Butyl benzyl phthalate	ug/l	lbs/day	5200.0	ug/l	130.36	lbs/day
Di-n-butyl phthalate	ug/l	lbs/day	12000.0	ug/l	300.83	lbs/day
Di-n-octyl phthlate						
Diethyl phthalate	ug/l	lbs/day	120000.0	ug/l	3008.27	lbs/day
Dimethyl phthlate	ug/l	lbs/day	2.9E+06	ug/l	7.27E+04	lbs/day
Benzo(a)anthracene (P/	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day

Benzo(a)pyrene (PAH)	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Benzo(b)fluoranthene (F	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Benzo(k)fluoranthene (F	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Chrysene (PAH)	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Acenaphthylene (PAH)						
Anthracene (PAH)	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Dibenzo(a,h)anthracene	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Indeno(1,2,3-cd)pyrene	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Pyrene (PAH)	ug/l	lbs/day	11000.0	ug/l	275.76	lbs/day
Tetrachloroethylene	ug/l	lbs/day	8.9	ug/l	0.22	lbs/day
Toluene	ug/l	lbs/day	200000.0	ug/l	5013.78	lbs/day
Trichloroethylene	ug/l	lbs/day	81.0	ug/l	2.03	lbs/day
Vinyl chloride	ug/l	lbs/day	525.0	ug/l	13.16	lbs/day
						lbs/day
Pesticides						lbs/day
Aldrin	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Dieldrin	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Chlordane	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
4,4'-DDT	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
4,4'-DDE	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
4,4'-DDD	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
alpha-Endosulfan	ug/l	lbs/day	2.0	ug/l	0.05	lbs/day
beta-Endosulfan	ug/l	lbs/day	2.0	ug/l	0.05	lbs/day
Endosulfan sulfate	ug/l	lbs/day	2.0	ug/l	0.05	lbs/day
Endrin	ug/l	lbs/day	0.8	ug/l	0.02	lbs/day
Endrin aldehyde	ug/l	lbs/day	0.8	ug/l	0.02	lbs/day
Heptachlor	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Heptachlor epoxide						
PCB's						
PCB 1242 (Arochlor 124	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
PCB-1254 (Arochlor 125	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
PCB-1221 (Arochlor 122	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
PCB-1232 (Arochlor 123	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
PCB-1248 (Arochlor 124	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
PCB-1260 (Arochlor 126	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
PCB-1016 (Arochlor 10	ug/l	lbs/day	0.0	ug/l	0.00	lbs/day
Pesticide						
Toxaphene	ug/l		0.0	ug/l	0.00	lbs/day
Dioxin						
Dioxin (2,3,7,8-TCDD)	ug/l	lbs/day				
Metals						
Antimony	ug/l	lbs/day				
Arsenic	ug/l	lbs/day	4300.00	ug/l	107.80	lbs/day
Asbestos	ug/l	lbs/day				
Beryllium						
Cadmium						

Chromium (III)				
Chromium (VI)				
Copper				
Cyanide	ug/l	lbs/day	2.2E+05 ug/l	5515.16 lbs/day
Lead	ug/l	lbs/day		
Mercury			0.15 ug/l	0.00 lbs/day
Nickel			4600.00 ug/l	115.32 lbs/day
Selenium	ug/l	lbs/day		
Silver	ug/l	lbs/day		
Thallium			6.30 ug/l	0.16 lbs/day
Zinc				

There are additional standards that apply to this receiving water, but were not considered in this modeling/waste load allocation analysis.

VII. Mathematical Modeling of Stream Quality

Model configuration was accomplished utilizing standard modeling procedures. Data points were plotted and coefficients adjusted as required to match observed data as closely as possible.

The modeling approach used in this analysis included one or a combination of the following models.

(1) The Utah River Model, Utah Division of Water Quality, 1992. Based upon STREAMDO IV (Region VIII) and Supplemental Ammonia Toxicity Models; EPA Region VIII, Sept. 1990 and QUAL2E (EPA, Athens, GA).

(2) Utah Ammonia/Chlorine Model, Utah Division of Water Quality, 1992.

(3) AMMTOX Model, University of Colorado, Center of Limnology, and EPA Region 8

(4) Principles of Surface Water Quality Modeling and Control. Robert V. Thomann, et.al. Harper Collins Publisher, Inc. 1987, pp. 644.

Coefficients used in the model were based, in part, upon the following references:

(1) Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling. Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens Georgia. EPA/600/3-85/040 June 1985.

(2) Principles of Surface Water Quality Modeling and Control. Robert V. Thomann, et.al. Harper Collins Publisher, Inc. 1987, pp. 644.

VIII. Modeling Information

The required information for the model may include the following information for both the upstream conditions at low flow and the effluent conditions:

Flow, Q, (cfs or MGD)	D.O. mg/l
Temperature, Deg. C.	Total Residual Chlorine (TRC), mg/l
pH	Total NH3-N, mg/l
BOD5, mg/l	Total Dissolved Solids (TDS), mg/l
Metals, ug/l	Toxic Organics of Concern, ug/l

Other Conditions

In addition to the upstream and effluent conditions, the models require a variety of physical and biological coefficients and other technical information. In the process of actually establishing the permit limits for an effluent, values are used based upon the available data, model calibration, literature values, site visits and best professional judgement.

Model Inputs

The following is upstream and discharge information that was utilized as inputs for the analysis. Dry washes are considered to have an upstream flow equal to the flow of the discharge.

Current Upstream Information

	Stream Critical Low Flow cfs	Temp. Deg. C	pH	T-NH3 mg/l as N	BOD5 mg/l	DO mg/l	TRC mg/l	TDS mg/l
Summer (Irrig. Season)	0.0	20.0	8.2	0.05	0.10	---	0.00	350.0
Fall	0.0	12.0	8.1	0.05	0.10	---	0.00	350.0
Winter	0.0	4.0	8.0	0.05	0.10	---	0.00	350.0
Spring	0.0	12.0	8.1	0.05	0.10	10.86	0.00	350.0

Dissolved Metals	Al ug/l	As ug/l	Cd ug/l	CrIII ug/l	CrVI ug/l	Copper ug/l	Fe ug/l	Pb ug/l
All Seasons	1.59*	0.53*	0.053*	0.53*	2.65*	0.53*	0.83*	0.53*

Dissolved Metals	Hg ug/l	Ni ug/l	Se ug/l	Ag ug/l	Zn ug/l	Boron ug/l	
All Seasons	0.0000	0.53*	1.06*	0.1*	0.053*	10.0	* 1/2 MDL

Projected Discharge Information

Season	Flow, MGD	Temp.	TDS mg/l	TDS tons/day
Summer	3.00000	22.5	350.00	4.37762
Fall	3.00000	10.0		
Winter	3.00000	4.0		
Spring	3.00000	10.0		

All model numerical inputs, intermediate calculations, outputs and graphs are available for discussion, inspection and copy at the Division of Water Quality.

IX. Effluent Limitations

Current State water quality standards are required to be met under a variety of conditions including in-stream flows targeted to the 7-day, 10-year low flow (R317-2-9).

Other conditions used in the modeling effort coincide with the environmental conditions expected at low stream flows.

Effluent Limitation for Flow based upon Water Quality Standards

In-stream criteria of downstream segments will be met with an effluent flow maximum value as follows:

Season	Daily Average	
Summer	3.000 MGD	4.641 cfs
Fall	3.000 MGD	4.641 cfs
Winter	3.000 MGD	4.641 cfs
Spring	3.000 MGD	4.641 cfs

Flow Requirement or Loading Requirement

The calculations in this wasteload analysis utilize the maximum effluent discharge flow of 3 MGD. If the discharger is allowed to have a flow greater than 3 MGD during 7Q10 conditions, and effluent limit concentrations as indicated, then water quality standards will be violated. In order to prevent this from occuring, the permit writers must include the discharge flow limititation as indicated above; or, include loading effluent limits in the permit.

Effluent Limitation for Whole Effluent Toxicity (WET) based upon WET Policy

Effluent Toxicity will not occur in downstream segements if the values below are met.

WET Requirements	LC50 >	EOP Effluent	[Acute]
	IC25 >	99.8% Effluent	[Chronic]

Effluent Limitation for Biological Oxygen Demand (BOD) based upon Water Quality Standards or Regulations

In-stream criteria of downstream segments for Dissolved Oxygen will be met with an effluent BOD limitation as follows:

Season	Concentration	
Summer	25.0 mg/l as BOD5	625.4 lbs/day
Fall	25.0 mg/l as BOD5	625.4 lbs/day
Winter	25.0 mg/l as BOD5	625.4 lbs/day
Spring	25.0 mg/l as BOD5	625.4 lbs/day

Effluent Limitation for Dissolved Oxygen (DO) based upon Water Quality Standards

In-stream criteria of downstream segments for Dissolved Oxygen will be met with an effluent D.O. limitation as follows:

Season	Concentration
Summer	4.00
Fall	4.00
Winter	4.00
Spring	4.00

Effluent Limitation for Total Ammonia based upon Water Quality Standards

In-stream criteria of downstream segments for Total Ammonia will be met with an effluent limitation (expressed as Total Ammonia as N) as follows:

Season		Concentration		Load	
Summer	4 Day Avg. - Chronic	12.5	mg/l as N	312.2	lbs/day
	1 Hour Avg. - Acute	55.9	mg/l as N	1,397.3	lbs/day
Fall	4 Day Avg. - Chronic	13.1	mg/l as N	327.7	lbs/day
	1 Hour Avg. - Acute	57.9	mg/l as N	1,447.4	lbs/day
Winter	4 Day Avg. - Chronic	14.1	mg/l as N	352.0	lbs/day
	1 Hour Avg. - Acute	62.1	mg/l as N	1,553.4	lbs/day
Spring	4 Day Avg. - Chronic	13.1	mg/l as N	0.0	lbs/day
	1 Hour Avg. - Acute	57.9	mg/l as N	0.0	lbs/day

Acute limit calculated with an Acute Zone of Initial Dilution (ZID) to be equal to 100.%.
Note: Values are from combined Payson/Salem WLAs June 15-16, 2004.

Effluent Limitation for Total Residual Chlorine based upon Water Quality Standards

In-stream criteria of downstream segments for Total Residual Chlorine will be met with an effluent limitation as follows:

Season		Concentration		Load	
Summer	4 Day Avg. - Chronic	1.1	mg/l	26.29	lbs/day
	1 Hour Avg. - Acute	1.9	mg/l	47.90	lbs/day
Fall	4 Day Avg. - Chronic	1.6	mg/l	39.45	lbs/day
	1 Hour Avg. - Acute	2.7	mg/l	68.22	lbs/day
Winter	4 Day Avg. - Chronic	2.4	mg/l	59.29	lbs/day
	1 Hour Avg. - Acute	4.1	mg/l	101.36	lbs/day
Spring	4 Day Avg. - Chronic	1.6	mg/l	0.00	lbs/day
	1 Hour Avg. - Acute	2.7	mg/l	0.00	lbs/day

Note: Values are from combined Payson/Salem WLAs June 15-16, 2004.

Effluent Limitations for Total Dissolved Solids based upon Water Quality Standards

Season		Concentration		Load	
Summer	Maximum, Acute	1201.8	mg/l	15.03	tons/day
Fall	Maximum, Acute	1201.8	mg/l	15.03	tons/day
Winter	Maximum, Acute	1201.8	mg/l	15.03	tons/day
Spring	4 Day Avg. - Chronic	1201.8	mg/l	15.03	tons/day

Colorado Salinity Form Limits — Determined by Permitting Section

Effluent Limitations for Total Recoverable Metals based upon Water Quality Standards

In-stream criteria of downstream segments for Dissolved Metals will be met with an effluent limitation as follows (based upon a hardness of 300.11 mg/l):

	4 Day Average				1 Hour Average			
	Concentration		Load		Concentration		Load	
Aluminum	N/A		N/A		751.6	ug/l	18.8	lbs/day
Arsenic	190.41	ug/l	3.1	lbs/day	340.7	ug/l	8.5	lbs/day
Cadmium	0.61	ug/l	0.0	lbs/day	6.5	ug/l	0.2	lbs/day
Chromium III	212.43	ug/l	3.4	lbs/day	4,444.6	ug/l	111.2	lbs/day
Chromium VI	11.02	ug/l	0.2	lbs/day	16.0	ug/l	0.4	lbs/day
Copper	23.91	ug/l	0.4	lbs/day	39.5	ug/l	1.0	lbs/day
Iron	N/A		N/A		1,002.2	ug/l	25.1	lbs/day
Lead	12.91	ug/l	0.2	lbs/day	331.5	ug/l	8.3	lbs/day
Mercury	0.01	ug/l	0.0	lbs/day	2.4	ug/l	0.1	lbs/day
Nickel	132.45	ug/l	2.1	lbs/day	1,191.4	ug/l	29.8	lbs/day
Selenium	4.61	ug/l	0.1	lbs/day	20.0	ug/l	0.5	lbs/day
Silver	N/A	ug/l	N/A	lbs/day	25.1	ug/l	0.6	lbs/day
Zinc	304.68	ug/l	4.9	lbs/day	304.7	ug/l	7.6	lbs/day
Cyanide	5.21	ug/l	0.1	lbs/day	22.0	ug/l	0.6	lbs/day

Effluent Limitations for Heat/Temperature based upon Water Quality Standards

Summer	24.0 Deg. C.	75.2 Deg. F
Fall	16.0 Deg. C.	60.8 Deg. F
Winter	8.0 Deg. C.	46.4 Deg. F
Spring	14.0 Deg. C.	57.2 Deg. F

Effluent Limitations for Organics [Pesticides] Based upon Water Quality Standards

In-stream criteria of downstream segments for Organics [Pesticides] will be met with an effluent limit as follows:

	4 Day Average				1 Hour Average			
	Concentration		Load		Concentration		Load	
Aldrin					1.5E+00	ug/l	5.80E-02	lbs/day
Chlordane	4.30E-03	ug/l	1.08E-01	lbs/day	1.2E+00	ug/l	4.64E-02	lbs/day
DDT, DDE	1.00E-03	ug/l	2.50E-02	lbs/day	5.5E-01	ug/l	2.13E-02	lbs/day
Dieldrin	1.90E-03	ug/l	4.75E-02	lbs/day	1.3E+00	ug/l	4.84E-02	lbs/day
Endosulfan	5.60E-02	ug/l	1.40E+00	lbs/day	1.1E-01	ug/l	4.26E-03	lbs/day
Endrin	2.30E-03	ug/l	5.75E-02	lbs/day	9.0E-02	ug/l	3.48E-03	lbs/day
Guthion	0.00E+00	ug/l	0.00E+00	lbs/day	1.0E-02	ug/l	3.87E-04	lbs/day
Heptachlor	3.80E-03	ug/l	9.51E-02	lbs/day	2.6E-01	ug/l	1.01E-02	lbs/day
Lindane	8.00E-02	ug/l	2.00E+00	lbs/day	1.0E+00	ug/l	3.87E-02	lbs/day
Methoxychlor	0.00E+00	ug/l	0.00E+00	lbs/day	3.0E-02	ug/l	1.16E-03	lbs/day
Mirex	0.00E+00	ug/l	0.00E+00	lbs/day	1.0E-02	ug/l	3.87E-04	lbs/day
Parathion	0.00E+00	ug/l	0.00E+00	lbs/day	4.0E-02	ug/l	1.55E-03	lbs/day
PCB's	1.40E-02	ug/l	3.50E-01	lbs/day	2.0E+00	ug/l	7.74E-02	lbs/day
Pentachlorophenol	1.30E+01	ug/l	3.25E+02	lbs/day	2.0E+01	ug/l	7.74E-01	lbs/day
Toxephene	2.00E-04	ug/l	5.00E-03	lbs/day	7.3E-01	ug/l	2.82E-02	lbs/day

Effluent Targets for Pollution Indicators
Based upon Water Quality Standards

In-stream criteria of downstream segments for Pollution Indicators will be met with an effluent limit as follows:

	1 Hour Average			
	Concentration		Loading	
Gross Beta (pCi/l)	50.0	pCi/L		
BOD (mg/l)	5.0	mg/l	125.1	lbs/day
Nitrates as N	4.0	mg/l	100.1	lbs/day
Total Phosphorus as P	0.05	mg/l	1.3	lbs/day
Total Suspended Solids	90.0	mg/l	2251.3	lbs/day

Note: Pollution indicator targets are for information purposes only.

Effluent Limitations for Protection of Human Health [Toxics Rule]
Based upon Water Quality Standards (Most stringent of 1C or 3A & 3B as appropriate.)

In-stream criteria of downstream segments for Protection of Human Health [Toxics] will be met with an effluent limit as follows:

	Maximum Concentration			
	Concentration		Load	
Toxic Organics				
Acenaphthene	2.71E+03	ug/l	6.77E+01	lbs/day
Acrolein	7.82E+02	ug/l	1.96E+01	lbs/day
Acrylonitrile	6.61E-01	ug/l	1.65E-02	lbs/day
Benzene	7.12E+01	ug/l	1.78E+00	lbs/day
Benzidine		ug/l		lbs/day

Carbon tetrachloride	4.41E+00 ug/l	1.10E-01 lbs/day
Chlorobenzene	2.10E+04 ug/l	5.26E+02 lbs/day
1,2,4-Trichlorobenzene		
Hexachlorobenzene	7.72E-04 ug/l	1.93E-05 lbs/day
1,2-Dichloroethane	9.92E+01 ug/l	2.48E+00 lbs/day
1,1,1-Trichloroethane		
Hexachloroethane	8.92E+00 ug/l	2.23E-01 lbs/day
1,1-Dichloroethane		
1,1,2-Trichloroethane	4.21E+01 ug/l	1.05E+00 lbs/day
1,1,2,2-Tetrachloroethane	1.10E+01 ug/l	2.76E-01 lbs/day
Chloroethane		
Bis(2-chloroethyl) ether	1.40E+00 ug/l	3.51E-02 lbs/day
2-Chloroethyl vinyl ether		
2-Chloronaphthalene	4.31E+03 ug/l	1.08E+02 lbs/day
2,4,6-Trichlorophenol	6.51E+00 ug/l	1.63E-01 lbs/day
p-Chloro-m-cresol		
Chloroform (HM)	4.71E+02 ug/l	1.18E+01 lbs/day
2-Chlorophenol	4.01E+02 ug/l	1.00E+01 lbs/day
1,2-Dichlorobenzene	1.70E+04 ug/l	4.26E+02 lbs/day
1,3-Dichlorobenzene	2.61E+03 ug/l	6.52E+01 lbs/day
1,4-Dichlorobenzene	2.61E+03 ug/l	6.52E+01 lbs/day
3,3'-Dichlorobenzidine	7.72E-02 ug/l	1.93E-03 lbs/day
1,1-Dichloroethylene	3.21E+00 ug/l	8.02E-02 lbs/day
1,2-trans-Dichloroethylene1		
2,4-Dichlorophenol	7.92E+02 ug/l	1.98E+01 lbs/day
1,2-Dichloropropane	3.91E+01 ug/l	9.78E-01 lbs/day
1,3-Dichloropropylene	1.70E+03 ug/l	4.26E+01 lbs/day
2,4-Dimethylphenol	2.30E+03 ug/l	5.77E+01 lbs/day
2,4-Dinitrotoluene	9.12E+00 ug/l	2.28E-01 lbs/day
2,6-Dinitrotoluene		
1,2-Diphenylhydrazine	5.41E-01 ug/l	1.35E-02 lbs/day
Ethylbenzene	2.91E+04 ug/l	7.27E+02 lbs/day
Fluoranthene	3.71E+02 ug/l	9.28E+00 lbs/day
4-Chlorophenyl phenyl ether		
4-Bromophenyl phenyl ether		
Bis(2-chloroisopropyl) ether	1.70E+05 ug/l	4.26E+03 lbs/day
Bis(2-chloroethoxy) methane		
Methylene chloride (HM)	1.60E+03 ug/l	4.01E+01 lbs/day
Methyl chloride (HM)		
Methyl bromide (HM)		
Bromoform (HM)	3.61E+02 ug/l	9.02E+00 lbs/day
Dichlorobromomethane(HM)	2.20E+01 ug/l	5.52E-01 lbs/day
Chlorodibromomethane (HM)	3.41E+01 ug/l	8.52E-01 lbs/day
Hexachlorocyclopentadiene	1.70E+04 ug/l	4.26E+02 lbs/day
Isophorone	6.01E+02 ug/l	1.50E+01 lbs/day
Naphthalene		
Nitrobenzene	1.90E+03 ug/l	4.76E+01 lbs/day
2-Nitrophenol		
4-Nitrophenol		
2,4-Dinitrophenol	1.40E+04 ug/l	3.51E+02 lbs/day
4,6-Dinitro-o-cresol	7.67E+02 ug/l	1.92E+01 lbs/day

N-Nitrosodimethylamine	8.12E+00 ug/l	2.03E-01 lbs/day
N-Nitrosodiphenylamine	1.60E+01 ug/l	4.01E-01 lbs/day
N-Nitrosodi-n-propylamine	1.40E+00 ug/l	3.51E-02 lbs/day
Pentachlorophenol	8.22E+00 ug/l	2.06E-01 lbs/day
Phenol	4.61E+06 ug/l	1.15E+05 lbs/day
Bis(2-ethylhexyl)phthalate	5.91E+00 ug/l	1.48E-01 lbs/day
Butyl benzyl phthalate	5.21E+03 ug/l	1.30E+02 lbs/day
Di-n-butyl phthalate	1.20E+04 ug/l	3.01E+02 lbs/day
Di-n-octyl phthlate		
Diethyl phthalate	1.20E+05 ug/l	3.01E+03 lbs/day
Dimethyl phthlate	2.91E+06 ug/l	7.27E+04 lbs/day
Benzo(a)anthracene (PAH)	3.11E-02 ug/l	7.77E-04 lbs/day
Benzo(a)pyrene (PAH)	3.11E-02 ug/l	7.77E-04 lbs/day
Benzo(b)fluoranthene (PAH)	3.11E-02 ug/l	7.77E-04 lbs/day
Benzo(k)fluoranthene (PAH)	3.11E-02 ug/l	7.77E-04 lbs/day
Chrysene (PAH)	3.11E-02 ug/l	7.77E-04 lbs/day
Acenaphthylene (PAH)		
Anthracene (PAH)		
Dibenzo(a,h)anthracene (PAH)	3.11E-02 ug/l	7.77E-04 lbs/day
Indeno(1,2,3-cd)pyrene (PAH)	3.11E-02 ug/l	7.77E-04 lbs/day
Pyrene (PAH)	1.10E+04 ug/l	2.76E+02 lbs/day
Tetrachloroethylene	8.92E+00 ug/l	2.23E-01 lbs/day
Toluene	2.00E+05 ug/l	5.01E+03 lbs/day
Trichloroethylene	8.12E+01 ug/l	2.03E+00 lbs/day
Vinyl chloride	5.26E+02 ug/l	1.32E+01 lbs/day
Pesticides		
Aldrin	1.40E-04 ug/l	3.51E-06 lbs/day
Dieldrin	1.40E-04 ug/l	3.51E-06 lbs/day
Chlordane	5.91E-04 ug/l	1.48E-05 lbs/day
4,4'-DDT	5.91E-04 ug/l	1.48E-05 lbs/day
4,4'-DDE	5.91E-04 ug/l	1.48E-05 lbs/day
4,4'-DDD	8.42E-04 ug/l	2.11E-05 lbs/day
alpha-Endosulfan	2.00E+00 ug/l	5.01E-02 lbs/day
beta-Endosulfan	2.00E+00 ug/l	5.01E-02 lbs/day
Endosulfan sulfate	2.00E+00 ug/l	5.01E-02 lbs/day
Endrin	8.12E-01 ug/l	2.03E-02 lbs/day
Endrin aldehyde	8.12E-01 ug/l	2.03E-02 lbs/day
Heptachlor	2.10E-04 ug/l	5.26E-06 lbs/day
Heptachlor epoxide		
PCB's		
PCB 1242 (Arochlor 1242)	4.51E-05 ug/l	1.13E-06 lbs/day
PCB-1254 (Arochlor 1254)	4.51E-05 ug/l	1.13E-06 lbs/day
PCB-1221 (Arochlor 1221)	4.51E-05 ug/l	1.13E-06 lbs/day
PCB-1232 (Arochlor 1232)	4.51E-05 ug/l	1.13E-06 lbs/day
PCB-1248 (Arochlor 1248)	4.51E-05 ug/l	1.13E-06 lbs/day
PCB-1260 (Arochlor 1260)	4.51E-05 ug/l	1.13E-06 lbs/day
PCB-1016 (Arochlor 1016)	4.51E-05 ug/l	1.13E-06 lbs/day
Pesticide		

Toxaphene	7.52E-04	ug/l	1.88E-05	lbs/day
Metals				
Antimony		ug/l		lbs/day
Arsenic		ug/l		lbs/day
Asbestos		ug/l		lbs/day
Beryllium				
Cadmium				
Chromium (III)				
Chromium (VI)				
Copper		ug/l		lbs/day
Cyanide		ug/l		lbs/day
Lead				
Mercury		ug/l		lbs/day
Nickel		ug/l		lbs/day
Selenium				
Silver				
Thallium		ug/l		lbs/day
Zinc				
Dioxin				
Dioxin (2,3,7,8-TCDD)	1.40E-08	ug/l	3.51E-10	lbs/day

Metals Effluent Limitations for Protection of All Beneficial Uses Based upon Water Quality Standards and Toxics Rule

	Class 4 Acute Agricultural ug/l	Class 3 Acute Aquatic Wildlife ug/l	Acute Toxics Drinking Water Source ug/l	Acute Toxics Wildlife ug/l	1C Acute Health Criteria ug/l	Acute Most Stringent ug/l	Class 3 Chronic Aquatic Wildlife ug/l
Aluminum		751.6				751.6	N/A
Antimony				4309.3		4309.3	
Arsenic	100.2	340.7			0.0	100.2	190.4
Barium						0.0	
Beryllium						0.0	
Cadmium	10.0	6.5			0.0	6.5	0.6
Chromium (III)		4444.6			0.0	4444.6	212.4
Chromium (VI)	100.2	16.0			0.0	16.03	11.02
Copper	200.4	39.5				39.5	23.9
Cyanide		22.0	220474			22.0	5.2
Iron		1002.2				1002.2	
Lead	100.2	331.5			0.0	100.2	12.9
Mercury		2.41		0.15	0.0	0.15	0.012
Nickel		1191.4		4609.9		1191.4	132.5
Selenium	50.1	20.0			0.0	20.0	4.6
Silver		25.1			0.0	25.1	

Thallium			6.3	6.3	
Zinc		304.7		304.7	304.7
Boron	751.6			751.6	

Summary Effluent Limitations for Metals [Wasteload Allocation, TMDL]
[If Acute is more stringent than Chronic, then the Chronic takes on the Acute value.]

	WLA Acute ug/l	WLA Chronic ug/l	
Aluminum	751.6	N/A	
Antimony	4309.27		
Arsenic	100.2	190.4	Acute Controls
Asbestos	0.00E+00		
Barium			
Beryllium			
Cadmium	6.5	0.6	
Chromium (III)	4444.6	212	
Chromium (VI)	16.0	11.0	
Copper	39.5	23.9	
Cyanide	22.0	5.2	
Iron	1002.2		
Lead	100.2	12.9	
Mercury	0.150	0.012	
Nickel	1191.4	132	
Selenium	20.0	4.6	
Silver	25.1	N/A	
Thallium	6.3		
Zinc	304.7	304.7	
Boron	751.62		

Other Effluent Limitations are based upon R317-1.

E. coli	126.0	organisms per 100 ml

X. Antidegradation Considerations

The Utah Antidegradation Policy allows for degradation of existing quality where it is determined that such lowering of water quality is necessary to accommodate important economic or social development in the area in which the waters are protected [R317-2-3]. It has been determined that certain chemical parameters introduced by this discharge will cause an increase of the concentration of said parameters in the receiving waters. Under no conditions will the increase in concentration be allowed to interfere with existing instream water uses.

The antidegradation rules and procedures allow for modification of effluent limits less than those based strictly upon mass balance equations utilizing 100% of the assimilative capacity of the receiving water. Additional factors include considerations for "Blue-ribbon" fisheries, special recreational areas, threatened and endangered species, and drinking water sources.

An Antidegradation Level I Review was conducted on this discharge and its effect on the

receiving water. Based upon that review, it has been determined that an
Antidegradation Level II Review is NOT Required

XI. Colorado River Salinity Forum Considerations

Discharges in the Colorado River Basin are required to have their discharge at a TDS loading of less than 1.00 tons/day unless certain exemptions apply. Refer to the Forum's Guidelines for additional information allowing for an exceedence of this value.

XII. Summary Comments

The mathematical modeling and best professional judgement indicate that violations of receiving water beneficial uses with their associated water quality standards, including important down-stream segments, will not occur for the evaluated parameters of concern as discussed above if the effluent limitations indicated above are met.

XIII. Notice of UPDES Requirement

This Addendum to the Statement of Basis does not authorize any entity or party to discharge to the waters of the State of Utah. That authority is granted through a UPDES permit issued by the Utah Division of Water Quality. The numbers presented here may be changed as a function of other factors. Dischargers are strongly urged to contact the Permits Section for further information. Permit writers may utilize other information to adjust these limits and/or to determine other limits based upon best available technology and other considerations provided that the values in this wasteload analysis [TMDL] are not compromised. See special provisions in Utah Water Quality Standards for adjustments in the Total Dissolved Solids values based upon background concentration.

XIV. Special Considerations

TMDL Issues and Calculations may adjust these values as appropriate. See TMDL Section of DWQ.

Prepared by:
William O. Moellmer, Ph.D.
Utah Division of Water Quality
801-538-6329
File Name: Payson January 14 2008

APPENDIX - Coefficients and Other Model Information

CBOD Coeff. (Kd)20 1/day	CBOD Coeff. FORCED (Kd)/day	CBOD Coeff. (Ka)T 1/day	REAER. Coeff. (Ka)20 (Ka)/day	REAER. Coeff. FORCED 1/day	REAER. Coeff. (Ka)T 1/day	NBOD Coeff. (Kn)20 1/day	NBOD Coeff. (Kn)T 1/day
2.000	0.000	0.843	925.945	0.000	592.852	0.400	0.094

Open Coeff. (K4)20 1/day	Open Coeff. (K4)T 1/day	NH3 LOSS (K5)20 1/day	NH3 (K5)T 1/day	NO2+NO3 LOSS (K6)20 1/day	NO2+NO3 (K6)T 1/day	TRC Decay K(Cl)20 1/day	TRC K(Cl)(T) 1/day

0.000	0.000	4.000	1.687	0.000	0.000	32.000	10.700

BENTHIC DEMAND (SOD)20 gm/m2/day	BENTHIC DEMAND (SOD)T gm/m2/day
1.000	0.306

K1 CBOD {theta}	K2 Reaer. {theta}	K3 NH3 {theta}	K4 Open {theta}	K5 NH3 Loss {theta}	K6 NO2+3 {theta}	K(Cl) TRC {theta}	S Benthic {theta}
1.0	1.0	1.1	1.0	1.0	1.0	1.1	1.1

Level I Antidegradation Review for: Payson WWTP

Payson January 14 2008

Major Parameter of concern:	**TDS**	
WQ Standard	**1200.0**	**mg/l**
Current Stream Conditions Above Discharge		
Flow, Average	**0.0**	**cfs**
Concentration	**350.0**	**mg/l**
Loading	**3.4**	**tons/year**
Flow, 7Q10 (20th Percentile)	**0.0**	**cfs**
Concentration (80th Percentile)	**350.0**	**mg/l**
Loading	**3.4**	
Remaining Assimilative Conc. Capacity @ 7Q10		
Concentration	**850.0**	**mg/l**
Loading	**8.4**	**tons/year**
Percentage	**70.8%**	
Current Discharge Conditions		
Flow	**3.0**	**MGD**
Concentration	**350.0**	**mg/l**
Loading	**1597.8**	**tons/year**
Projected Discharge Conditions		
Flow	**1.4**	**MGD**
Concentration	**350.0**	**mg/l**
Loading	**745.7**	**tons/year**
Current Stream Conditions Below Discharge		
Flow @ 7Q10	**4.7**	**cfs**
Concentration	**350.0**	**mg/l**
Loading	**1601.3**	**tons/year**
Projected Stream Conditions Below Discharge		
Flow @ 7Q10	**2.2**	**cfs**
Concentration	**350.0**	**mg/l**
Loading	**749.1**	**tons/year**
Proposed Discharge Conc. <= Current.	**Yes**	**Off-ramped**

Utah Division of Water Quality
Salt Lake City, Utah

Discharge limits are from a TMDL.	No		
Impacts to stream are temporary.	No		See 317-2-3.4(a-e)
Impacts are related to sediments only.	No		
Fish spawning will be impaired.	No		
Current asimilative capacity @ 100%	No		
Classification excludes 3A or 3B	Yes	Off-ramped	
Considered as "poor quality" [DNR]	No		
Water body listed on 303(d) list	No	0.0	
Existing stream WQ > standard	No		
Water Quality Impacts are minor			
Increase in project loading < 20%	Yes	Off-ramped	-53.3%
Increase in Pollutant loading			
is < 20% over [avg] background	Yes	Off-ramped	-24752.0%
Small Discharge Volume			
Stream flow (avg) / Discharge Flow >100:1	No	0.0	0.0
Stream flow (7Q10) / Discharge Flow >25:1	No	0.0	5.1
Stream increase conc. < 10%	Yes	0.0	0.0%
All three above conditions are not violated.			
Executive Director requires Level II Review	No		

Antidegradation Level II Review is NOT Required

Justification / Other Information:

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Review by: ______________________________ 1/14/2008

Appendix E

Overall Site Plan

DESIGN DATA

INFLUENT CONDITION	DESIGN 2005	CURRENT 1999	PROJECTED 2020
POPULATION	20,000	12,190	24,000
AVERAGE DESIGN FLOW			
CITY (MGD)	3.00	1.50	3.00
PER CAPITA FLOW (GPCD)	150	125	125
PEAK DAY AVERAGE FLOW			
CITY (MGD)	5.75	1.90	4.50
AVERAGE BIOCHEMICAL OXGEN DEMAND (BOD5)			
CITY (LBS/DAY)	4400	2,355	4,636
Total (MG/L)	176	188	188
City Per Capita Loading (lbs/capita)	0.22	0.19	0.19
PAYSON FRUIT GROWERS (LBS/DAY)	N/A	435	1200
AVERAGE AMMONIA			
CITY (LBS/DAY)	N/A	343	686
CONCENTRATION (MG/L)	N/A	27.40	27.40

2020 DESIGN DATA

HEADWORKS

	CAPACITY
SCREEN:	
(2) MECHANICAL FINE SCREEN 2'-6" CHANNEL	4.5 MGD (EA.)
FLOW MEASUREMENT:	
(1) 30" PALMER-BOWLUS FLUME (INFLUENT)	10.68 MGD
(2) 18" PARSHALL FLUME (EFFUENT)	11.26 MGD
GRIT REMOVAL:	
(1) VORTEX GRIT CHAMBER	6.4 MGD
(2) COANDA GRIT WASHING PLANT	400 GPM

PRIMARY PUMP STATION

NO. OF PUMPS - 3

PUMPING CAPACITY (WITH ONE STANDBY PUMP) - 0.5 - 7.0 MGD

CLARIFIERS

TYPES.	NO. OF UNITS	SIZE DIAMETER (FT.)	AVG. OVERFLOW RATE (GAL/DAY SQ. FT.)	AVG. FLOW WEIR LOADING RATE (GAL/DAY LF.)
PRIMARY	1	70	780	13,642
INTERMEDIATE	2	45	943	10,610
FINAL	2	(1) 60	450	6,730
		(1) 70	450	8,365

TRICKLER FILTERS:

TYPES.	NO. OF UNITS	DIAMETER (FT.)	ROCK MEDIA VOLUME (CU. FT.)
PRIMARY	1	102	57,200

AEROTOR BASINS

UNIT	WIDTH (FT)	DEPTH (FT)	LENGTH (FT)	VOLUME(CU FT)
(1)	23	15.5	87	30,837
(2)	23	15.5	87	30,837

AERATION TANKS

UNIT	DIA (FT)	DEPTH (FT)	VOLUME(CU FT)
(1)	66	11	37,633
(2)	66	10	34,212

SECONDARY PUMP STATION

NO. OF PUMPS - 3

PUMPING CAPACITY (WITH ONE STANDBY PUMP) - 0.5 - 6.5 MGD

PUMPING CAPACITY (WITH 3 OPERRATING) - 9.0 MGD MAX.

SAND FILTER

TYPE: SHALLOW BED, TRAVELING BRIDGE RAPID SAND FILTER

NO. OF UNITS: 2

PEAK LOADING WITH ONE FILTER OFF LINE: 5 GPM/SQ. FT.

AVERAGE LOADING WITH BOTH FILTERS OPERATING: 1.44 GPM/SQ. FT.

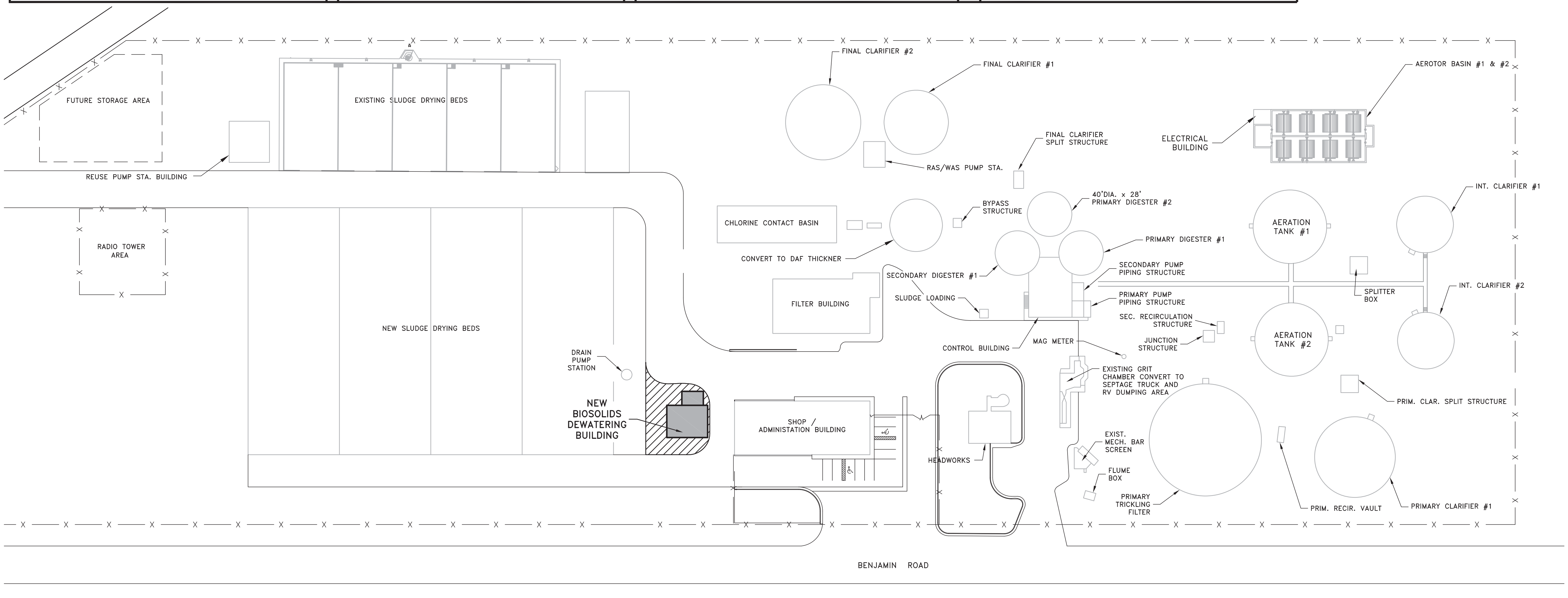
MAX. BACKWASH RETURN: 15% AVERAGE INFLUENT FLOW

AVERAGE BACKWASH RETURN: 7.5% AVERAGE INFLUENT FLOW

CHLORINATION BASIN

DESIGN CRITERIA: 40:1 CHANNEL LENGTH TO WIDTH RATIO

DETENTION TIME: 60 MINUTES AT AVERAGE FLOW



0 50 100 150

Scale in Feet

LEGEND

EXISTING

2010 UPGRADE

SLUDGE HANDLING CRITERIA

ANAEROBIC SLUDGE DIGESTION

TYPE	NO. OF UNITS	SIZE DIAMETER (FT.)	VOLUME (CU. FT.)
PRIMARY	2	40	27,640
		40	36,191
SECONDARY	1	40	27,640

DAF THICKENER

UNIT	DIAMETER (FT)	VOLUME
(1)	45	12,723

DE-WATERING PRESS

NO. OF UNITS	TYPE	HP	SOLIDS LOADING	SOLIDS CONTENT	GPM
(1)	SCREW PRESS	(2)	500 lb/hr MAX.	3-4%	25 gpm @ 4% 33 gpm @ 3%

POLYMER FEED UNIT

NO. OF UNITS	HP	DILUTION WATER	NET POLYMER
(1)	N/A	120-1,200 GPM	0.3-3.0 GPM

SHAFTLESS SCREW CONVEYOR:

NO. OF UNITS	TYPE	HP	CAPACITY
(1)	INCLINE (ANGLE = 29°)	(3)	1,000 lb/hr

SLUDGE FEED PUMPS:

NO. OF UNITS	HP	CAPACITY
(1)	(5) VARIABLE SPEED	120 GPM

SLUDGE DRYING BEDS

TYPE	NO. OF UNITS	AREA (SQ. FT.)	TOTAL AREA (SQ. FT.)
ASPHALT BEDS W/ UNDERDRAINS	5	5000	25,000
	4	19,550	78,200

0 1/2 1

DRAWING IS NOT TO SCALE IF BAR DOES NOT MEASURE 1"

CITY OF PAYSON

WASTEWATER TREATMENT FACILITY UPGRADE
SOLIDS DE-WATERING BUILDING
DESIGN CRITERIA

NO.	DATE	DESIGN	DRAWN	CHECKED	REVISIONS
B	2/22/2010	BP	KRB	BMR	

ORIGINAL

AQUA ENGINEERING, INC.
533 W. 2600 S., SUITE 275 BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

SHEET G-4

KRB 02/24/2010 X:\Payson Dewatering\09 BLDG\GENERAL\G-4.dwg

Appendix F

Phosphorus Chemical Removal Testing

Statepoint Engineering
Wastewater Processes
Evaluation & Training

TECHNICAL MEMORANDUM

TO: Jeff Hiatt
Payson City

Travis Jockumsen, PE
Payson City

FROM: Paul Krauth, PE
Statepoint Engineering

DATE: January 8, 2019

SUBJECT: Results of Chemical Phosphorus Dosing Study for Springville City

As per your request. I have completed the preliminary testing of various chemicals to achieve the new State mandated phosphorus limit of 1.0 mg/L.

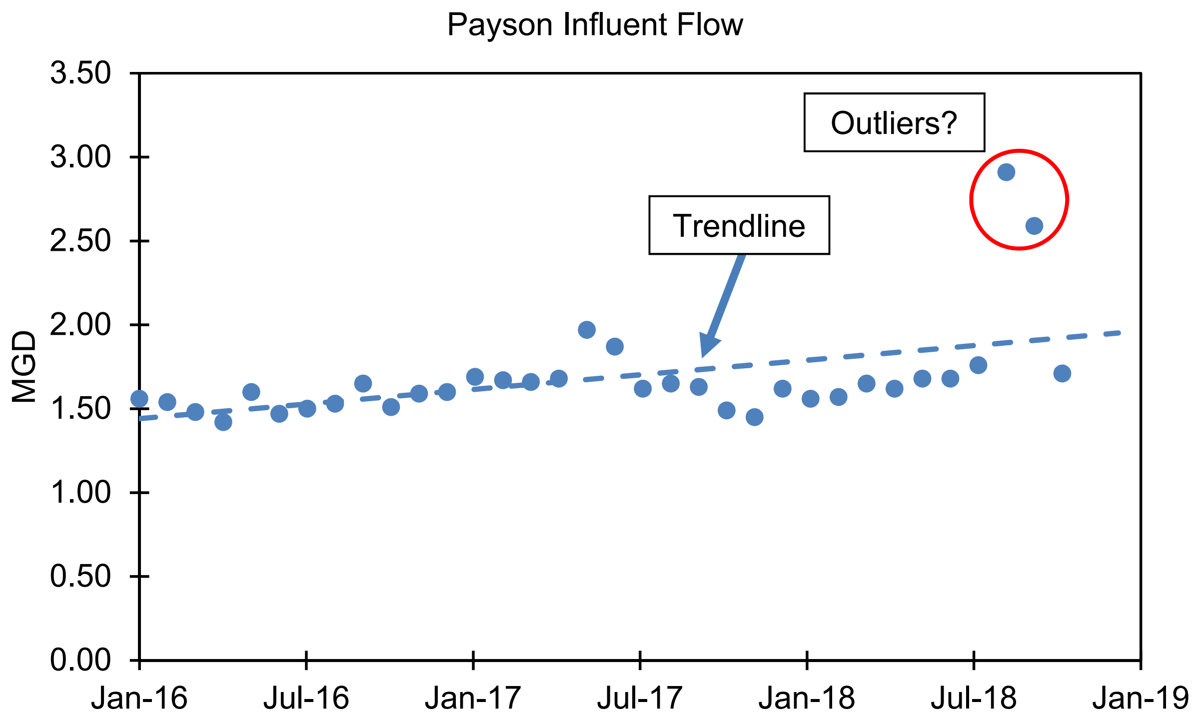
Since Payson City will be eventually use ultra violet light (UV) for disinfection, any iron based (ferric or ferrous) chemicals were eliminated from testing. This is mainly due to both staining issues and light scattering from the iron.

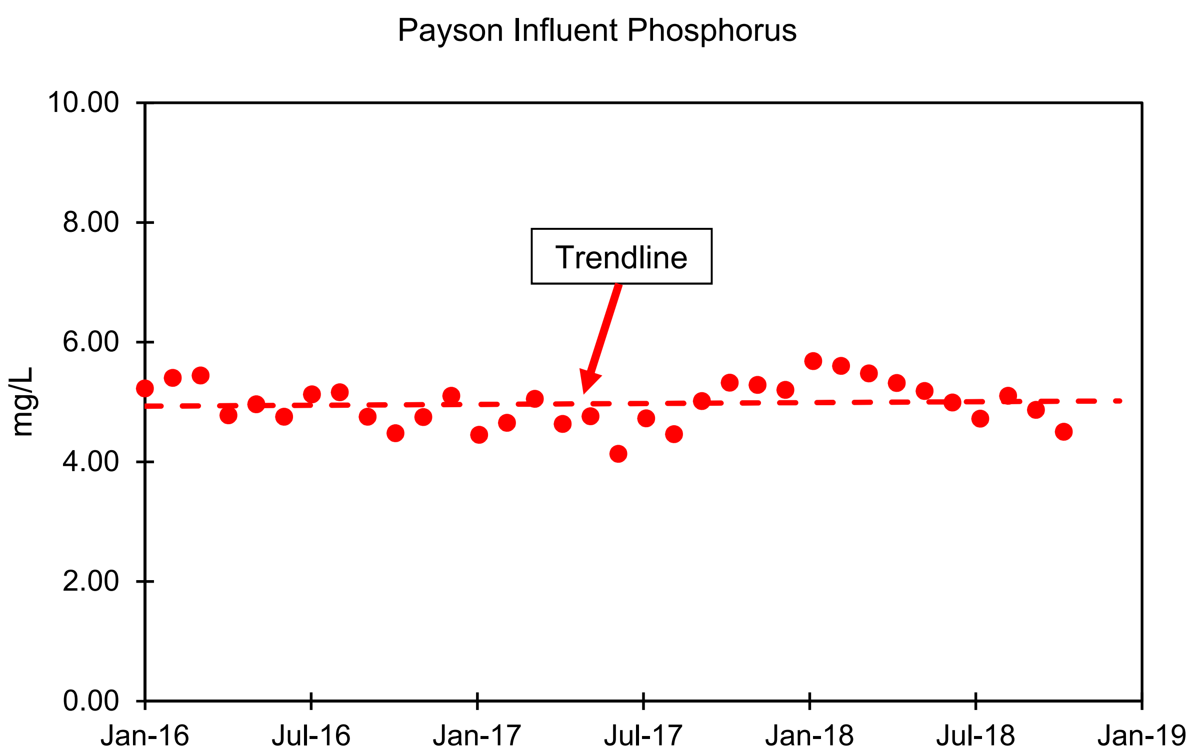
Current Conditions

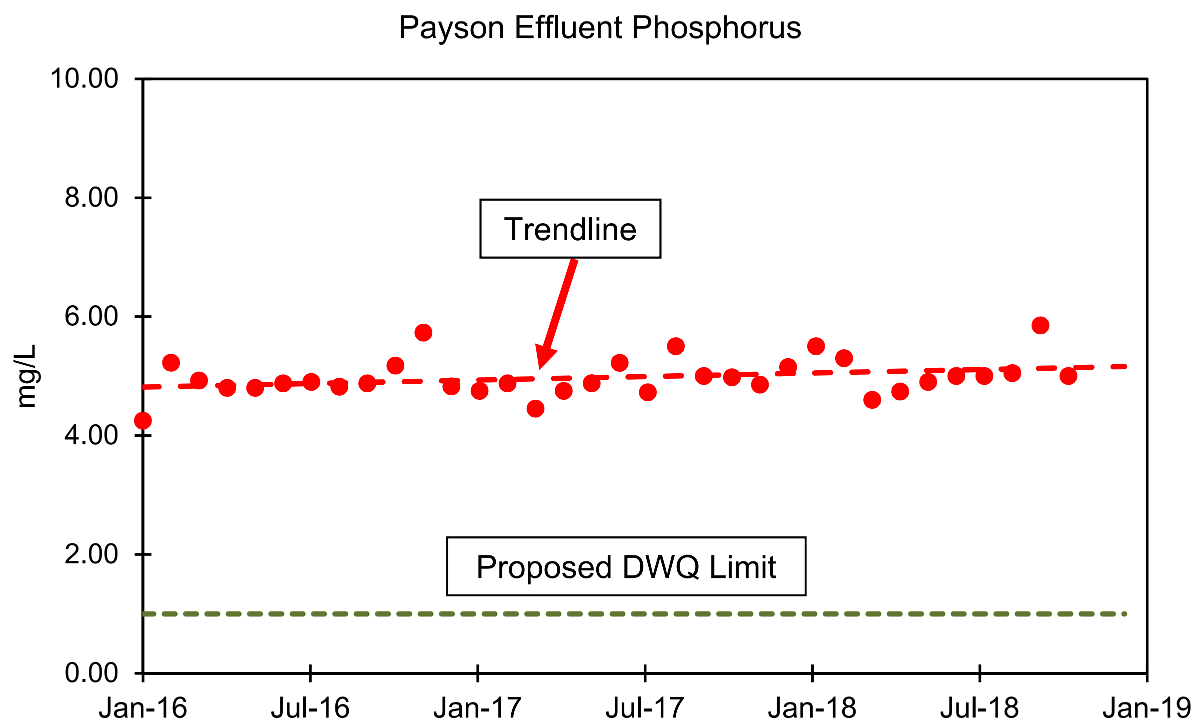
Payson has been sampling for both total phosphorus (TP) and ortho phosphorus (OP) in their influent and their effluent since July 2015.

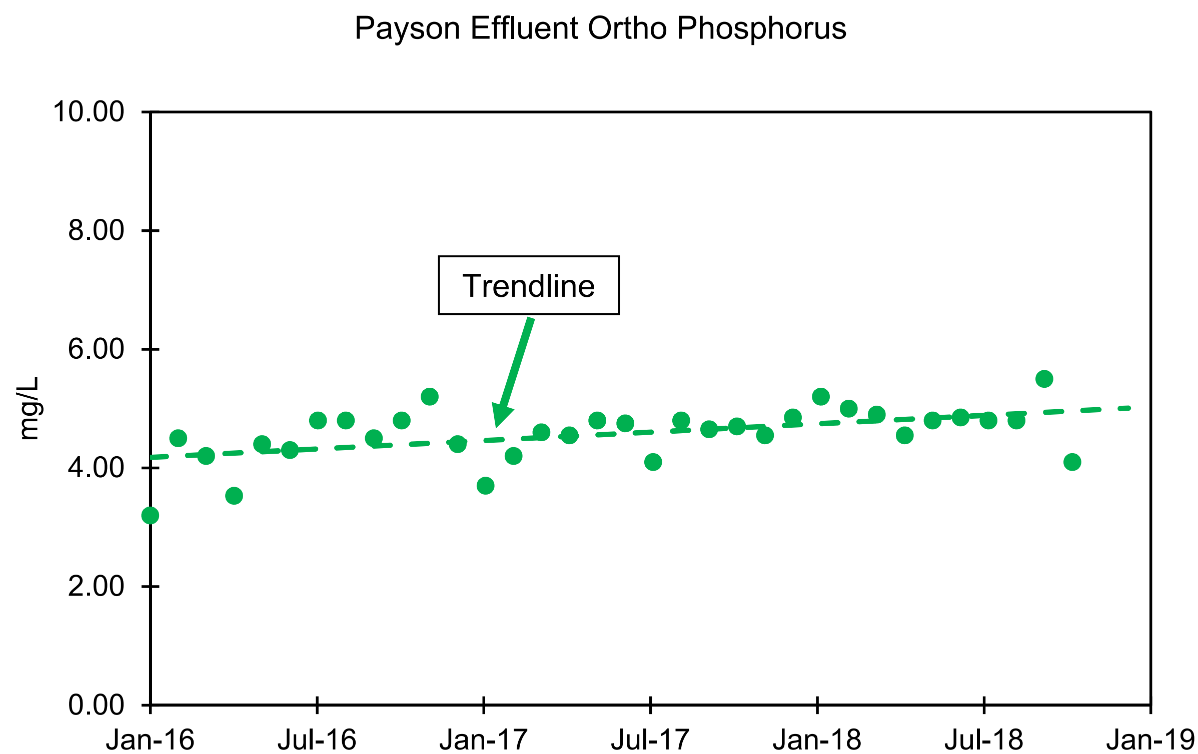
Year	Averages						
	Flow MGD	Influent			Effluent		
		TP mg/L	OP mg/L	Percent	TP mg/L	OP mg/L	Percent
2016	1.54	5.00	3.01	63.5%	4.95	4.04	92.9%
2017	1.67	4.80	3.10	67.1%	4.93	4.52	94.9%
2018	1.87	5.14	3.57	64.7%	5.09	4.85	92.8%

Plotting this data revels to revel any trends.





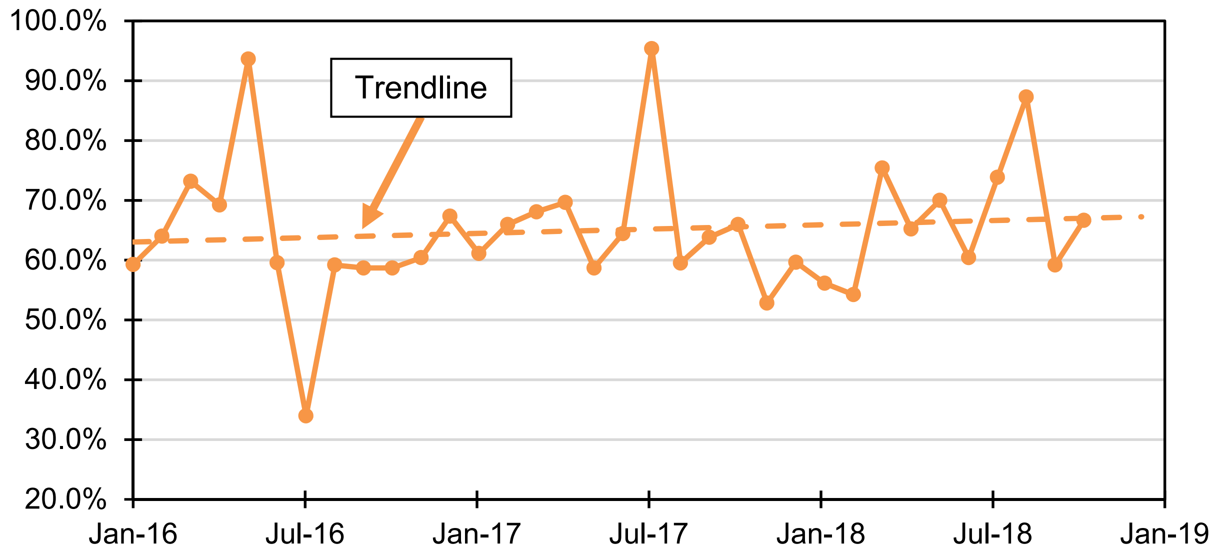

Payson Effluent Phosphorus
10.00
8.00
6.00
4.00
2.00
0.00
mg/L
Trendline
Proposed DWQ Limit
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19


Payson Effluent Ortho Phosphorus
10.00
8.00
6.00
4.00
2.00
0.00
mg/L
Trendline
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19

A quick discussion on total vs ortho phosphorus. Total phosphorus is a measurement of all the forms of phosphorus in the sample (orthophosphate, condensed phosphate, and organic phosphate). Orthophosphate is a measurement of the "reactive" phosphorus, it is referred to as "reactive" because of its three "extra" electrons which makes it very easy to make it bond with other compounds. The ortho phosphorus is the fraction that will react with the chemical dose. Since Payson will eventually have a limit total phosphorus, the ratio of total vs. ortho phosphorus will determine the target dosing of the flocculant chemicals.

Influent Ratio

The percentage of ortho phosphorus versus total phosphorus varies between 34% to 92% with an average of 67%, but this has been slowly increasing over the last 3 years.

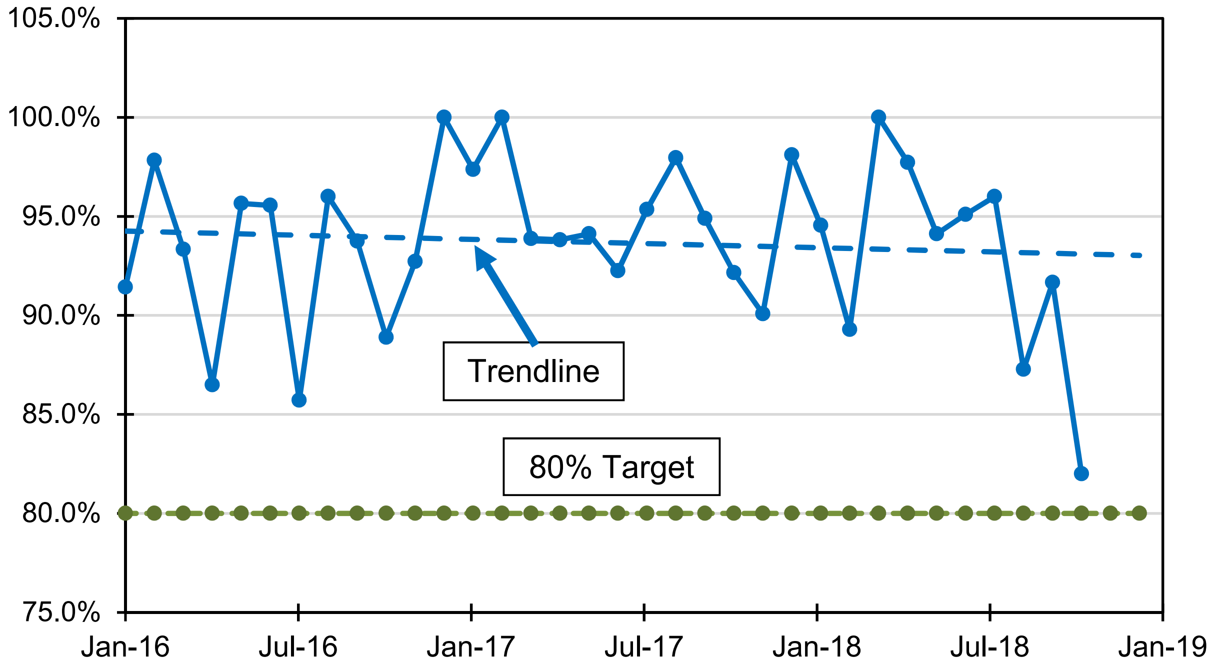


This implies that about one third of the influent phosphorus in "non-reactive" and not subject to chemical removal. But this is still a potential dosing location because of additional benefits to the plant outside of pure phosphorus removal.

Effluent Ratio

Through the treatment process (particular an activated sludge system) the "non-reactive" phosphorus (poly-phosphates) are broken down into orthophosphorus. This accounts for the higher percentage of the effluent total phosphorus being orthophosphorus. Thus, being more amenable to chemical removal.

The percentage of ortho phosphorus versus total phosphorus varies between 82% to 100% with an average of 88%, but this has been slowly declining over the last 3 years.



To ensure compliance with an annual average of 1.0 mg/L Total Phosphorus. A target of 0.8 mg/L (80%) Orthophosphorus was used in all the testing to ensure the ability to meet the 1.0 mg/L limit.

Example (82% being worst case)

$$Total\ P\ \frac{mg}{liter} \cong \frac{0.8\ \frac{mg}{liter}}{82\%\ \frac{op}{tp}} \cong 0.98\ \frac{mg}{liter}$$

This would meet the proposed permit limits

Aluminum as a Coagulant Considerations

Alum or hydrated aluminum is used precipitating phosphates and aluminum phosphates ($AlPO_4$). The simplified reaction is:

$Al_3^+ + H_nPO_4^{3-n} \leftrightarrow AlPO^4 + \underline{\boldsymbol{nH^+}}$

This reaction is actually not occurring above a pH of 6, so it is only used to show the impact on pH $\underline{\boldsymbol{(nH^+)}}$, There are many competing side reactions, effects on alkalinity, pH, colloidal solids need to be considered in actual applications. In practice, 80-90% removal rates can be achieved at coagulant dosage rates between 50 and 200 mg/L High doses of Aluminum coagulants can adversely affect the microbial population in activated sludge, especially protozoa and rotifers, typically at dosage rates higher than 150 mg/L

A Water Environment Research Foundation (WERF) study in 2010 found that when aluminum was added to WAS, a lower percentage of volatile solids destruction was observed. The decrease in volatile solids reduction is approximately 2 percent.

Iron as a Coagulant Considerations

Ferric chloride or sulphate and ferrous sulphate are all widely used for phosphorous removal, although the actual reactions are not fully understood. The basic reaction is:

$Fe^{3+} + H_nPO_4{}^{3-n} \leftrightarrow FePO_4 + nH^+$

This reaction is actually not occurring above a pH of 6, so it is only used to show the impact on pH ***(nH^+)***, There are many competing side reactions, effects on alkalinity, pH, colloidal solids need to be considered in actual applications.

Sampling Locations for Study

There are numerous chemical dosing locations that could be used by Payson. The three main options for chemical additions are.

1. Pre-precipitation - treatment of raw/primary influent
2. Side stream-precipitation - treatment of the higher concentrations in side streams
3. Post-precipitation - treatment of final effluent

Pre-precipitation

Application Point	Advantages	Disadvantages
Primary Clarifiers	Removes additional BOD & Solids Uses lower stoichiometric dose	Does not remove polyphosphates – converted in bioprocess Competing reactions decrease dose efficiency Removes alkalinity before nitrification More primary sludge production

While the removal of additional BOD and Solids would have the advantage of reducing the loadings on the aerotor. The possible impacts of aluminum on volatile solids reduction along with the cost differential versus iron typically precludes dosing Aluminum salts at this location.

Side stream-precipitation

Application Point	Advantages	Disadvantages
Pressate and Digestor Decant Return Line	Reduces phosphorus load to liquid treatment process More stable operation for liquid treatment Optimal use of chemicals – can work at lower Molar ratios	Additional operational complexity Removes alkalinity before nitrification

While this location would have the highest efficiency in both removal percentage and chemical usage Payson's digester limitation of uncontrolled decant, the controls needed for this would precludes dosing at this location. A sample was taken of the digester overflow on August 15 (which may or may not have pressate in it). This sample had an Orthophosphorus of 17.2 mg/L. but since there is no way to measure the flow, the loading rate is unknown.

Post-precipitation

Application Point	Advantages	Disadvantages
Secondary Clarifiers	Polyphosphates converted so most of phosphorus is available May help improve TSS removal in clarifiers	Removing alkalinity within the biological nitrification process MLSS increase with inerts More secondary sludge production

The industry standard for meeting a 1.0 mg/L phosphorus limit is dosing into (before) the secondary clarifiers. The advantage to this is a single application point and through the return activated sludge (RAS) any remaining chemical will continue to react until exhausted. Given these facts, both Pre-precipitation in the raw influent. And Post-precipitation of the mixed liquor were chosen to for the study.

Theoretical Calculations

The stochiometric amounts of for both aluminum and iron were calculated based upon following assumptions

Flow	Annual Ortho	Target Ortho	Removal %
2.00 MGD	3.60 mg/L	0.80 mg/L	80%

Pounds of orthophosphorus to be removed

$$P\ \frac{lbs}{day} = 8.34\ \frac{lbs}{gal}\ x2.00\ MGD\ x\ (3.60 - 0.80)\ \frac{mg}{L} \cong\ 47\frac{lbs}{day}$$

Calculate the Weight of Ferric Chloride

$$Ferric\ Chloride\ \frac{lbs}{gal} = 8.34\ \frac{lbs}{gal}\ x\ specific\ gravity\ Ferric\ Chloride$$

From SDS sheet Hi-Valley Chemical

$FeCl_3$ specific gravity = 1.37

$$Ferric\ Chloride\ \frac{lbs}{gal} = 8.34\ \frac{lbs}{gal}\ x\ 1.37\ \cong 11.43\ \frac{lbs}{gal}$$

Calculate the Actual Metal in the Solution

$$Iron\ \frac{lbs}{gal} = 11.43\ \frac{lbs}{gal}\ x\ percent\ metal$$

From SDS sheet (14%)

$$Iron\ \frac{lbs}{gal} = 11.43\ \frac{lbs}{gal}\ x\ 14\%\ \cong 1.60\ \frac{lbs}{gal}$$

Calculate Required Dose of Iron to Remove Phosphorus

$$Dose\ Iron\ \frac{lbs}{day} = Phosphorus\ Removed\ \frac{lbs}{day}\ x\ Weight\ Ratio$$

Fe : P Weight Ratio = 1.8 : 1

$$Dose\ Iron\ \frac{lbs}{day} \cong 47\ \frac{lbs}{day}\ x\ 1.8\ \cong 85\ \frac{lbs}{day}$$

Finally Calculate Dosing Rate

$$Dose\ FeCl_3\ \frac{gal}{day} \cong \frac{85\ \frac{lbs}{day}}{1.60\ \frac{lbs}{gal}}\ \cong 53\frac{gal}{day}$$

This is just used as a starting basis, typically the required dose is often 4 to 5 times greater to account for side reactions and pH ranges.

Now looking at Weight of Aluminum Sulfate (Alum)

$$Alum\ \frac{lbs}{gal} \cong 11.13\ \frac{lbs}{gal}$$

Aluminum in the Solution

Assume worst case (8%)

$$Aluminum\ \frac{lbs}{gal} = 11.13\ \frac{lbs}{gal}\ x\ 8\%\ \cong 0.89\ \frac{lbs}{gal}$$

Dose of Aluminum to Remove Phosphorus

Al : P Weight Ratio = 0.87 : 1

$$Dose\ Aluminum\ \frac{lbs}{day} \cong 47\ \frac{lbs}{day}\ x\ 0.87\ \cong 41\ \frac{lbs}{day}$$

Stochiometric Dosing Rate

$$Dose\ Al_2(SO_4)^3\ \frac{gal}{day} \cong \frac{41\ \frac{lbs}{day}}{0.89\ \frac{lbs}{gal}}\ \cong 46\ \frac{gal}{day}$$

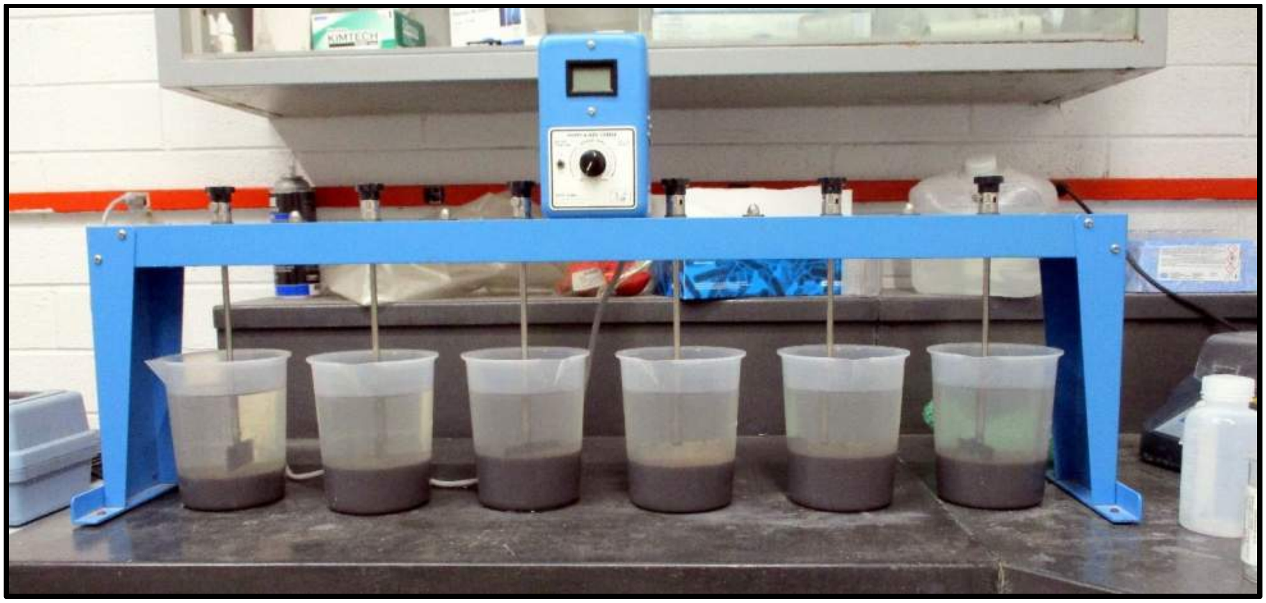
This is just used as a starting basis, typically the required dose is often 4 to 5 times greater to account for side reactions and pH ranges.

As shown from the jar testing these assumptions are nowhere near what was encountered onsite at the plant.

Testing Method

A series of jar tests were conducted to determine the approximate dosage necessary for effective phosphorus removal using a 6-gang stirrer.

Raw influent or mixed liquor samples were taken, then they were injected with varying chemicals and doses. Each sample was flashed mixed for five minutes at 100 rpm, then flocculated for 10 minutes at 20-25 rpm and allowed to settle for 30 minutes. The supernatant was then analyzed for ortho phosphorus and pH



+

Results

There were six different chemicals tested during study.

From ATS chemical

ATS 809
RE300 (two tests only as proof of concept)

From High-Valley Chemical

Ferric Chloride
Ferric Sulfate

From Thatcher chemical

Aluminum Sulfate
Sodium Aluminate

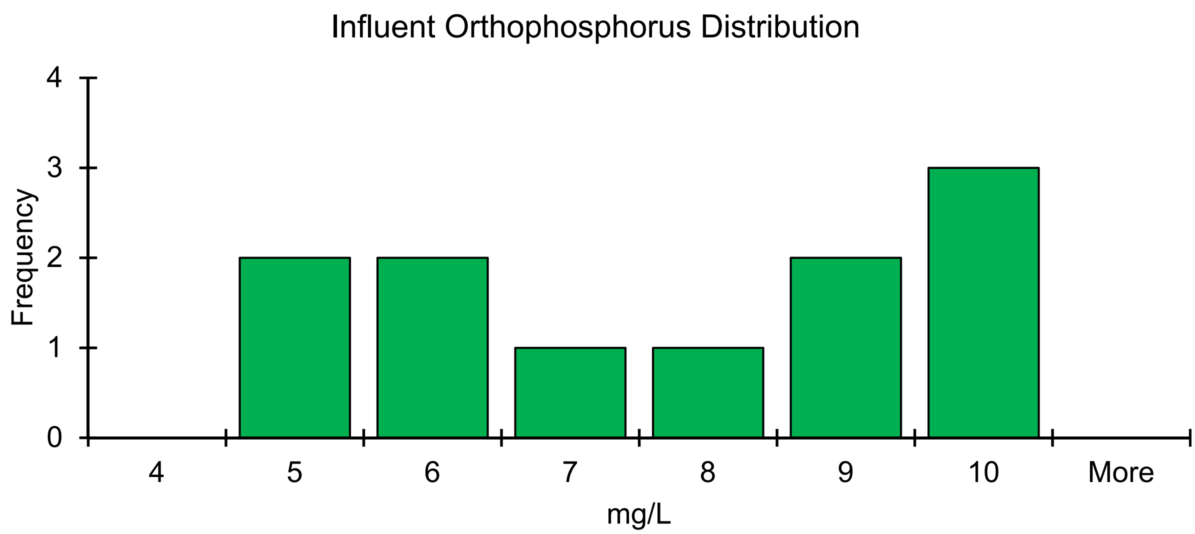
Both the Ferric Chloride and Ferric Sulfate were diluted to 50:1 ratio, and 100:1 ratio While all other were diluted to a 100:1 ratio as a laboratory safety precaution

During these tests a total of 148 othrophosphorus samples were run at a variety of chemical concentrations.

Raw Influent

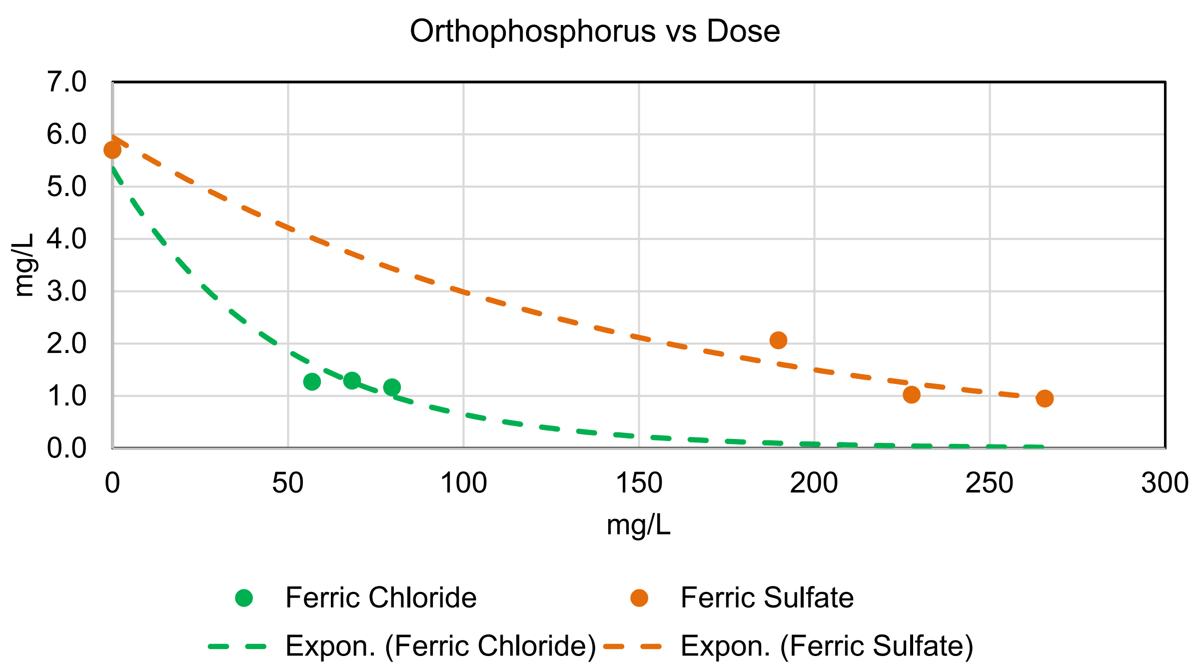
The raw was treated using either Ferric Chloride or Ferric Sulfate, no other chemicals were used on the raw sewage

Of the 11 separate raw grab samples, all of them had an orthophosphorus higher than expected two to three times higher than the compliance composite samples.



As shown, there was no discernable pattern to the influent orthophosphorus concentrations.

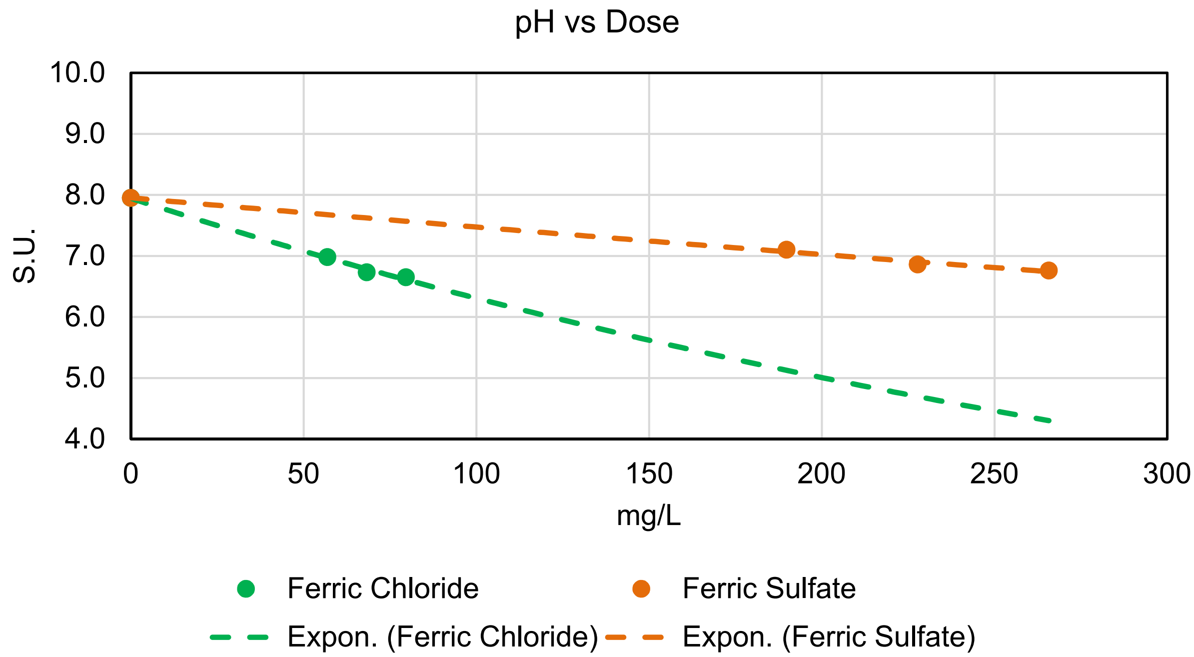
First run (8/26 - 10:00) using both Ferric Chloride and Ferric Sulfate (at 50:1)



Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 5.70 mg/L would appear to suggest a dose of 90 mg/L of Ferric Chloride or a dose of 285 mg/L of Ferric Sulfate. While the Ferric Chloride dose is ***realistic*** the Ferric Sulfate is completely ***unrealistic*** from a cost standpoint.

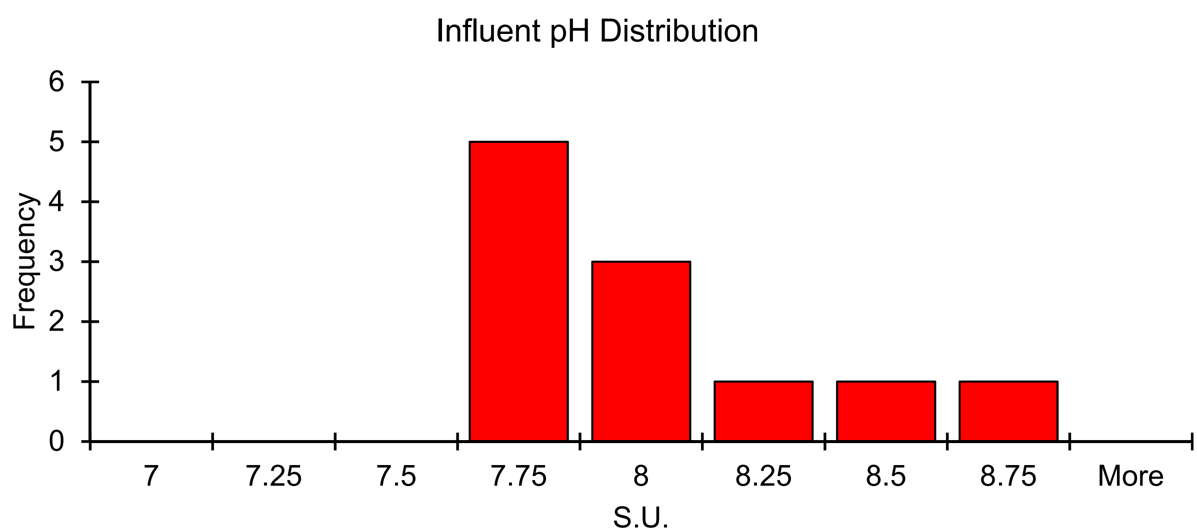
Payson high influent pH maybe contribution to this high demand. The optimal pH range for coagulation is 6 to 7 when using aluminum and 5.5 to 6.5 when using iron. For high alkalinity water, excessive amounts of coagulant may be needed to lower the pH to the optimal pH range.

Looking at the dose's impact on the pH



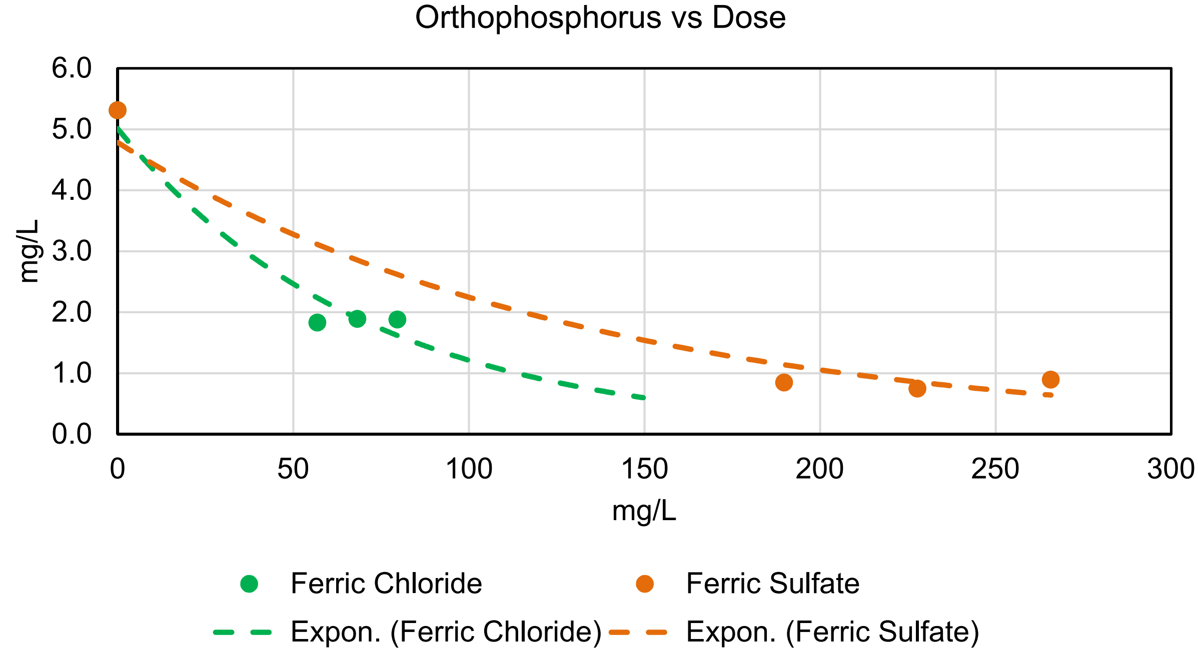
As you can see the Ferric Chloride suppresses the pH at a much lower dose.

Looking at the influent pH distribution at the time of sampling shows a high degree of alkalinity.



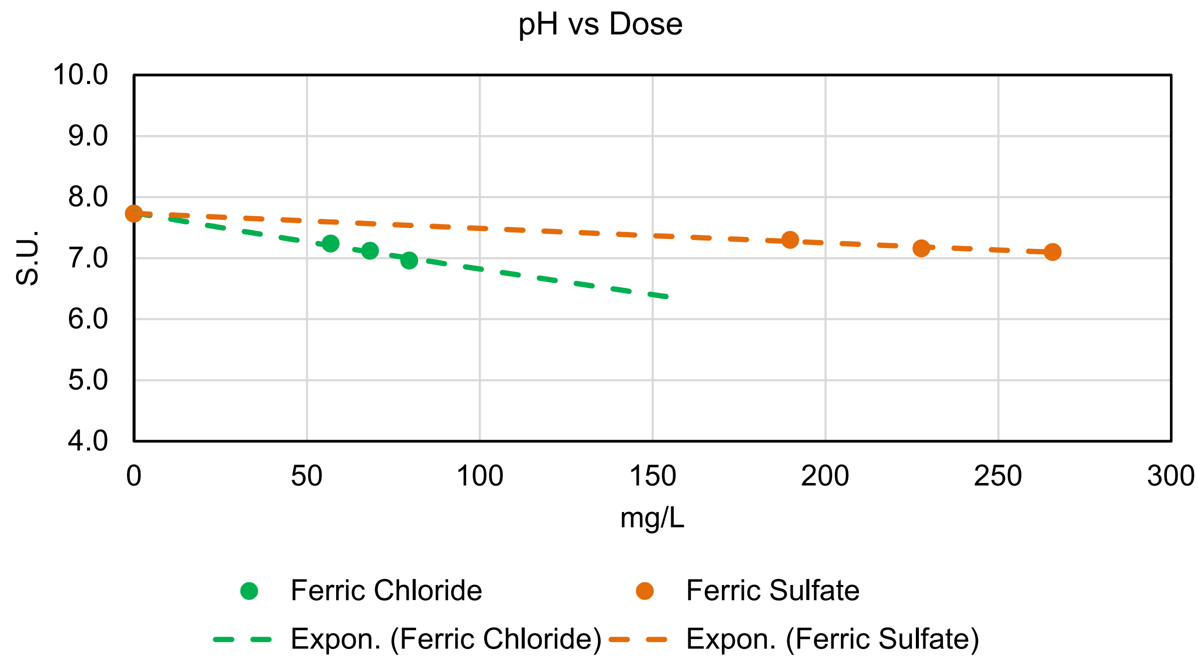
The influent pH ranges from 7.65 to 8.65 S.U. The higher the pH the more chemical will be needed to lower the pH to form the metal floc. This large of range will make optimizing the chemical usage difficult.

Second run (8/26 - 13:10) using both Ferric Chloride and Ferric Sulfate (at 50:1)

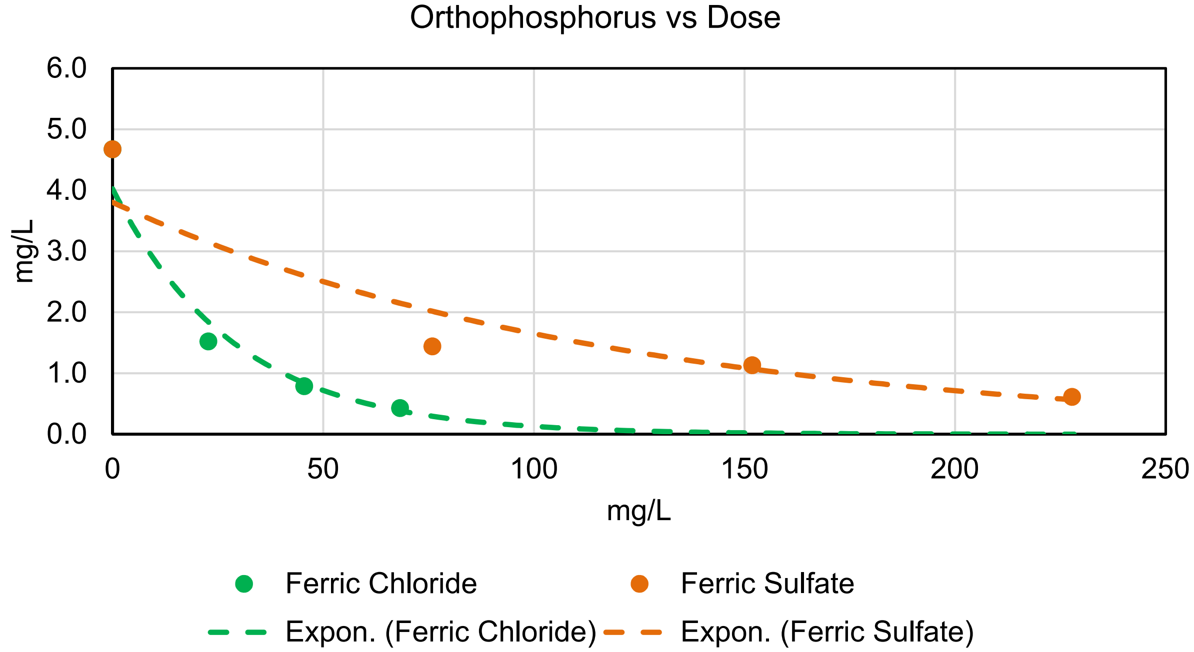


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 5.31 mg/L would appear to suggest a dose of 130 mg/L of Ferric Chloride or a dose of 215 mg/L of Ferric Sulfate. Again, these are completely ***unrealistic*** from a cost standpoint.

The impact of pH on dosage is shown by a small pH change (7.95 vs 7.73), reducing the amount of Ferric Sulfate need by 65 mg/L for nearly the same influent phosphorus (5.70 vs 5.31).

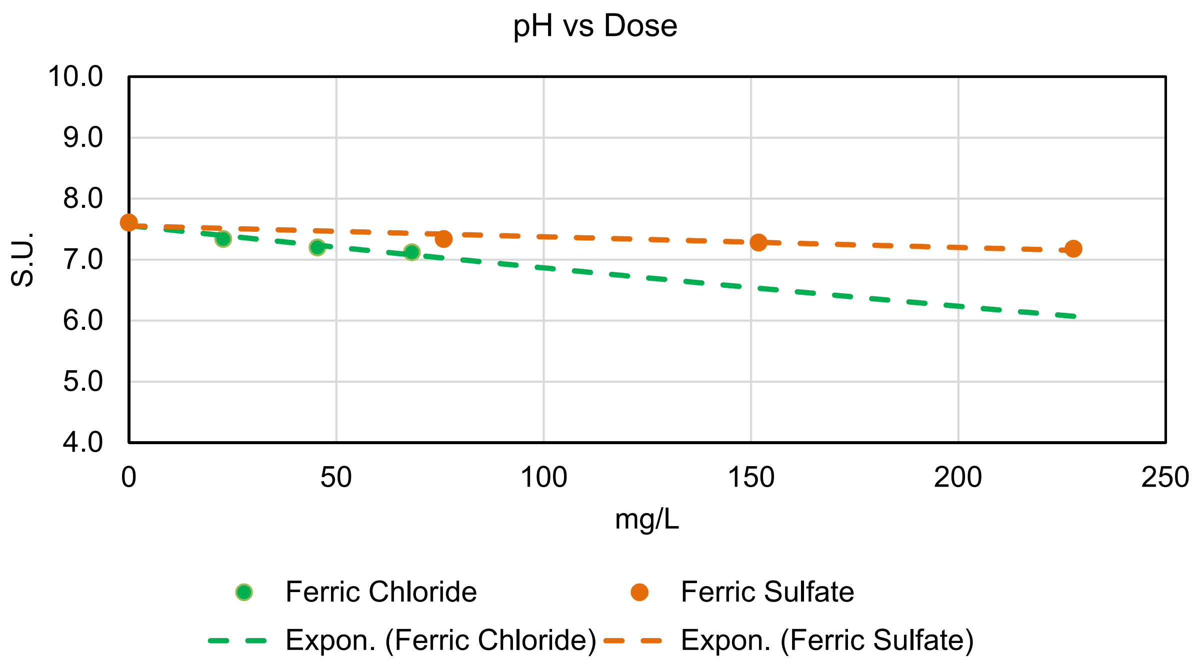


Third run (8/26 - 15:30) using both Ferric Chloride and Ferric Sulfate (at 50:1)

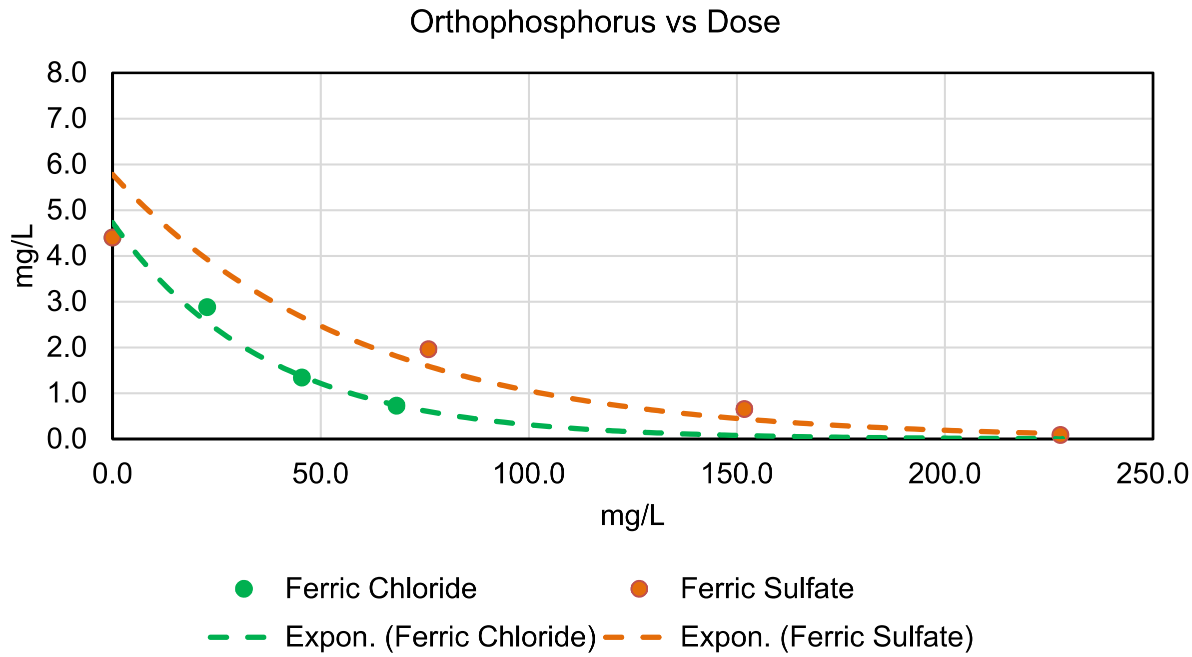


Estimating from, the exponential ***curve*** fit the required dose to reach 0.80 mg/L from initial concentration 4.67 mg/L would appear to suggest a dose of 50 mg/L of Ferric Chloride or a dose of 195 mg/L of Ferric Sulfate. While the Ferric Chloride dose is ***realistic*** the Ferric Sulfate is completely ***unrealistic*** from a cost standpoint.

While the phosphorus was lower (4.67 vs 5.31), the impact of pH on dosage is shown by a small pH change (7.73 vs 7.61), reducing the amount of Ferric Chloride needed by 80 mg/L.

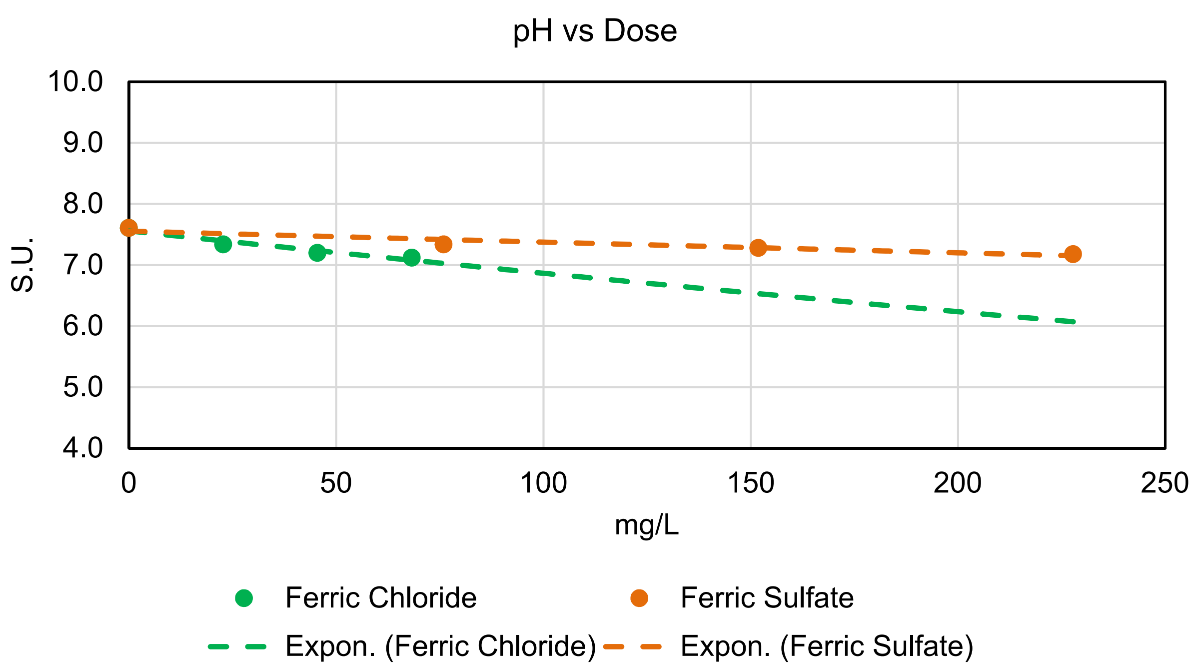


Fourth run (8/29 - 8:30) using both Ferric Chloride and Ferric Sulfate (at 50:1)

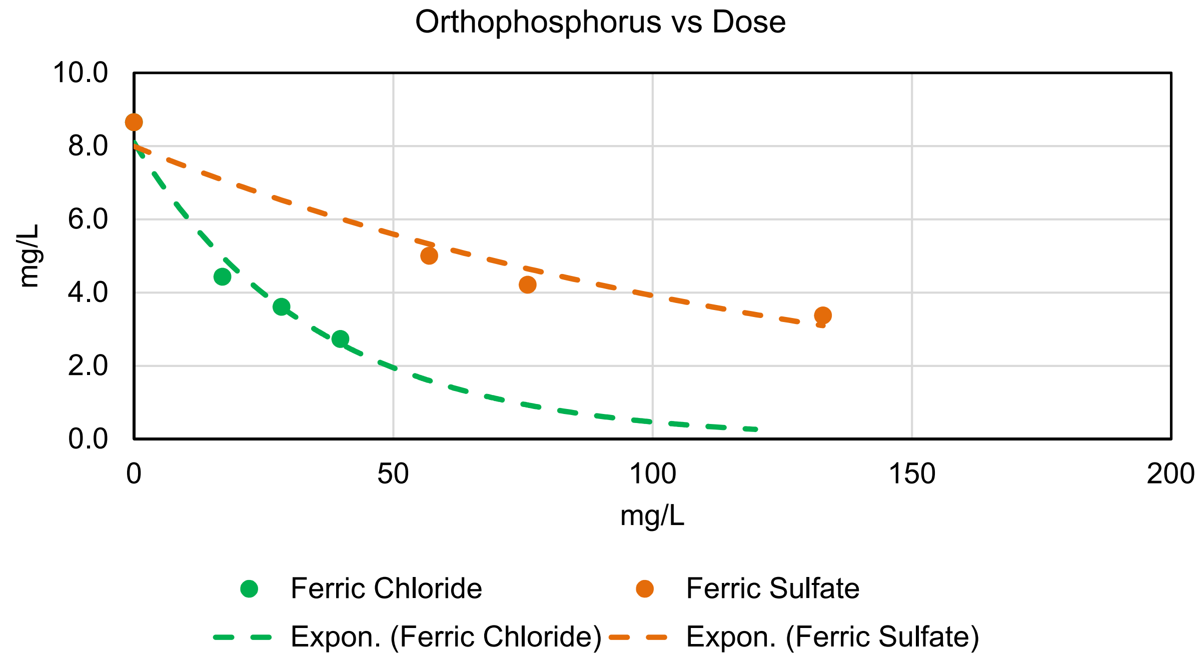


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 4.40 mg/L would appear to suggest a dose of 65 mg/L of Ferric Chloride or a dose of 115 mg/L of Ferric Sulfate. Both the Ferric Chloride and Ferric Sulfate doses is completely ***realistic*** from a cost standpoint.

While the phosphorus was lower (4.67 vs 4.40), the impact of pH on dosage is shown by a small pH change (7.61 vs 7.74), increased the amount of Ferric Chloride need by 15 mg/L.

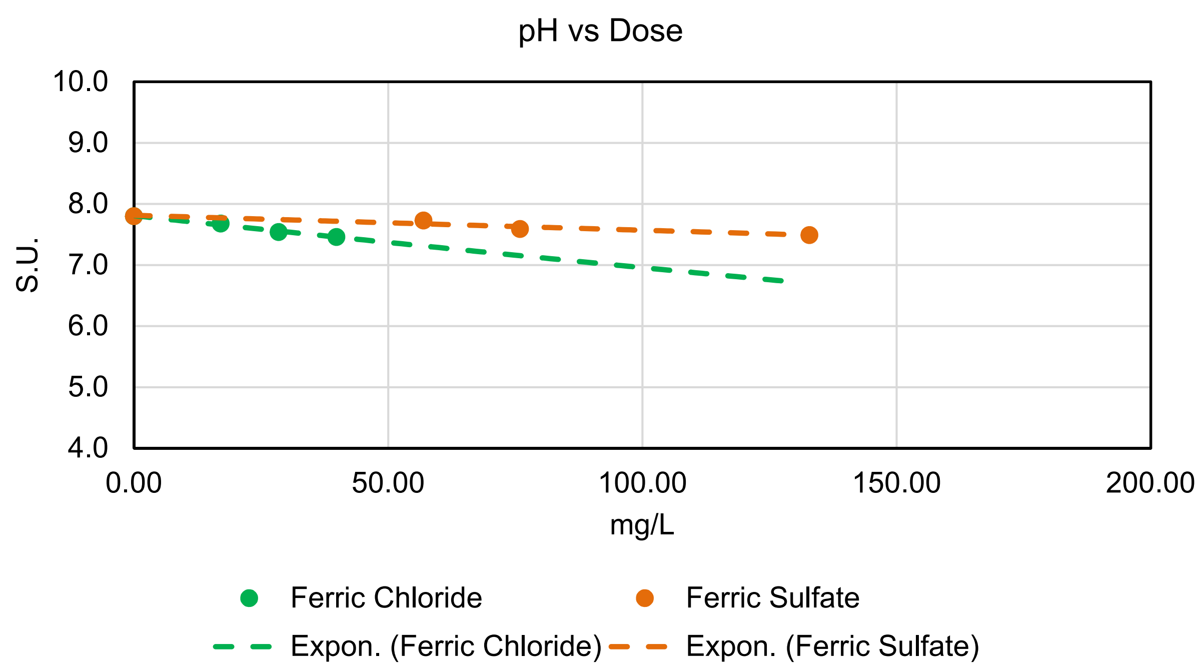


Fifth run (9/5 - 8:15) using both Ferric Chloride and Ferric Sulfate (at 100:1)



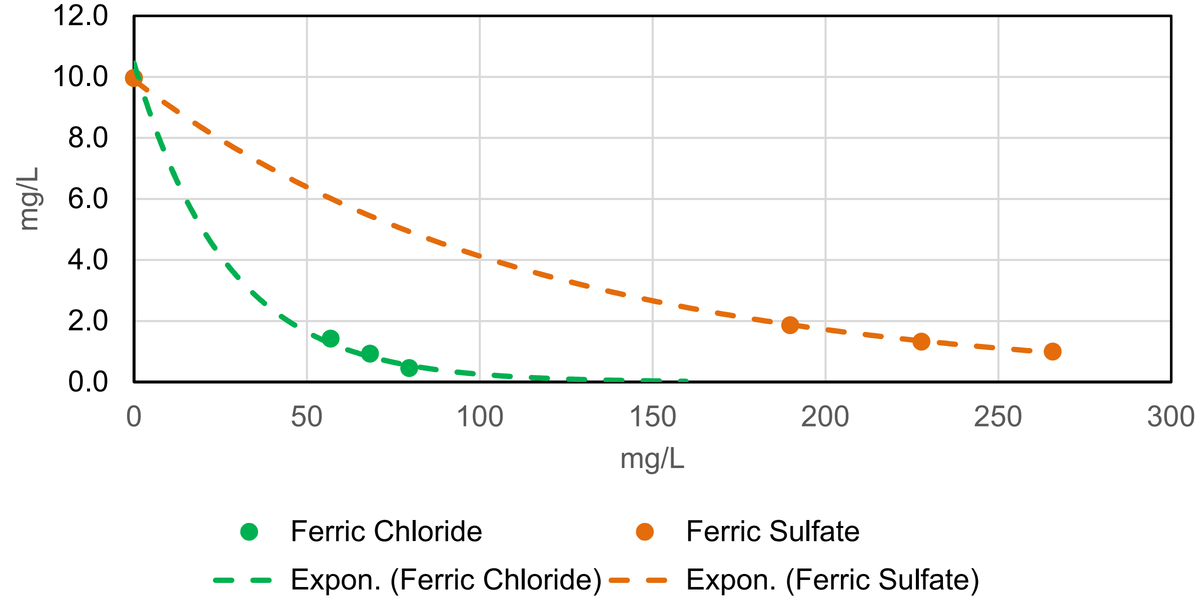
Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 8.65 mg/L would appear to suggest a dose of 80 mg/L of Ferric Chloride or a dose of 330 mg/L of Ferric Sulfate. While the Ferric Chloride dose is ***realistic*** the Ferric Sulfate is completely ***unrealistic*** from a cost standpoint.

This was a sample where the influent phosphorus was high along with the pH being high, the worst-case scenario for dosing.



Sixth run (9/5 - 9:50) using both Ferric Chloride and Ferric Sulfate (at 100:1)

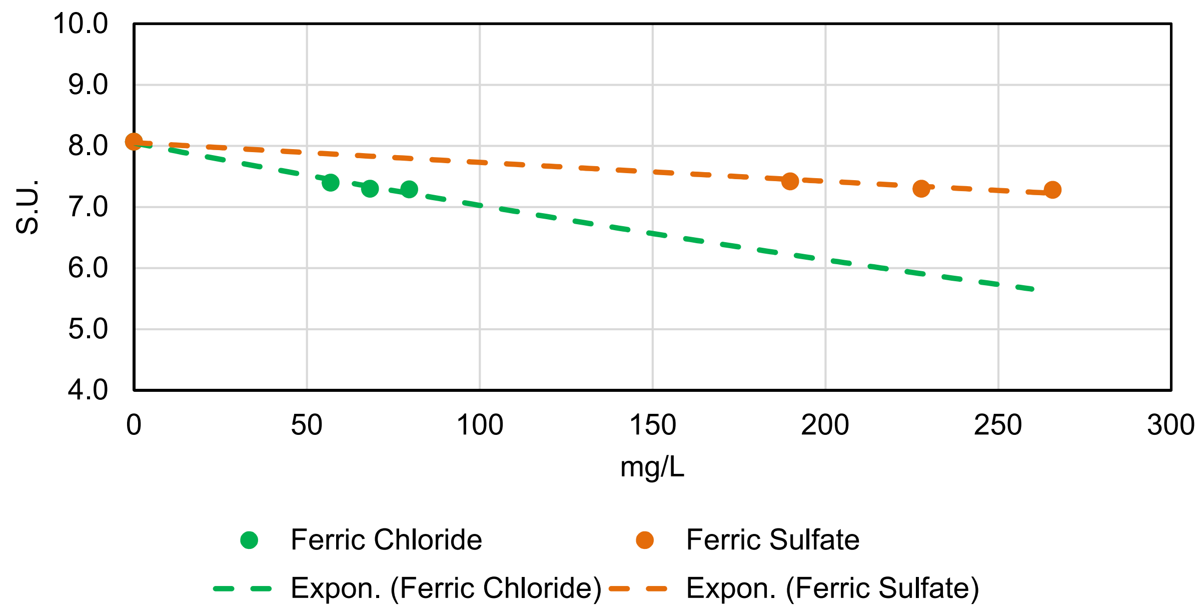
Orthophosporus vs Dose



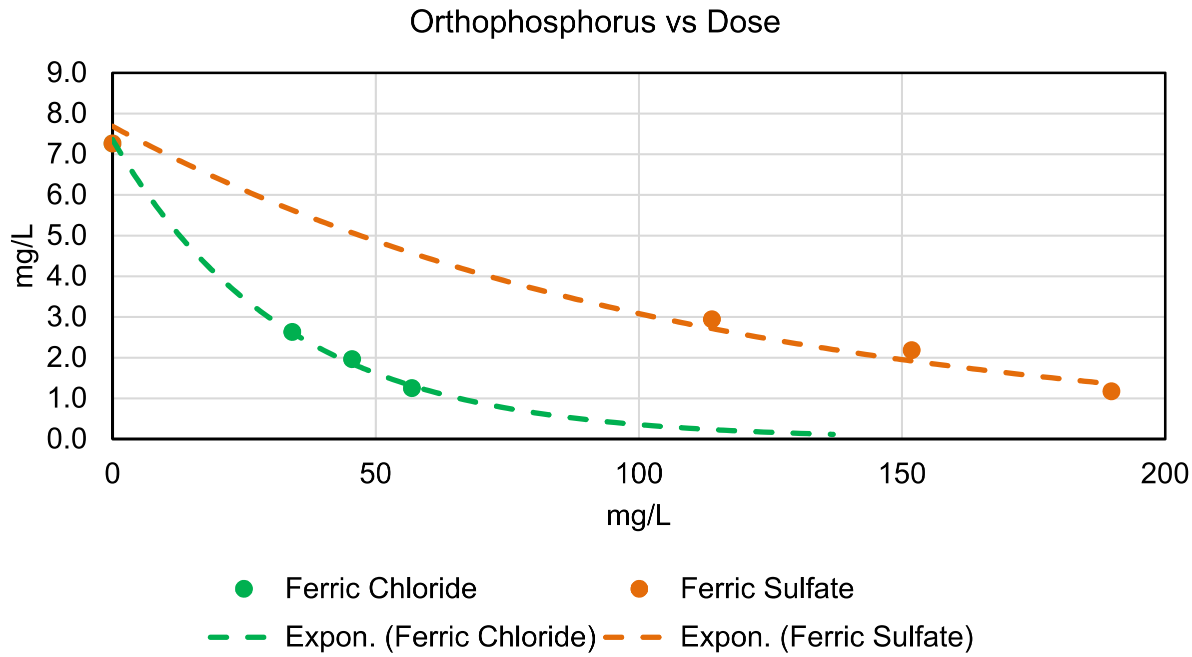
Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 9.96 mg/L would appear to suggest a dose of 70 mg/L of Ferric Chloride or a dose of 280 mg/L of Ferric Sulfate. While the Ferric Chloride dose is ***realistic*** the Ferric Sulfate is completely ***unrealistic*** from a cost standpoint.

This was a sample where the influent phosphorus was high along with the pH being high, the worst-case scenario for dosing.

pH vs Dose

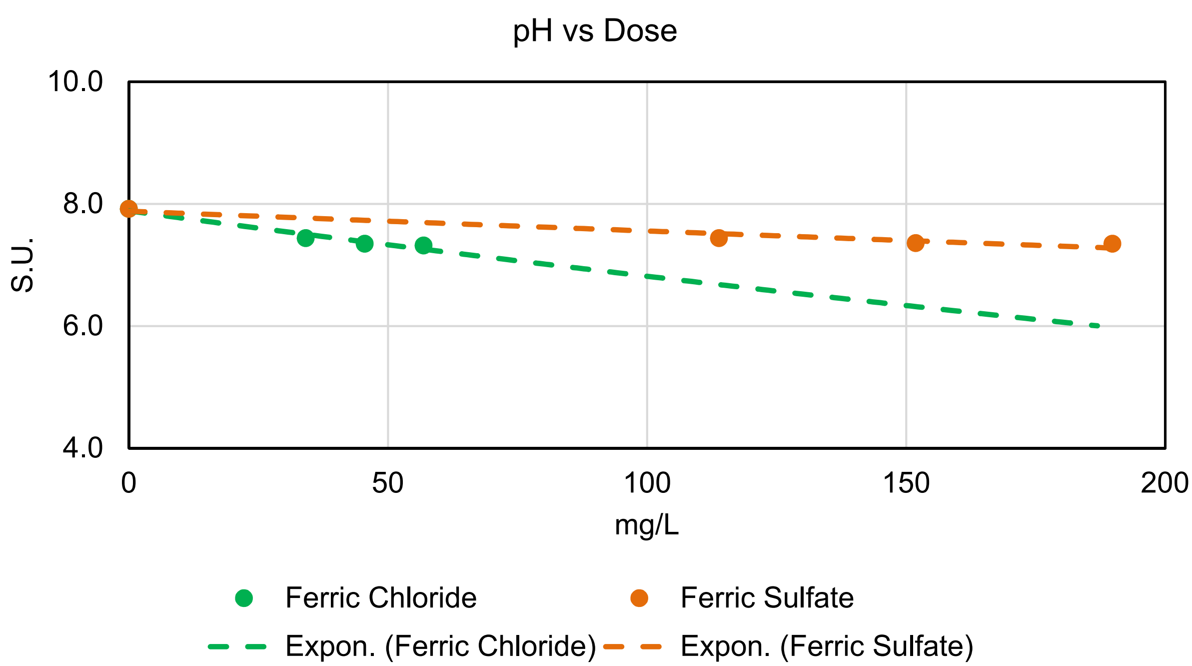


Seventh run (9/12 - 8:30) using both Ferric Chloride and Ferric Sulfate (at 100:1)

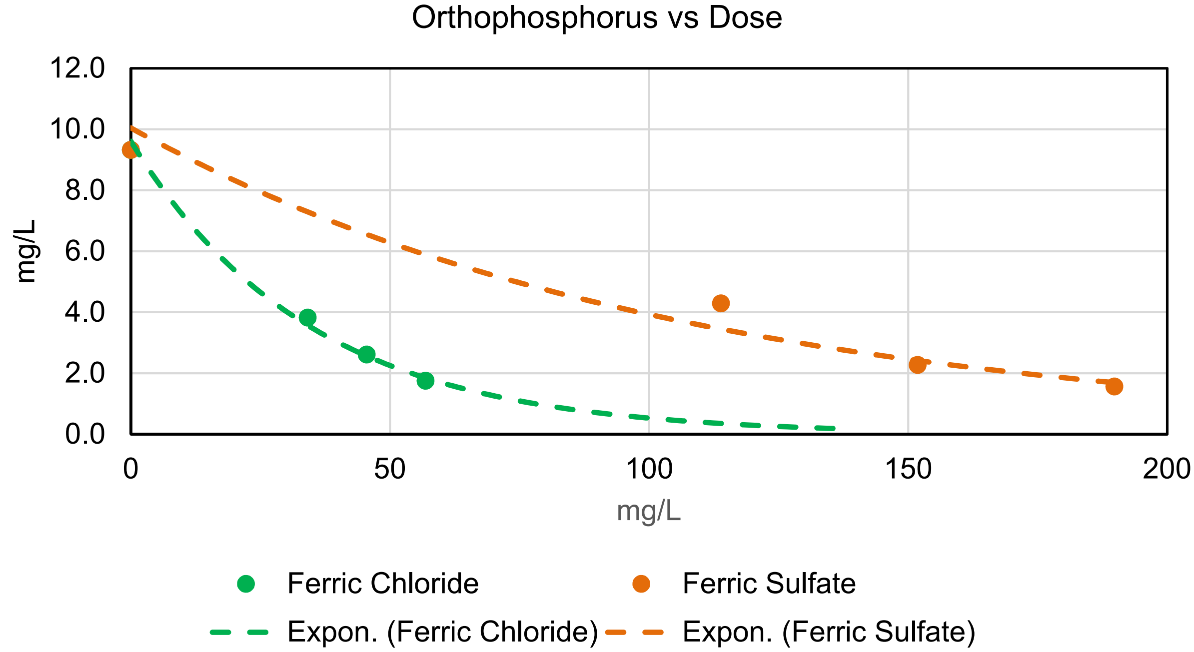


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 7.30 mg/L would appear to suggest a dose of 75 mg/L of Ferric Chloride or a dose of 250 mg/L of Ferric Sulfate. While the Ferric Chloride dose is ***realistic*** the Ferric Sulfate is completely ***unrealistic*** from a cost standpoint.

Again, this was a sample where the influent phosphorus was high along with the pH being high, the worst-case scenario for dosing.

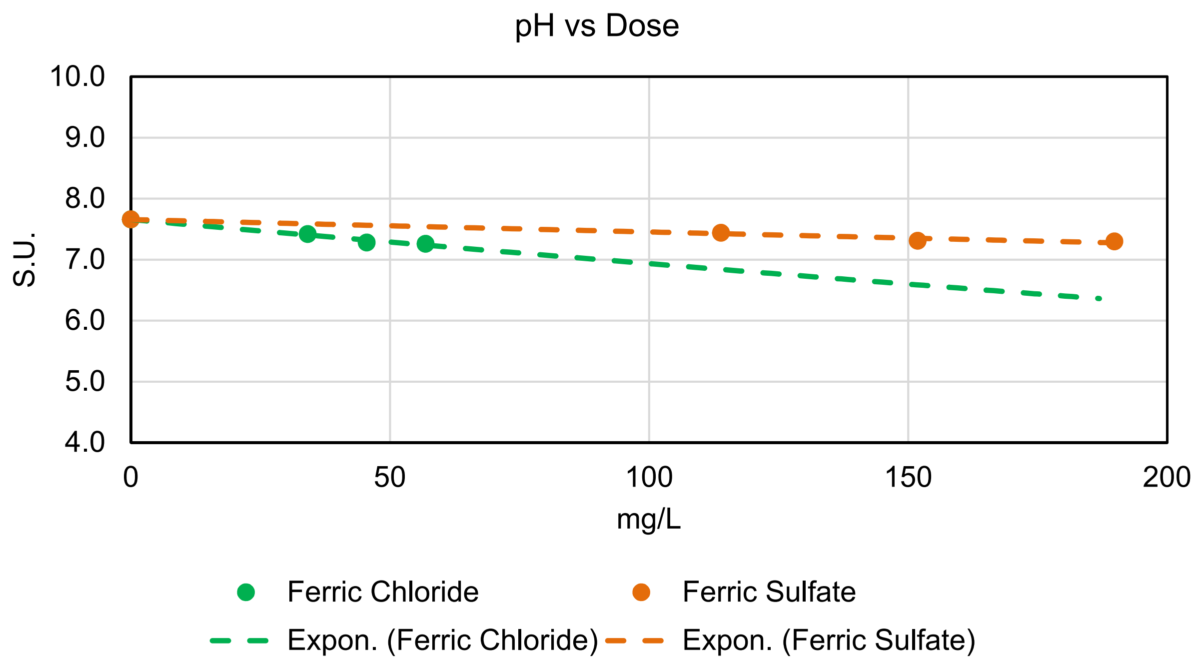


Eighth run (9/12 - 8:30) using both Ferric Chloride and Ferric Sulfate (at 100:1)

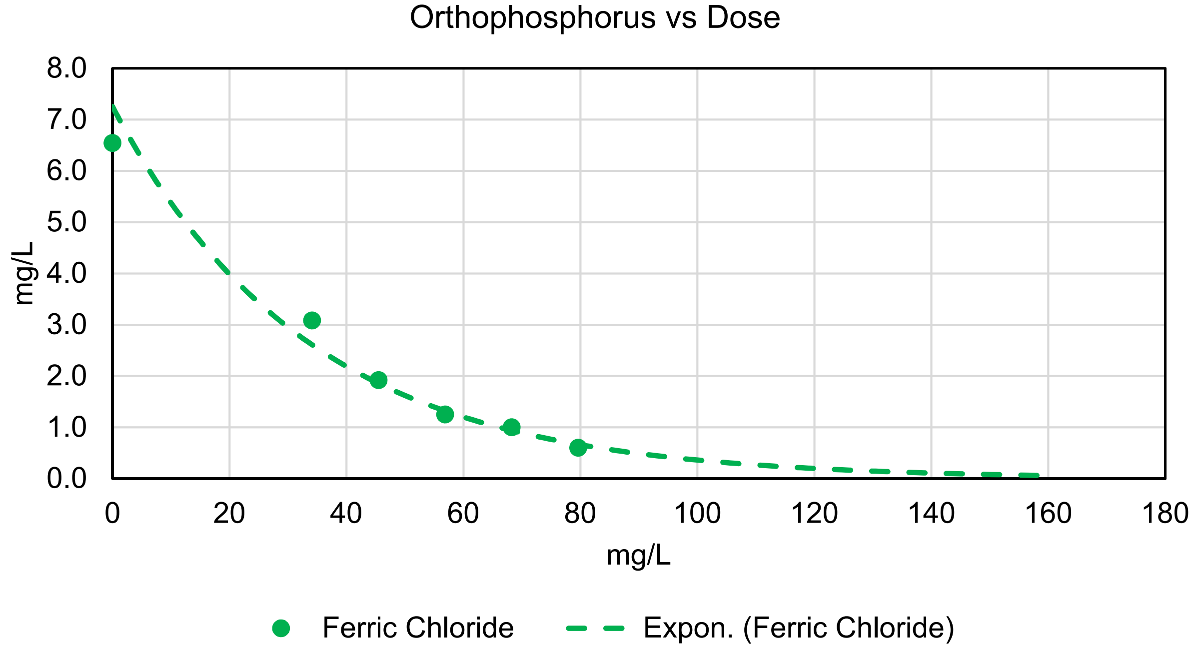


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 9.32 mg/L would appear to suggest a dose of 85 mg/L of Ferric Chloride or a dose of 280 mg/L of Ferric Sulfate. While the Ferric Chloride dose is ***realistic*** the Ferric Sulfate is completely ***unrealistic*** from a cost standpoint.

Again, this was a sample where the influent phosphorus was high along with the pH being high, the worst-case scenario for dosing.

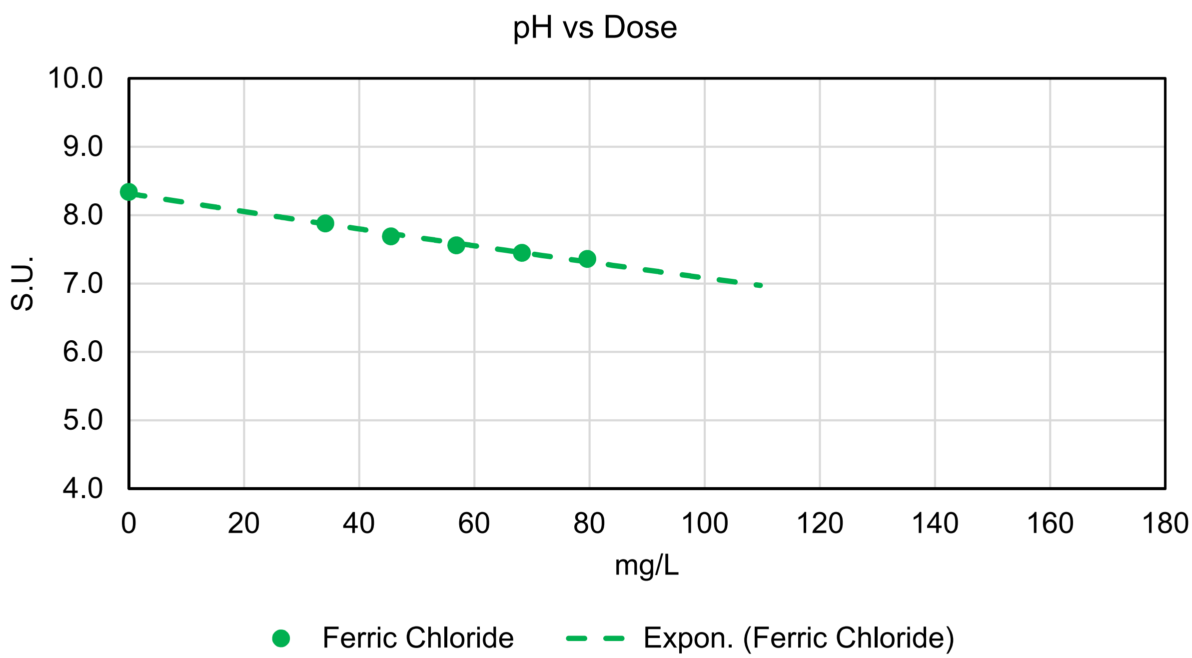


Ninth run (9/20 - 8:15) using only Ferric Chloride (at 100:1)

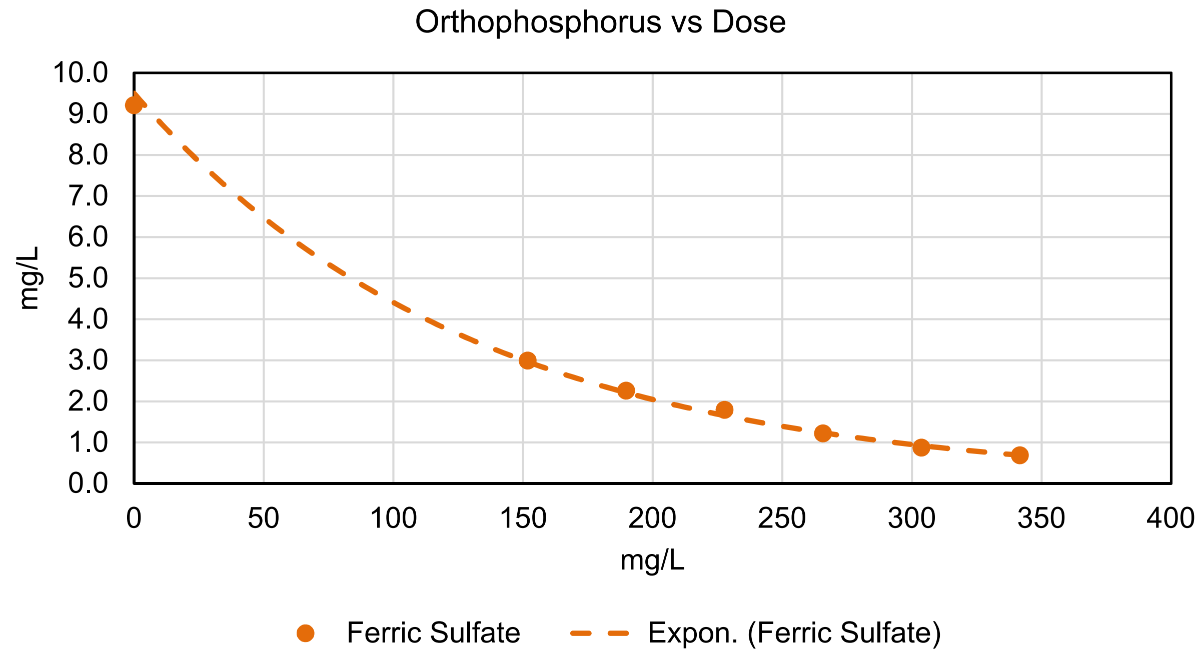


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 6.54 mg/L would appear to suggest a dose of 75 mg/L of Ferric Chloride. The dose on the Ferric Chloride is ***reasonable*** from a cost standpoint.

Again, this was a sample where the influent phosphorus was high along with the pH being high, the worst-case scenario for dosing.

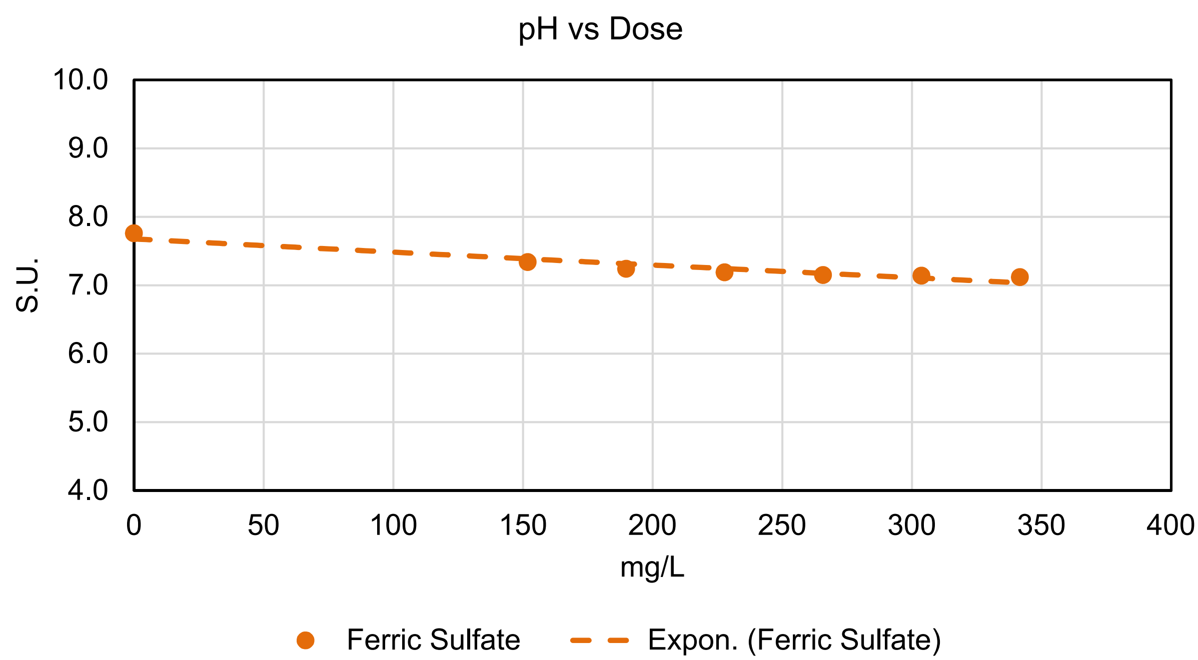


Tenth run (9/20 -10:00) using only Ferric Sulfate (at 100:1)

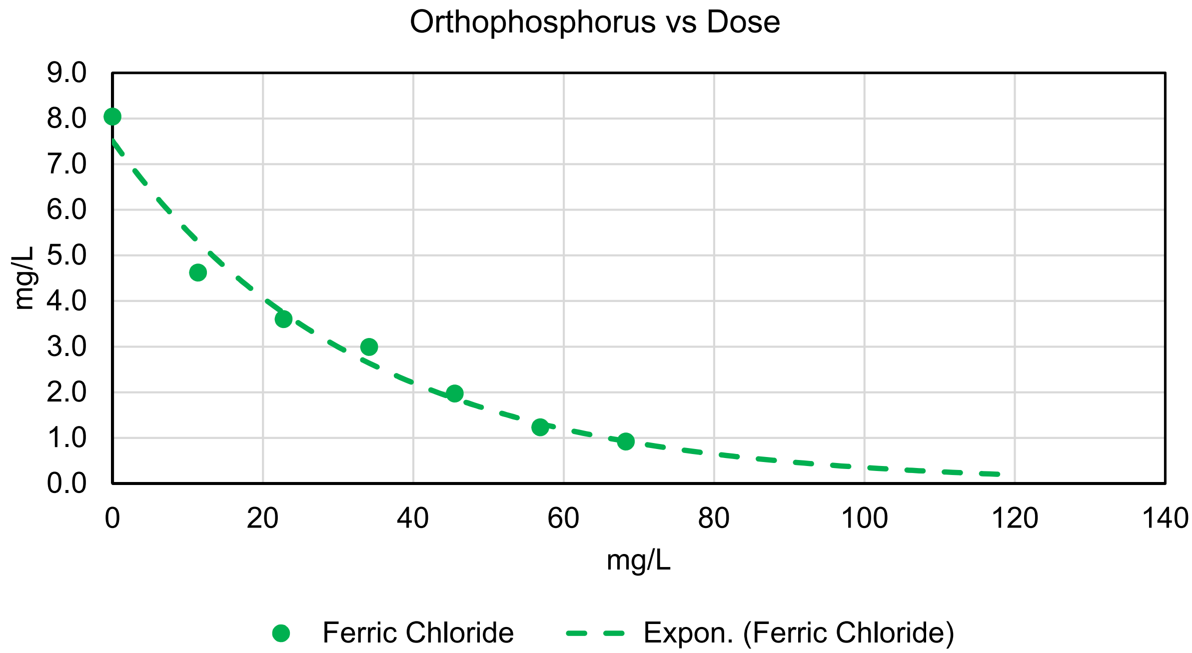


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 9.21 mg/L would appear to suggest a dose of 310 mg/L of Ferric Sulfate. The dose on the Ferric Sulfate is ***unreasonable*** from a cost standpoint.

Again, this was a sample where the influent phosphorus was high along with the pH being high, the worst-case scenario for dosing.

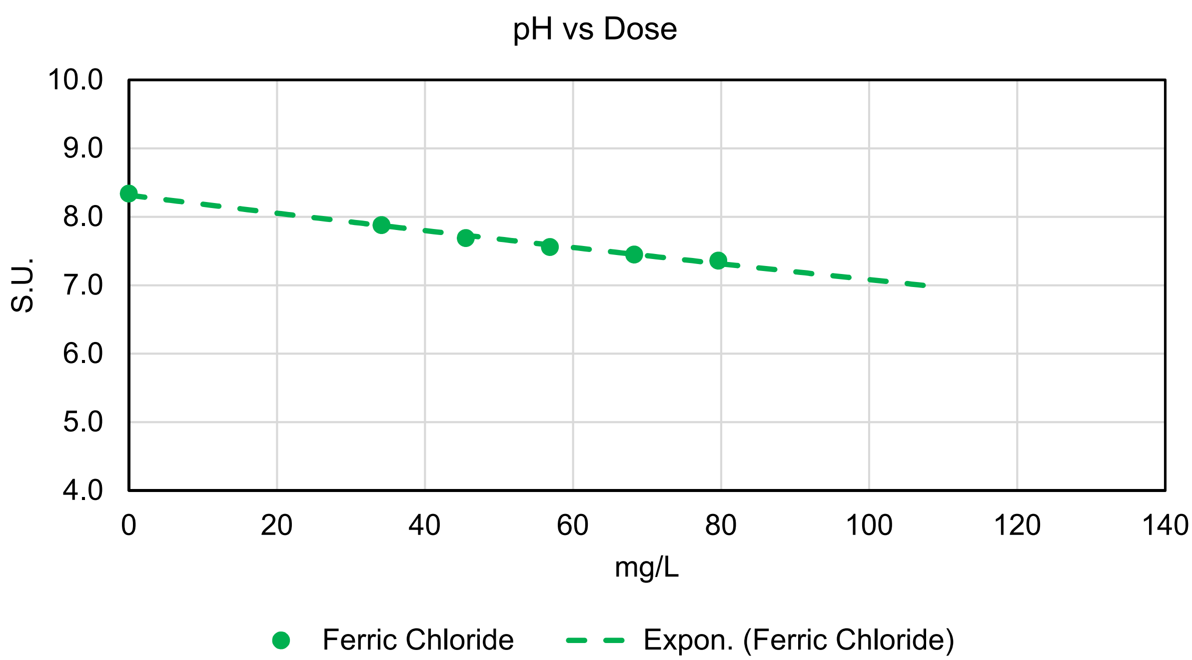


Eleventh run (10/8 -9:15) using only Ferric Chloride (at 100:1)

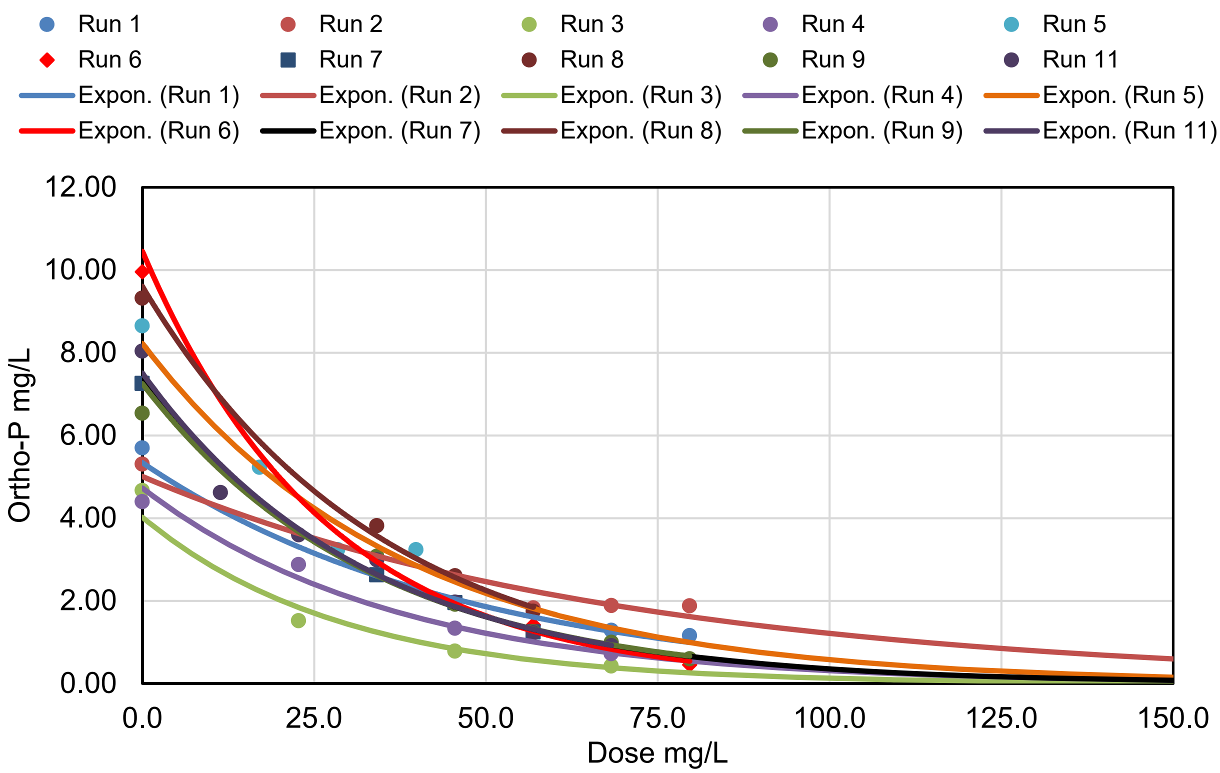


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 8.04 mg/L would appear to suggest a dose of 75 mg/L of Ferric Chloride. The dose on the Ferric Chloride is ***reasonable*** from a cost standpoint.

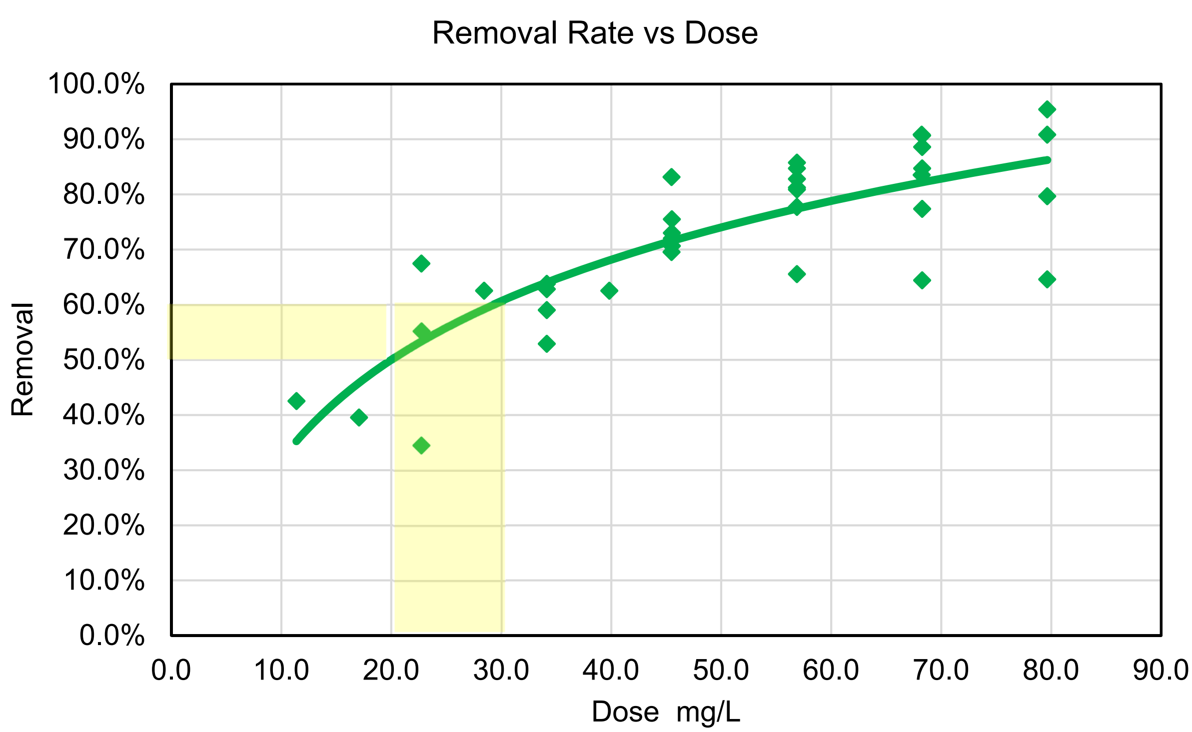
Again, this was a sample where the influent phosphorus was high along with the pH being high, the worst-case scenario for dosing.



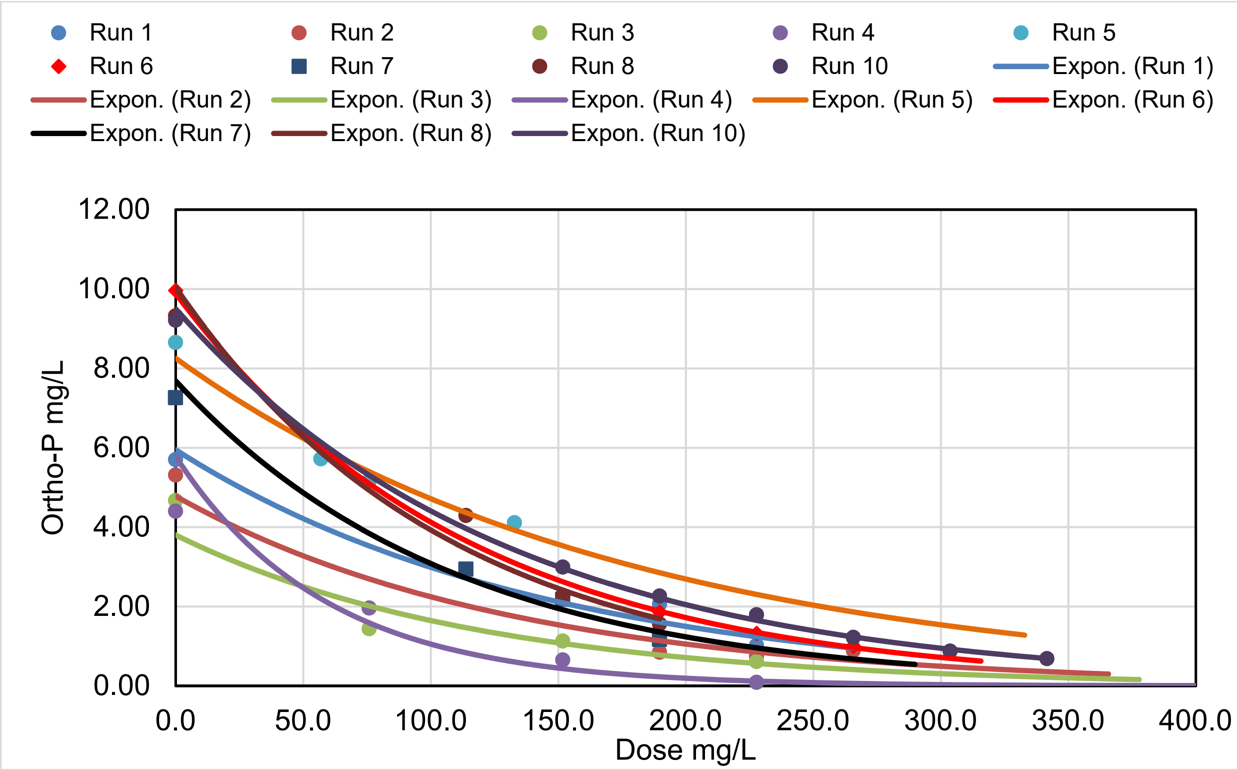
Compiling all of the exponential trendlines of the Ferric Chloride samples as a visual check on repeatability gives the following graph.



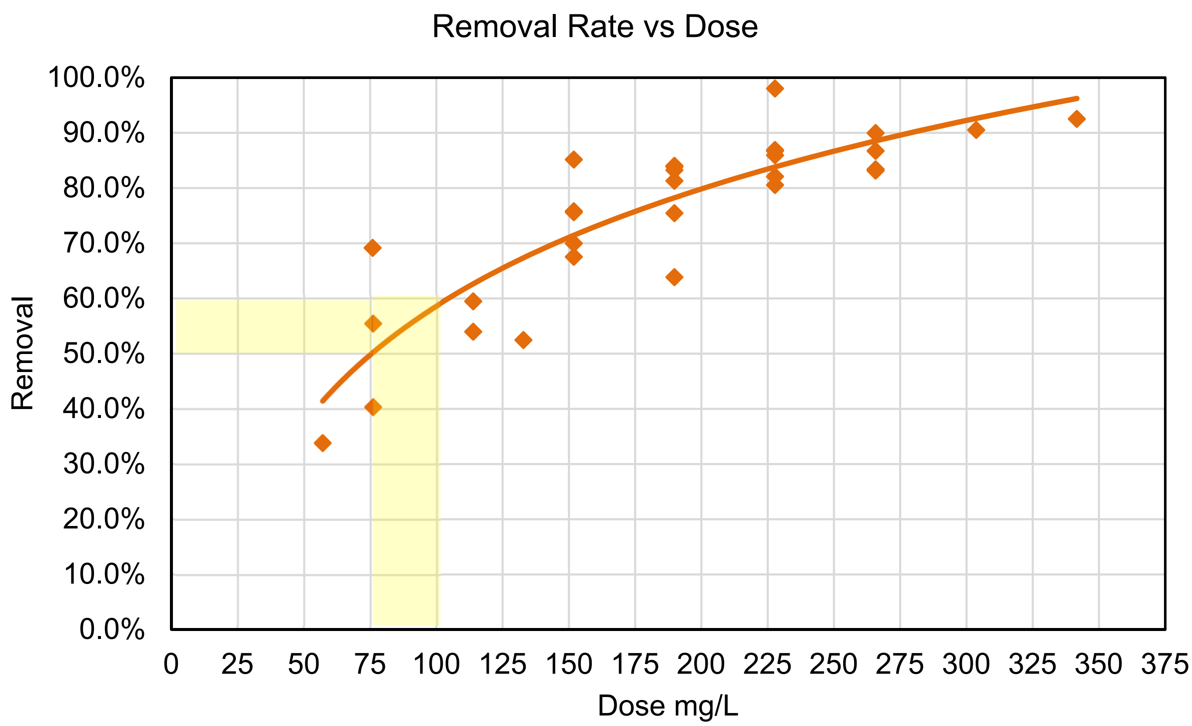
It is more interesting to look at the percent removal versus the dose. This graph tends to lead to a recommendation of a dose of between 20-30 mg/L of Iron from Ferric Chloride to target between 50-60% removal in the primaries of the "Orthophosphorus". This would still require additional aluminum addition after the Aerotor's but at a much lower dosing rate.



Compiling all of the exponential trendlines of the Ferric Sulfide samples as a visual check on repeatability gives the following graph.



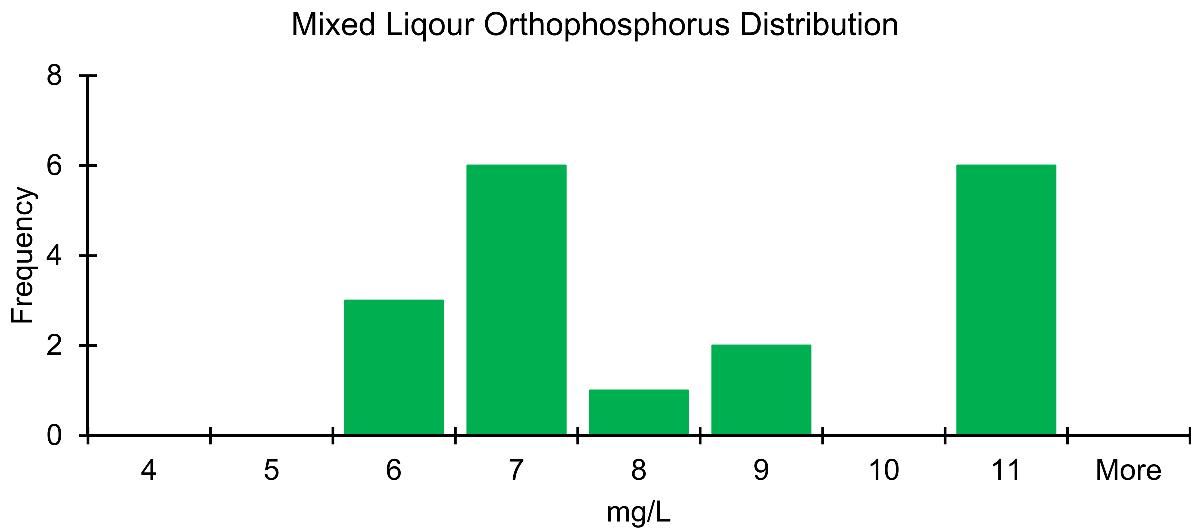
It is more interesting to look at the percent removal versus the dose. This graph tends to lead to a recommendation of a dose of between 75-100 mg/L of Iron from Ferric Chloride to target between 50-60% removal in the primaries of the "Orthophosphorus". This would still require additional aluminum addition after the Aerotor's but at a much lower dosing rate.



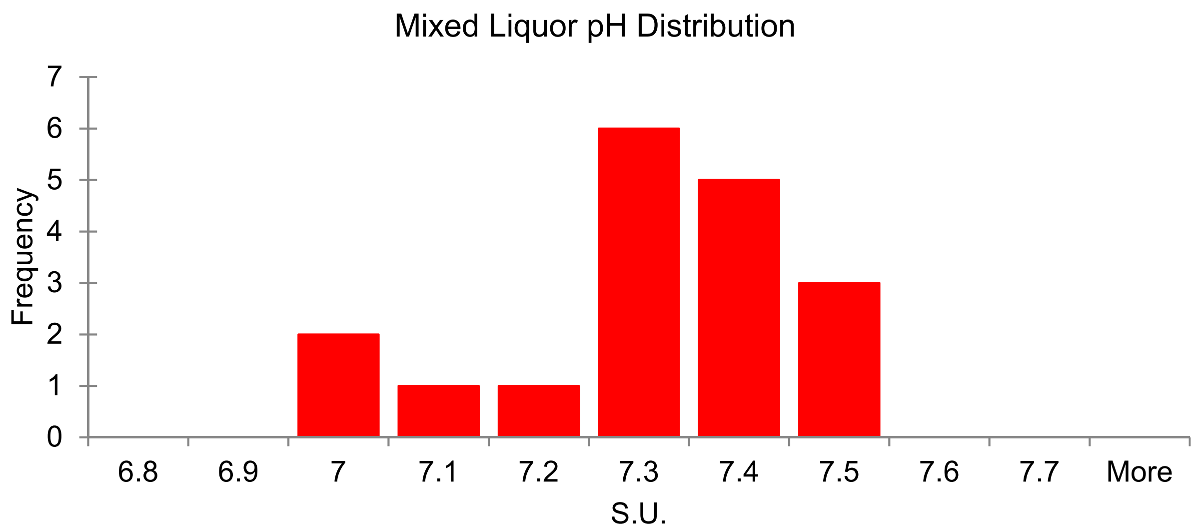
Mixed Liquor

The Mixed Liquor was treated using Ferric Chloride, Ferric Sulfate, ATS 809, Aluminum Sulfate Sodium Aluminate and RE300 (proof of concept)

Of the 18 separate mixed liquor grab samples, all of them had an orthophosphorus higher than expected two to three times higher than the compliance composite samples.

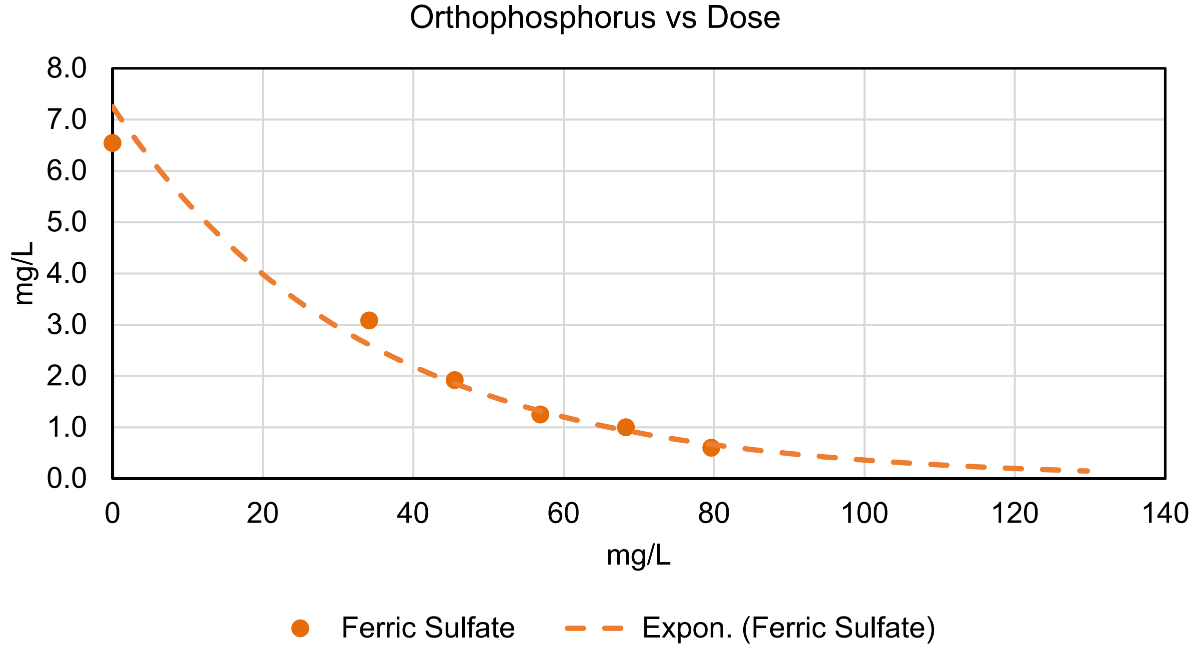


As with the influent orthophosphorus, there was no discernable pattern to the mixed liquor orthophosphorus concentrations. This indicates that close monitoring of the orthophosphorus to optimize the chemical dosing.



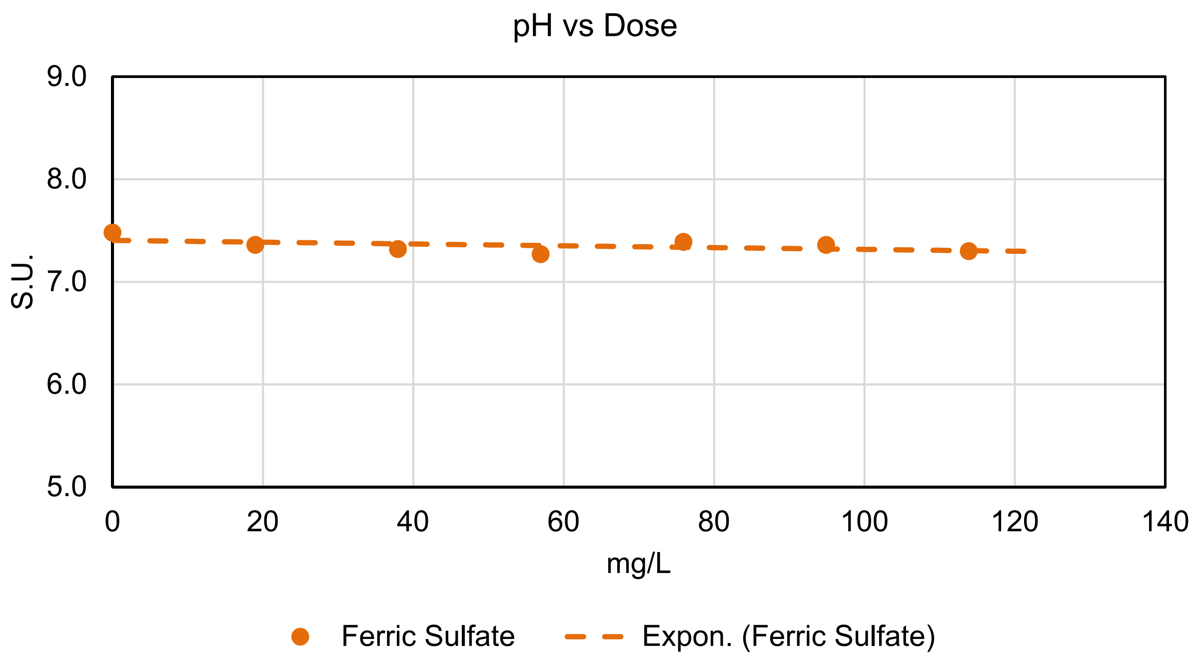
The activated sludge pH ranges from 6.91 to 7.48 S.U. This is lower than the influent pH as expected due to nitrification. The higher the pH the more chemical will be needed to lower the pH to form the metal floc. Again, this large of range will make optimizing the chemical usage difficult.

First run (7/31 – 8:05) using Ferric Sulfate (at 50:1)

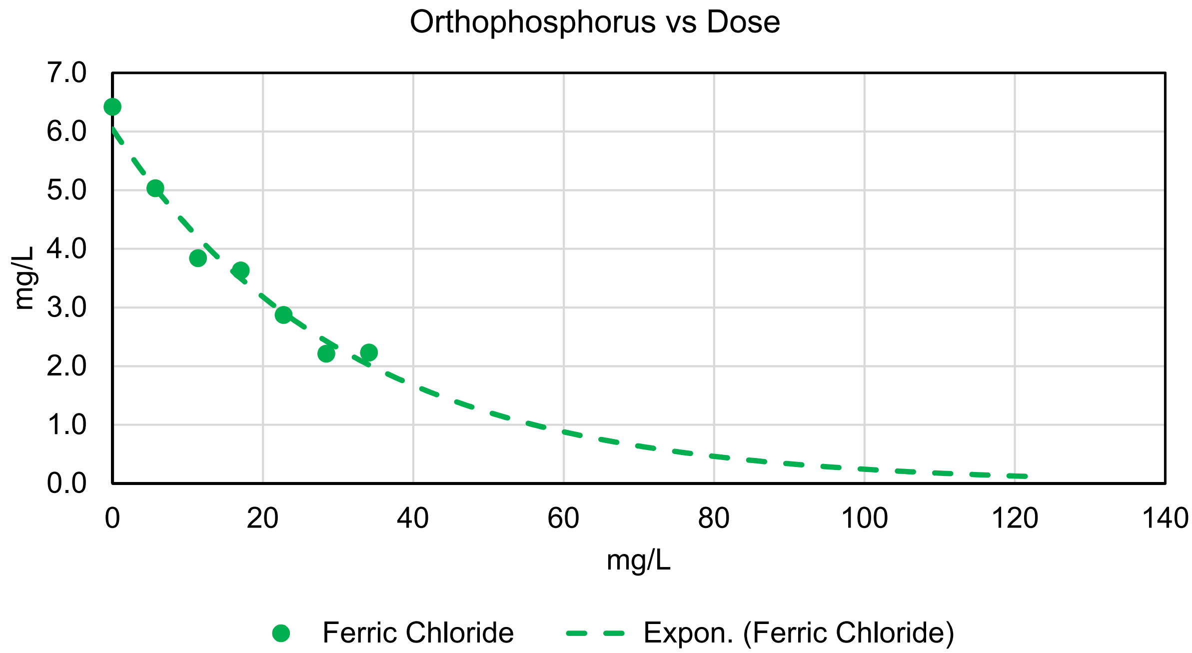


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 6.42 mg/L would appear to suggest a dose of 75 mg/L of Ferric Sulfate. This is completely ***realistic*** from a cost standpoint, but will not be available as an option after Payson goes to ultraviolet disinfection.

The impact of Ferric Sulfate on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance

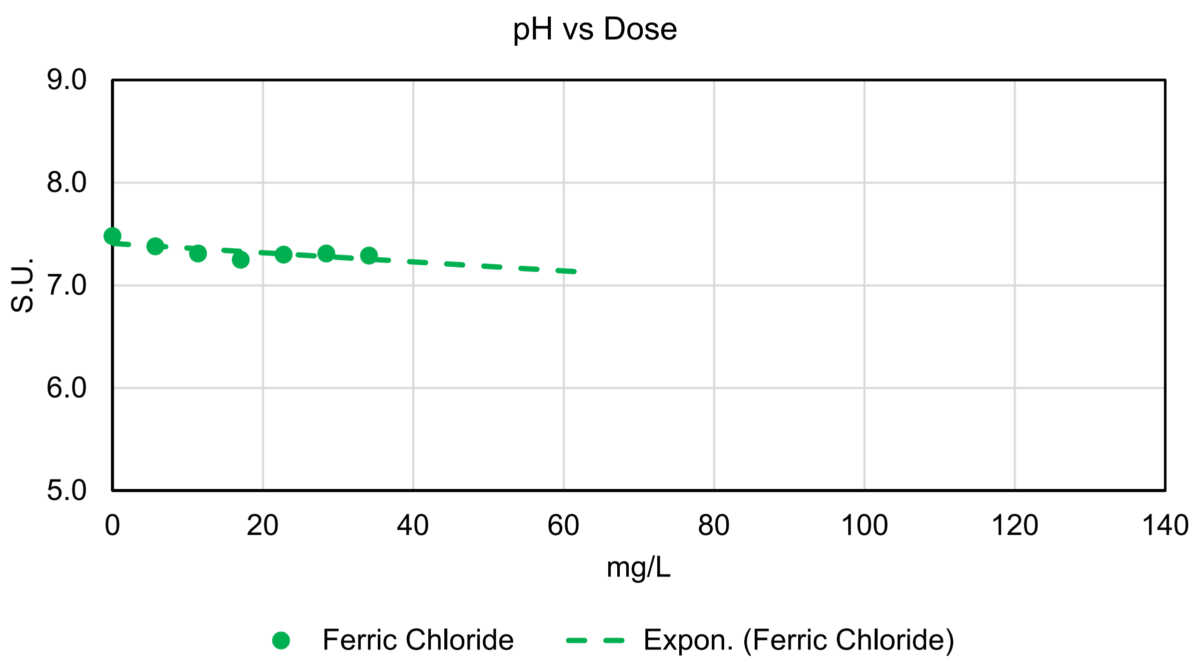


Second run (7/31 – 9:45) using Ferric Chloride (at 50:1)

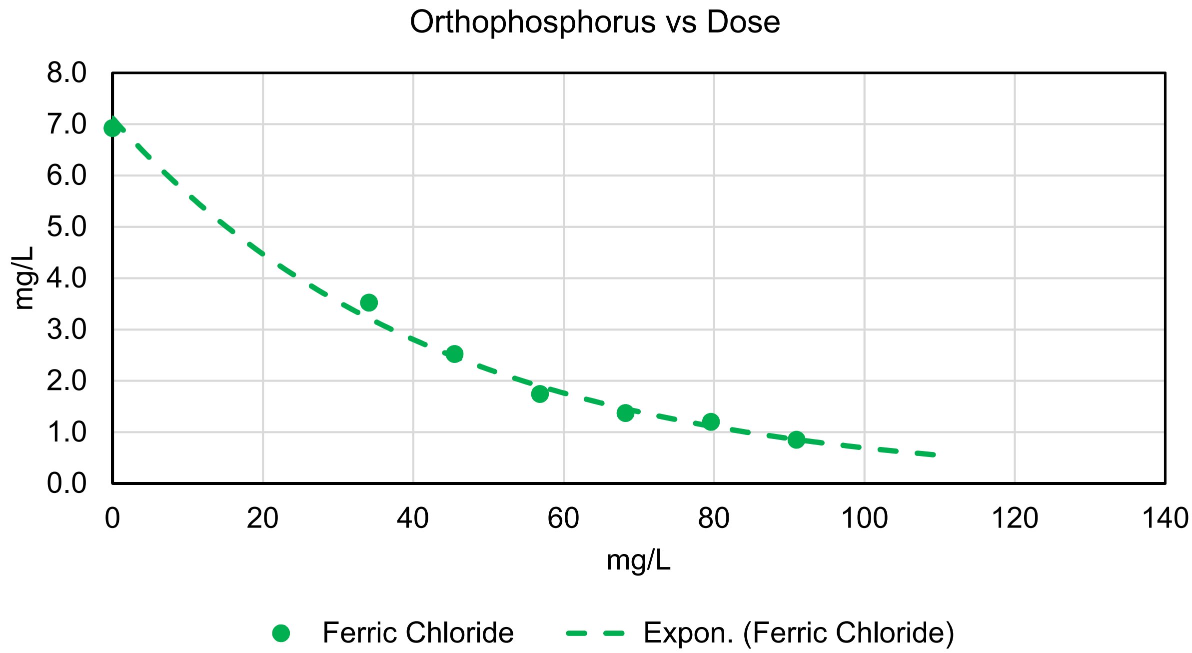


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 6.42 mg/L would appear to suggest a dose of 65 mg/L of Ferric Chloride. This is completely ***realistic*** from a cost standpoint, but will not be available as an option after Payson goes to ultraviolet disinfection. Interestingly there appears to be little different in the dose rate for Ferric Chloride or Ferric Sulfate.

The impact of Ferric Chloride on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance.

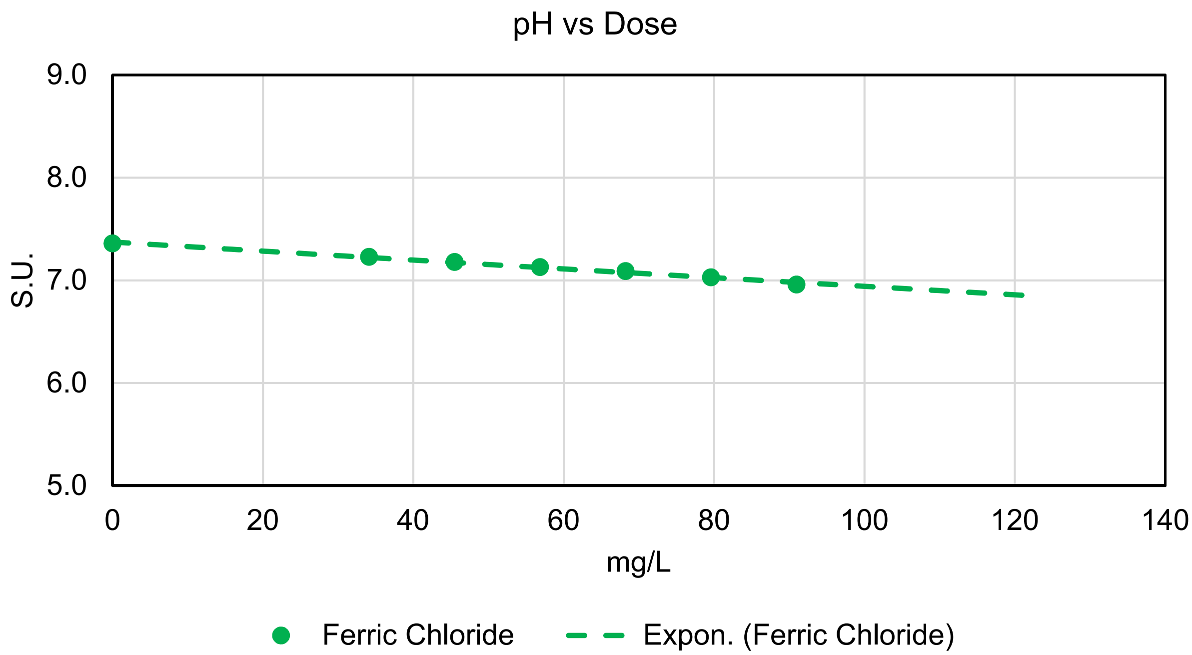


Third run (7/31 – 13:00) using Ferric Chloride (at 50:1)

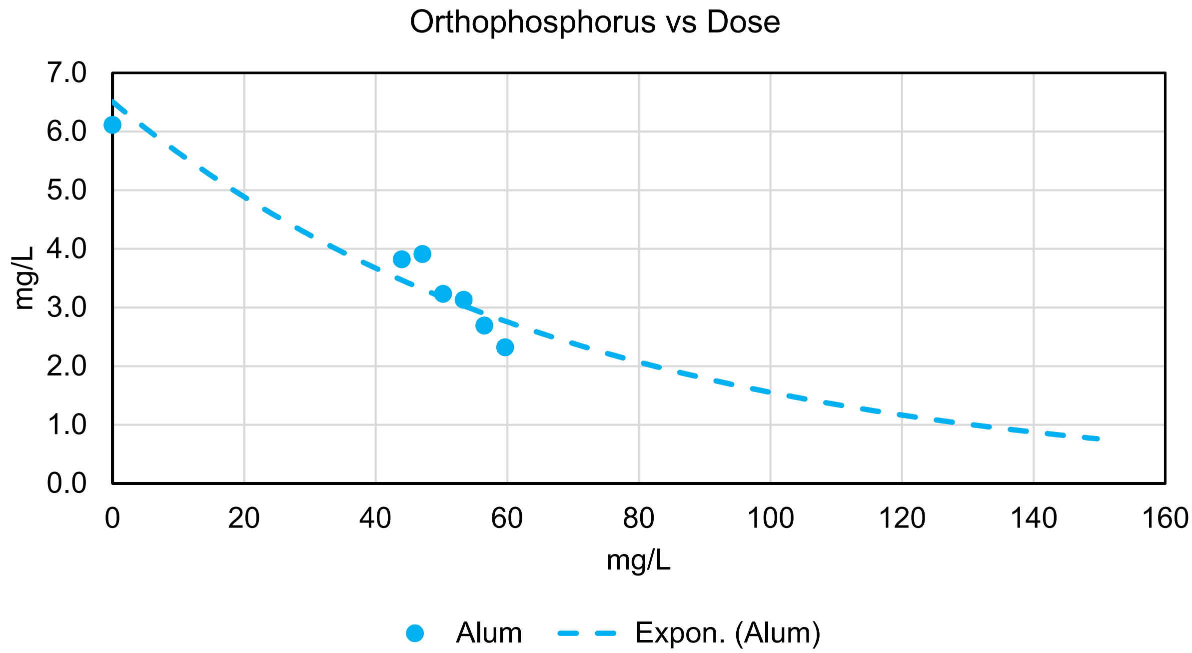


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 6.92 mg/L would appear to suggest a dose of 95 mg/L of Ferric Chloride. This is completely ***realistic*** from a cost standpoint, but will not be available as an option after Payson goes to ultraviolet disinfection. Interestingly there appears to be little different in the dose rate for Ferric Chloride or Ferric Sulfate.

The impact of Ferric Chloride on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance.

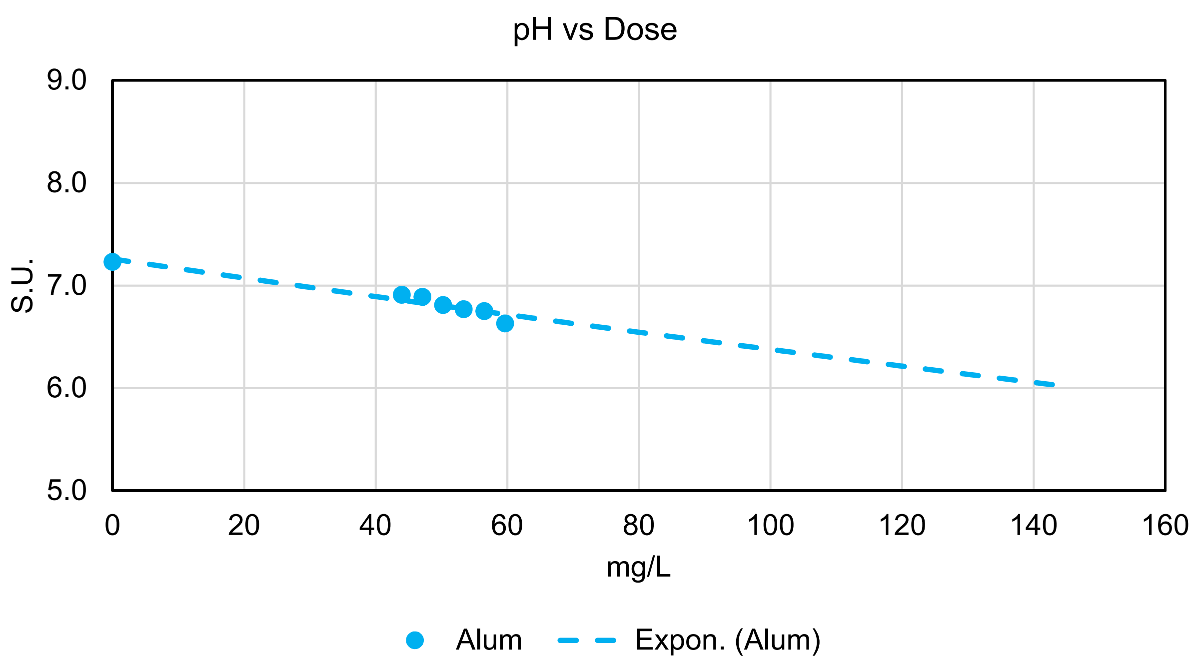


Fourth run (8/1 – 8:05) using Aluminum Sulfate (Alum) (at 100:1)

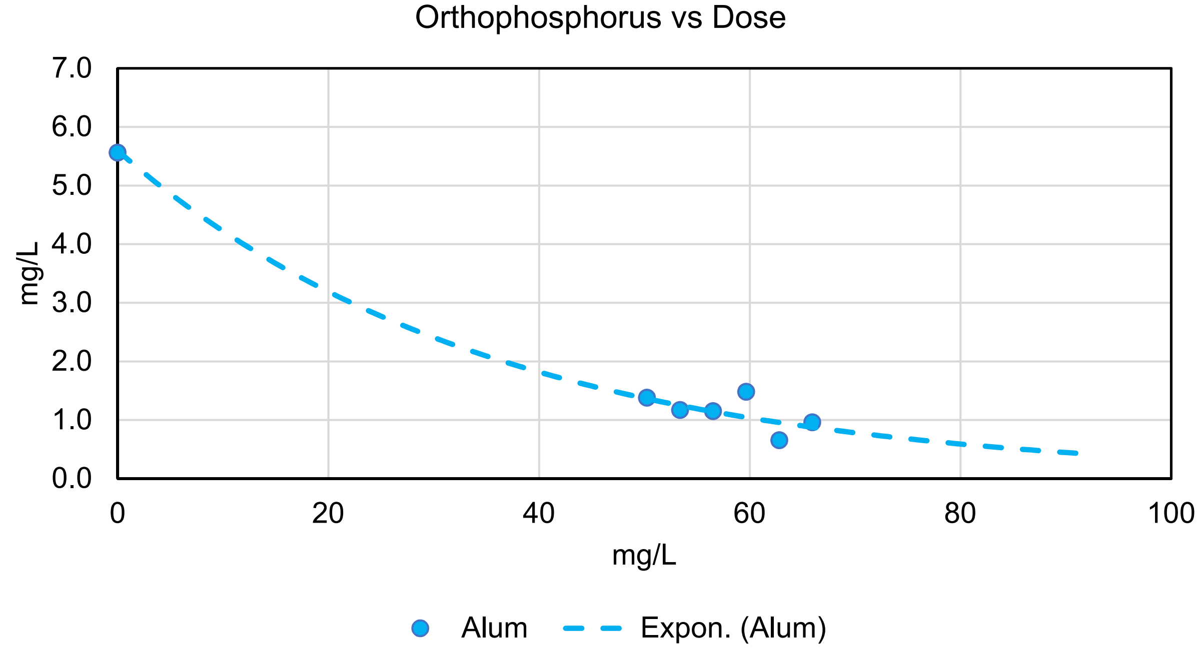


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 6.92 mg/L would appear to suggest a dose of 150 mg/L of Alum. This is completely ***unrealistic*** from a cost standpoint.

The impact of Alum on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 150 mg/L would imply the pH would be below 6.5 S.U. which would violate the permit.

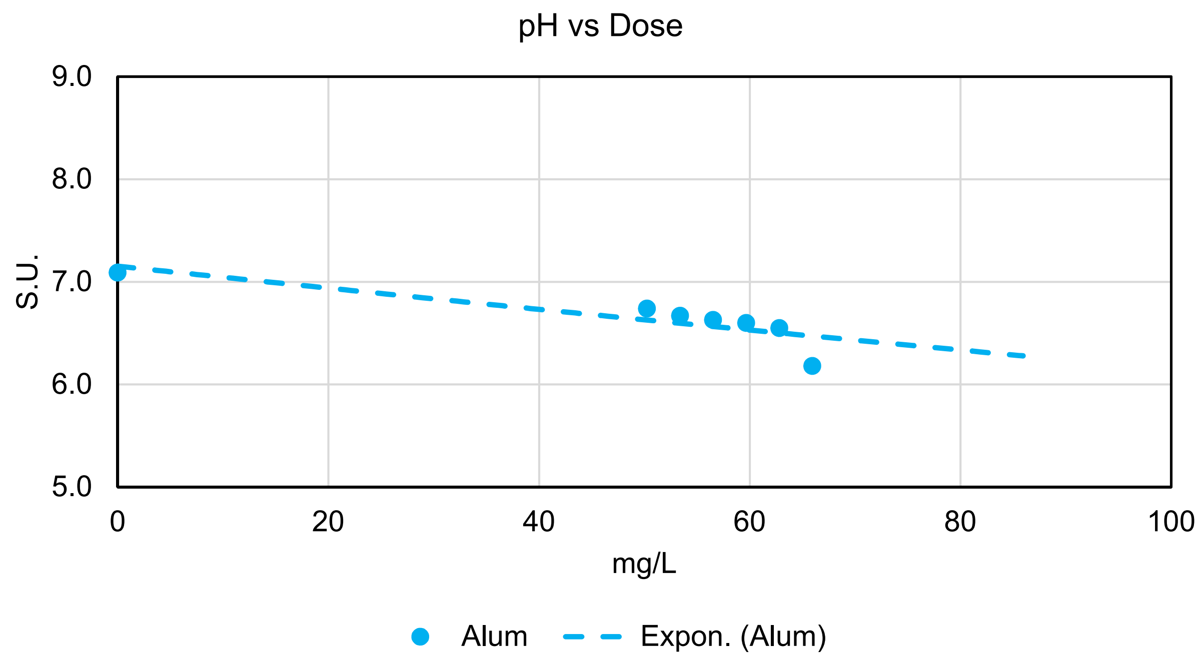


Fifth run (8/8 – 8:15) using Aluminum Sulfate (Alum) (at 100:1)

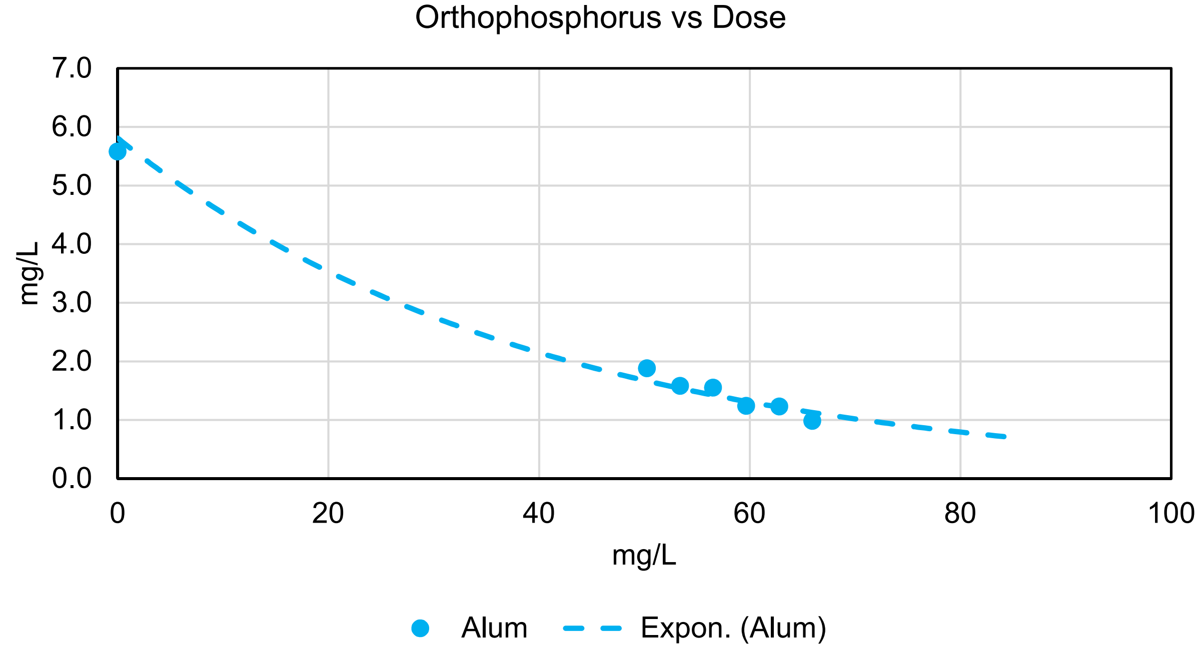


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 5.56 mg/L would appear to suggest a dose of 70 mg/L of Alum. This is completely ***realistic*** from a cost standpoint.

The impact of Alum on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 70 mg/L would imply the pH would be below 6.5 S.U. which would violate the permit.

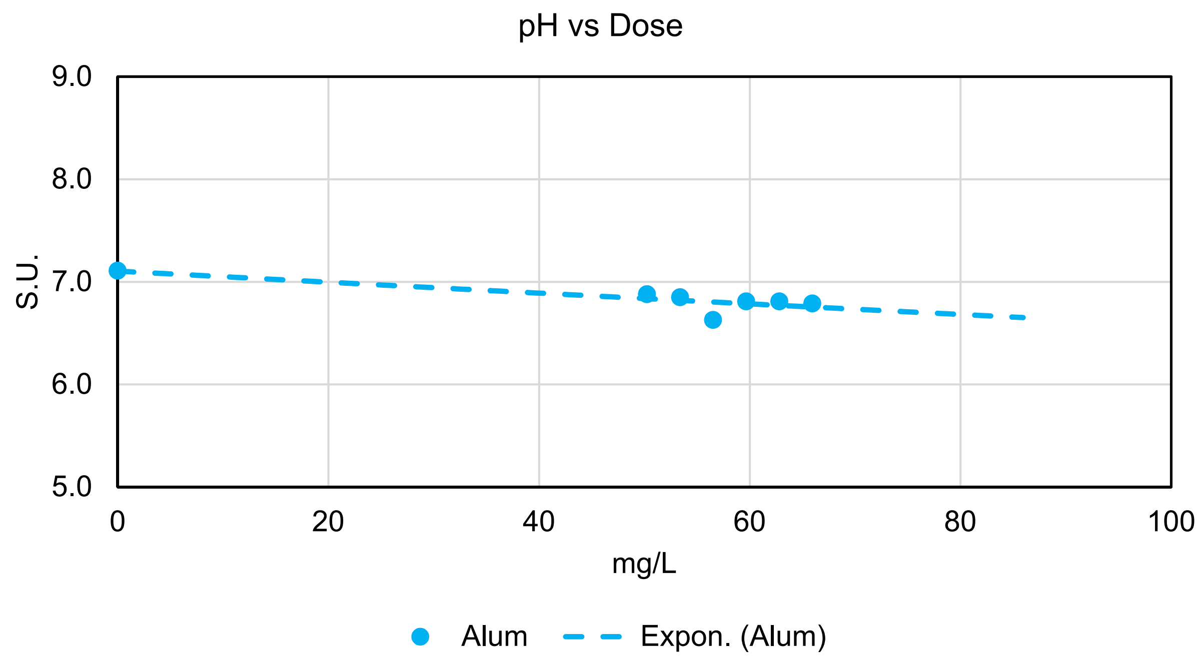


Sixth run (8/8 – 10:30) using Aluminum Sulfate (Alum) (at 100:1)

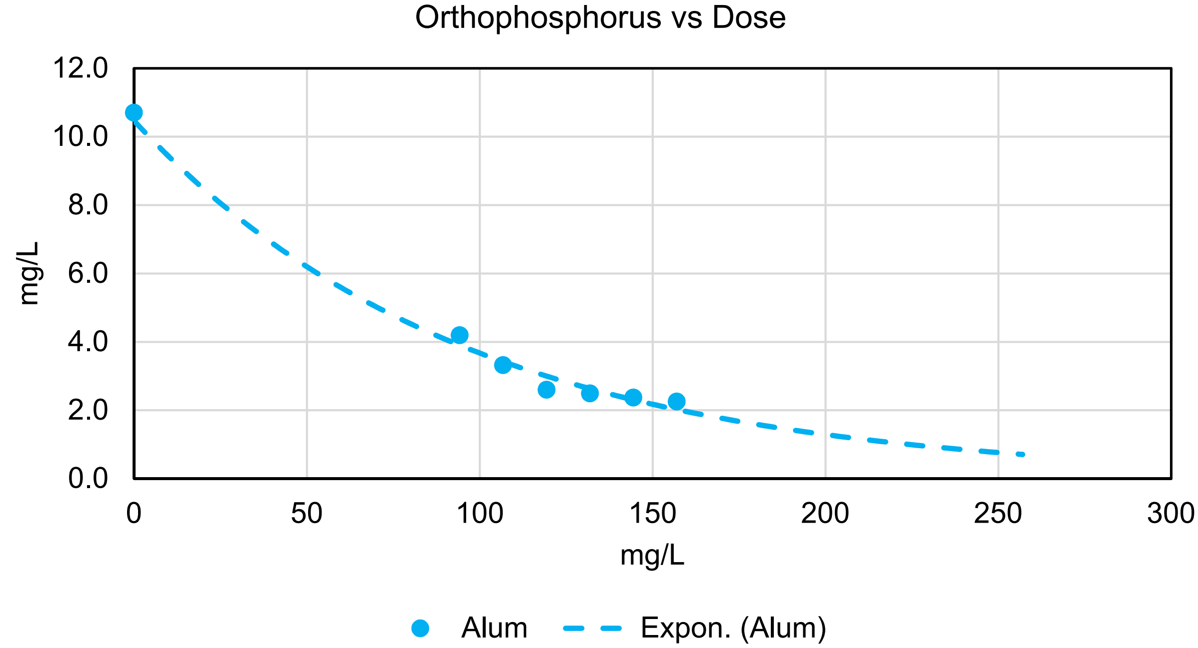


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 5.58 mg/L would appear to suggest a dose of 80 mg/L of Alum. This is completely ***realistic*** from a cost standpoint.

The impact of Alum on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 80 mg/L would imply the pH would be above 6.5 S.U. which would be in compliance with the permit.

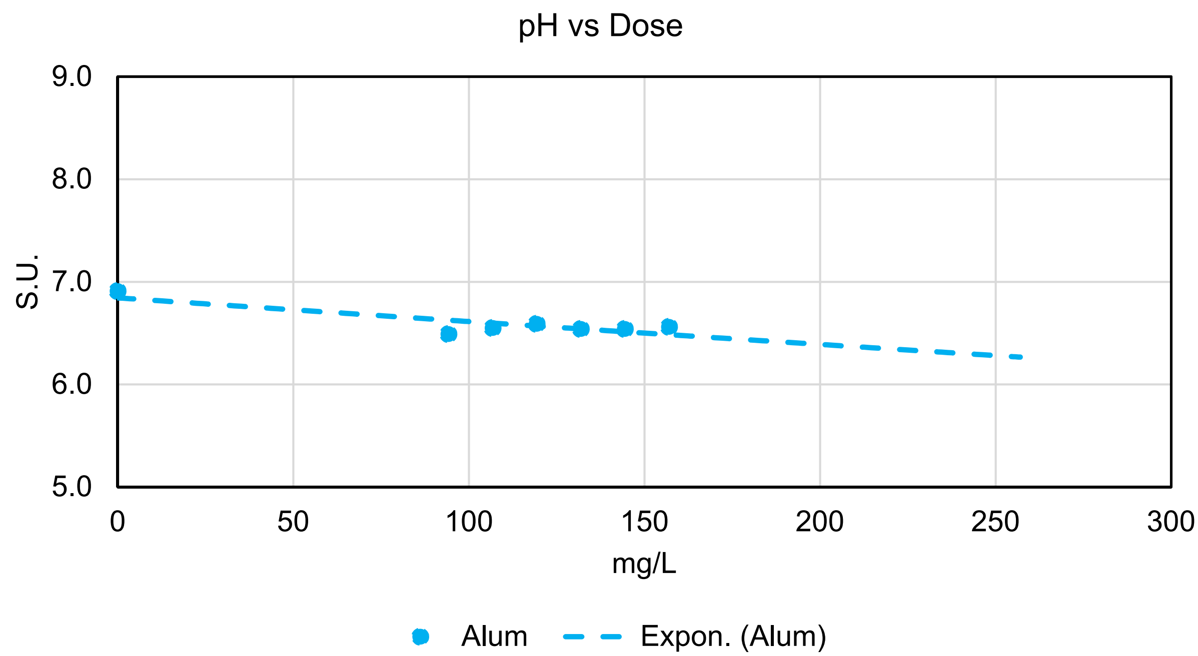


Seventh run (8/15 – 8:15) using Aluminum Sulfate (Alum) (at 100:1)

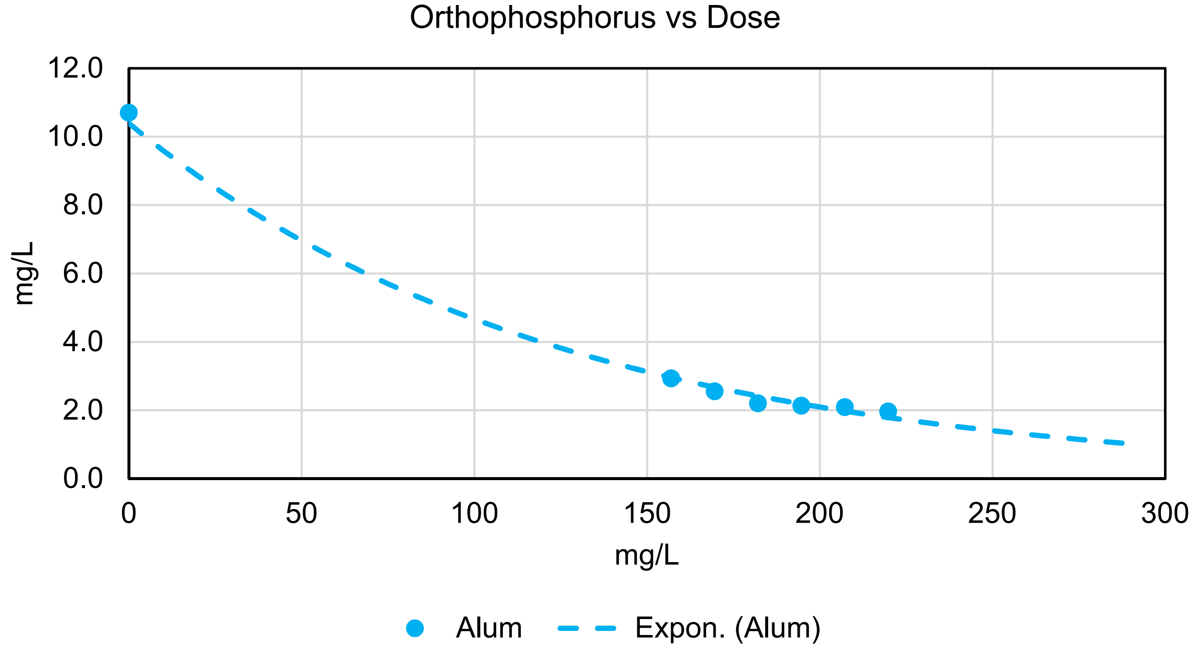


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 10.70 mg/L would appear to suggest a dose of 260 mg/L of Alum. This is completely ***unrealistic*** from a cost standpoint.

The impact of Alum on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 260 mg/L would imply the pH would be below 6.5 S.U. which would violate the permit

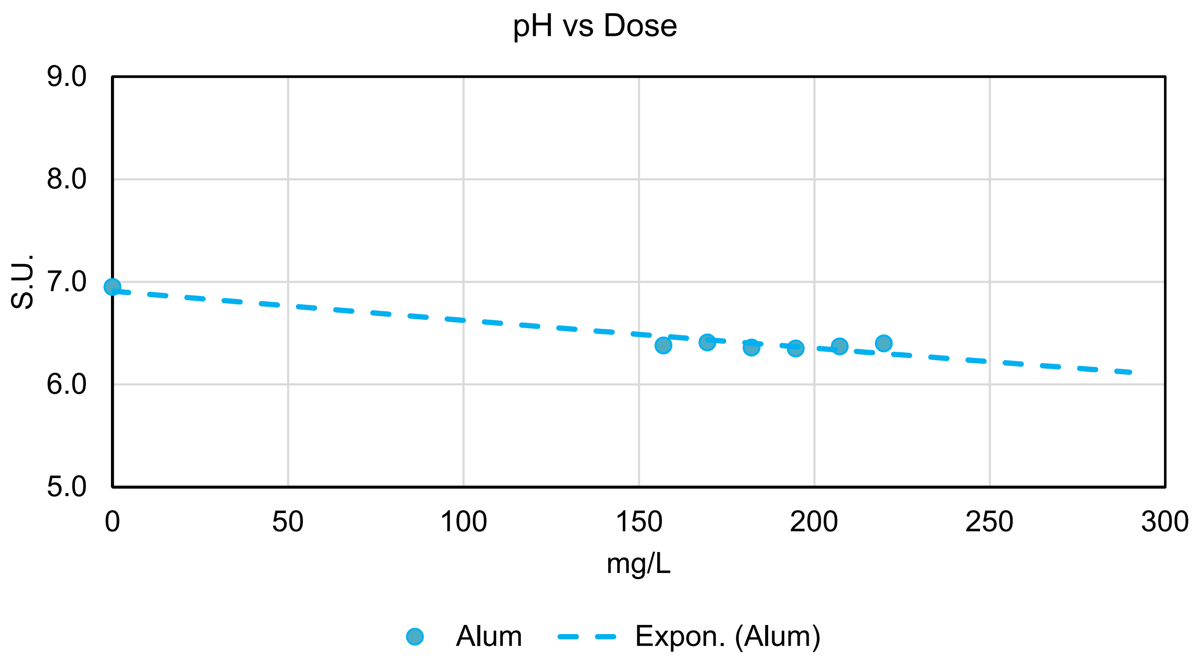


Eighth run (8/15 – 9:45) using Aluminum Sulfate (Alum) (at 100:1)

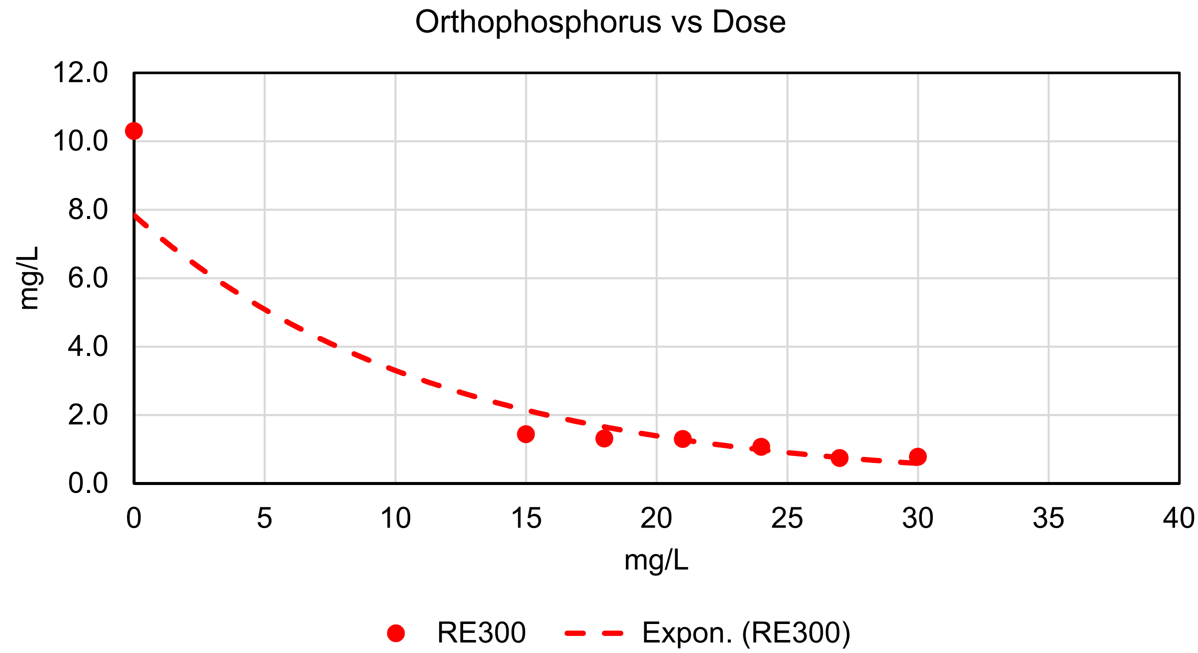


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 10.70 mg/L would appear to suggest a dose of 320 mg/L of Alum. This is completely ***unrealistic*** from a cost standpoint.

The impact of Alum on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 320 mg/L would imply the pH would be below 6.5 S.U. which would violate the permit.

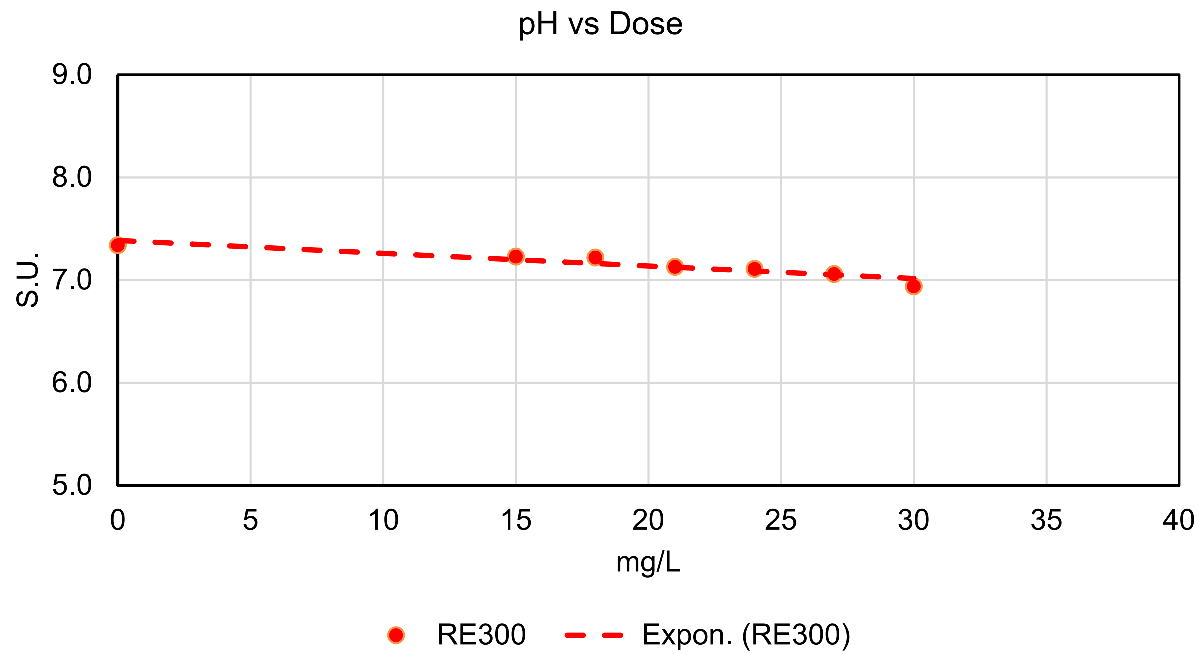


Ninth run (8/17 – 8:25) using RE300 (Rare Earth) (at 100:1)

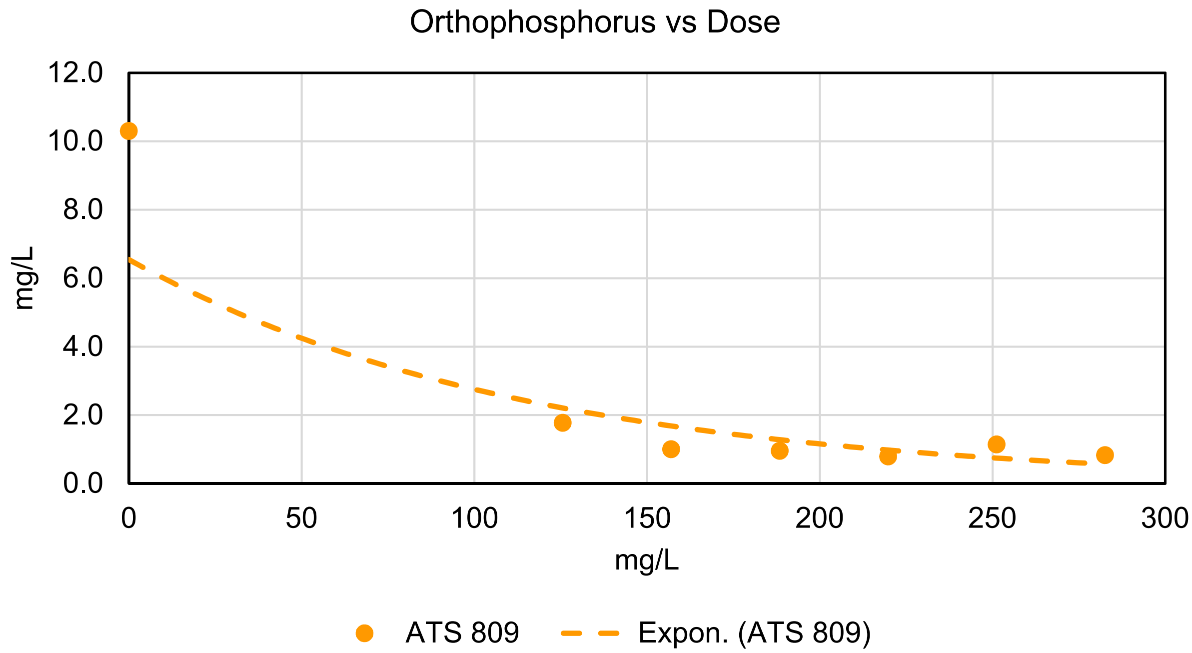


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 10.30 mg/L would appear to suggest a dose of 25 mg/L of RE300. This is completely ***unrealistic*** from a cost standpoint though.

The impact of RE300 on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 25 mg/L would imply the pH would be above 6.5 S.U. which would be in compliance with the permit.

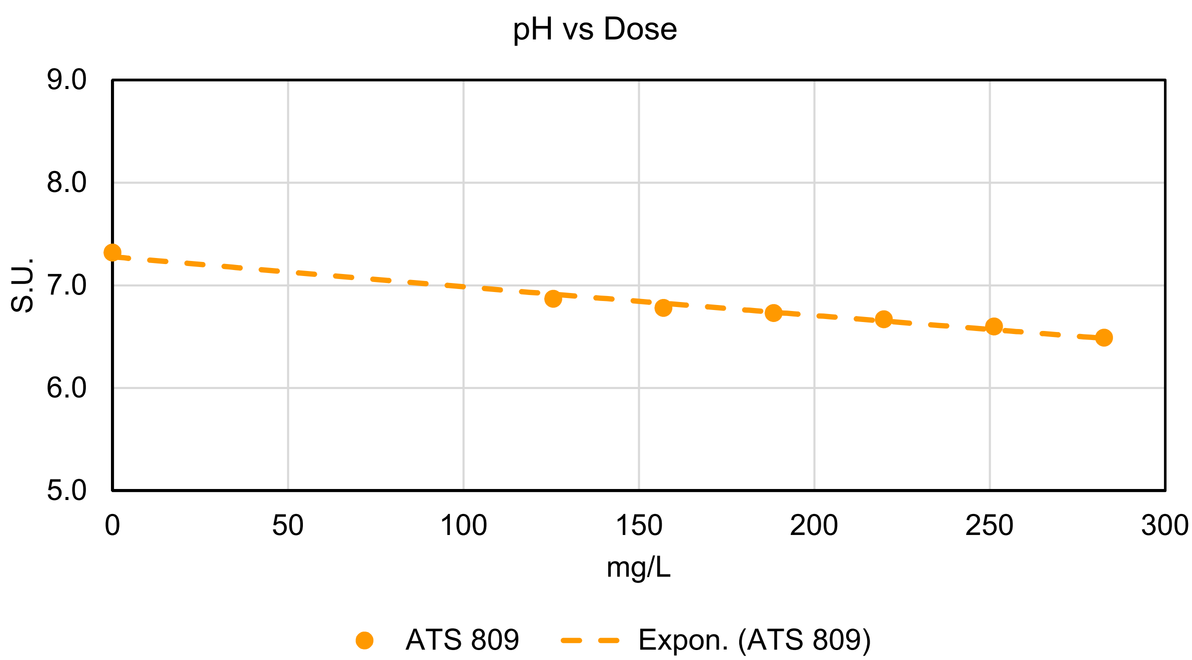


Tenth run (8/17 – 10:25) using ATS 809 (at 100:1)

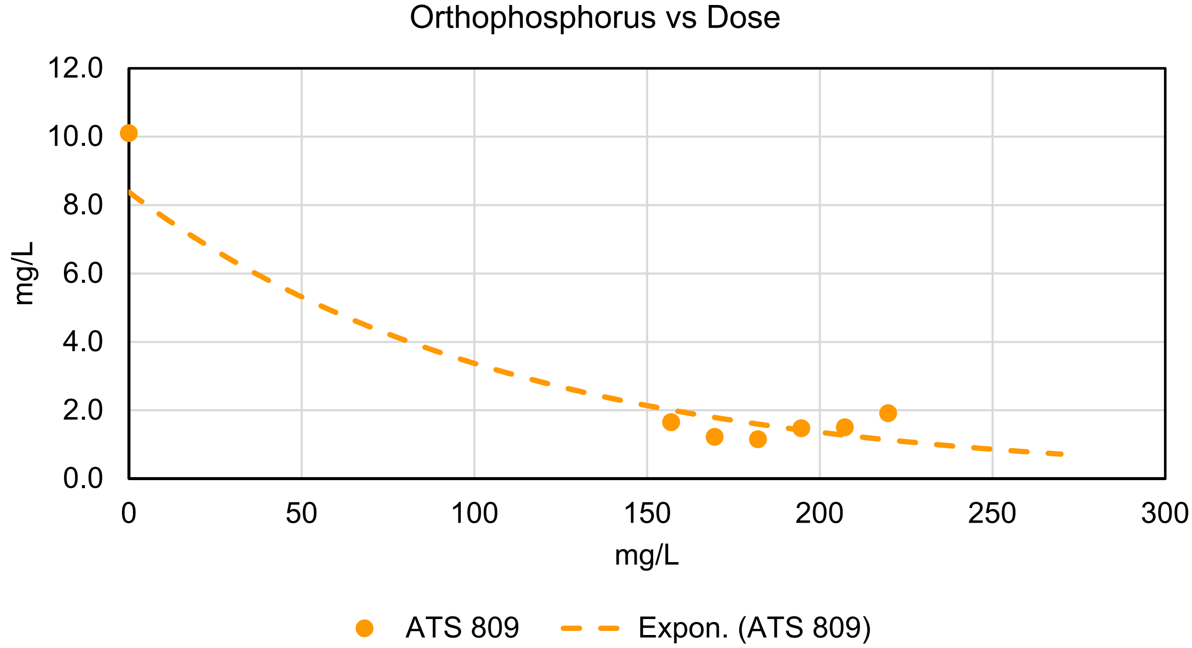


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 10.30 mg/L would appear to suggest a dose of 235 mg/L of ATS 809. This is completely ***unrealistic*** from a cost standpoint.

The impact of ATS 809 on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 235 mg/L would imply the pH would be above 6.5 S.U. which would be in compliance with the permit.

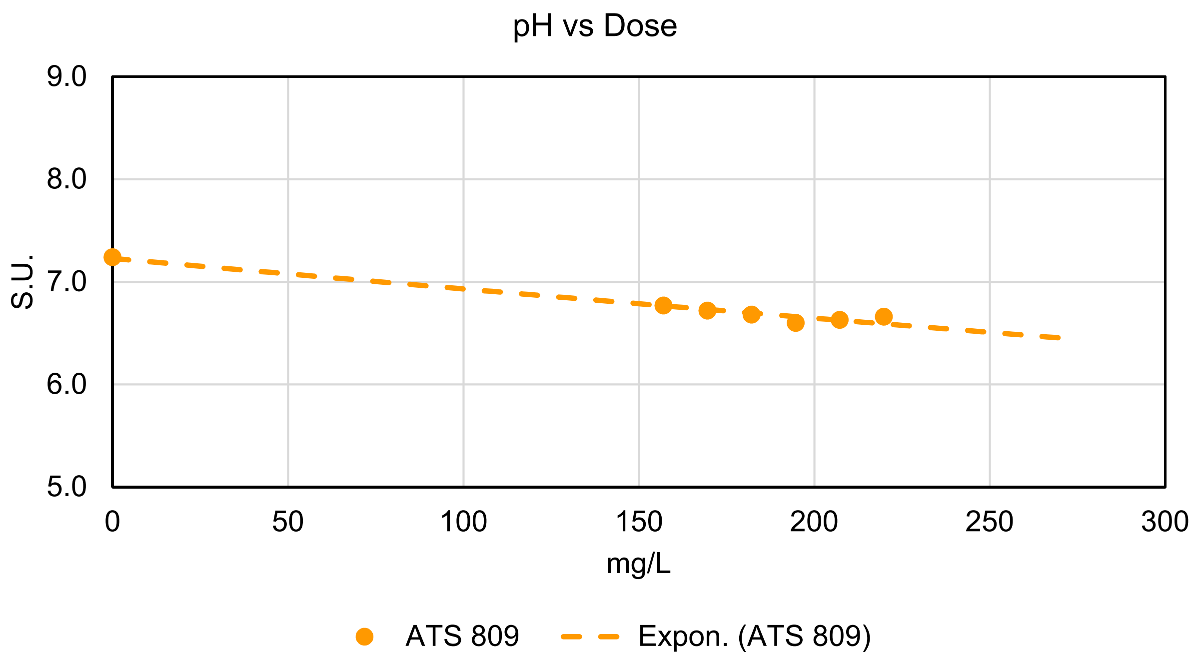


Eleventh run (8/17 – 12:30) using ATS 809 (at 100:1)

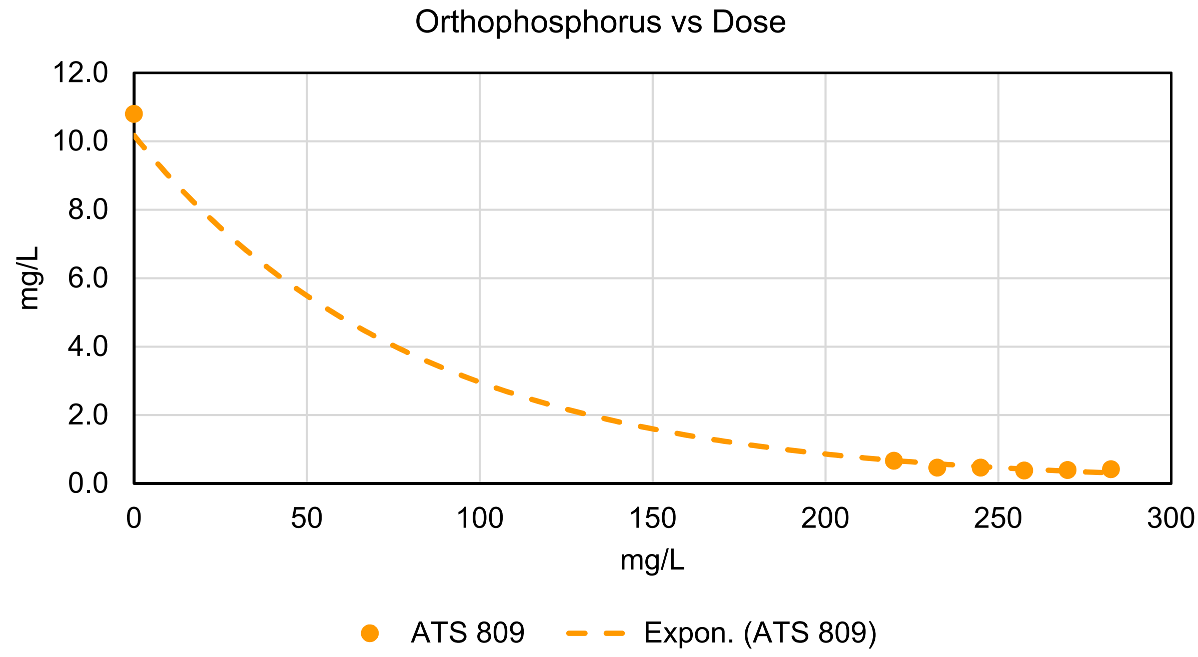


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 10.10 mg/L would appear to suggest a dose of 260 mg/L of ATS 809. This is completely ***unrealistic*** from a cost standpoint.

The impact of ATS 809 on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 260 mg/L would imply the pH would be below 6.5 S.U. which would violate the permit.

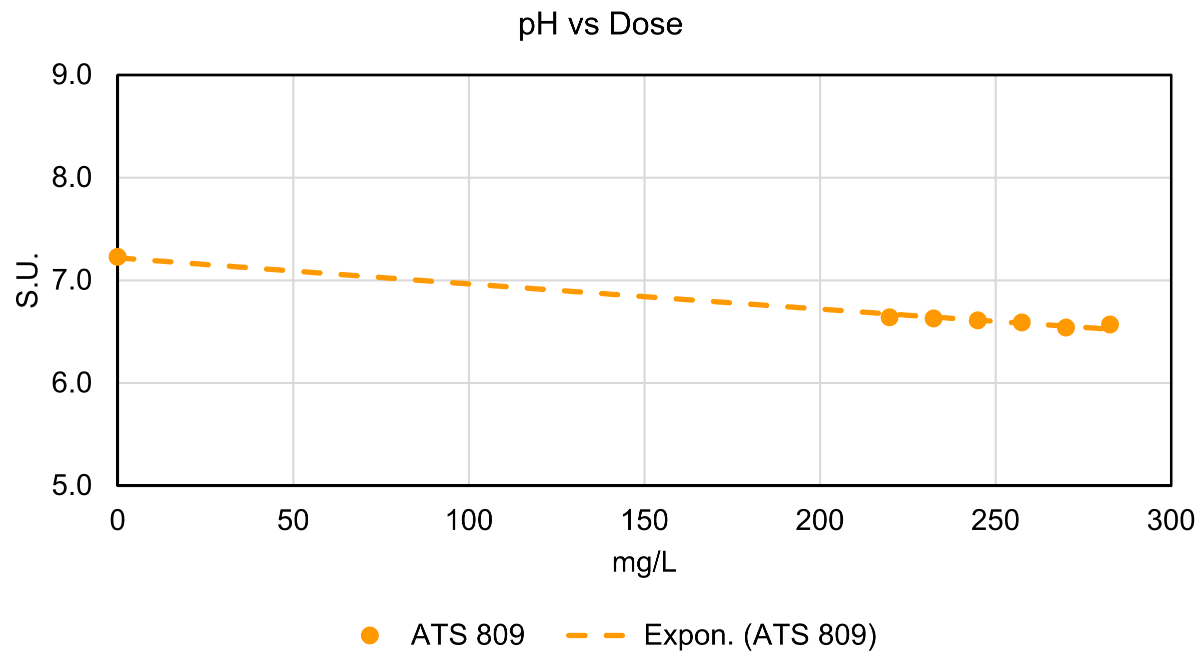


Twelfth run (8/17 – 13:50) using ATS 809 (at 100:1)

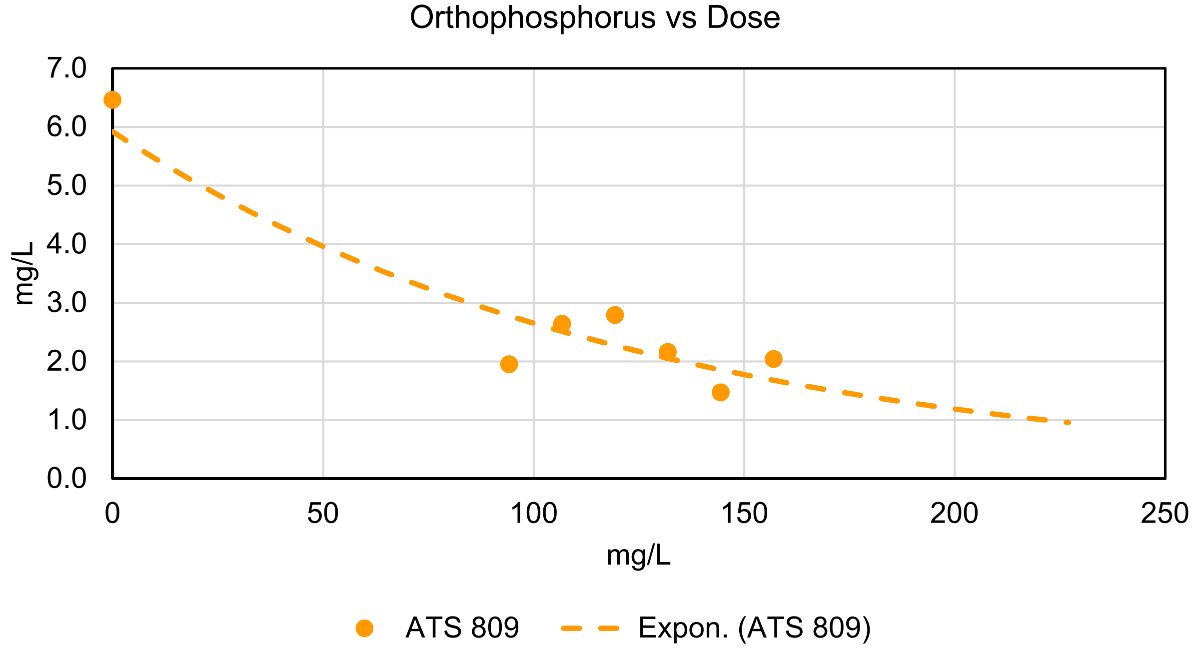


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 10.80 mg/L would appear to suggest a dose of 210 mg/L of ATS 809. This is completely ***unrealistic*** from a cost standpoint.

The impact of ATS 809 on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 210 mg/L would imply the pH would be above 6.5 S.U. which would be in compliance with the permit.

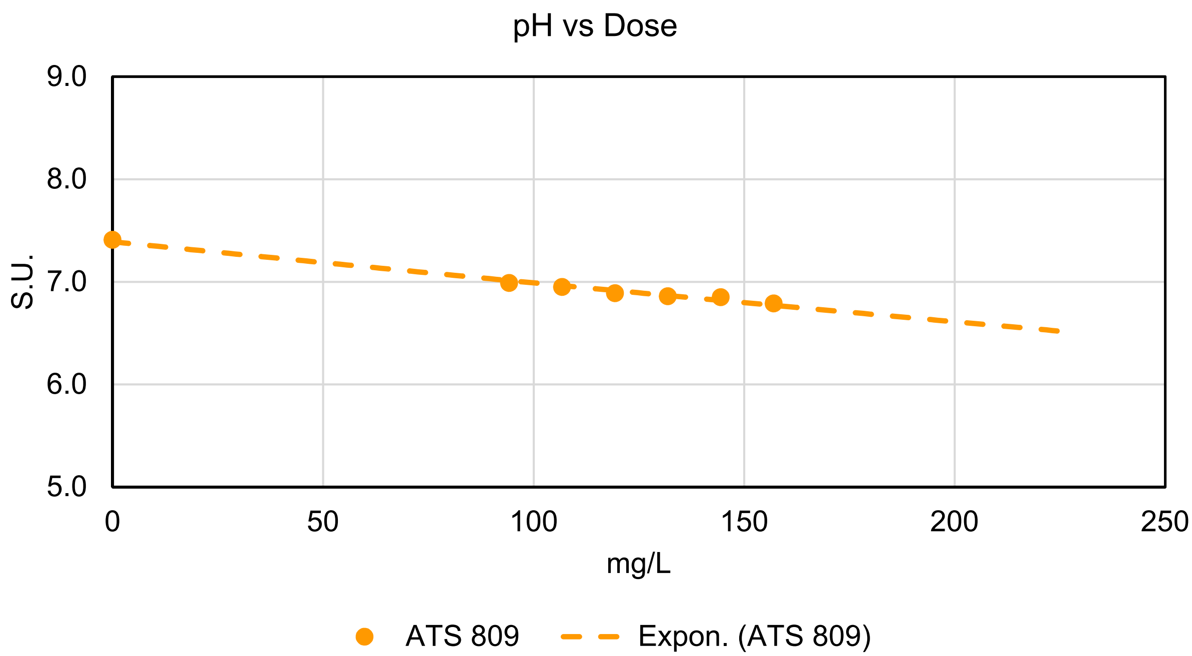


Thirteenth run (8/20 – 8:15) using ATS 809 (at 100:1)

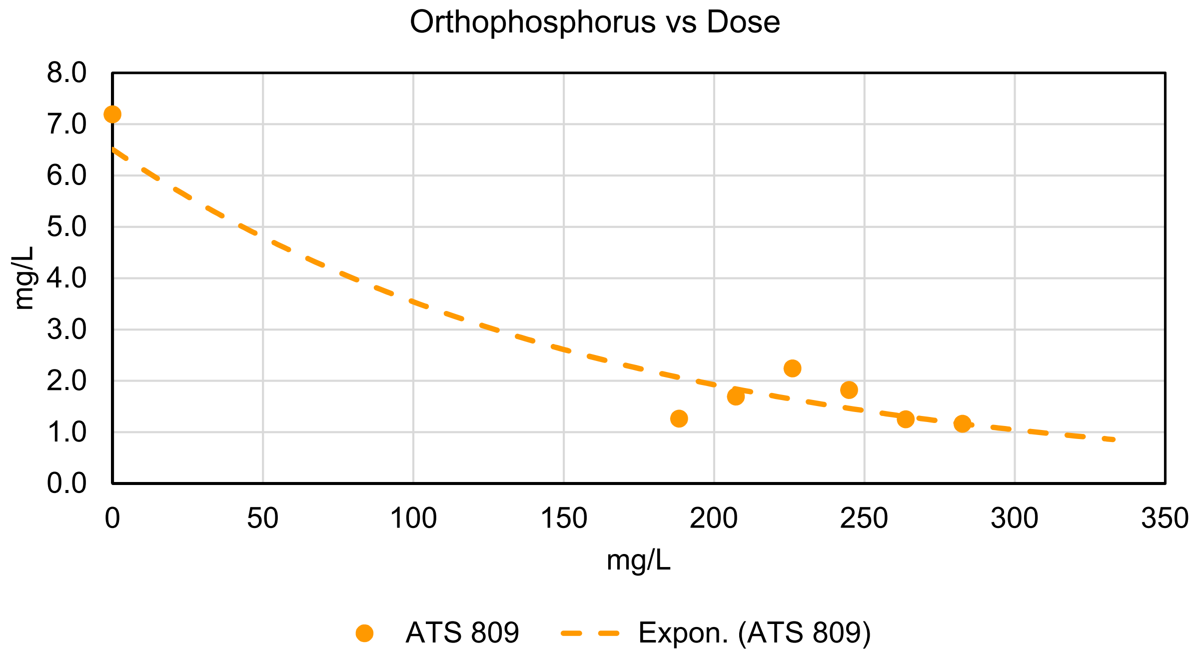


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 6.46 mg/L would appear to suggest a dose of 235 mg/L of ATS 809. This is completely ***unrealistic*** from a cost standpoint.

The impact of ATS 809 on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 235 mg/L would imply the pH would be below 6.5 S.U. which would violate the permit.

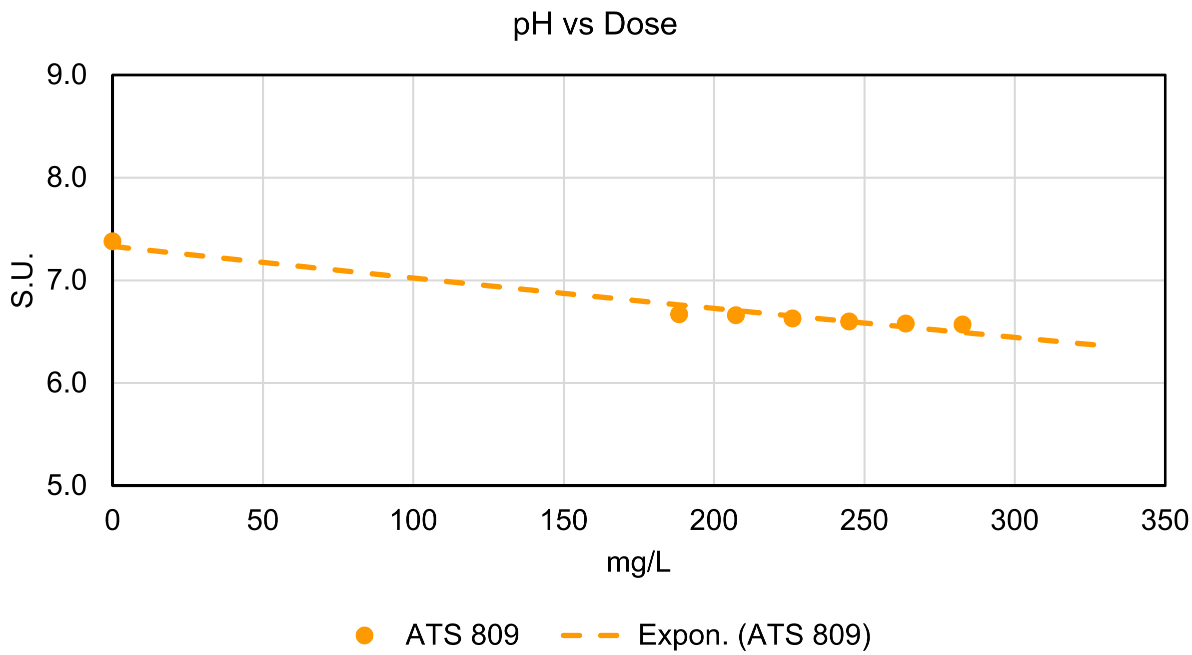


Fourteenth run (8/20 – 10:30) using ATS 809 (at 100:1)

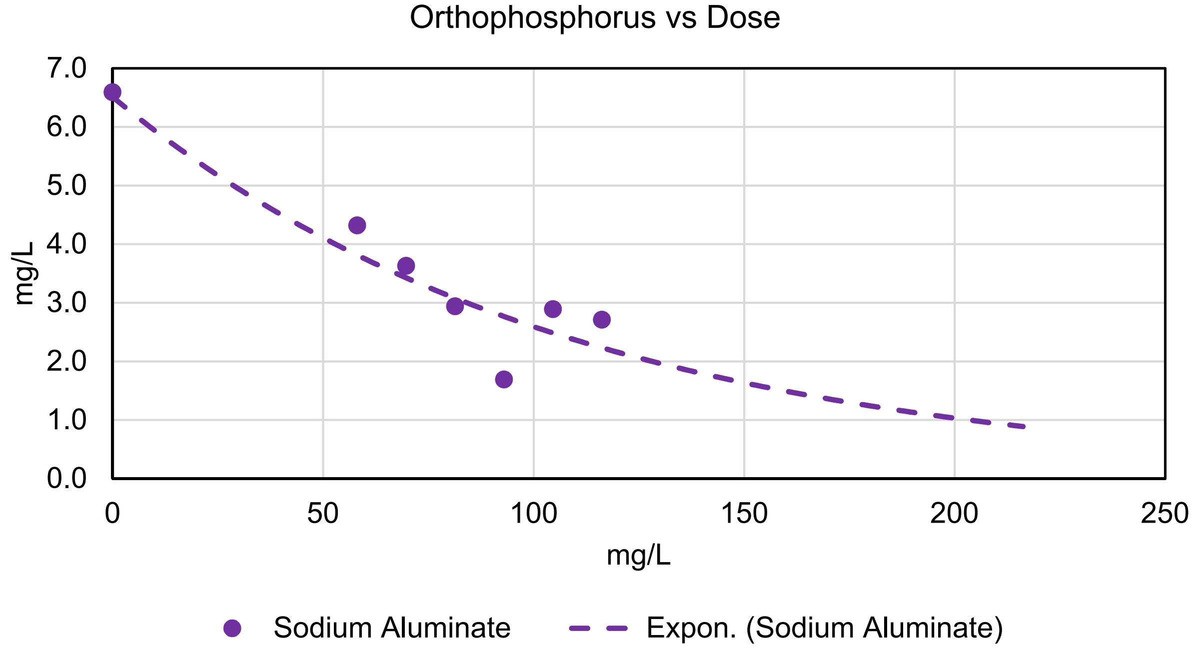


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 7.19 mg/L would appear to suggest a dose of 345 mg/L of ATS 809. This is completely ***unrealistic*** from a cost standpoint.

The impact of ATS 809 on pH on dosage is shown below. As long as the pH is above 6.50 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 235 mg/L would imply the pH would be above 6.5 S.U. which would be in compliance with the permit.

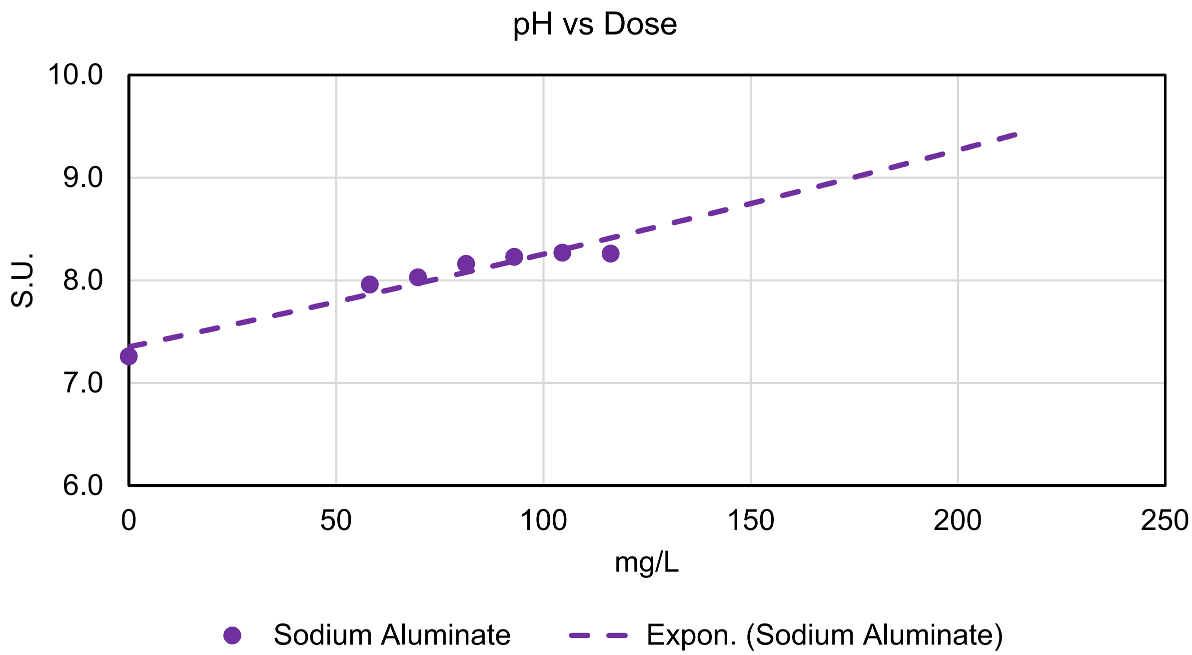


Fifteenth run (8/20 – 13:20) using Sodium Aluminate (at 100:1)

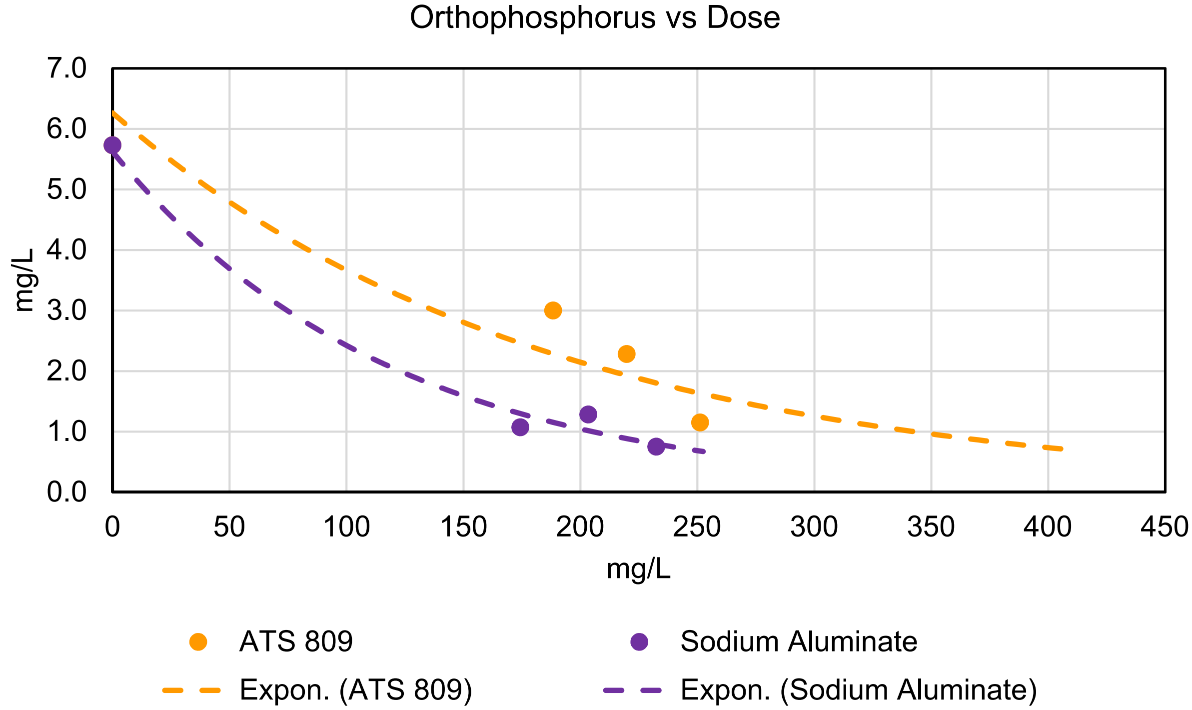


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 6.59 mg/L would appear to suggest a dose of 230 mg/L of Sodium Aluminate. This is completely ***unrealistic*** from a cost standpoint.

The impact of Sodium Aluminate on pH on dosage is shown below. Sodium Aluminate is a base so as long as the pH is below 9.00 Payson will remain in Permit compliance. Projecting pH curve out to a dose of 230 mg/L would imply the pH would be above 9.0 S.U. which would violate the permit.

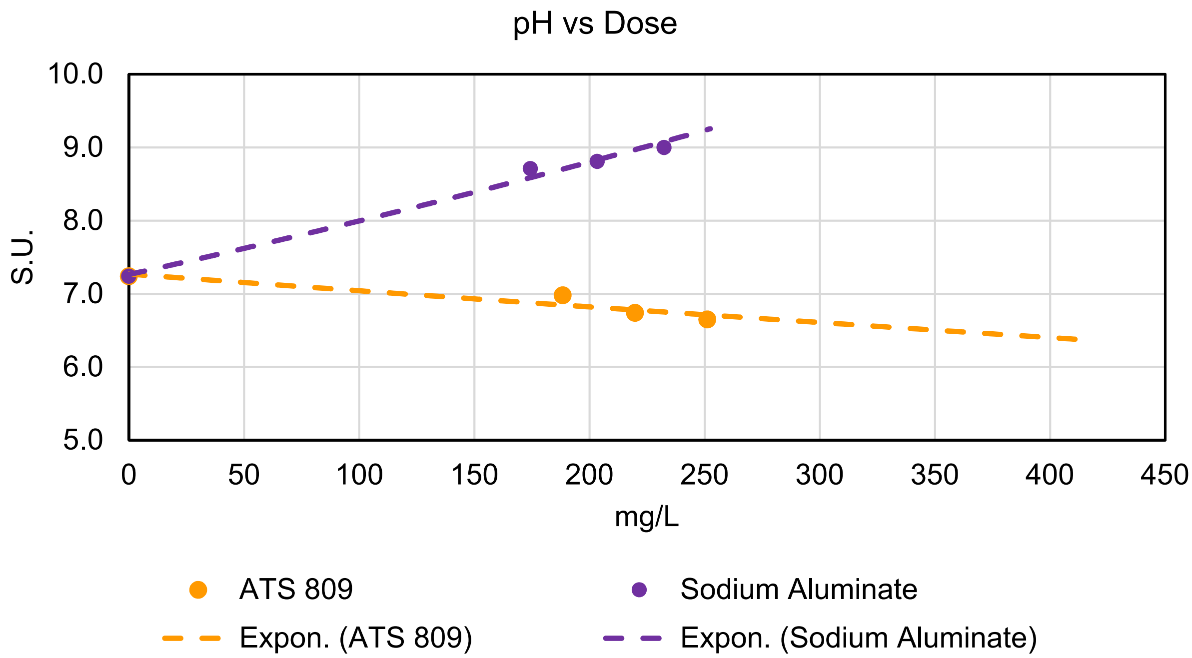


Sixteenth run (8/22 – 8:10) using ATS 809 and Sodium Aluminate (at 100:1)

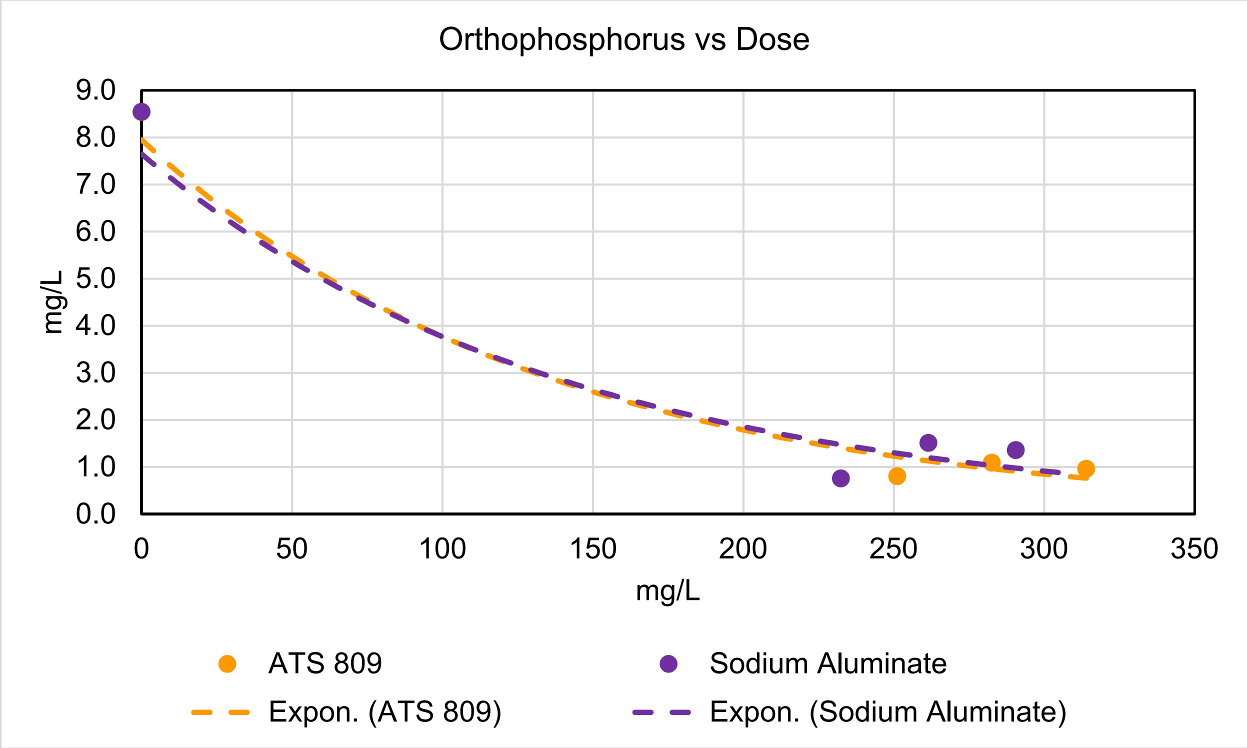


Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 5.73 mg/L would appear to suggest a dose of 415 mg/L of ATS 809, and a dose of 245 mg/L of Sodium Aluminate. Both of these are ***unrealistic*** from a cost standpoint.

The impact of ATS 809 and Sodium Aluminate on pH on dosage is shown below. Sodium Aluminate is a base so as long as the pH is below 9.00 and above 6.5 Payson will remain in Permit compliance. Projecting pH curves both would violate the permit.

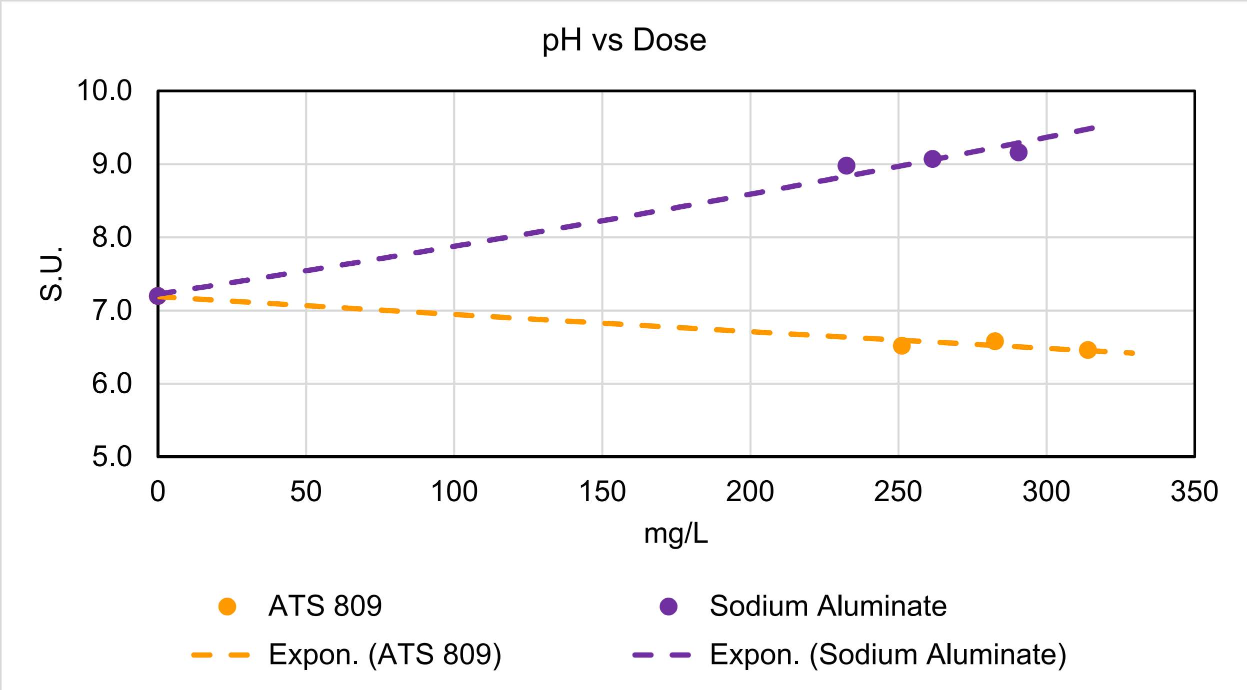


Seventeenth run (8/22 – 10:40) using ATS 809 and Sodium Aluminate (at 100:1)



Estimating from, the exponential curve fit the required dose to reach 0.80 mg/L from initial concentration 8.54 mg/L would appear to suggest a dose of 330 mg/L of ATS 809, and a dose of 320 mg/L of Sodium Aluminate. Both of these are ***unrealistic*** from a cost standpoint.

The impact of ATS 809 and Sodium Aluminate on pH on dosage is shown below. Sodium Aluminate is a base so as long as the pH is below 9.00 and above 6.5 Payson will remain in Permit compliance. Projecting pH curves both would violate the permit.

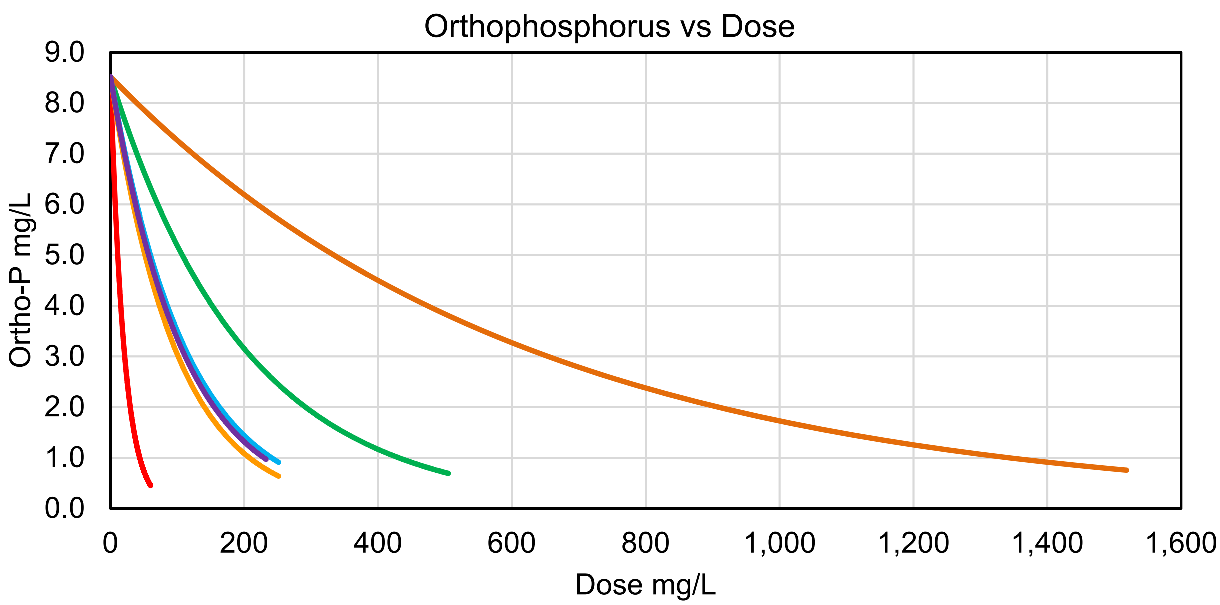


Eighteenth Run (8/26 – 8:00) This was a test using Ferric Chloride, Ferric Sulfate, Aluminum Sulfate, Sodium Aluminate, ATS 809 and RE300

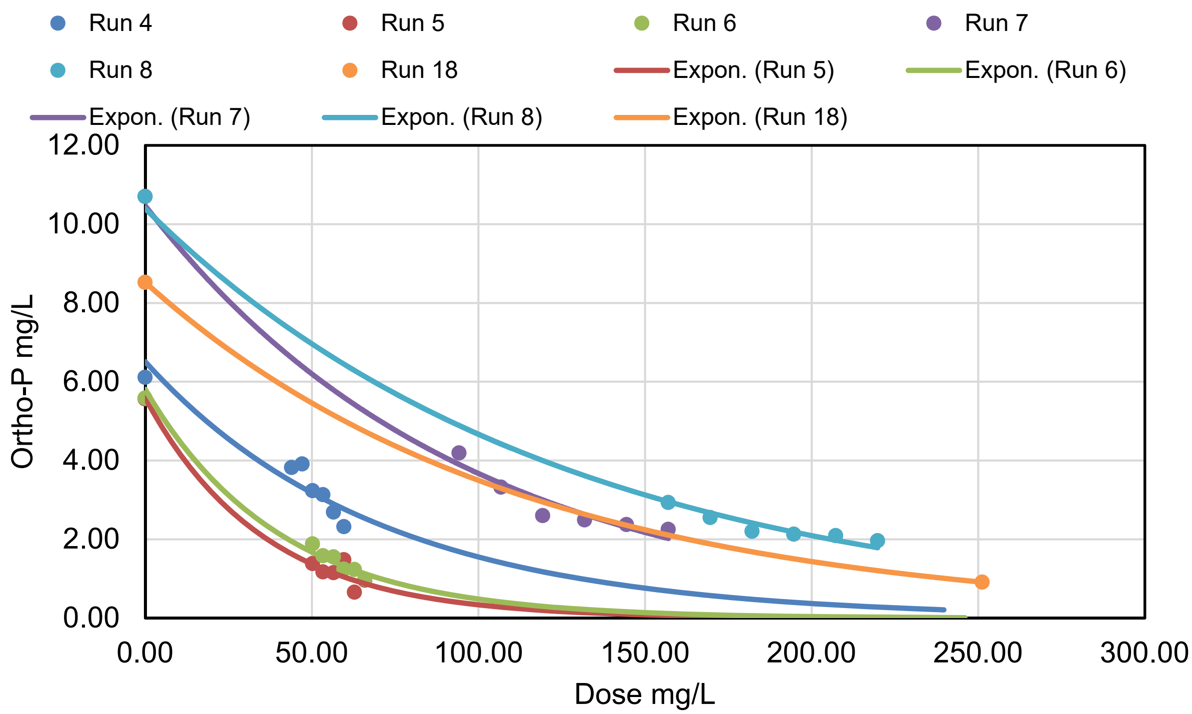
Each chemical was dose at 40 mL to see which would produce the lowest orthophosphorus, and the impact on pH. 40mL was used assuming that all would reach 0.80 mg/L.

Metal / Chemical		Dose mL	Dose mg/L	Initial OP mg/L	Final OP mg/L	Initial pH SU	Final pH SU
	Iron						
Ferric Chloride		40	455	8.52	0.89	7.36	**6.09**
Ferric Sulfate		40	1,518	8.52	0.76	7.36	**6.14**
	Aluminum						
Aluminum Sulfate		40	251	8.52	0.91	7.36	6.49
Sodium Aluminate		40	232	8.52	0.97	7.36	8.82
ATS 809		40	251	8.52	0.54	7.36	6.82
	Lanthanum-Cerium						
RE300		40	60	8.52	0.45	7.36	6.91

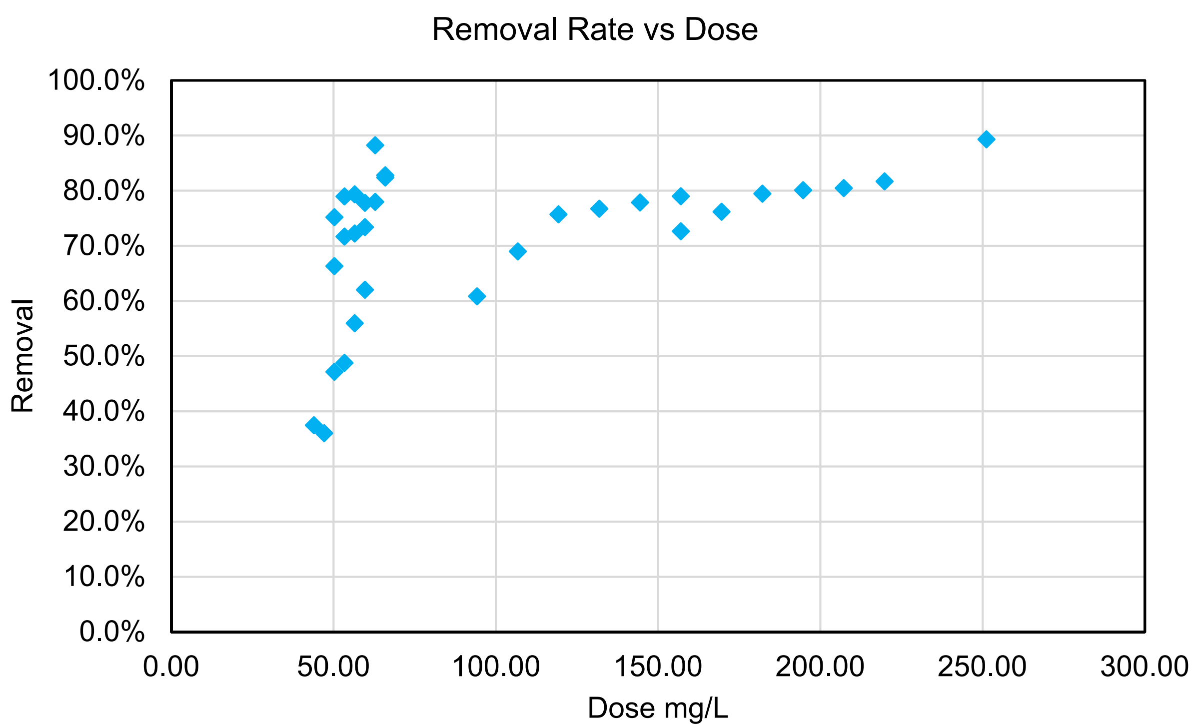
Plotting shows the Ferric Sulfate requiring the highest dose approximate 3 times the needed Ferric Chloride dose (as previously seem in the raw testing). Additionally, either would violate the Permit requirement of 6.5. All of the aluminum-based chemicals following similar dosing curves. And the Lanthanum/Cerium as expected required the lowest dose. Please note this are simple point only tests



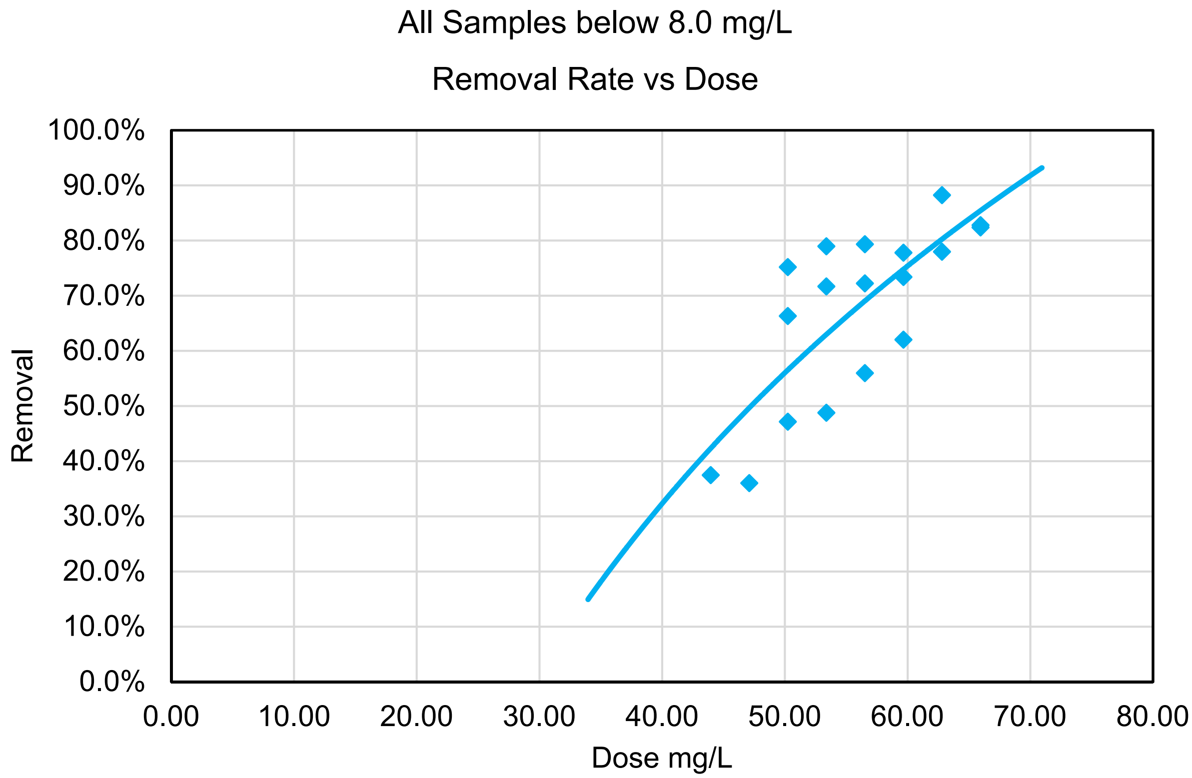
Compiling all of the exponential trendlines of the Aluminum Sulfate (Alum) samples as a visual check on repeatability gives the following graph.

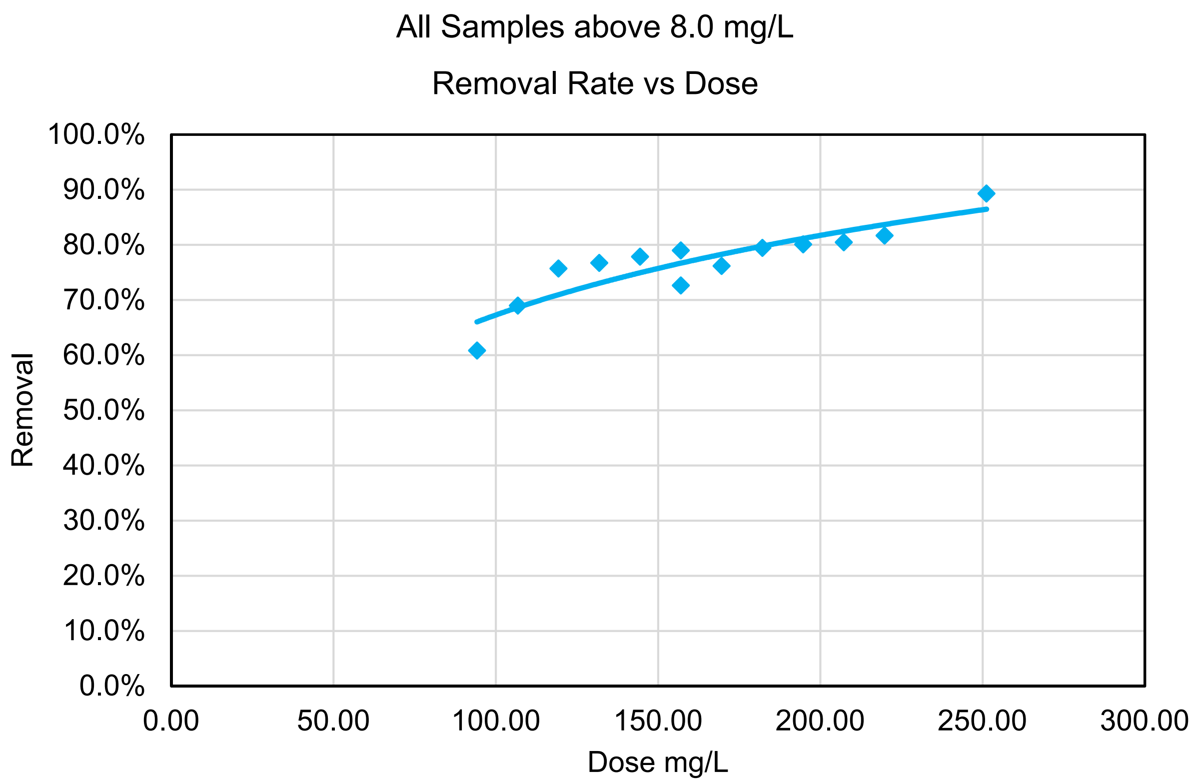


It is more interesting to look at the percent removal versus the dose.



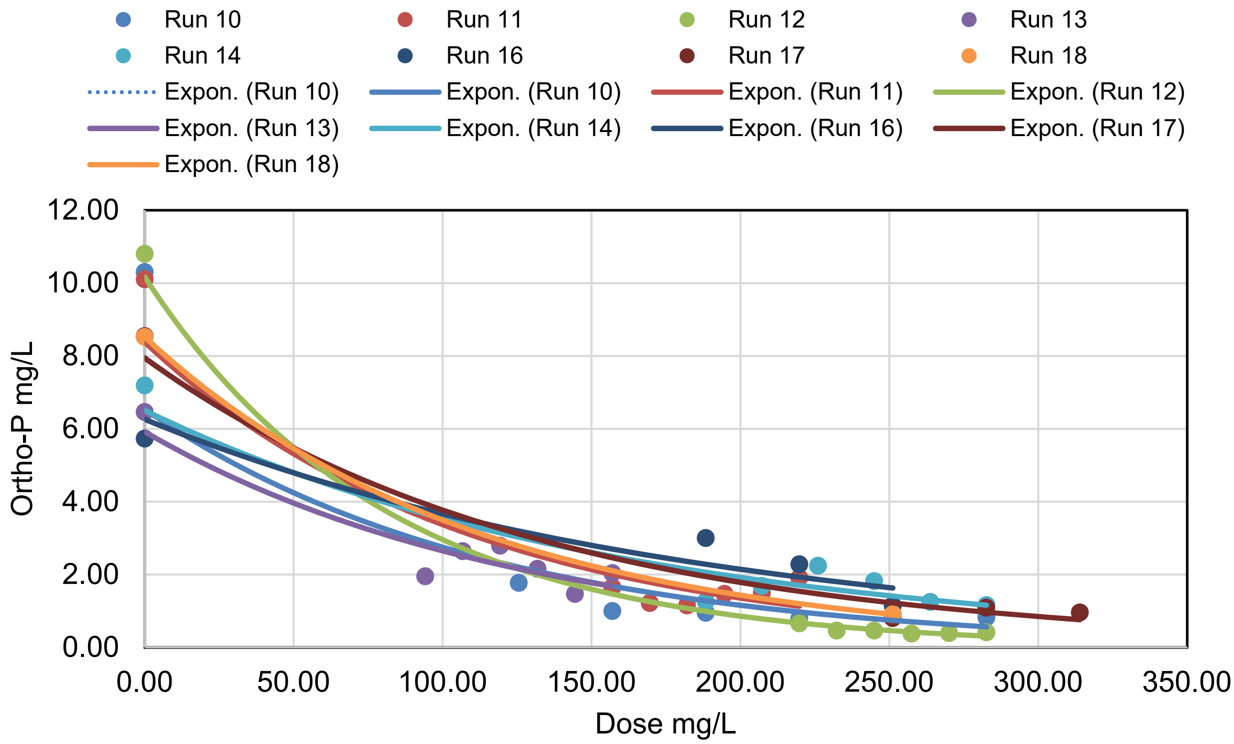
The above graph, appears to have two separate curves. Separating out the initial orthophosphorus samples into below 8.0 mg/L and above 8.0 mg/L, produces two differing curves.



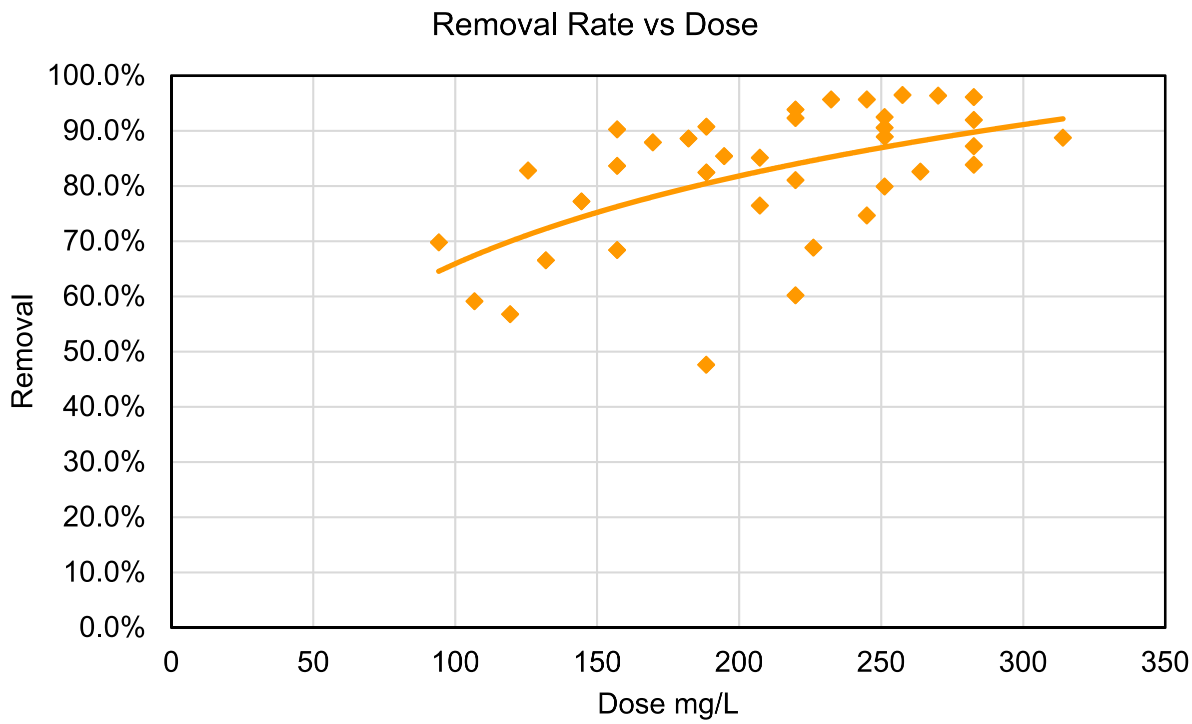


While this produces much better curve fits, it doesn't produce a general recommendation for dosage.

Compiling all of the exponential trendlines of the ATS 809 samples as a visual check on repeatability gives the following graph.

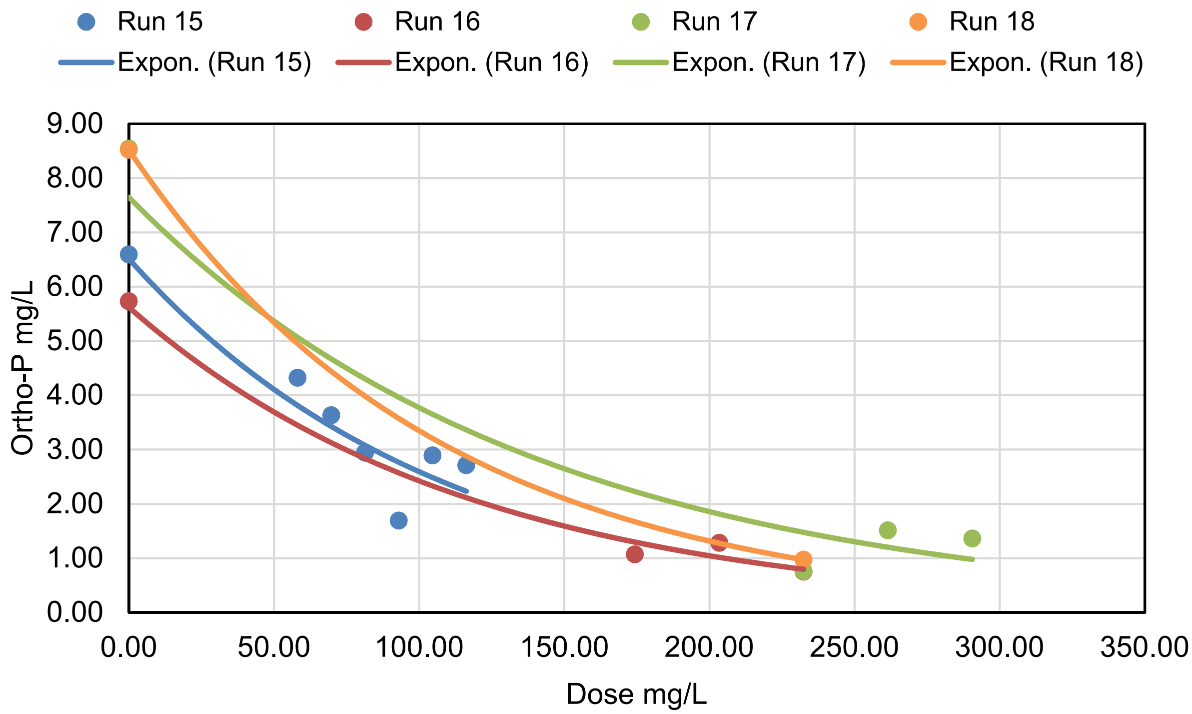


It is more interesting to look at the percent removal versus the dose.

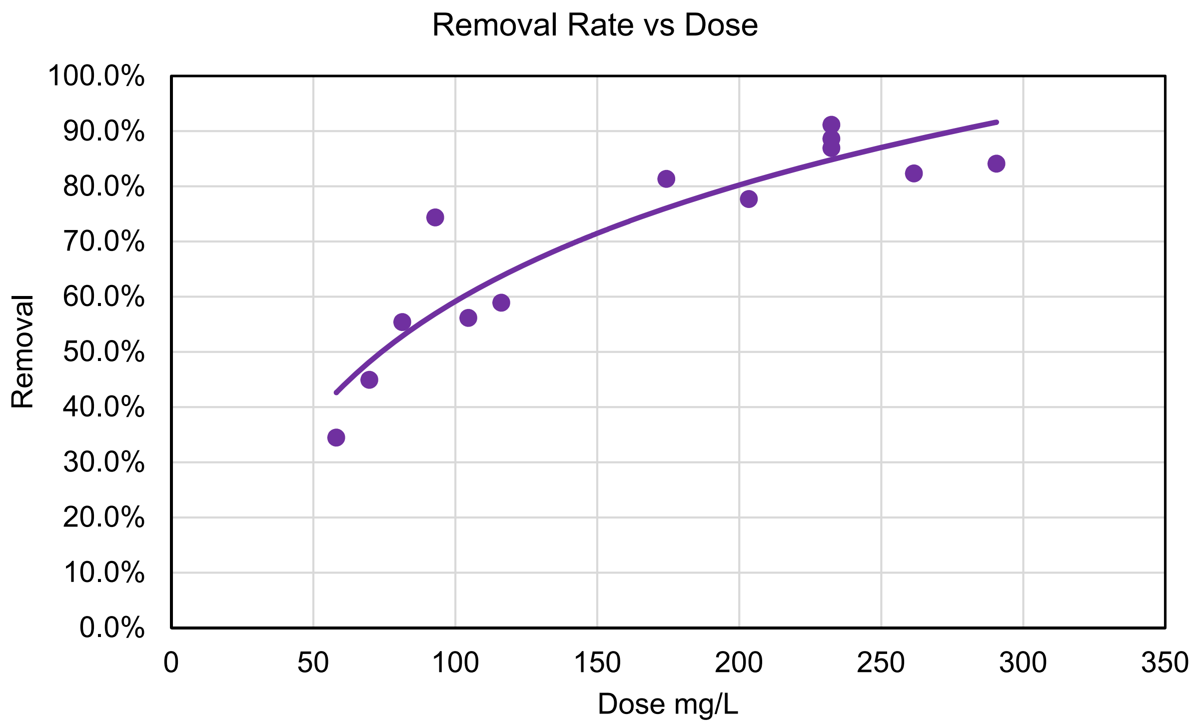


While this produces good curve fit, it doesn't produce a realistic recommendation for dosage it implies a need dose of 200 – 250 mg/L.

Compiling all of the exponential trendlines of the Sodium Aluminate samples as a visual check on repeatability gives the following graph.

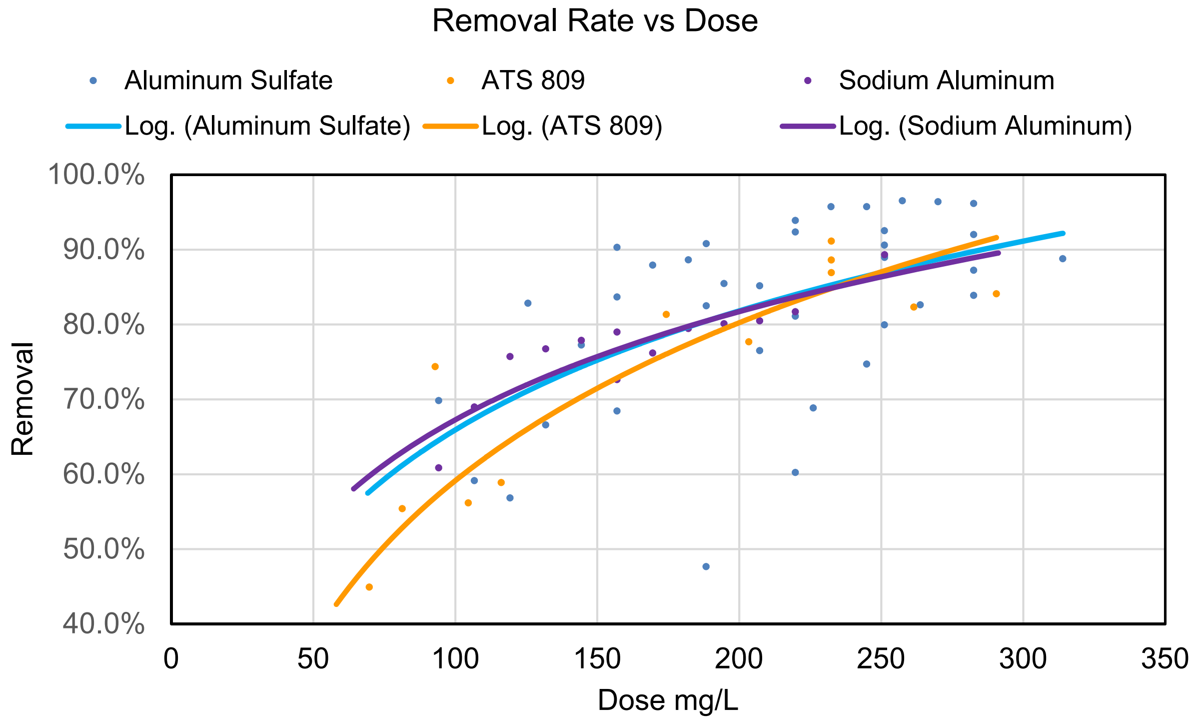


It is more interesting to look at the percent removal versus the dose.



While this produces good curve fit, it doesn't produce a realistic recommendation for dosage it implies a need dose of 200 – 250 mg/L.

Overlaying all of the Aluminum based chemicals



Based upon this graph the choice of chemical is more a cost consideration that a clear removal advantage.

Conclusions and Recommendations

The concentration of orthophosphorus that Payson needs to treat chemically is much higher than anticipated. The annual reported orthophosphorus in the effluent was 4.57 mg/L ranging from 3.20 mg/L to 5.50 mg/L. While the measured orthophosphorus during the testing averaged 7.94 mg/L ranging from 5.56 mg/L to 10.80 mg/L in the effluent. Payson will be able to meet the proposed phosphorus limit through chemical addition, but will require high doses. In order to reduce the overall chemical usage, use both Pre- and Post-precipitation. It appears that Payson could benefit from adding Ferric Chloride or Ferric Sulfate to the primary clarifiers to reduce the plant's phosphorus. Adding Iron here will have the additional benefit of increasing the density of the sludge in the primary clarifiers. By increasing density, this could reduce the volume pumped into the digestors. The potential for struvite formation will be reduced by this addition also. After the ultraviolet disinfection is installed Payson's choice for Post-precipitation chemical will be Aluminum based.

As the chemical is distributed throughout the aeration basin from return activated sludge, the actual dose may decrease. The impacted of the filtration should decrease the actual dose need also.

Recalculating theoretical dose of Iron versus Actual

Pounds of orthophosphorus to be removed

$$P\ \frac{lbs}{day} = 8.34\ \frac{lbs}{gal}\ x\ 2.00\ MGD\ x\ (7.94 - 0.80)\ \frac{mg}{L} \cong\ 120\frac{lbs}{day}$$

Calculate Required Dose of Iron to Remove Phosphorus

$$Dose\ Iron\ \frac{lbs}{day} = Phosphorus\ Removed\ \frac{lbs}{day}\ x\ Weight\ Ratio$$

Fe : P Weight Ratio = 1.8 : 1

$$Dose\ Iron\ \frac{lbs}{day} \cong 120\ \frac{lbs}{day}\ x\ 1.8\ \cong 216\ \frac{lbs}{day}$$

From Jar Testing

Assume a dose of 80 – 100 mg/L needed

$$Iron\ \frac{lbs}{day} = 8.34\ \frac{lbs}{gal}\ x\ 2.00\ MGD\ x\ 80\ \frac{mg}{L} \cong\ 1{,}325\frac{lbs}{day}$$

$$Iron\ \frac{lbs}{day} = 8.34\ \frac{lbs}{gal}\ x\ 2.00\ MGD\ x\ 100\ \frac{mg}{L} \cong\ 1{,}650\frac{lbs}{day}$$

Recalculating theoretical dose of Aluminum versus Actual

Pounds of orthophosphorus to be removed

$$P\ \frac{lbs}{day} = 8.34\ \frac{lbs}{gal}\ x\ 2.00\ MGD\ x\ (7.94 - 0.80)\ \frac{mg}{L} \cong\ 120\frac{lbs}{day}$$

$$Dose\ Aluminum\ \frac{lbs}{day} = Phosphorus\ Removed\ \frac{lbs}{day}\ x\ Weight\ Ratio$$

Dose of Aluminum to Remove Phosphorus

Al : P Weight Ratio = 0.87 : 1

$$Dose\ Aluminum\ \frac{lbs}{day} \cong 120\ \frac{lbs}{day}\ x\ 0.87\ \cong 105\ \frac{lbs}{day}$$

From Jar Testing

Assume a dose of 150 – 200 mg/L needed

$$Iron\ \frac{lbs}{day} = 8.34\ \frac{lbs}{gal}\ x\ 2.00\ MGD\ x\ 150\ \frac{mg}{L} \cong\ 2{,}500\frac{lbs}{day}$$

$$Iron\ \frac{lbs}{day} = 8.34\ \frac{lbs}{gal}\ x\ 2.00\ MGD\ x\ 200\ \frac{mg}{L} \cong\ 3{,}325\frac{lbs}{day}$$

The choice of which chemical to use will mainly depend on pricing that Payson can get from either Thatcher or ATS.

Appendix G

Detailed Cost Estimate

AQUA ENGINEERING
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Phone (801) 299-1327 Fax (801) 299-0153

Engineer's Opinion of Probable Cost
Client: Payson
5 MGD Expansion

ITEM	DESCRIPTION	Qty	Unit	Each	COST
Site Work and Yard Piping					
1	Sitework	1	lump	$100,000	$100,000
2	Yard Piping	1	lump	$200,000	$200,000
				Subtotal	$300,000
Plant Repairs					
3	Miscellaneous Upgrade	1	lump	$150,000	$150,000
				Subtotal	$150,000
Demolition					
4	Aeration Tank #1 & #2	800	ton	$50	$40,000
5	Aeration Tank Mechanical	1	lump	$5,000	$5,000
6	Old Trickling Filter Tank Concrete	350	ton	$50	$17,500
7	Trickling Filter Media Removal	3200	ton	$10	$32,000
8	Intermediate Clarifier	500	ton	$50	$25,000
9	Intermediate Clarifier Mechanical	1	lump	$5,000	$5,000
				Subtotal	$124,500
Headworks					
10	Building	250	sq ft	$150	$37,500
11	Screen	1	lump	$80,000	$80,000
12	Washpactor	1	lump	$50,000	$50,000
13	Installation	1	lump	$15,000	$15,000
				Subtotal	$182,500
Primary Lift Station					
14	Lift Station Basin	100	cu.yd.	$1,000	$100,000
15	Building	225	sq.ft.	$150	$33,750
16	Lift Pump	4	ea	$35,000	$140,000
17	Installation	1	lump	$50,000	$50,000
				Subtotal	$323,750
Anoxic Basin					
18	Eductor Mixer	4	basin	$15,000	$60,000
19	Concrete Basin	500	cu.yd.	$1,000	$500,000
20	Earthwork	6000	cu.yd.	$20	$120,000
21	Installation	1	lump	$136,000	$136,000
				Subtotal	$816,000

Aerobic Basin					
22	Concrete Basin	1400	cu.yd.	$1,000	$1,400,000
23	Earthwork	5000	cu.yd.	$20	$100,000
24	Diffuser	1	lump	$50,000	$50,000
25	Air Piping	1	lump	$80,000	$80,000
26	Blower	3	ea	$100,000	$300,000
27	Blower Building	1500	sq.ft.	$100	$150,000
28	Installation	1	lump	$100,000	$100,000
				Subtotal	$2,180,000
Primary Clarifier					
29	Clarifier Tanks	700	cu.yd.	$1,000	$700,000
30	Clarifier Mechanisms	3	ea	$300,000	$900,000
31	Clarifier Pumps	2	ea	$30,000	$60,000
32	Earthwork	10000	cu.yd.	$20	$200,000
33	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,930,000
Final Clarifier					
34	Clarifier Tank	350	cu.yd.	$1,000	$350,000
35	Clarifier Mechanism	2	ea	$300,000	$600,000
36	Clarifier Pump	1	ea	$30,000	$30,000
37	Earthwork	5000	cu.yd.	$20	$100,000
38	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,150,000
Digester					
39	Digester Tank	300	cu.yd.	$1,000	$300,000
40	Mixer	1	ea	$150,000	$150,000
41	Digester Cover	1	ea	$180,000	$180,000
42	Piping	1	lump	$150,000	$150,000
43	Earthwork	5000	cu.yd.	$20	$100,000
44	Installation	1	lump	$176,000	$176,000
				Subtotal	$1,056,000
Solid Handling					
45	Dewatering Mechanism	1	ea	$300,000	$300,000
46	Installation	1	lump	$60,000	$60,000
				Subtotal	$360,000
Chemical Storage					
47	Chemical Bulding	1200	sq. ft.	$100	$120,000
48	Chemical Storage Tank	2	ea	$40,000	$80,000
49	Chemical Pumps	4	ea	$8,000	$32,000
50	Installation	1	lump	$22,400	$22,400
				Subtotal	$254,400
UV Basin					
51	UV Lights	1	lump	$1,500,000	$1,500,000
52	Building	6000	sq.ft.	$100	$600,000
53	Installation	1	lump	$300,000	$300,000
				Subtotal	$2,400,000

Reuse Pump Station Remodel					
54	Piping Upgrades	1	lump	$30,000	$30,000
55	Pumps	4	ea	$20,000	$80,000
				Subtotal	$110,000
Filter Building Upgrade					
56	New Cloth Filters	1	lump	$810,000	$810,000
57	Installation	1	lump	$100,000	$100,000
				Subtotal	$910,000
Boiler & DAF Building					
58	DAF Building	12000	sq.ft.	$80	$960,000
59	Boiler	3	ea	$50,000	$150,000
60	Heat Exchanger	3	ea	$40,000	$120,000
61	Piping	1	ea	$70,000	$70,000
62	Installation	1	lump	$60,000	$60,000
				Subtotal	$1,360,000
Electrical					
63	Electrical and Instrumentation	20	%	$2,721,430.00	$2,721,430
				Subtotal	$2,721,430
				Construction Cost Subtotal	**$16,328,580**
				Contingency 20%	$3,265,716
				Construction Cost Total	$19,594,296
				Engineering, Construction Observation 10%	$1,959,430
				Legal & Permitting 5%	$979,715
				Total Probable Cost	**$22,533,440**

AQUA ENGINEERING
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Engineer's Opinion of Probable Cost
Client: Payson
5 MGD Expansion with ClearAs ABNR

ITEM	DESCRIPTION	Qty	Unit	Each	COST
Site Work and Yard Piping					
1	Sitework	1	lump	$100,000	$100,000
2	Yard Piping	1	lump	$200,000	$200,000
				Subtotal	$300,000
Plant Repairs					
3	Miscellaneous Upgrade	1	lump	$150,000	$150,000
				Subtotal	$150,000
Demolition					
4	Aeration Tank #1 & #2	800	ton	$45	$36,000
5	Aeration Tank Mechanical	1	lump	$5,000	$5,000
6	Old Trickling Filter Tank Concrete	350	ton	$45	$15,750
7	Trickling Filter Media Removal	3200	ton	$10	$32,000
8	Intermediate Clarifier	500	ton	$45	$22,500
9	Intermediate Clarifier Mechanical	1	lump	$5,000	$5,000
				Subtotal	$116,250
Headworks					
10	Building	250	sq ft	$100	$25,000
11	Screen	1	lump	$80,000	$80,000
12	Washpactor	1	lump	$50,000	$50,000
13	Installation	1	lump	$15,000	$15,000
				Subtotal	$170,000
Primary Lift Station					
14	Lift Station Basin	100	cu.yd.	$1,000	$100,000
15	Building	225	sq.ft.	$100	$22,500
16	Lift Pump	4	ea	$35,000	$140,000
17	Installation	1	lump	$50,000	$50,000
				Subtotal	$312,500
Aerobic Basin					
18	Concrete Basin	900	cu.yd.	$1,000	$900,000
19	Earthwork	3000	cu.yd.	$20	$60,000
20	Diffuser	1	lump	$50,000	$50,000
21	Air Piping	1	lump	$80,000	$80,000
22	Blower	3	ea	$100,000	$300,000
23	Blower Building	1500	sq.ft.	$100	$150,000
24	Installation	1	lump	$100,000	$100,000
				Subtotal	$1,640,000

Primary Clarifier					
25	Clarifier Tank	700	cu.yd.	$1,000	$700,000
26	Clarifier Mechanisms	3	ea	$300,000	$900,000
27	Clarifier Pump	2	ea	$30,000	$60,000
28	Earthwork	10000	cu.yd.	$20	$200,000
29	Installation	1	lump	$35,000	$35,000
				Subtotal	$1,895,000
Final Clarifier					
30	Clarifier Tank	350	cu.yd.	$1,000	$350,000
31	Clarifier Mechanism	2	ea	$300,000	$600,000
32	Clarifier Pump	1	ea	$30,000	$30,000
33	Earthwork	5000	cu.yd.	$20	$100,000
34	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,150,000
Digester					
35	Digester Tank	300	cu.yd.	$1,000	$300,000
36	Mixer	1	ea	$150,000	$150,000
37	Digester Cover	1	ea	$180,000	$180,000
38	Piping	1	lump	$150,000	$150,000
39	Earthwork	5000	cu.yd.	$20	$100,000
40	Installation	1	lump	$176,000	$176,000
				Subtotal	$1,056,000
Solid Handling					
41	Dewatering Mechanism	1	ea	$300,000	$300,000
42	Installation	1	lump	$60,000	$60,000
				Subtotal	$360,000
Advanced Biological Nutrient Removal (3MGD Bended Flow Treatment)					
43	Photobioreactor Equipment	1	lump	$6,820,000	$6,820,000
44	Monitoring Eq, Proves, Integration	1	lump	$590,000	$590,000
45	Membrane, Permeate Pump, Blowers	1	lump	$3,600,000	$3,600,000
46	Centrifuge, Dewatering Pump	1	lump	$1,370,000	$1,370,000
47	Wet well, Pumps, Prescreen	1	lump	$650,000	$650,000
48	Site Work, Yard Piping	1	lump	$500,000	$500,000
49	Separation Eq (i.e., air piping, tanks)	1	lump	$150,000	$150,000
50	Carbon Dioxide System	1	lump	$130,000	$130,000
51	Greenhouse	1	lump	$1,390,000	$1,390,000
				Subtotal	$15,200,000
UV Basin					
52	UV Lights	1	lump	$1,500,000	$1,500,000
53	Installation	1	lump	$300,000	$300,000
				Subtotal	$1,800,000
Reuse Pump Station Remodel					
54	Piping Upgrades	1	lump	$30,000	$30,000
55	Pumps	4	ea	$20,000	$80,000
				Subtotal	$110,000

Boiler & DAF Building					
56	DAF Building	12000	sq.ft.	$60	$720,000
57	Boiler	3	ea	$50,000	$150,000
58	Heat Exchanger	3	ea	$40,000	$120,000
59	Piping	1	ea	$70,000	$70,000
60	Installation	1	lump	$60,000	$60,000
				Subtotal	$1,120,000
Electrical					
61	Electrical and Instrumentation	15	%	$3,806,962.50	$3,806,963
				Subtotal	$3,806,963
				Construction Cost Subtotal	**$29,186,713**
				Contingency 20%	$5,837,343
				Construction Cost Total	$35,024,055
				Engineering, Construction Observation 10%	$3,502,406
				Legal & Permitting 5%	$1,751,203
				Total Probable Cost	**$40,277,663**

AQUA ENGINEERING
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Engineer's Opinion of Probable Cost
Client: Payson

5 MGD Expansion with ClearAs ABNR Aerobic Digestion

ITEM	DESCRIPTION	Qty	Unit	Each	COST
Site Work and Yard Piping					
1	Sitework	1	lump	$100,000	$100,000
2	Yard Piping	1	lump	$200,000	$200,000
				Subtotal	$300,000
Plant Repairs					
3	Miscellaneous Upgrade	1	lump	$150,000	$150,000
				Subtotal	$150,000
Demolition					
4	Aeration Tank #1 & #2	800	ton	$45	$36,000
				Subtotal	$36,000
Headworks					
5	Building	500	sq ft	$100	$50,000
6	Screen	1	lump	$80,000	$80,000
7	Washpactor	1	lump	$50,000	$50,000
8	Installation	1	lump	$15,000	$15,000
				Subtotal	$195,000
Primary Lift Station					
9	Lift Station Basin	100	cu.yd.	$1,000	$100,000
10	Building	225	sq.ft.	$100	$22,500
11	Lift Pump	4	ea	$35,000	$140,000
12	Installation	1	lump	$50,000	$50,000
				Subtotal	$312,500
Aerobic Basin					
13	Concrete Basin	1170	cu.yd.	$1,000	$1,170,000
14	Earthwork	3900	cu.yd.	$20	$78,000
15	Diffuser	1	lump	$80,000	$80,000
16	Air Piping	1	lump	$100,000	$100,000
17	Blower	3	ea	$120,000	$360,000
18	Blower Building	1500	sq.ft.	$100	$150,000
19	Installation	1	lump	$100,000	$100,000
				Subtotal	$2,038,000
Primary Clarifier					
25	Clarifier Tank	700	cu.yd.	$1,000	$700,000
26	Clarifier Mechanisms	3	ea	$300,000	$900,000
27	Clarifier Pump	2	ea	$30,000	$60,000
28	Earthwork	10000	cu.yd.	$20	$200,000
29	Installation	1	lump	$35,000	$35,000
				Subtotal	$1,895,000

Final Clarifier					
22	Clarifier Tank	350	cu.yd.	$1,000	$350,000
23	Clarifier Mechanism	2	ea	$300,000	$600,000
24	Clarifier Pump	1	ea	$30,000	$30,000
25	Earthwork	5000	cu.yd.	$20	$100,000
26	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,150,000
Convert Anaerobic Digester to Aerobic Eq Tanks					
27	Remove Existing Lids	1	Lump	$50,000	$50,000
28	Blowers	2	ea	$50,000	$100,000
29	Diffusers	1	Lump	$180,000	$180,000
30	Piping	1	lump	$50,000	$50,000
				Subtotal	$380,000
Solid Handling					
31	Dewatering Mechanism	2	ea	$300,000	$600,000
32	Installation	1	lump	$250,000	$250,000
				Subtotal	$850,000
Advanced Biological Nutrient Removal (3MGD Bended Flow Treatment)					
33	Photobioreactor Equipment	1	lump	$6,820,000	$6,820,000
34	Monitoring Eq, Proves, Integration	1	lump	$590,000	$590,000
35	Membrane, Permeate Pump, Blowers	1	lump	$3,600,000	$3,600,000
36	Centrifuge, Dewatering Pump	1	lump	$1,370,000	$1,370,000
37	Wet well, Pumps, Prescreen	1	lump	$650,000	$650,000
38	Site Work, Yard Piping	1	lump	$500,000	$500,000
39	Separation Eq (i.e., air piping, tanks)	1	lump	$150,000	$150,000
40	Carbon Dioxide System	1	lump	$130,000	$130,000
41	Greenhouse	1	lump	$1,390,000	$1,390,000
				Subtotal	$15,200,000
UV Basin					
42	UV Lights	1	lump	$700,000	$700,000
43	Installation	1	lump	$140,000	$140,000
				Subtotal	$840,000
Reuse Pump Station Remodel					
44	Piping Upgrades	1	lump	$30,000	$30,000
45	Pumps	4	ea	$20,000	$80,000
				Subtotal	$110,000
Electrical					
46	Electrical and Instrumentation	15	%	$3,518,475.00	$3,518,475
				Subtotal	$3,518,475
				Construction Cost Subtotal	**$26,974,975**
				Contingency 20%	$5,394,995
				Construction Cost Total	$32,369,970
				Engineering, Construction Observation 10%	$3,236,997
				Legal & Permitting 5%	$1,618,499
				Total Probable Cost	**$37,225,466**

AQUA ENGINEERING
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Engineer's Opinion of Probable Cost
Client: Payson
5 MGD Expansion Aerobic Stabilization

ITEM	DESCRIPTION	Qty	Unit	Each	COST
Site Work and Yard Piping					
1	Sitework	1	lump	$100,000	$100,000
2	Yard Piping	1	lump	$200,000	$200,000
				Subtotal	$300,000
Plant Repairs					
3	Miscellaneous Upgrade	1	lump	$150,000	$150,000
				Subtotal	$150,000
Demolition					
4	Aeration Tank #1 & #2	800	ton	$50	$40,000
5	Aeration Tank Mechanical	1	lump	$5,000	$5,000
6	Old Trickling Filter Tank Concrete	350	ton	$50	$17,500
7	Trickling Filter Media Removal	3200	ton	$10	$32,000
8	Intermediate Clarifier	500	ton	$50	$25,000
9	Intermediate Clarifier Mechanical	1	lump	$5,000	$5,000
				Subtotal	$124,500
Headworks					
10	Building	250	sq ft	$150	$37,500
11	Screen	1	lump	$80,000	$80,000
12	Washpactor	1	lump	$50,000	$50,000
13	Installation	1	lump	$15,000	$15,000
				Subtotal	$182,500
Primary Lift Station					
14	Lift Station Basin	100	cu.yd.	$1,000	$100,000
15	Building	225	sq.ft.	$150	$33,750
16	Lift Pump	4	ea	$35,000	$140,000
17	Installation	1	lump	$50,000	$50,000
				Subtotal	$323,750
Anoxic Basin					
18	Eductor Mixer	4	basin	$15,000	$60,000
19	Concrete Basin	500	cu.yd.	$1,000	$500,000
20	Earthwork	6000	cu.yd.	$20	$120,000
21	Installation	1	lump	$136,000	$136,000
				Subtotal	$816,000

Aerobic Basin					
22	Concrete Basin	1400	cu.yd.	$1,000	$1,400,000
23	Earthwork	5000	cu.yd.	$20	$100,000
24	Diffuser	1	lump	$50,000	$50,000
25	Air Piping	1	lump	$80,000	$80,000
26	Blower	3	ea	$100,000	$300,000
27	Blower Building	1500	sq.ft.	$100	$150,000
28	Installation	1	lump	$100,000	$100,000
				Subtotal	$2,180,000
Primary Clarifier					
29	Clarifier Tanks	700	cu.yd.	$1,000	$700,000
30	Clarifier Mechanisms	3	ea	$300,000	$900,000
31	Clarifier Pumps	2	ea	$30,000	$60,000
32	Earthwork	10000	cu.yd.	$20	$200,000
33	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,930,000
Final Clarifier					
34	Clarifier Tank	350	cu.yd.	$1,000	$350,000
35	Clarifier Mechanism	2	ea	$300,000	$600,000
36	Clarifier Pump	1	ea	$30,000	$30,000
37	Earthwork	5000	cu.yd.	$20	$100,000
38	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,150,000
Solid Handling					
39	Dewatering Mechanism	2	ea	$300,000	$600,000
40	Installation	1	lump	$120,000	$120,000
				Subtotal	$720,000
Chemical Storage					
41	Chemical Bulding	1200	sq. ft.	$100	$120,000
42	Chemical Storage Tank	2	ea	$40,000	$80,000
43	Chemical Pumps	4	ea	$8,000	$32,000
44	Installation	1	lump	$22,400	$22,400
				Subtotal	$254,400
UV Basin					
45	UV Lights	1	lump	$1,500,000	$1,500,000
46	Building	6000	sq.ft.	$100	$600,000
47	Installation	1	lump	$300,000	$300,000
				Subtotal	$2,400,000
Reuse Pump Station Remodel					
48	Piping Upgrades	1	lump	$30,000	$30,000
49	Pumps	4	ea	$20,000	$80,000
				Subtotal	$110,000

Filter Building Upgrade					
50	New Cloth Filters	1	lump	$810,000	$810,000
51	Installation	1	lump	$100,000	$100,000
				Subtotal	$910,000
Convert Anaerobic Digester to Aerobic Eq Tanks					
52	Remove Existing Lids	1	Lump	$50,000	$50,000
53	Blowers	2	ea	$50,000	$100,000
54	Diffusers	1	Lump	$180,000	$180,000
55	Piping	1	lump	$50,000	$50,000
				Subtotal	$380,000
Electrical					
56	Electrical and Instrumentation	20	%	$2,386,230.00	$2,386,230
				Subtotal	$2,386,230
				Construction Cost Subtotal	**$14,317,380**
				Contingency 20%	$2,863,476
				Construction Cost Total	$17,180,856
				Engineering, Construction Observation 10%	$1,718,086
				Legal & Permitting 5%	$859,043
				Total Probable Cost	**$19,757,984**

AQUA ENGINEERING
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Engineer's Opinion of Probable Cost
Client: Payson
3 MGD Expansion

ITEM	DESCRIPTION	Qty	Unit	Each	COST
Site Work and Yard Piping					
1	Sitework	1	lump	$70,000	$70,000
2	Yard Piping	1	lump	$150,000	$150,000
3	Miscellaneous	1	lump	$100,000	$100,000
				Subtotal	$320,000
Plant Repairs					
4	Miscellaneous Upgrade	1	lump	$150,000	$150,000
				Subtotal	$150,000
Demolition					
5	Aeration Tank #1 & #2	800	ton	$50	$40,000
6	Aeration Tank Mechanical	1	lump	$5,000	$5,000
7	Old Trickling Filter Tank Concrete	350	ton	$50	$17,500
8	Trickling Filter Media Removal	3200	ton	$10	$32,000
				Subtotal	$94,500
Aerobic Basin					
9	Concrete Basin	1000	cu.yd.	$1,000	$1,000,000
10	Earthwork	3000	cu.yd.	$20	$60,000
11	Diffuser	1	lump	$30,000	$30,000
12	Air Piping	1	lump	$50,000	$50,000
13	Blower	2	ea	$100,000	$200,000
14	Blower Building	1500	sq.ft.	$100	$150,000
15	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,560,000
Primary Clarifier					
16	Clarifier Tanks	350	cu.yd.	$1,000	$350,000
17	Clarifier Mechanisms	2	ea	$300,000	$600,000
18	Clarifier Pumps	1	ea	$30,000	$30,000
19	Earthwork	5000	cu.yd.	$20	$100,000
20	Installation	1	lump	$35,000	$35,000
				Subtotal	$1,115,000
Final Clarifier					
21	Clarifier Tank	350	cu.yd.	$1,000	$350,000
22	Clarifier Mechanism	2	ea	$300,000	$600,000
23	Clarifier Pump	1	ea	$30,000	$30,000
24	Earthwork	5000	cu.yd.	$20	$100,000
25	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,150,000

Solid Handling					
26	Dewatering Mechanism	1	ea	$300,000	$300,000
27	Installation	1	lump	$60,000	$60,000
				Subtotal	$360,000
Chemical Storage					
28	Chemical Building	1200	sq.ft.	$150	$180,000
29	Chemical Storage Tank	2	ea	$40,000	$80,000
30	Chemical Pumps	4	ea	$8,000	$32,000
31	Installation	1	lump	$22,400	$22,400
				Subtotal	$314,400
UV Basin					
32	UV Lights	1	lump	$600,000	$600,000
33	Building	6000	sq.ft.	$100	$600,000
34	Installation	1	lump	$120,000	$120,000
				Subtotal	$1,320,000
Reuse Pump Station Remodel					
35	Piping Upgrades	1	lump	$30,000	$30,000
36	Pumps	4	ea	$20,000	$80,000
				Subtotal	$110,000
Filter Building					
37	Disk Filters	1	lump	$600,000	$600,000
38	Installation	1	lump	$60,000	$60,000
				Subtotal	$660,000
Boiler & DAF Building					
39	DAF Building	12000	sq.ft.	$60	$720,000
40	Boiler	2	ea	$50,000	$100,000
41	Heat Exchanger	1	ea	$40,000	$40,000
42	Piping	1	ea	$50,000	$50,000
43	Installation	1	lump	$50,000	$50,000
				Subtotal	$960,000
Electrical					
44	Electrical and Instrumentation	20	%	$1,622,780.00	$1,622,780
				Subtotal	$1,622,780
				Construction Cost Subtotal	**$9,736,680**
				Contingency 20%	$1,947,336
				Construction Cost Total	$11,684,016
				Engineering, Construction Observation 10%	$1,168,402
				Legal & Permitting 5%	$584,201
				Total Probable Cost	**$13,436,618**

AQUA ENGINEERING
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Engineer's Opinion of Probable Cost
Client: Payson
3 MGD Expansion with ClearAs ABNR

ITEM	DESCRIPTION	Qty	Unit	Each	COST
Site Work and Yard Piping					
1	Sitework	1	lump	$70,000	$70,000
2	Yard Piping	1	lump	$150,000	$150,000
3	Miscellaneous	1	lump	$100,000	$100,000
				Subtotal	$320,000
Plant Repairs					
4	Miscellaneous Upgrade	1	lump	$150,000	$150,000
				Subtotal	$150,000
Demolition					
5	Aeration Tank #1 & #2	400	ton	$45	$18,000
6	Aeration Tank Mechanical	1	lump	$3,000	$3,000
7	Old Trickling Filter Tank Concrete	350	ton	$45	$15,750
8	Trickling Filter Media Removal	3200	ton	$10	$32,000
				Subtotal	$68,750
Aerobic Basin					
9	Concrete Basin	200	cu.yd.	$1,000	$200,000
10	Earthwork	3000	cu.yd.	$20	$60,000
11	Diffuser	1	lump	$15,000	$15,000
12	Air Piping	1	lump	$50,000	$50,000
13	Blower	2	ea	$100,000	$200,000
14	Blower Building	1500	sq.ft.	$100	$150,000
15	Installation	1	lump	$70,000	$70,000
				Subtotal	$745,000
Primary Clarifier					
16	Clarifier Tanks	350	cu.yd.	$1,000	$350,000
17	Clarifier Mechanisms	2	ea	$300,000	$600,000
18	Clarifier Pumps	1	ea	$30,000	$30,000
19	Earthwork	5000	ea	$20	$100,000
20	Installation	1	lump	$35,000	$35,000
				Subtotal	$1,115,000
Final Clarifier					
21	Clarifier Tank	350	cu.yd.	$1,000	$350,000
22	Clarifier Mechanism	2	ea	$300,000	$600,000
23	Clarifier Pump	1	ea	$30,000	$30,000
24	Earthwork	5000	cu.yd.	$20	$100,000
25	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,150,000

Solid Handling					
26	Dewatering Mechanism	1	ea	$300,000	$300,000
27	Installation	1	lump	$60,000	$60,000
				Subtotal	$360,000
Advanced Biological Nutrient Removal (2MGD Blended Flow Treatment)					
28	Photobioreactor Equipment	1	lump	$4,550,000	$4,550,000
29	Monitoring Eq, Proves, Integration	1	lump	$460,000	$460,000
30	Membrane, Permeate Pump, Blowers	1	lump	$2,600,000	$2,600,000
31	Centrifuge, Dewatering Pump	1	lump	$1,360,000	$1,360,000
32	Wet well, Pumps, Prescreen	1	lump	$490,000	$490,000
33	Site Work, Yard Piping	1	lump	$320,000	$320,000
34	Separation Eq (i.e., air piping, tanks)	1	lump	$100,000	$100,000
35	Carbon Dioxide System	1	lump	$90,000	$90,000
36	Greenhouse	1	lump	$1,000,000	$1,000,000
				Subtotal	$10,970,000
UV Basin					
37	UV Lights	1	lump	$600,000	$600,000
38	Installation	1	lump	$120,000	$120,000
				Subtotal	$720,000
Reuse Pump Station Remodel					
39	Piping Upgrades	1	lump	$30,000	$30,000
40	Pumps	4	ea	$20,000	$80,000
				Subtotal	$110,000
Boiler & DAF Building					
41	DAF Building	12000	sq.ft.	$60	$720,000
42	Boiler	2	ea	$50,000	$100,000
43	Heat Exchanger	1	ea	$40,000	$40,000
44	Piping	1	ea	$50,000	$50,000
45	Installation	1	lump	$50,000	$50,000
				Subtotal	$960,000
Electrical					
46	Electrical and Instrumentation	15	%	$2,500,312.50	$2,500,313
				Subtotal	$2,500,313
				Construction Cost Subtotal	**$19,169,063**
				Contingency 20%	$3,833,813
				Construction Cost Total	$23,002,875
				Engineering, Construction Observation 10%	$2,300,288
				Legal & Permitting 5%	$1,150,144
				Total Probable Cost	**$26,453,306**

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Engineer's Opinion of Probable Cost

Client: Payson

3 MGD Expansion with ClearAs ABNR With Aerobic Stabilization

ITEM	DESCRIPTION	Qty	Unit	Each	COST
Site Work and Yard Piping					
1	Sitework	1	lump	$70,000	$70,000
2	Yard Piping	1	lump	$150,000	$150,000
				Subtotal	$220,000
Plant Repairs					
4	Miscellaneous Upgrade	1	lump	$150,000	$150,000
					$150,000
Demolition					
5	Aeration Tank #1 & #2	800	ton	$45	$36,000
				Subtotal	$36,000
Aerobic Basin					
6	Concrete Basin	260	cu.yd.	$1,000	$260,000
7	Earthwork	3900	cu.yd.	$20	$78,000
8	Diffuser	1	lump	$30,000	$30,000
9	Air Piping	1	lump	$50,000	$50,000
10	Blower	2	ea	$120,000	$240,000
11	Blower Building	1500	sq.ft.	$100	$150,000
12	Installation	1	lump	$70,000	$70,000
				Subtotal	$878,000
Primary Clarifier					
13	Clarifier Mechanism	1	ea	$300,000	$300,000
14	Installation	1	lump	$35,000	$35,000
				Subtotal	$335,000
Final Clarifier					
15	Clarifier Tank	350	cu.yd.	$1,000	$350,000
16	Clarifier Mechanism	2	ea	$300,000	$600,000
17	Clarifier Pump	1	ea	$30,000	$30,000
18	Earthwork	5000	cu.yd.	$20	$100,000
19	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,150,000
Solid Handling					
20	Dewatering Mechanism	2	ea	$350,000	$700,000
21	Installation	1	lump	$250,000	$250,000
				Subtotal	$950,000

Advanced Biological Nutrient Removal (2MGD Blended Flow Treatment)					
22	Photobioreactor Equipment	1	lump	$4,550,000	$4,550,000
23	Monitoring Eq, Proves, Integration	1	lump	$460,000	$460,000
24	Membrane, Permeate Pump, Blowers	1	lump	$2,600,000	$2,600,000
25	Centrifuge, Dewatering Pump	1	lump	$1,360,000	$1,360,000
26	Wet well, Pumps, Prescreen	1	lump	$490,000	$490,000
27	Site Work, Yard Piping	1	lump	$320,000	$320,000
28	Separation Eq (i.e., air piping, tanks)	1	lump	$100,000	$100,000
29	Carbon Dioxide System	1	lump	$90,000	$90,000
30	Greenhouse	1	lump	$1,000,000	$1,000,000
				Subtotal	$10,970,000
Convert Anaerobic Digester to Aerobic Eq Tanks					
31	Remove Existing Lids	1	Lump	$50,000	$50,000
32	Blowers	2	ea	$50,000	$100,000
33	Diffusers	1	Lump	$180,000	$180,000
34	Piping	1	lump	$50,000	$50,000
				Subtotal	$380,000
UV Basin					
35	UV Lights	1	lump	$600,000	$600,000
36	Installation	1	lump	$60,000	$60,000
				Subtotal	$660,000
Reuse Pump Station Remodel					
37	Piping Upgrades	1	lump	$30,000	$30,000
38	Pumps	4	ea	$20,000	$80,000
				Subtotal	$110,000
Electrical					
39	Electrical and Instrumentation	15	%	$2,375,850	$2,375,850
				Subtotal	$2,375,850
				Construction Cost Subtotal	**$18,214,850**
				Contingency 20%	$3,642,970
				Construction Cost Total	$21,857,820
				Engineering, Construction Observation 10%	$2,185,782
				Legal & Permitting 5%	$1,092,891
				Total Probable Cost	**$25,136,493**

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Engineer's Opinion of Probable Cost
Client: Payson
3 MGD Expansion

ITEM	DESCRIPTION	Qty	Unit	Each	COST
Site Work and Yard Piping					
1	Sitework	1	lump	$70,000	$70,000
2	Yard Piping	1	lump	$150,000	$150,000
3	Miscellaneous	1	lump	$100,000	$100,000
				Subtotal	$320,000
Plant Repairs					
4	Miscellaneous Upgrade	1	lump	$150,000	$150,000
				Subtotal	$150,000
Demolition					
5	Aeration Tank #1 & #2	800	ton	$50	$40,000
6	Aeration Tank Mechanical	1	lump	$5,000	$5,000
7	Old Trickling Filter Tank Concrete	350	ton	$50	$17,500
8	Trickling Filter Media Removal	3200	ton	$10	$32,000
				Subtotal	$94,500
Aerobic Basin					
9	Concrete Basin	1000	cu.yd.	$1,000	$1,000,000
10	Earthwork	3000	cu.yd.	$20	$60,000
11	Diffuser	1	lump	$30,000	$30,000
12	Air Piping	1	lump	$50,000	$50,000
13	Blower	2	ea	$100,000	$200,000
14	Blower Building	1500	sq.ft.	$100	$150,000
15	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,560,000
Primary Clarifier					
16	Clarifier Tanks	350	cu.yd.	$1,000	$350,000
17	Clarifier Mechanisms	2	ea	$300,000	$600,000
18	Clarifier Pumps	1	ea	$30,000	$30,000
19	Earthwork	5000	cu.yd.	$20	$100,000
20	Installation	1	lump	$35,000	$35,000
				Subtotal	$1,115,000
Final Clarifier					
21	Clarifier Tank	350	cu.yd.	$1,000	$350,000
22	Clarifier Mechanism	2	ea	$300,000	$600,000
23	Clarifier Pump	1	ea	$30,000	$30,000
24	Earthwork	5000	cu.yd.	$20	$100,000
25	Installation	1	lump	$70,000	$70,000
				Subtotal	$1,150,000

Solid Handling					
26	Dewatering Mechanism	1	ea	$300,000	$300,000
27	Installation	1	lump	$60,000	$60,000
				Subtotal	$360,000
Chemical Storage					
28	Chemical Building	1200	sq.ft.	$150	$180,000
29	Chemical Storage Tank	2	ea	$40,000	$80,000
30	Chemical Pumps	4	ea	$8,000	$32,000
31	Installation	1	lump	$22,400	$22,400
				Subtotal	$314,400
UV Basin					
32	UV Lights	1	lump	$600,000	$600,000
33	Building	6000	sq.ft.	$100	$600,000
34	Installation	1	lump	$120,000	$120,000
				Subtotal	$1,320,000
Reuse Pump Station Remodel					
35	Piping Upgrades	1	lump	$30,000	$30,000
36	Pumps	4	ea	$20,000	$80,000
				Subtotal	$110,000
Filter Building					
37	Disk Filters	1	lump	$600,000	$600,000
38	Installation	1	lump	$60,000	$60,000
				Subtotal	$660,000
Convert Anaerobic Digester to Aerobic Eq Tanks					
39	Remove Existing Lids	1	Lump	$50,000	$50,000
40	Blowers	2	ea	$50,000	$100,000
41	Diffusers	1	Lump	$180,000	$180,000
42	Piping	1	lump	$50,000	$50,000
				Subtotal	$380,000
Electrical					
43	Electrical and Instrumentation	20	%	$1,506,780.00	$1,506,780
				Subtotal	$1,506,780
				Construction Cost Subtotal	**$9,040,680**
				Contingency 20%	$1,808,136
				Construction Cost Total	$10,848,816
				Engineering, Construction Observation 10%	$1,084,882
				Legal & Permitting 5%	$542,441
				Total Probable Cost	**$12,476,138**