Utah Division of Water Quality
Statement of Basis
ADDENDUM
Wasteload Analysis and Antidegradation Level I Review

Date: **April 10, 2017**

Facility: **Payson Power Project**
Payson, UT
UPDES No. UT0025518

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.

Discharge
Outfall 001: Irrigation Ditch → Beer Creek → Benjamin Slough → Utah Lake

The maximum daily design discharge is 1.0 MGD and the maximum monthly design discharge is 1.0 MGD for the facility, as provided by Payson Power (AQUA Engineering 2017a).

Receiving Water
The receiving water for Outfall 001 is an unnamed irrigation ditch, which is tributary to Beer Creek, which drains to Benjamin Slough and then 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 City Wastewater Treatment Plant (UPDES UT0020427) also discharges to the same irrigation ditch and has the potential to discharge concurrently with the Payson Power Project discharge; therefore, the design capacity discharge rate for the Payson City Wastewater Treatment Plant is shown in Table 1.

Table 1: Annual critical low flow

Season	Flow (cfs)			
	Payson WWTP Discharge During Chronic Conditions	Payson WWTP Discharge During Acute Conditions	Irrigation Ditch above WWTP	Beer Creek above confluence with Irrigation Ditch
Summer	1.55	4.64	0.0	4.0
Fall	1.55	4.64	0.0	10.0
Winter	1.55	4.64	0.0	13.2
Spring	1.55	4.64	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), total dissolved solids (TDS), dissolved oxygen (DO), total ammonia (TAN), copper, cyanide, chromium, iron, zinc, total residual chlorine (TRC), temperature and pH 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	28%
Fall	13%
Winter	10%
Spring	13%

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 limits for total residual chlorine were determined assuming an average decay rate of 42 /day (at 20 C°) 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)		1.0	1 day		1.0	30 days
Ammonia (mg/L)[1]						
Summer (Jul-Sep)		20.0			10.0	
Fall (Oct-Dec)	Varies	15.0	1 hour	Varies	12.4	30 days
Winter (Jan-Mar)		26.0			12.4	
Spring (Apr-Jun)		24.0			12.4	
Min. Dissolved Oxygen (mg/L)	3.0	4.0	Instantaneous	5.0	5.0	30 days
Total Residual Chlorine (mg/L)						
Summer (Jul-Sep)		2.2			3.3	
Fall (Oct-Dec)	0.019	1.2	1 hour	0.011	2.3	4 days
Winter (Jan-Mar)		0.7			2.0	
Spring (Apr-Jun)		1.0			1.8	
Total Dissolved Solids	1,200	3,396	Instantaneous	N/A		
Dissolved Metals (µg/L)						
Copper	51	272		30	120	
Cyanide	22	119	1 hour	5.2	15	4 days
Iron	1,000	5,570		N/A		
Zinc (µg/L)	380	2,071		380	1,678	
Temperature (°C)						
Summer (Jul-Sep)		39.9				
Fall (Oct-Dec)	27 deg and 4 deg change	46.6	Instantaneous	N/A		
Winter (Jan-Mar)		47.8				
Spring (Apr-Jun)		47.0				

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.**
Water Quality Management Section

Documents:

WLA Document: *payson_potw_wla_2017-04-10.docx*
QUAL2Kw Calibration Model: *payson_potw_cal_2013.xlsm*
QUAL2Kw Wasteload Model: *payson_potw_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 Power		
UPDES No:	UT-0025518		
Permit Flow [MGD]:	1.00	Maximum Monthly Flow	
	1.00	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)	1.0	1.0	1.0	1.0
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
Dissolved Oxygen (mg/L)	5.0	5.0	5.0	5.0
$CBOD_5$ (mg/L)	25.0	25.0	25.0	25.0
Organic Nitrogen (mg/L)	5.000	5.000	5.000	5.000
NH4-Nitrogen (mg/L)	6.000	9.000	9.500	12.000
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)	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
Dissolved Oxygen (mg/L)	4.0	4.0	4.0	4.0
$CBOD_5$ (mg/L)	35.0	35.0	35.0	35.0
Organic Nitrogen (mg/L)	10.000	10.000	10.000	10.000
NH4-Nitrogen (mg/L)	10.000	12.000	13.000	12.000
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)	1.0	1.0	1.0	1.0
Temperature (deg C)	30.0	25.9	27.5	23.6
Specific Conductance (µmhos)	4000	4000	4000	4000
Inorganic Suspended Solids (mg/L)	5.4	4.3	4.2	3.7
Dissolved Oxygen (mg/L)	5.0	5.0	5.0	5.0
$CBOD_5$ (mg/L)	3.6	5.0	6.4	3.3
Organic Nitrogen (mg/L)	1.300	1.300	1.300	1.300
NH4-Nitrogen (mg/L)	10.000	12.400	12.400	12.400
NO3-Nitrogen (mg/L)	37.267	34.400	55.500	45.800
Organic Phosphorus (mg/L)	0.000	0.610	1.130	2.886
Inorganic Ortho-Phosphorus (mg/L)	3.549	4.341	10.220	5.524
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)	222	222	222	222
pH	7.1	6.6	6.7	6.9

Acute	Summer	Fall	Winter	Spring
Flow (MGD)	1.0	1.0	1.0	1.0
Temperature (deg C)	30.0	25.9	27.5	23.6
Specific Conductance (µmhos)	4000	4000	4000	4000
Inorganic Suspended Solids (mg/L)	5.4	4.3	4.2	3.7
Dissolved Oxygen (mg/L)	4.0	4.0	4.0	4.0
$CBOD_5$ (mg/L)	3.6	5.0	6.4	3.3
Organic Nitrogen (mg/L)	1.300	1.300	1.300	1.300
NH4-Nitrogen (mg/L)	20.000	15.000	26.000	24.000
NO3-Nitrogen (mg/L)	37.267	34.400	55.500	45.800
Organic Phosphorus (mg/L)	0.000	0.610	1.130	2.886
Inorganic Ortho-Phosphorus (mg/L)	3.549	4.341	10.220	5.524
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)	222	222	222	222
pH	7.9	7.8	7.0	8.2

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	1.00	1.00	1.00	1.00
NH4-Nitrogen (mg/L)	Varies	10.0	12.4	12.4	12.4
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	3.0	3.0	3.0	3.0
NH4-Nitrogen (mg/L)	Varies	20.0	15.0	26.0	24.0
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] Date: 4/10/2017
Appendix B: Total Residual Chlorine

Discharging Facility: Payson Power
UPDES No: UT-0025518

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 °C (/day)	Decay Rate @ T °C (/day)	Travel Time (min)	Decay Coefficient	Effluent Limit
Discharge (cfs)	Summer	4.0		1.5	1.5	3.1	7.1	2.6							
	Fall	10.0		1.5	1.5	3.1	13.1	6.5							
	Winter	13.2		1.5	1.5	3.1	16.3	8.5							
	Spring	10.0		1.5	1.5	3.1	13.1	6.5							
Temperature (°C)	Summer			22.7	30.0	26.4									
	Fall			17.1	25.9	21.5									
	Winter			11.4	27.5	19.4									
	Spring			16.9	23.6	20.3									
TRC (mg/L)	Summer	0.000	0.011						0.025	26.4	42	56.3	124.66667	0.01	3.300
	Fall	0.000	0.011						0.047	21.5	42	45.0	124.66667	0.02	2.282
	Winter	0.000	0.011						0.058	19.4	42	40.9	124.66667	0.03	2.002
	Spring	0.000	0.011						0.047	20.3	42	42.5	124.66667	0.03	1.847

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 °C (/day)	Decay Rate @ T °C (/day)	Travel Time (min)	Decay Coefficient	Effluent Limit
Discharge (cfs)	Summer	2.0		4.6	1.5	6.2	8.2	0.4							
	Fall	5.0		4.6	1.5	6.2	11.2	1.1							
	Winter	6.6		4.6	1.5	6.2	12.8	1.4							
	Spring	5.0		4.6	1.5	6.2	11.2	1.1							
Temperature (°C)	Summer			22.7	30.0	24.5									
	Fall			17.1	25.9	19.3									
	Winter			11.4	27.5	15.4									
	Spring			16.9	23.6	18.6									
TRC (mg/L)	Summer	0.000	0.019						0.025	24.5	42	51.8	124.66667	0.01	2.220
	Fall	0.000	0.019						0.034	19.3	42	40.7	124.66667	0.03	1.160
	Winter	0.000	0.019						0.039	15.4	42	34.0	124.66667	0.05	0.747
	Spring	0.000	0.019						0.034	18.6	42	39.4	124.66667	0.03	1.040

WASTELOAD ANALYSIS [WLA] Date: 4/10/2017

Appendix C: Mass Balance Mixing Analysis for Conservative Constituents

Discharging Facility:	Payson Power	
UPDES No:	UT-0025518	
Permit Flow [MGD]:	1.00	Maximum Monthly Discharge
	1.00	Maximum Daily Discharge
Payson WWTP:	1.00	Chronic Discharge
	3.00	Acute 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]:	7.1	Chronic
	8.2	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.

Background Conditions

Total Recoverable Metals	Chronic			Acute		
Parameter	**Beer Creek**	**WWTP**	**Combined**	**Beer Creek**	**WWTP**	**Combined**
Flow (cfs)	4.0	1.5	5.5	2.0	4.6	6.6
Aluminum (µg/L)	5.4	86.4	28.0	5.4	86.4	62.0
Arsenic (µg/L)	7.7	1.2	5.9	7.7	1.2	3.2
Cadmium (µg/L)	0.4	0.4	0.4	0.4	0.4	0.4
Chromium VI (µg/L)	2.5	2.1	2.4	2.5	2.1	2.2
Chromium III (µg/L)	2.5	2.1	2.4	2.5	2.1	2.2
Copper (µg/L)	5.3	9.3	6.4	5.3	9.3	8.1
Cyanide (µg/L)	3.5	3.5	3.5	3.5	3.5	3.5
Iron (µg/L)				6.7	48.7	36.1
Lead (µg/L)	0.3	1.2	0.6	0.3	1.2	0.9
Mercury (µg/L)	0.008	0.008	0.008	0.008	0.008	0.008
Nickel (µg/L)	0.5	4.5	1.6	0.5	4.5	3.3
Selenium (µg/L)	1.9	0.9	1.6	1.9	0.9	1.2
Silver (µg/L)				0.8	0.8	0.8
Tributylin (µg/L)	0.048	0.048	0.048	0.048	0.048	0.048
Zinc (µg/L)	10.0	61.1	24.3	10.0	61.1	45.7
TDS (mg/L)	754	972	815			

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)

Inorganics Parameter	Chronic Standard (4 Day Average) Standard	Acute Standard (1 Hour Average) 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	62.0	4,130
Arsenic (µg/L)	150	5.9	673	340	3.2	1,906
Cadmium (µg/L)	0.7	0.4	2.3	8.5	0.4	47.3
Chromium VI (µg/L)	11.0	2.4	44.3	16.0	2.2	86.9
Chromium III (µg/L)	263	2.4	1,199	5,497	2.2	30,886
Copper (µg/L)	29.8	6.4	120	50.5	8.1	272
Cyanide (µg/L)	5.2	3.5	14.8	22.0	3.5	119
Iron (µg/L)				1,000	36.1	5,570
Lead (µg/L)	18.0	0.6	81.1	462	0.9	2,593
Mercury (µg/L)	0.012	0.008	0.034	2.4	0.008	13.5
Nickel (µg/L)	165	1.6	752	1,484	3.3	8,334
Selenium (µg/L)	4.6	1.6	16.9	18.4	1.2	102
Silver (µg/L)				39.3	0.8	220
Tributylin (µg/L)	0.072	0.048	0.206	0.46	0.05	2.52
Zinc (µg/L)	380	24.3	1,678	380	45.7	2,071

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	7.1
Chlordane (µg/L)	0.0043	0.0029	0.0123	1.2	0.0	6.7
DDT, DDE (µg/L)	0.001	0.001	0.003	0.55	0.00	3.09
Diazinon (µg/L)	0.17	0.11	0.49	0.17	0.11	0.80
Dieldrin (µg/L)	0.0056	0.0038	0.0160	0.24	0.00	1.34
Endosulfan, a & b (µg/L)	0.056	0.038	0.160	0.11	0.04	0.57
Endrin (µg/L)	0.036	0.024	0.103	0.086	0.024	0.450
Heptachlor & H. epoxide (µg/L)	0.0038	0.0025	0.0108	0.26	0.00	1.46
Lindane (µg/L)	0.08	0.05	0.23	1.0	0.1	5.5
Methoxychlor (µg/L)				0.03	0.02	0.14
Mirex (µg/L)				0.001	0.001	0.005
Nonylphenol (µg/L)	6.6	4.4	18.8	28.0	4.4	151.3
Parathion (µg/L)	0.0130	0.0087	0.0371	0.066	0.009	0.359
PCB's (µg/L)	0.014	0.009	0.040			
Pentachlorophenol (µg/L)	15.0	10.1	42.8	19.0	10.1	93.0
Toxephene (µg/L)	0.0002	0.0001	0.0006	0.73	0.00	4.10

1: Background concentration assumed 67% of chronic standard

Radiological	Maximum Concentration		
Parameter	Standard	Background[1]	Limit
Gross Alpha (pCi/L)	15	10.1	21.4

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	815	3,396
Boron (mg/L)	0.75	0.2	3.0
Arsenic, Dissolved (µg/L)	100	5.9	443
Cadmium, Dissolved (µg/L)	10	0.4	44.8
Chromium, Dissolved (µg/L)	100	2.4	452
Copper, Dissolved (µg/L)	200	6.4	901
Lead, Dissolved (µg/L)	100	0.6	457
Selenium, Dissolved (µg/L)	50	1.6	225
Gross Alpha (pCi/L)	15	10.1	42.8

1: Background concentration assumed 67% of chronic standard; TDS is based on observed ambient data

WASTELOAD ANALYSIS [WLA] Date: 4/10/2017
Appendix D: Temperature and Heat

Discharging Facility:	Payson Power	
UPDES No:	UT-0025518	
Permit Flow [MGD]:	1.00	Maximum Monthly Flow
	1.00	Maximum Daily Flow
Receiving Water:	Beer Creek	
Stream Classification:	2B, 3C, 4	

Modeling Information

A mass balance mixing analysis 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

	Flow	Temperature
	cfs	deg C
Summer	4.0	21.2
Fall	10.0	12.1
Winter	13.2	5.0
Spring	10.0	12.6

Discharge Informtion

Payson WWTP	Flow	Temperature
	cfs	deg C
Summer	1.5	22.7
Fall	1.5	17.1
Winter	1.5	11.4
Spring	1.5	16.9

Payson Power	Flow
	cfs
Summer	1.5
Fall	1.5
Winter	1.5
Spring	1.5

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 Aquatic Wildlife (Class 3C Waters)

Standard	Maximum Concentration
Temperature (deg C)	27
Temperature Change (deg C)	4

Payson Power	Temperature	Heat Load
	deg C	MBTU/day
Summer	39.9	599.5
Fall	46.6	699.8
Winter	47.8	716.9
Spring	47.0	705.2