Utah Division of Water Quality
ADDENDUM
Statement of Basis
Wasteload Analysis

Date: **March 13, 2017**

Facility: **Oakley WWTP**
UPDES No. UT020061

Receiving water: **Weber River (1C, 2B, 3A, 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 002: Weber River

The design flow for the discharge is 0.5 MGD maximum daily and 0.25 MGD maximum monthly average discharge.

Receiving Water
The receiving water for Outfall 002 is the Weber River. Per UAC R317-2-13.4.a, the designated uses for the Weber River and tributaries, from Stoddard diversion to headwaters are 1C, 2B, 3A, and 4.

- *Class 1C - Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water.*
- *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 3A - Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.*
- *Class 4 - Protected for agricultural uses including irrigation of crops and stock watering.*

The critical flow for the wasteload analysis is typically considered the lowest stream flow for seven consecutive days with a ten year return frequency (7Q10). However, since continuous flow measurements were not available immediately upstream of the wastewater treatment plant, the 20th percentile of the flow records at the water quality monitoring site 4928005 Weber River above Oakley City WWTP above Millrace Road was used to estimate critical low flow.

Critical Low Flow (Annual) = 9.7 cfs

Mixing Zone

Per UAC R317-2-5, 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. Water quality standards must be met at the end of the mixing zone. The mixing zone was not delineated for this WLA; however, the discharge is presumed fully mixed within the maximum allowable mixing zone. For chronic conditions, the annual critical low flow was simulated, and for acute conditions, 50% of the critical low flow was simulated.

TMDL

The immediate receiving assessment unit (UT16020101-023 Weber River from Rockport Reservoir to Weber-Provo Canal) is not listed as impaired for any parameters per the *2016 Utah Integrated Report* (DWQ, 2017).

Rockport Reservoir and Echo Reservoir downstream are listed as impaired for temperature in the *2016 Utah Integrated Report*. The *Rockport Reservoir and Echo Reservoir TMDL Final Report* (SWCA Environmental Consultants, 2014) includes waste load allocations for total phosphorus and total nitrogen for Oakley. These load limits are summarized below under effluent limits.

Parameters of Concern

The potential parameters of concern for the discharge/receiving water identified were total suspended solids (TSS), dissolved oxygen (DO), BOD_5, total phosphorus (TP), total nitrogen (TN) and total ammonia (TAN), 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). The model was calibrated to synoptic survey data collected in the summer of 2010 by USU and DWQ (Neilson et al., 2012). Subsequently, the model was extended downstream to the confluence with Beaver Creek.

Receiving water quality data was obtained from monitoring site 4928005 Weber River above Oakley City WWTP above Millrace Road for 2005-2016. The average seasonal value was calculated for each constituent in the receiving water.

The calibrated model was used to determine WQBELs for BOD_5, TAN, TN, TP, and DO. Effluent concentrations were adjusted so that water quality standards were not exceeded at the end of the mixing zone. QUAL2Kw rates, input and output for nutrient related constituents are summarized in Appendix A. The calibration and wasteload QUAL2Kw models are available for review by request.

Effluent limits for conservative constituents were determined using a mass balance mixing analysis (DWQ, 2012). The mass balance analysis is summarized in Appendix B.

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 1: WET Limits for IC_{25}

Season	Percent Effluent
Annual	4%

Effluent Limits

Water quality based effluent limits are summarized in Table 2. The complete list of limits is included in Appendix A and B.

The DO in the Weber River is not significantly impacted by the discharge from the Oakley WWTP. Therefore, secondary treatment requirements (R317-1-3) for BOD_5 are sufficient to meet water quality standards in the receiving water.

Table 2: Water Quality Based Effluent Limits

Effluent Constituent	Acute			Chronic		
	Standard	Limit	Averaging Period	Standard	Limit	Averaging Period
Flow (MGD)		0.50	1 day		0.25	30 days
Dissolved Oxygen (mg/L)	4.0	5.0	Instant	6.5	5.0	30 days
BOD_5 (mg/L)	None	35	7 days	None	25	30 days
Ammonia (mg/l)	Varies	20	1 hour	Varies	20	30 days
Total Phosphorus (kg)						
Summer: April – Sept.					173	
Annual					346	
Total Nitrogen (kg)						
Summer: April – Sept.					1,732	
Annual					3,464	

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 since the receiving water is designated as a Class 1C drinking water source.

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Files:
WLA Document: *oakley_potw_wla_2017-03-13.doc*
QUAL2Kw Wasteload Model: *oakley_potw_wla_2017.xls*
QUAL2Kw Calibration Model: *qual2kw Oakley City Calibration V1.2b.xls*

References:
Utah Wasteload Analysis Procedures Version 1.0. 2012. Utah Division of Water Quality.

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

Using QUAL2K Modeling to Support Nutrient Criteria Development and Wasteload Analyses in Utah. 2012. Neilson, B.T., A.J. Hobson, N. von Stackelberg, M. Shupryt, and J.D. Ostermiller.

2016 Integrated Report. 2016. Utah Division of Water Quality.

Rockport Reservoir and Echo Reservoir Total Maximum Daily Loads Final Report. 2014. SWCA Environmental Consultants, Inc.

Rockport Reservoir and Echo Reservoir Total Maximum Daily Loads Implementation Plan. 2013. SWCA Environmental Consultants, Inc.

DWQ-2017-002333

WASTELOAD ANALYSIS [WLA] Date: 3/6/2017
Appendix A: QUAL2Kw Model

Discharging Facility: Oakley WWTP
UPDES No: UT-0020061
Permit Flow [MGD]: 0.25 Maximum Monthly Flow
0.50 Maximum Daily Flow

Receiving Water: Weber River
Stream Classification: 1C, 2B, 3A, 4
Stream Flows [cfs]: 9.7 Annual Chronic Critical Low Flow
4.9 Annual Acute Critical Low Flow

Acute River Width: 50.0%
Chronic River Width: 100.0%

Modeling Information

Headwater/Upstream Information	**Summer**	**Fall**	**Winter**	**Spring**
Flow (cfs)	9.7	9.7	9.7	9.7
Temperature (deg C)	13.7	2.0	2.1	9.8
Specific Conductance (µmhos)	265	265	265	265
Inorganic Suspended Solids (mg/L)	2.3	2.3	2.3	2.3
Dissolved Oxygen (mg/L)	8.7	11.4	11.1	9.5
$CBOD_5$ (mg/L)	2.2	2.2	2.2	2.2
Organic Nitrogen (mg/L)	0.117	0.117	0.117	0.117
NH4-Nitrogen (mg/L)	0.022	0.022	0.022	0.022
NO3-Nitrogen (mg/L)	0.041	0.041	0.041	0.041
Organic Phosphorus (mg/L)	0.002	0.002	0.002	0.002
Inorganic Ortho-Phosphorus (mg/L)	0.010	0.010	0.010	0.010
Phytoplankton (µg/L)	2.0	2.0	2.0	2.0
Detritus [POM] (mg/L)	0.6	0.6	0.6	0.6
Alkalinity (mg/L)	111	111	111	111
pH	7.95	7.82	8.17	8.26

Discharge Information				
Chronic	**Summer**	**Fall**	**Winter**	**Spring**
Flow (cfs)	0.3	0.3	0.3	0.3
Temperature (deg C)	15.9	12.1	8.1	11.3
Inorganic Suspended Solids (mg/L)	583	583	583	583
Organic Nitrogen (mg/L)	6.000	6.000	6.000	6.000
NO3-Nitrogen (mg/L)	3.097	7.638	5.278	3.675
Organic Phosphorus (mg/L)	0.255	0.000	0.174	0.218
Inorganic Phosphorus (mg/L)	0.962	1.956	1.015	0.824
Alkalinity (mg/L)	142	142	142	142
pH	7.57	7.34	7.54	7.55

Acute	**Summer**	**Fall**	**Winter**	**Spring**
Flow (cfs)	0.5	0.5	0.5	0.5
Temperature (deg C)	15.9	12.1	8.1	11.3
Inorganic Suspended Solids (mg/L)	583	583	583	583
Organic Nitrogen (mg/L)	6.000	6.000	6.000	6.000
NO3-Nitrogen (mg/L)	3.097	7.638	5.278	3.675
Organic Phosphorus (mg/L)	0.255	0.000	0.174	0.218
Inorganic Phosphorus (mg/L)	0.255	0.000	0.174	0.218
Alkalinity (mg/L)	142	142	142	142
pH	7.85	7.84	8.13	8.15

Effluent Limitation for Biological Oxygen Demand (BOD_5) based upon Water Quality Standards

In-stream criteria of downstream segments for Dissolved Oxygen will be met with an effluent BOD_5 limitation as follows:

	Concentration		
Season	**Chronic**	**Acute**	
Summer	25.0	35.0	mg/L as CBOD5
Fall	25.0	35.0	mg/L as CBOD5
Winter	25.0	35.0	mg/L as CBOD5
Spring	25.0	35.0	mg/L as CBOD5

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 DO limitation as follows:

	Concentration		
Season	**Chronic**	**Acute**	
Summer	5.0	5.0	mg/L
Fall	5.0	5.0	mg/L
Winter	5.0	5.0	mg/L
Spring	5.0	5.0	mg/L

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:

	Total Ammonia		
Season	**Chronic**	**Acute**	
Summer	20.0	20.0	mg/L as N
Fall	20.0	20.0	mg/L as N
Winter	20.0	20.0	mg/L as N
Spring	20.0	20.0	mg/L as N

Summary Comments

The mathematical modeling and best professional judgement indicate that violations of receiving stream segments will not occur for the evaluated parameters of concern 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	Internal	
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	0.22265	/d
Temp correction	1.047	
Fast CBOD:		
Oxidation rate	10	/d
Temp correction	1.047	
Organic N:		
Hydrolysis	0.0810275	/d
Temp correction	1.07	
Settling velocity	0.155642	m/d
Ammonium:		
Nitrification	3.483972	/d
Temp correction	1.07	
Nitrate:		
Denitrification	0.902462	/d
Temp correction	1.07	
Sed denitrification transfer coeff	0.2395	m/d
Temp correction	1.07	
Organic P:		
Hydrolysis	0.199205	/d
Temp correction	1.07	
Settling velocity	0.165438	m/d
Inorganic P:		
Settling velocity	1.6467	m/d
Sed P oxygen attenuation half sat constant	0.8846	mgO2/L

Phytoplankton:		
Max Growth rate	2.427675	/d
Temp correction	1.07	
Respiration rate	0.1954895	/d
Temp correction	1.07	
Death rate	0.57862	/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	15	ugN/L
Settling velocity	0.4811	m/d
Bottom Plants:		
Growth model	Zero-order	
Max Growth rate	30.371825	gD/m2/d or /d
Temp correction	1.07	
First-order model carrying capacity	100	gD/m2
Basal respiration rate	0.1285202	/d
Photo-respiration rate parameter	0.39	unitless
Temp correction	1.07	
Excretion rate	0.193645	/d
Temp correction	1.07	
Death rate	0.017	/d
Temp correction	1.07	
External nitrogen half sat constant	143.544	ugN/L
External phosphorus half sat constant	89.5825	ugP/L
Inorganic carbon half sat constant	2.92E-06	moles/L
Bottom algae use HCO3- as substrate	Yes	
Light model	Half saturation	
Light constant	67.0276	langleys/d
Ammonia preference	20.3871	ugN/L
Subsistence quota for nitrogen	1.2329748	mgN/gD
Subsistence quota for phosphorus	0.1469345	mgP/gD
Maximum uptake rate for nitrogen	1359.3435	mgN/gD/d
Maximum uptake rate for phosphorus	155.915	mgP/gD/d
Internal nitrogen half sat ratio	4.637943	
Internal phosphorus half sat ratio	3.090491	
Nitrogen uptake water column fraction	1	
Phosphorus uptake water column fraction	1	
Detritus (POM):		
Dissolution rate	1.319081	/d
Temp correction	1.07	
Settling velocity	0.3537095	m/d
pH:		
Partial pressure of carbon dioxide	370	ppm

Atmospheric Inputs:	Summer	Fall	Winter	Spring
Max. Air Temperature, F	83.5	46.2	39.8	66.1
Min. Air Temperature, F	46.6	21.1	14.7	35.0
Dew Point, Temp., F	55.7	29.3	23.7	37.7
Wind, ft./sec. @ 21 ft.	5.7	4.0	3.9	7.3
Cloud Cover, %	0.1	0.1	0.1	0.1
Shade, %	0.0	0.0	0.0	0.0

Other Inputs:

Bottom Algae Coverage	100.0%	
Bottom SOD Coverage	100.0%	
Prescribed SOD	0.0	gO2/m2/d

WASTELOAD ANALYSIS [WLA] Date: 3/13/2017

Appendix B: Mass Balance Mixing Analysis for Conservative Constituents

Discharging Facility:	Oakley WWTP		
UPDES No:	UT-0020061		
Permit Flow [MGD]:	0.25	Maximum Monthly Flow	
	0.50	Maximum Daily Flow	
Receiving Water:	Weber River		
Stream Classification:	1C, 2B, 3A, 4		
Stream Flows [cfs]:	9.7	Annual	Chronic Critical Low Flow
	4.9	Annual	Acute Critical Low Flow
Combined Flow [cfs]			
	10.1	Chronic	
	5.6	Acute	
Acute River Width:	50%		
Chronic River Width:	100%		

Modeling Information

A simple 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.

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)

Parameter	Maximum Concentration
Physical	
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 3A Waters)

Parameter	Maximum Concentration	
Physical		

Inorganics	Chronic Standard (4 Day Average)		Acute Standard (1 Hour Average)		
	Standard	Limit	Standard	Limit	
Phenol			0.010	0.010	mg/L
Hydrogen Sulfide (Undissociated)			0.002	0.002	mg/L

Total Recoverable Metals

	Chronic Standard (4 Day Average)			Acute Standard (1 Hour Average)		
Parameter (µg/L)	Standard[1]	Background[2]	Limit	Standard[1]	Background[2]	Limit
Aluminum	N/A[3]	35.0	N/A	750	35.0	5,233
Arsenic	150	1.0	3,887	340	1.0	2,466
Cadmium	0.4	0.1	7.7	3.5	0.1	25.0
Chromium VI	11.0	2.0	237	16.0	2.0	103.8
Chromium III	129	2.0	3,320	2,704	2.0	19,644
Copper	14.2	0.6	356	22.3	0.6	158
Cyanide[2]	5.2	3.5	48.7	22.0	3.5	138
Iron				1,000	19.3	7,149
Lead	6.0	0.1	153	153.3	0.1	1,114
Mercury[2]	0.012	0.008	0.112	2.4	0.008	17.4
Nickel	79	0.2	2,062	713	0.2	5,182
Selenium	4.6	1.0	94.9	18.4	1.0	128
Silver				8.9	0.5	61.3
Tributylin[2]	0.072	0.048	0.674	0.46	0.048	3.04
Zinc	182	10.0	4,501	182	10.0	1,262

1: Based upon a Hardness of 164 mg/l as CaCO3

2: Background concentration assumed 67% 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 Standard (4 Day Average)			Acute Standard (1 Hour Average)		
Parameter (µg/L)	Standard	Background	Limit	Standard	Background	Limit
Aldrin				1.5	1.000	4.6
Chlordane	0.0043	0.0029	0.0402	1.2	0.003	8.7
DDT, DDE	0.001	0.0007	0.0094	0.55	0.001	3.99
Diazinon	0.17	0.1133	1.59	0.17	0.113	0.53
Dieldrin	0.0056	0.0037	0.0524	0.24	0.004	1.72
Endosulfan, a & b	0.056	0.0373	0.524	0.11	0.037	0.57
Endrin	0.036	0.0240	0.337	0.086	0.024	0.475
Heptachlor & H. epoxide	0.0038	0.0025	0.0356	0.26	0.003	1.87
Lindane	0.08	0.0533	0.75	1.0	0.053	6.9
Methoxychlor				0.03	0.020	0.09
Mirex				0.001	0.001	0.003
Nonylphenol	6.6	4.4	61.8	28.0	4.4	176.0
Parathion	0.0130	0.0087	0.1217	0.066	0.009	0.425
PCB's	0.014	0.0093	0.131			
Pentachlorophenol	15.00	10	140.4	19.0	10.0	75.4
Toxephene	0.0002	0.0001	0.0019	0.73	0.0001	5.31

Radiological

Parameter	Maximum Concentration
Gross Alpha	15 pCi/L

Effluent Limitation for Protection of Agriculture (Class 4 Waters)

	Maximum Concentration		
Parameter	**Standard**	**Background**	**Limit**
Total Dissolved Solids (mg/L)	1,200	521	18,230
Boron (µg/L)	750	110	16,802
Arsenic (µg/L)	100	1.0	2,583
Cadmium (µg/L)	10	0.1	258
Chromium (µg/L)	100	2.0	2,558
Copper (µg/L)	200	0.6	5,201
Lead (µg/L)	100	0.1	2,606
Selenium (µg/L)	50	1.0	1,279
Gross Alpha (pCi/L)	15	10	140