Utah Division of Water Quality
Statement of Basis
ADDENDUM
Wasteload Analysis and Antidegradation Level I Review
Facility Upgrade and Expansion– Preliminary WLA Intended for Planning Purposes

Date:	**October 28, 2020**
Prepared by:	**Nicholas von Stackelberg, P.E.** **Watershed Protection Section**
Facility:	**Spanish Fork Wastewater Treatment Plant** **UPDES No. UT0021741**
Receiving water:	**Dry Creek (2B, 3E, 4)** **Provo Bay/Utah Lake (2A, 3B, 3D, 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.

Discharge
Outfall 001: Discharge pipe to Dry Creek.

The maximum daily design discharge is 10.4 MGD and the maximum monthly design discharge is 8.4 MGD for the facility.

Receiving Water
The receiving water for Outfall 001 is Dry Creek, which drains to Provo Bay of Utah Lake.

Per UAC R317-2-13.5.c, the designated beneficial uses for Dry Creek and tributaries from Utah Lake (Provo Bay) to Highway-US are 2B, 3E, 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 3E -- Severely habitat-limited waters. Narrative standards will be applied to protect these waters for aquatic wildlife.*
- *Class 4 - Protected for agricultural uses including irrigation of crops and stock watering.*

Per UAC R317-2-8 Protection of Downstream Uses, all actions to control waste discharges under these rules shall be modified as necessary to protect downstream designated uses. Since the aquatic life use class for Dry Creek (3E) only has narrative standards, the numeric standards for Utah Lake (Provo Bay) were used to determine the aquatic life use WQBELs for this discharge. Per UAC R317-2-13.12.x, the designated beneficial uses for Utah Lake are 2A, 3B, 3D, and 4.

- *Class 2A - Protected for frequent primary contact recreation where there is a high likelihood of ingestion of water or a high degree of bodily contact with the water. Examples include, but are not limited to, swimming, rafting, kayaking, diving, and water skiing.*
- *Class 3B -- Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.*
- *Class 3D -- Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.*

Water Quality Standards

Numeric criteria based on designated beneficial uses are specified in UAC R317-2-14. In addition, narrative water quality standards must not be violated per UAC R317-2-7.2:

> *It shall be unlawful, and a violation of these rules, for any person 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 bioassay or other tests performed in accordance with standard procedures; or determined by biological assessments in Subsection R317-2-7.3.*

Critical Low Flow

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 Dry Creek, the 20th percentile of flow measurements from monitoring site 4996030 Dry Creek above Spanish Fork WWTP was calculated to estimate seasonal critical low flow in the receiving water (Table 1). The flows for an unnamed channel that discharges into Dry Creek near the outlet to Provo Bay was estimated from monitoring site 4996044 Drainage Canal 0.5 mile below I-15 at about 2500 West, Springville.

Table 1: Seasonal critical low flow

Season	Dry Creek (cfs)	Unnamed Channel Flow (cfs)
Summer	7.7	3.8
Fall	13.2	3.8
Winter	13.2	3.8
Spring	10.2	3.8

Impaired Waters and Total Maximum Daily Loads (TMDL)

Dry Creek (Assessment Unit UT16020202-035) is not listed as impaired for any parameters according to the 303(d) list in *Utah's 2016 Integrated Report* (UDWQ 2016). Provo Bay (Assessment Unit UT-L-16020201-004_02) is listed as impaired for total phosphorus, ammonia and PCBs in fish tissue. Utah Lake (Assessment Unit UT-L-16020201-004_01) is listed as impaired for harmful algal blooms, total phosphorus, total dissolved solids and PCBs in fish tissue. No TMDLs have been approved for these impairments.

Mixing Zone

Per UAC R317-2-5, the discharge is considered instantaneously fully mixed since the discharge is more than half the background receiving water 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 under contract by Utah State University (USU) (Neilson et al. 2012). The model was calibrated to synoptic survey data collected in the summer of 2010 by USU and DWQ. The model extends from immediately above the plant discharge to upstream of the crossing at North Main Street (approximately 0.85 km).

The QUAL2Kw model of Dry Creek was extended to Provo Bay based on physiographic information from Google Earth and site data collected by DWQ staff (approximately 5.15 km total). To validate the model parameterization, an additional synoptic survey was conducted by DWQ staff in October 2012 using standard operating procedures (DWQ 2020). Both the QUAL2Kw calibration and validation models are available for review by request.

A wasteload QUAL2Kw model was built based on the calibrated model and using seasonal flow and water quality data for the receiving water. Receiving water quality data was obtained from monitoring site 4996030 Dry Creek above Spanish Fork WWTP. The average seasonal value was calculated for each constituent with available data in the receiving water. The wasteload model is available for review by request.

The QUAL2Kw model was used for determining the WQBELs related to eutrophication and low dissolved oxygen, including ammonia. 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. QUAL2Kw rates, input and output are summarized in Appendix A.

A mass balance mixing analysis was conducted for conservative constituents such as dissolved metals. The WQBELs determined using the mass balance mixing analysis are summarized in Appendix B.

The limits for total residual chlorine were dependent on travel time and decay rate. The travel time was determined by adding the travel time in the outlet pipe (2,700 linear feet) to the travel time in Dry Creek prior to discharge to Provo Bay (per travel time in QUAL2Kw). Based on field sampling conducted by AQUA Engineering (2014), an average decay rate of 29.9 /day at 20 ºC was used for determining chlorine decay through the outlet pipe and Dry Creek. The analysis for TRC is summarized in Appendix C.

Ammonia Limits

The QUAL2Kw model was utilized to determine seasonal limits for ammonia. Ammonia exerts an oxygen demand on the water column through nitrification to nitrate and is toxic to aquatic life above certain thresholds that are pH and temperature dependent. Seasonal limits were determined that meet both in-stream DO criteria and in-stream toxicity criteria.

The pH and temperature of the discharge from the existing plant were assumed appropriate for the upgraded and expanded facility. Annual average pH and seasonal average temperature was used for determining chronic limits (30-day average) and maximum pH was used for determining acute limits (1-hour).

In 2013, EPA adopted new criteria for ammonia that are lower than current criteria based on the presence of unionid mussels and nonpulmonate snails. States are required to adopt the criteria or establish alternative, scientifically defensible criteria. Utah is initiating studies to support adoption of new ammonia criteria. For planning purposes, ammonia limits were calculated to meet the new criteria assuming presence of the most sensitive species (Table 3). Acute limits were only evaluated up to the current permit limit of 18.0 mg/l).

Table 3: Ammonia Limits to Meet EPA 2013 Ammonia Criteria with Mussels Present

Effluent Constituent	Acute			Chronic		
	Standard	Limit	Averaging Period	Standard	Limit	Averaging Period
Ammonia (mg/l) [Toxicity]						
Summer		18.0			3.0	
Fall	Varies	18.0	1 hour	Varies	4.0	30 days
Winter		18.0			4.0	
Spring		18.0			4.0	

Whole Effluent Toxicity (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. Per UAC R317-2-5, at no time shall concentrations within the mixing zone be allowed which are acutely lethal as determined by bioassay. Therefore, the WET limit for LC_{50} is 100% effluent for all seasons.

Table 2: WET Limits for IC_{25}

Season	Percent Effluent
Summer	63%
Fall	50%
Winter	50%
Spring	56%

Effluent Limits

The effect of the effluent on the DO in the receiving water was evaluated using the QUAL2Kw model. A large amount of filamentous benthic algae growth was observed and predicted in the model downstream of the treatment plant discharge, resulting in a DO sag and high diel range. Other factors contributing to the low minimum DO include low reaeration rate due to the flat gradient of Dry Creek, decay of BOD in the effluent, and sediment oxygen demand (SOD) resulting from decomposition of organic matter. The DO sag recovered somewhat within the model extents; however, in order to meet the minimum DO standard at the mouth of Dry Creek at Provo Bay, ammonia had to be limited during the summer (Table 4).

Table 4: Water Quality Based Effluent Limits Summary

Effluent Constituent	Acute			Chronic		
	Standard[a]	Limit	Averaging Period	Standard[a]	Limit	Averaging Period
Flow (MGD)		10.4	1 day		8.4	30 days
Min. Dissolved Oxygen (mg/L)	5.0	5.0	Instantaneous	5.5	5.0	30 days
BOD_5 (mg/L)[c]	None	35	7 days	None	25	30 days
Ammonia (mg/L)						
Summer		18[b]			6	
Fall	Varies	18[b]	1 hour	Varies	6	30 days
Winter		18[b]			6	
Spring		18[b]			9	
Total Residual Chlorine (mg/L)						
Summer		45.8			181.7	
Fall	0.019	5.4	1 hour	0.011	7.3	4 days
Winter		2.6			3.1	
Spring		4.7			6.2	

a: Applicable standard in Provo Bay.
b: Limit from previous permit – meets water quality standards for this analysis.
c: Limits based on Utah Secondary Treatment Standards (*UAC R317-1-3.2*).

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 required for this discharge, as this wasteload is for an increased discharge of pollutants to the receiving water.

Documents:

WLA Document: *SpanishForkWLA_Upgrade_2020-10-28.docx*
QUAL2Kw Models:
Calibration: *Qual2kw Spanish Fork 1.1a.xls*
Validation: *spanish_fork_val_2012_v2.xlsm*
Wasteload: *SpanishForkWLA_2020Upgrade.xlsm*

References:

AQUA Engineering. 2014. *Spanish Fork City Waste-Load Parameters for Wastewater Discharge Permit*. City of Spanish Fork.

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 State University Department of Civil and Environmental Engineering and Utah Department of Environmental Quality, Division of Water Quality.

Utah Division of Water Quality. 2012a. *Field Data Collection for QUAL2Kw Model Build and Calibration Standard Operating Procedures Version 1.0*.

Utah Division of Water Quality. 2012b. *Utah Wasteload Analysis Procedures Version 1.0*.

Utah Division of Water Quality. 2020. *QUAL2Kw Model Validation Report for Dry Creek/Spanish Fork WWTP.*

WASTELOAD ANALYSIS [WLA] Date: 10/28/2020

Appendix A: QUAL2Kw Analysis for Eutrophication

Discharging Facility:	Spanish Fork WWTP		
UPDES No:	UT-0021741		
Permit Flow [MGD]:	8.40	Maximum Monthly Flow	
	10.40	Maximum Daily Flow	
Receiving Water:	Dry Creek		
Stream Classification:	2B, 3E, 4		
Stream Flows [cfs]:	7.66	Summer (July-Sept)	Critical Low Flow
	13.20	Fall (Oct-Dec)	
	13.20	Winter (Jan-Mar)	
	10.20	Spring (Apr-June)	
Acute River Width:	100.0%		
Chronic River Width:	100.0%		

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)	7.7	13.2	13.2	10.2
Temperature (deg C)	23.6	8.1	6.3	13.2
Specific Conductance (µmhos)	950	950	950	950
Inorganic Suspended Solids (mg/L)	59.8	52.4	58.7	47.7
Dissolved Oxygen (mg/L)	8.7	11.2	12.3	10.5
$CBOD_5$ (mg/L)	1.5	1.5	1.5	3.2
Organic Nitrogen (mg/L)	0.519	0.354	0.425	0.729
NH4-Nitrogen (mg/L)	0.044	0.076	0.118	0.090
NO3-Nitrogen (mg/L)	2.468	3.484	3.457	2.000
Organic Phosphorus (mg/L)	0.009	0.109	0.209	0.309
Inorganic Ortho-Phosphorus (mg/L)	0.082	0.982	1.882	2.782
Phytoplankton (µg/L)	3.7	3.7	3.7	3.7
Detritus [POM] (mg/L)	6.6	3.1	4.0	4.9
Alkalinity (mg/L)	321	353	386	324
pH	8.0	8.2	8.2	8.0

Discharge Information

Chronic	Summer	Fall	Winter	Spring
Flow (cfs)	8.4	8.4	8.4	8.4
Temperature (deg C)	20.1	14.7	11.2	14.5
Inorganic Suspended Solids (mg/L)	5.9	1.1	0.0	5.7
Organic Nitrogen (mg/L)	5.953	6.840	4.576	6.386
NO3-Nitrogen (mg/L)	7.425	9.175	6.347	7.135
Organic Phosphorus (mg/L)	0.200	0.200	0.200	0.200
Inorganic Phosphorus (mg/L)	0.800	0.800	0.800	0.800
Alkalinity (mg/L)	314	308	339	317
pH	7.5	7.5	7.5	7.5

Acute	Summer	Fall	Winter	Spring
Flow (cfs)	10.4	10.4	10.4	10.4
Temperature (deg C)	20.1	14.7	11.2	14.5
Inorganic Suspended Solids (mg/L)	5.9	1.1	0.0	5.7
Organic Nitrogen (mg/L)	5.953	6.840	4.576	6.386
NO3-Nitrogen (mg/L)	7.425	9.175	6.347	7.135
Organic Phosphorus (mg/L)	0.200	0.200	0.200	0.200
Inorganic Phosphorus (mg/L)	0.800	0.800	0.800	0.800
Alkalinity (mg/L)	314	308	339	317
pH	7.7	7.7	7.7	7.7

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 Toxicity

In-stream criteria of downstream segments for Dissolved Oxygen will be met with an effluent limitation as follows:

Chronic	Standard	Averaging Period	Summer	Fall	Winter	Spring
Flow (MGD)	N/A	30-day	8.4	8.4	8.4	8.4
NH4-Nitrogen (mg/L)	Varies	30-day	6.0	6.0	6.0	9.0
$CBOD_5$ (mg/L)	N/A	30-day	25.0	25.0	25.0	25.0
Dissolved Oxygen (mg/L)	5.5	30-day	5.0	5.0	5.0	5.0

Acute	Standard	Averaging Period	Summer	Fall	Winter	Spring
Flow (cfs)	N/A	Max-day	10.4	10.4	10.4	10.4
NH4-Nitrogen (mg/L)	Varies	1-hour	18.0	18.0	18.0	18.0
$CBOD_5$ (mg/L)	N/A	7-day	35.0	35.0	35.0	35.0
Dissolved Oxygen (mg/L)	5.0	Minimum	5.0	5.0	5.0	5.0

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	0.2	m/d
Oxygen:		
Reaeration model	USGS(channel-control)	
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	0.25219	/d
Temp correction	1.07	
Settling velocity	0.072248	m/d
Ammonium:		
Nitrification	3.840973	/d
Temp correction	1.07	
Nitrate:		
Denitrification	0.440663	/d
Temp correction	1.07	
Sed denitrification transfer coeff	0.89485	m/d
Temp correction	1.07	
Organic P:		
Hydrolysis	0.11173	/d
Temp correction	1.07	
Settling velocity	0.153214	m/d
Inorganic P:		
Settling velocity	1.49684	m/d
Sed P oxygen attenuation half sat constant	1.22794	mgO2/L

Phytoplankton:		
Max Growth rate	2.817285	/d
Temp correction	1.07	
Respiration rate	0.183875	/d
Temp correction	1.07	
Death rate	0.75246	/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	16.22865	ugN/L
Settling velocity	0.217562	m/d
Bottom Plants:		
Growth model	Zero-order	
Max Growth rate	39.236835	gD/m2/d or /d
Temp correction	1.07	
First-order model carrying capacity	100	gD/m2
Basal respiration rate	0.196733	/d
Photo-respiration rate parameter	0.01	unitless
Temp correction	1.07	
Excretion rate	0.002735	/d
Temp correction	1.07	
Death rate	0.00755	/d
Temp correction	1.07	
External nitrogen half sat constant	464.684	ugN/L
External phosphorus half sat constant	56.1985	ugP/L
Inorganic carbon half sat constant	7.79E-05	moles/L
Bottom algae use HCO3- as substrate	Yes	
Light model	Smith	
Light constant	47.8192	mgO^2/L
Ammonia preference	23.29875	ugN/L
Subsistence quota for nitrogen	0.8422416	mgN/gD
Subsistence quota for phosphorus	0.1719125	mgP/gD
Maximum uptake rate for nitrogen	956.625	mgN/gD/d
Maximum uptake rate for phosphorus	98.1245	mgP/gD/d
Internal nitrogen half sat ratio	3.5499945	
Internal phosphorus half sat ratio	3.8810835	
Nitrogen uptake water column fraction	1	
Phosphorus uptake water column fraction	1	
Detritus (POM):		
Dissolution rate	1.071086	/d
Temp correction	1.07	
Settling velocity	0.4923905	m/d
pH:		
Partial pressure of carbon dioxide	370	ppm

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	100%
Bottom SOD Coverage	100%
Prescribed SOD, gO_2/m^2/day	0

WASTELOAD ANALYSIS [WLA] Date: 10/28/2020

Appendix B: Mass Balance Mixing Analysis

Discharging Facility:	Spanish Fork WWTP		
UPDES No:	UT-0021741		
Permit Flow [MGD]:	8.40	Max. Monthly	
	10.40	Max. Daily	
Receiving Water:	Dry Creek		
Beneficial Uses:	2B, 3E, 4		
Stream Flows [cfs]:	7.66	Summer (July-Sept)	Critical Low Flow
	13.20	Fall (Oct-Dec)	
	13.20	Winter (Jan-Mar)	
	10.20	Spring (Apr-June)	
Acute River Width:	100.0%		
Chronic River Width:	100.0%		

Modeling Information

A mass balance mixing analysis was used to determine the effluent limits.

All model numerical inputs, intermediate calculations, outputs and graphs are available for discussion, inspection and copy at the Division of Water Quality.

Model Inputs

Headwater/Upstream Information

	7Q10 Flow
	cfs
Summer	7.7
Fall	13.2
Winter	13.2
Spring	10.2

Discharge Information

	Flow
	MGD
Maximum Daily	10.4
Maximum Monthly	8.4

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 2A Waters)

Physical	Concentration	
Parameter	Minimum	Maximum
pH	6.5	9.0
Turbidity Increase (NTU)		10.0

Bacteriological

E. coli (30 Day Geometric Mean)	206	(#/100 mL)
E. coli (Maximum)	668	(#/100 mL)

Effluent Limitations for Protection of Aquatic Wildlife (Class 3B Waters)

Physical	Concentration	
Parameter	Minimum	Maximum
pH	6.5	9.0

Dissolved Oxygen (mg/L)	Minimum Concentration
Instantaneous	3.0
30-day Average	5.0

Inorganics

Parameter	Acute Standard (1 Hour Average) Standard
Phenol (mg/L)	0.010
Hydrogen Sulfide (Undissociated) [mg/L]	0.002

Metals-Total Recoverable

	Chronic (4-day ave)				Acute (1-hour ave)			
Parameter	Standard[1]	Background[2]	Conc. Limit (µg/L)	Load Limit (lbs/day)	Standard[1]	Background[2]	Conc. Limit (µg/L)	Load Limit (lbs/day)
Aluminum	N/A[3]	12.0	N/A[3]	N/A[3]	750	12.0	1,294	112.3
Arsenic	150	5.9	281	19.7	340	5.9	586	50.9
Cadmium	0.7	0.1	1.2	0.1	7.4	0.1	13	1.1
Chromium VI	11.0	2.3	19	1.3	16.0	2.3	26	2.3
Chromium III	234	2.3	445	31.2	4,889	2.3	8,488	737
Copper	26.4	2.0	49	3.4	44.1	2.0	75	6.5
Cyanide[2]	5.2	2.6	7.6	0.5	22.0	2.6	36	3.1
Iron					1,000	23.5	1,719	149
Lead	15.0	0.3	28	2.0	385	0.3	668	58.0
Mercury[2]	0.012	0.006	0.017	0.001	2.4	0.006	4.2	0.4
Nickel	146	2.8	277	19.4	1,315	2.8	2,281	198
Selenium	4.6	1.0	7.9	0.6	18.4	1.0	31	2.7
Silver					30.7	0.3	53	4.6
Tributylin[2]	0.072	0.036	0.105	0.007	0.46	0.036	0.8	0.07
Zinc	336	8.2	635	44.5	336	8.2	578	50.2

1: Based upon a Hardness of 1000 mg/l as CaCO3

2: Background concentration assumed 50% of chronic standard

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 (4-day ave)				Acute (1-hour ave)			
Parameter	Standard	Background	Conc. Limit (µg/L)	Load Limit (lbs/day)	Standard	Background	Conc. Limit (µg/L)	Load Limit (lbs/day)
Aldrin					1.5	0.75	2.05E+00	1.78E-01
Chlordane	0.0043	0.00215	6.26E-03	4.39E-04	1.2	0.00215	2.08E+00	1.81E-01
DDT, DDE	0.001	0.0005	1.46E-03	1.02E-04	0.55	0.0005	9.55E-01	8.29E-02
Diazinon	0.17	0.085	2.48E-01	1.74E-02	0.17	0.085	2.33E-01	2.02E-02
Dieldrin	0.0056	0.0028	8.15E-03	5.72E-04	0.24	0.0028	4.15E-01	3.60E-02
Endosulfan, a & b	0.056	0.028	8.15E-02	5.72E-03	0.11	0.028	1.70E-01	1.48E-02
Endrin	0.036	0.018	5.24E-02	3.67E-03	0.086	0.018	1.36E-01	1.18E-02
Heptachlor & H. epoxide	0.0038	0.0019	5.53E-03	3.88E-04	0.26	0.0019	4.50E-01	3.91E-02
Lindane	0.08	0.04	1.16E-01	8.17E-03	1.0	0.04	1.71E+00	1.48E-01
Methoxychlor					0.03	0.015	4.10E-02	3.56E-03
Mirex					0.001	0.0005	1.37E-03	1.19E-04
Nonylphenol	6.6	3.3	9.61E+00	6.74E-01	28.0	3.3	4.62E+01	4.01E+00
Parathion	0.0130	0.0065	1.89E-02	1.33E-03	0.066	0.0065	1.10E-01	9.53E-03
PCB's	0.014	0.007	2.04E-02	1.43E-03				
Pentachlorophenol	15.0	7.5	2.18E+01	1.53E+00	19.0	7.5	2.75E+01	2.38E+00
Toxephene	0.0002	0.0001	2.91E-04	2.04E-05	0.73	0.0001	1.27E+00	1.10E-01

1: Background concentration assumed 50% of standard

Radiological

Parameter	Maximum Concentration Standard
Gross Alpha (pCi/L)	15

Numeric Criteria for the Protection of Human Health from Consumption of Water and Fish

	Class 1C (Water and Organism)				Class 3 (Organism Only)			
Toxic Organics	**Standard**	**Background**	**Conc. Limit (µg/L)**	**Load Limit (lbs/day)**	**Standard**	**Background**	**Conc. Limit (µg/L)**	**Load Limit (lbs/day)**
Antimony	5.6	2.8	8.15E+00	5.72E-01	640	2.8	1.11E+03	9.63E+01
Copper	1300	650	1.89E+03	1.33E+02				
Nickel	610	305	8.88E+02	6.23E+01	4600	305	7.76E+03	6.74E+02
Selenium	170	85	2.48E+02	1.74E+01	4200	85	7.23E+03	6.28E+02
Thallium	0.24	0.12	3.49E-01	2.45E-02	0.47	0.12	7.28E-01	6.32E-02
Zinc	7400	3700	1.08E+04	7.55E+02	26000	3700	4.24E+04	3.68E+03
Cyanide	4	2	5.82E+00	4.08E-01	400	2	6.93E+02	6.02E+01
Asbestos (million fibers/L)	7	3.5	1.02E+01	7.14E-01				
2,3,7,8-TCDD Dioxin	5.00E-09	2.50E-09	7.28E-09	5.10E-10	5.1E-09	2.5E-09	7.02E-09	6.09E-10
Acrolein	3	1.5	4.37E+00	3.06E-01	400	1.5	6.94E+02	6.02E+01
Acrylonitrile	0.061	0.0305	8.88E-02	6.23E-03	7	0.0305	1.21E+01	1.05E+00
Benzene	2.1	1.05	3.06E+00	2.14E-01	51	1.05	8.78E+01	7.62E+00
Bromoform	7	3.5	1.02E+01	7.14E-01	120	3.5	2.06E+02	1.79E+01
Carbon Tetrachloride	0.4	0.2	5.82E-01	4.08E-02	5	0.2	8.54E+00	7.41E-01
Chlorobenzene	100	50	1.46E+02	1.02E+01	800	50	1.35E+03	1.17E+02
Chlorodibromomethane	0.8	0.4	1.16E+00	8.17E-02	21	0.4	3.62E+01	3.14E+00
Chloroform	60	30	8.74E+01	6.12E+00	2000	30	3.45E+03	3.00E+02
Dalapon	200	100	2.91E+02	2.04E+01				
Dichlorobromomethane	0.95	0.475	1.38E+00	9.70E-02	27	0.475	4.65E+01	4.04E+00
1,2-Dichloroethane	9.9	4.95	1.44E+01	1.01E+00	2000	4.95	3.47E+03	3.01E+02
1,1-Dichloroethylene	300	150	4.37E+02	3.06E+01	20000	150	3.46E+04	3.00E+03
1,2-Dichloropropane	0.9	0.45	1.31E+00	9.19E-02	31	0.45	5.35E+01	4.64E+00
1,3-Dichloropropene	0.27	0.135	3.93E-01	2.76E-02	12	0.135	2.07E+01	1.80E+00
Ethylbenzene	68	34	9.90E+01	6.94E+00	130	34	2.01E+02	1.74E+01
Ethylene Dibromide	0.05	0.025	7.28E-02	5.10E-03				
Methyl Bromide	100	50	1.46E+02	1.02E+01	10000	50	1.73E+04	1.50E+03
Methylene Chloride	20	10	2.91E+01	2.04E+00	1000	10	1.73E+03	1.50E+02
1,1,2,2-Tetrachloroethane	0.2	0.1	2.91E-01	2.04E-02	3	0.1	5.14E+00	4.46E-01
Tetrachloroethylene	10	5	1.46E+01	1.02E+00	29	5	4.67E+01	4.05E+00
Toluene	57	28.5	8.30E+01	5.82E+00	520	28.5	8.82E+02	7.66E+01
1,2 -Trans-Dichloroethyle	100	50	1.46E+02	1.02E+01	4000	50	6.91E+03	6.00E+02
1,1,1-Trichloroethane	10000	5000	1.46E+04	1.02E+03	200000	5000	3.44E+05	2.98E+04
1,1,2-Trichloroethane	0.55	0.275	8.01E-01	5.61E-02	8.9	0.275	1.53E+01	1.32E+00
Trichloroethylene	0.6	0.3	8.74E-01	6.12E-02	7	0.3	1.19E+01	1.04E+00
Vinyl Chloride	0.022	0.011	3.20E-02	2.25E-03	1.6	0.011	2.77E+00	2.40E-01
2-Chlorophenol	30	15	4.37E+01	3.06E+00	800	15	1.38E+03	1.20E+02
2,4-Dichlorophenol	10	5	1.46E+01	1.02E+00	60	5	1.01E+02	8.72E+00
2,4-Dimethylphenol	100	50	1.46E+02	1.02E+01	3000	50	5.17E+03	4.49E+02
2-Methyl-4,6-Dinitrophenol	2	1	2.91E+00	2.04E-01	30	1	5.14E+01	4.46E+00
2,4-Dinitrophenol	10	5	1.46E+01	1.02E+00	300	5	5.17E+02	4.49E+01
3-Methyl-4-Chlorophenol	500	250	7.28E+02	5.10E+01	2000	250	3.29E+03	2.85E+02
Penetachlorophenol	0.03	0.015	4.37E-02	3.06E-03	0.04	0.015	5.84E-02	5.07E-03
Phenol	4000	2000	5.82E+03	4.08E+02	300000	2000	5.19E+05	4.51E+04
2,4,5-Trichlorophenol	300	150	4.37E+02	3.06E+01	600	150	9.31E+02	8.08E+01
2,4,6-Trichlorophenol	1.5	0.75	2.18E+00	1.53E-01	2.8	0.75	4.31E+00	3.74E-01
Acenaphthene	70	35	1.02E+02	7.14E+00	90	35	1.31E+02	1.13E+01
Anthracene	300	150	4.37E+02	3.06E+01	400	150	5.84E+02	5.07E+01
Benzidine	0.00014	0.00007	2.04E-04	1.43E-05	0.011	0.00007	1.91E-02	1.65E-03
BenzoaAnthracene	0.0012	0.0006	1.75E-03	1.22E-04	0.0013	0.0006	1.82E-03	1.58E-04
BenzoaPyrene	0.00012	0.00006	1.75E-04	1.22E-05	0.00013	0.00006	1.82E-04	1.58E-05
BenzobFluoranthene	0.0012	0.0006	1.75E-03	1.22E-04	0.0013	0.0006	1.82E-03	1.58E-04
BenzokFluoranthene	0.012	0.006	1.75E-02	1.22E-03	0.013	0.006	1.82E-02	1.58E-03

	Class 1C (Water and Organism)				Class 3 (Organism Only)			
Toxic Organics	**Standard**	**Background**	**Conc. Limit (µg/L)**	**Load Limit (lbs/day)**	**Standard**	**Background**	**Conc. Limit (µg/L)**	**Load Limit (lbs/day)**
Bis2-Chloro1methylether	0.00015	0.000075	2.18E-04	1.53E-05	0.017	0.000075	2.95E-02	2.56E-03
Bis2-Chloro1methylethylether	200	100	2.91E+02	2.04E+01	4000	100	6.87E+03	5.96E+02
Bis2-ChloroethylEther	0.03	0.015	4.37E-02	3.06E-03	2.2	0.015	3.81E+00	3.31E-01
Bis2-Chloroisopropy1Ether	1400	700	2.04E+03	1.43E+02	65000	700	1.12E+05	9.75E+03
Bis2-EthylhexylPhthalate	0.32	0.16	4.66E-01	3.27E-02	0.37	0.16	5.25E-01	4.55E-02
Butylbenzyl Phthalate	0.1	0.05	1.46E-01	1.02E-02	0.1	0.05	1.37E-01	1.19E-02
2-Chloronaphthalene	800	400	1.16E+03	8.17E+01	1000	400	1.44E+03	1.25E+02
Chrysene	0.12	0.06	1.75E-01	1.22E-02	0.13	0.06	1.82E-01	1.58E-02
Dibenzoa, (h)Anthracene	0.00012	0.00006	1.75E-04	1.22E-05	0.00013	0.00006	1.82E-04	1.58E-05
1,2-Dichlorobenzene	1000	500	1.46E+03	1.02E+02	3000	500	4.84E+03	4.20E+02
1,3-Dichlorobenzene	7	3.5	1.02E+01	7.14E-01	10	3.5	1.48E+01	1.28E+00
1,4-Dichlorobenzene	300	150	4.37E+02	3.06E+01	900	150	1.45E+03	1.26E+02
3,3-Dichlorobenzidine	0.049	0.0245	7.13E-02	5.00E-03	0.15	0.0245	2.42E-01	2.10E-02
Diethyl Phthalate	600	300	8.74E+02	6.12E+01	600	300	8.21E+02	7.13E+01
Dimethyl Phthalate	2000	1000	2.91E+03	2.04E+02	2000	1000	2.74E+03	2.38E+02
Di-n-Butyl Phthalate	20	10	2.91E+01	2.04E+00	30	10	4.47E+01	3.88E+00
2,4-Dinitrotoluene	0.049	0.0245	7.13E-02	5.00E-03	1.7	0.0245	2.93E+00	2.55E-01
Dinitrophenols	10	5	1.46E+01	1.02E+00	1000	5	1.73E+03	1.50E+02
1,2-Diphenylhydrazine	0.03	0.015	4.37E-02	3.06E-03	0.2	0.015	3.36E-01	2.92E-02
Fluoranthene	20	10	2.91E+01	2.04E+00	20	10	2.74E+01	2.38E+00
Fluorene	50	25	7.28E+01	5.10E+00	70	25	1.03E+02	8.95E+00
Hexachlorobenzene	0.000079	0.0000395	1.15E-04	8.06E-06	0.000079	0.0000395	1.08E-04	9.38E-06
Hexachlorobutedine	0.01	0.005	1.46E-02	1.02E-03	0.01	0.005	1.37E-02	1.19E-03
Hexachloroethane	0.1	0.05	1.46E-01	1.02E-02	0.1	0.05	1.37E-01	1.19E-02
Hexachlorocyclopentadiene	4	2	5.82E+00	4.08E-01	4	2	5.47E+00	4.75E-01
Ideno 1,2,3-cdPyrene	0.0012	0.0006	1.75E-03	1.22E-04	0.0013	0.0006	1.82E-03	1.58E-04
Isophorone	34	17	4.95E+01	3.47E+00	1800	17	3.11E+03	2.70E+02
Nitrobenzene	10	5	1.46E+01	1.02E+00	600	5	1.04E+03	9.01E+01
N-Nitrosodiethylamine	0.0008	0.0004	1.16E-03	8.17E-05	1.24	0.0004	2.15E+00	1.87E-01
N-Nitrosodimethylamine	0.00069	0.000345	1.00E-03	7.04E-05	3	0.000345	5.21E+00	4.52E-01
N-Nitrosodi-n-Propylamine	0.005	0.0025	7.28E-03	5.10E-04	0.51	0.0025	8.84E-01	7.67E-02
N-Nitrosodiphenylamine	3.3	1.65	4.80E+00	3.37E-01	6	1.65	9.20E+00	7.99E-01
N-Nitrosopyrrolidine	0.016	0.008	2.33E-02	1.63E-03	34	0.008	5.90E+01	5.12E+00
Pentachlorobenzene	0.1	0.05	1.46E-01	1.02E-02	0.1	0.05	1.37E-01	1.19E-02
Pyrene	20	10	2.91E+01	2.04E+00	30	10	4.47E+01	3.88E+00
1,2,4-Trichlorobenzene	0.071	0.0355	1.03E-01	7.25E-03	0.076	0.0355	1.06E-01	9.19E-03
Aldrin	0.00000077	0.000000385	1.12E-06	7.86E-08	0.00000077	0.000000385	1.05E-06	9.14E-08
alpha-BHC	0.00036	0.00018	5.24E-04	3.67E-05	0.00039	0.00018	5.45E-04	4.73E-05
beta-BHC	0.008	0.004	1.16E-02	8.17E-04	0.014	0.004	2.14E-02	1.85E-03
gamma-BHC (Lindane)	4.2	2.1	6.12E+00	4.29E-01	4.4	2.1	6.09E+00	5.29E-01
Hexachlorocyclohexane (HCH)	0.0066	0.0033	9.61E-03	6.74E-04	0.01	0.0033	1.49E-02	1.30E-03
Chlordane	0.00031	0.000155	4.51E-04	3.16E-05	0.00032	0.000155	4.42E-04	3.83E-05
4,4-DDT	0.00003	0.000015	4.37E-05	3.06E-06	0.00003	0.000015	4.10E-05	3.56E-06
4,4-DDE	0.000018	0.000009	2.62E-05	1.84E-06	0.000018	0.000009	2.46E-05	2.14E-06
4,4-DDD	0.00012	0.00006	1.75E-04	1.22E-05	0.00012	0.00006	1.64E-04	1.43E-05
Dieldrin	0.0000012	0.0000006	1.75E-06	1.22E-07	0.0000012	0.0000006	1.64E-06	1.43E-07
alpha-Endosulfan	20	10	2.91E+01	2.04E+00	30	10	4.47E+01	3.88E+00
beta-Endosulfan	20	10	2.91E+01	2.04E+00	40	10	6.21E+01	5.39E+00
Endosulfan Sulfate	20	10	2.91E+01	2.04E+00	40	10	6.21E+01	5.39E+00
Endrin	0.03	0.015	4.37E-02	3.06E-03	0.03	0.015	4.10E-02	3.56E-03
Endrin Aldehyde	1	0.5	1.46E+00	1.02E-01	1	0.5	1.37E+00	1.19E-01
Heptachlor	0.0000059	0.00000295	8.59E-06	6.02E-07	0.0000059	0.00000295	8.07E-06	7.01E-07
Heptachlor Epoxide	0.000032	0.000016	4.66E-05	3.27E-06	0.000032	0.000016	4.38E-05	3.80E-06
Methoxychlor	0.02	0.01	2.91E-02	2.04E-03	0.02	0.01	2.74E-02	2.38E-03
Polychlorinated Biphenyls (PCB)	0.000064	0.000032	9.32E-05	6.53E-06	0.000064	0.000032	8.76E-05	7.60E-06
Toxaphene	0.0007	0.00035	1.02E-03	7.14E-05	0.00071	0.00035	9.75E-04	8.46E-05

Effluent Limitation for Protection of Agriculture (Class 4 Waters)

Maximum Concentration

Parameter	Standard	Background	Conc. Limit	Load Limit (lbs/day)	
Total Dissolved Solids (mg/L)	1,200		1,200	84,122	Impaired
Boron (µg/L)	750	348	1.05E+03	9.08E+01	
Arsenic, Dissolved (µg/L)	100	13.6	1.64E+02	1.42E+01	
Cadmium, Dissolved (µg/L)	10	0.1	1.73E+01	1.50E+00	
Chromium, Dissolved (µg/L)	100	1.3	1.73E+02	1.50E+01	
Copper, Dissolved (µg/L)	200	1.5	3.46E+02	3.00E+01	
Lead, Dissolved (µg/L)	100	0.4	1.73E+02	1.50E+01	
Selenium, Dissolved (µg/L)	50	1.1	8.60E+01	7.47E+00	
Gross Alpha (pCi/L)	15		2.60E+01	2.26E+00	

WASTELOAD ANALYSIS [WLA]
Appendix C: Total Residual Chlorine

Date: 10/28/2020

Discharging Facility: Spanish Fork WWTP
UPDES No: UT-0021741

CHRONIC

	Season	Receiving Water	Standard	Total Effluent	Mixing Zone Boundary	Effluent Limit Without Decay	Temperature (°C)	Decay Rate (/day) @ 20 deg C	Decay Rate (/day) @ T deg C	Travel Time (min)	Decay Coefficient	Effluent Limit
Discharge (cfs)	Summer	7.7		13.0	20.7							
	Fall	13.2		13.0	26.2							
	Winter	13.2		13.0	26.2							
	Spring	10.2		13.0	23.2							
TRC (mg/L)	Summer	0.000	0.011			0.017	20.1	29.86	30.0	443	0.0001	**181.668**
	Fall	0.000	0.011			0.022	14.7	29.86	23.4	357	0.0031	**7.269**
	Winter	0.000	0.011			0.022	11.2	29.86	19.9	357	0.0072	**3.096**
	Spring	0.000	0.011			0.020	14.5	29.86	23.2	357	0.0032	**6.152**

ACUTE

	Season	Receiving Water	Standard	Total Effluent	Mixing Zone Boundary	Effluent Limit Without Decay	Temperature (°C)	Decay Rate (/day) @ 20 °C	Decay Rate (/day) @ T °C	Travel Time (min)	Decay Coefficient	Effluent Limit
Discharge (cfs)	Summer	7.7		16.1	23.7							
	Fall	13.2		16.1	29.3							
	Winter	13.2		16.1	29.3							
	Spring	10.2		16.1	26.3							
TRC (mg/L)	Summer	0.000	0.019			0.028	20.1	29.86	30.0	355	0.0006	**45.833**
	Fall	0.000	0.019			0.035	14.7	29.86	23.4	311	0.0064	**5.422**
	Winter	0.000	0.019			0.035	11.2	29.86	19.9	311	0.0134	**2.575**
	Spring	0.000	0.019			0.031	14.5	29.86	23.2	311	0.0066	**4.678**