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

Date: **August 21, 2018**

Facility: **Tremonton Wastewater Treatment Facility**
UPDES No. UT0020303

Receiving water: **Malad River (2B, 3C)**

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: Malad River → Bear River → Bear River Bay of Great Salt Lake

The maximum monthly average design discharge is 2.0 MGD and the maximum daily design discharge is 3.0 MGD.

Receiving Water
The receiving water for Outfall 001 is the Malad River, a tributary of the Bear River that drains to Bear River Bay of the Great Salt Lake.

Per UAC R317-2-13, the designated beneficial uses for Malad River and tributaries, from confluence with Bear River to the state line are 2B and 3C.

- *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*

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 the Malad River in Tremonton, the 20th percentile of flow measurements at monitoring location 4902720 Malad River above Tremonton WWTP from 2005-2015 was calculated to estimate seasonal critical low flow (Table 1).

Table 1: Malad River critical low flow

Season	Flow (cfs)
Summer	35.7
Fall	37.0
Winter	53.1
Spring	42.1

TMDL

Due to insufficient data, the Malad River was not assessed in the 2016 Integrated Report (DWQ).

The downstream receiving water, Bear River from Great Salt Lake to Malad River, was listed as impaired on the 2016 303(d) list for dissolved oxygen, total dissolved solids, and benthic macroinvertebrates. Refer to the memorandum (Allred, August 20, 2018)(DWQ-2018-009170) for the status of the TMDL addressing the dissolved oxygen impairment.

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.

Based on field observations of specific conductivity laterally across the cross-section, the discharge was determined to be fully mixed approximately 150 meters downstream of the discharge point. Therefore, the allowable mixing zone is 150 meters.

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 (NH3), 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 August of 2011 by DWQ staff using standard operating procedures (DWQ 2012). The model was augmented with hydraulic data collected by Utah State University, under contract with DWQ, in the summer of 2010. The model extends from immediately above the plant discharge to the crossing at West 8800 North (approximately 4.9 km).

Receiving water quality data was obtained from monitoring sites 4902720 Malad River above Tremonton WWTP. The average seasonal value was calculated for each constituent with available data in the receiving water.

The QUAL2Kw model was used for determining WQBELs related to eutrophication and low dissolved oxygen. Effluent concentrations were adjusted so that water quality standards were not exceeded in the receiving water.

The QUAL2Kw model was also used to determine the limits for ammonia. The water quality standard for chronic ammonia toxicity is dependent on temperature and pH, and the water quality standard for acute ammonia toxicity is dependent on pH. 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 simple mixing analysis are summarized in Appendix B.

Where WQBELs exceeded secondary standards, categorical limits or previous permit limits, the concentration in the model was set at the secondary standard, categorical limit or previous permit limit.

Models and supporting documentation are available for review upon 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	8%
Fall	8%
Winter	6%
Spring	7%

Effluent Limits

Selected WQBELs are summarized in Table 3. Eutrophication and dissolved oxygen in the receiving water were evaluated using the QUAL2Kw model. Significant algal growth was predicted downstream of the WWTP during critical conditions; however, excursion of the DO criteria for 3C waters was not predicted to occur and Utah Secondary Treatment Standards for BOD_5 are sufficiently protective of the receiving water.

Table 3: Water Quality Based Effluent Limits Summary

Effluent Constituent	Acute			Chronic		
	Standard	Limit	Averaging Period	Standard	Limit	Averaging Period
Flow (MGD)		3.0	1 day		2.0	30 days
Ammonia (mg/L)[1]	Varies		1 hour	Varies		30 days
Summer		12			2.5	
Fall		17			5	
Winter		25			15	
Spring		30			15	
Min. Dissolved Oxygen (mg/L)	3.0	5.0	Minimum	5.0	5.0	30 days
BOD_5 (mg/L)[2]	None	35	7 days	None	25	30 days

1: Limits due to toxicity criteria.
2: Limits based on Utah Secondary Treatment Standards (*UAC R317-1-3.2*).

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 are not increasing beyond the design capacity of the facility.

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Documents:

WLA Document: *tremonton_potw_wla_2018-07-09.docx*
QUAL2Kw Wasteload Model: *tremonton_potw_wla_2018.xlsm*

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.

Utah's 2012-2014 Final Integrated Report. 2015. Utah Division of Water Quality.

Lower Bear River Watershed Restoration Action Strategy. 2002. Utah Division of Water Quality

Anticipated total phosphorus waste load allocation for Tremonton WWTP. Memorandum from Michael Allred. 2018. Utah Division of Water Quality.

WASTELOAD ANALYSIS [WLA] Date: 4/11/2018
Appendix A: QUAL2Kw Analysis Results

Discharging Facility:	Tremonton WWTP		
UPDES No:	UT-0020303		
Permit Flow [MGD]:	3.00	Max. Daily	
	2.00	Max. Monthly Average	
Receiving Water:	Malad River		
Stream Classification:	2B, 3C		
Stream Flows [cfs]:	35.67	Summer (July-Sept)	Critical Low Flow
	37.03	Fall (Oct-Dec)	
	53.12	Winter (Jan-Mar)	
	42.09	Spring (Apr-June)	
Instantaneously Fully Mixed:	No		
Acute River Width:	50%		
Chronic River Width:	100%		
Combined Flow [cfs]:	17.84	Acute	
	38.77	Chronic	

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)	35.7	37.0	53.1	42.1
Temperature (deg C)	20.2	7.7	4.2	14.1
Specific Conductance (µmhos)	4,671	4,596	3,874	4,280
Inorganic Suspended Solids (mg/L)	98.5	42.7	45.1	116.1
Dissolved Oxygen (mg/L)	9.1	10.8	11.0	9.3
Dissolved Oxygen Diel Range (mg/L)	4.0	3.0	2.0	3.0
$CBOD_5$ (mg/L)	3.4	3.4	3.4	3.4
Organic Nitrogen (mg/L)	0.453	0.413	0.323	0.357
NH4-Nitrogen (mg/L)	0.080	0.061	0.062	0.108
NO3-Nitrogen (mg/L)	2.333	1.216	0.940	1.257
Organic Phosphorus (mg/L)	0.112	0.025	0.044	0.113
Inorganic Ortho-Phosphorus (mg/L)	0.052	0.036	0.026	0.035
Phytoplankton (µg/L)	37.4	8.0	8.0	33.1
Detritus [POM] (mg/L)	17.2	2.9	8.4	14.2
Alkalinity (mg/L)	358	358	358	358
pH	8.3	8.2	8.2	8.2

Discharge Information Acute	Summer	Fall	Winter	Spring
Flow (cfs)	3.0	3.0	3.0	3.0
Temperature (deg C)	20.2	16.5	12.6	15.6
Specific Conductance (µmhos)	1,646	1,653	1,629	1,525
Inorganic Suspended Solids (mg/L)	14.6	0.0	9.2	1.7
Dissolved Oxygen (mg/L)	5.0	5.0	5.0	5.0
$CBOD_5$ (mg/L)	35.0	35.0	35.0	35.0
Organic Nitrogen (mg/L)	5.200	5.200	5.200	5.200
NH4-Nitrogen (mg/L)	12.000	17.000	25.000	30.000
NO3-Nitrogen (mg/L)	4.022	4.022	4.022	4.022
Organic Phosphorus (mg/L)	0.163	0.323	0.000	1.041
Inorganic Ortho-Phosphorus (mg/L)	0.365	3.763	3.316	2.343
Phytoplankton (µg/L)	0.000	0.000	0.000	0.000
Detritus [POM] (mg/L)	10.400	4.400	2.000	7.600
Alkalinity (mg/L)	383	383	383	383
pH	8.1	7.9	7.8	7.8

Chronic	Summer	Fall	Winter	Spring
Flow (cfs)	2.0	2.0	2.0	2.0
Temperature (deg C)	20.2	16.5	12.6	15.6
Specific Conductance (µmhos)	1,646	1,653	1,629	1,525
Inorganic Suspended Solids (mg/L)	14.6	0.0	9.2	1.7
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)	5.200	5.200	5.200	5.200
NH4-Nitrogen (mg/L)	2.500	5.000	15.000	15.000
NO3-Nitrogen (mg/L)	4.022	4.022	4.022	4.022
Organic Phosphorus (mg/L)	0.163	0.323	0.000	1.041
Inorganic Ortho-Phosphorus (mg/L)	0.365	3.763	3.316	2.343
Phytoplankton (µg/L)	0.000	0.000	0.000	0.000
Detritus [POM] (mg/L)	10.400	4.400	2.000	7.600
Alkalinity (mg/L)	383	383	383	383
pH	7.6	7.7	7.4	7.6

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 Limitation for Biological Oxygen Demand (BOD_5) based upon Secondary 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 Secondary 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	2.5	12.0	mg/L as N
Fall	5.0	17.0	mg/L as N
Winter	15.0	25.0	mg/L as N
Spring	15.0	30.0	mg/L as N

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	Churchill	
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	0.2903475	/d
Temp correction	1.07	
Settling velocity	0.242158	m/d
Ammonium:		
Nitrification	0.2693435	/d
Temp correction	1.07	
Nitrate:		
Denitrification	1.6900865	/d
Temp correction	1.07	
Sed denitrification transfer coeff	0.21487	m/d
Temp correction	1.07	
Organic P:		
Hydrolysis	0.228215	/d
Temp correction	1.07	
Settling velocity	0.05548	m/d
Inorganic P:		
Settling velocity	0.85204	m/d
Sed P oxygen attenuation half sat constant	1.98778	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	72.858765	gD/m2/d or /d
Temp correction	1.07	
First-order model carrying capacity	100	gD/m2
Basal respiration rate	0.1996688	/d
Photo-respiration rate parameter	0.01	unitless
Temp correction	1.07	
Excretion rate	0.225035	/d
Temp correction	1.07	
Death rate	1.1864	/d
Temp correction	1.07	
External nitrogen half sat constant	424.656	ugN/L
External phosphorus half sat constant	63.89725	ugP/L
Inorganic carbon half sat constant	3.89E-05	moles/L
Bottom algae use HCO3- as substrate	Yes	
Light model	Smith	
Light constant	93.4186	mgO^2/L
Ammonia preference	19.602	ugN/L
Subsistence quota for nitrogen	0.3791592	mgN/gD
Subsistence quota for phosphorus	0.1186205	mgP/gD
Maximum uptake rate for nitrogen	1474.3665	mgN/gD/d
Maximum uptake rate for phosphorus	111.866	mgP/gD/d
Internal nitrogen half sat ratio	3.167674	
Internal phosphorus half sat ratio	2.9784295	
Nitrogen uptake water column fraction	1	
Phosphorus uptake water column fraction	1	
Detritus (POM):		
Dissolution rate	0.168998	/d
Temp correction	1.07	
Settling velocity	0.206573	m/d
pH:		
Partial pressure of carbon dioxide	370	ppm

Atmospheric Inputs:	Spring	Fall	Winter	Spring
Max. Air Temperature, F	89.1	47.7	38.8	70.4
Min. Air Temperature, F	58.6	26.6	20.7	44.2
Dew Point, Temp., F	57.2	34.0	28.6	47.3
Wind, ft./sec. @ 21 ft.	7.7	6.1	6.2	7.8
Cloud Cover, %	0.1	0.1	0.1	0.1

Other Inputs:

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

WASTELOAD ANALYSIS [WLA] Date: 4/11/2018

Appendix B: Mass Balance Mixing Analysis for Conservative Constituents

Discharging Facility:	Tremonton WWTP		
UPDES No:	UT-0020303		
Permit Flow [MGD]:	3.00	Maximum Daily Flow	
	2.00	Maximum Monthly Flow	
Receiving Water:	Malad River		
Stream Classification:	2B, 3C		
Stream Flows [cfs]:	35.67	Summer (July-Sept)	Critical Low Flow
	37.03	Fall (Oct-Dec)	
	53.12	Winter (Jan-Mar)	
	42.09	Spring (Apr-June)	
Instantaneously Fully Mixed:	No		
Acute River Width:	50%		
Chronic River Width:	100%		
Combined Flow [cfs]:	17.84	Acute	
	38.77	Chronic	

Modeling Information

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

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

Dissolved Metals	Chronic Standard (4 Day Average)[1]			Acute Standard (1 Hour Average)[1]		
Parameter	Standard	Background	Limit	Standard	Background[2]	Limit
Aluminum (µg/L)	N/A[3]	9.9	NONE	750	9.9	2,845
Arsenic (µg/L)	150	19.0	1,660	340	19.0	1,234
Cadmium (µg/L)	0.5	0.13	4.3	4.9	0.13	18.4
Chromium VI (µg/L)	11.0	3.4	98.6	16.0	3.4	48.4
Chromium III (µg/L)	157	3.4	1,928	1,207	3.4	4,626
Copper (µg/L)	19.6	3.8	202	31.9	3.8	108
Cyanide (µg/L)[2]	5.2	3.5	25.0	22.0	3.5	71.2
Iron (µg/L)				1,000	670.0	1,269
Lead (µg/L)	6.7	0.4	79.5	172	0.4	661
Mercury (µg/L)[2]	0.012	0.008	0.058	2.4	0.0	9.2
Nickel (µg/L)	113	3.1	1,379	1,017	3.1	3,896
Selenium (µg/L)	4.6	1.9	35.7	18.4	1.9	63.4
Silver (µg/L)				15.6	10.4	19.7
Tributylin (µg/L)[2]	0.072	0.048	0.346	0.46	0.05	1.583
Zinc (µg/L)	257	11.7	3,082	255	11.7	934

1: Based upon a Hardness of 250 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	Standard	Background[1]	Limit	Standard	Background[1]	Limit
Aldrin (µg/L)				1.5	1.0	1.9
Chlordane (µg/L)	0.0043	0.0029	0.0207	1.2	0.0	4.6
DDT, DDE (µg/L)	0.001	0.001	0.005	0.55	0.00	2.11
Diazinon (µg/L)	0.17	0.11	0.82	0.17	0.11	0.22
Dieldrin (µg/L)	0.0056	0.0038	0.0269	0.24	0.00	0.91
Endosulfan, a & b (µg/L)	0.056	0.038	0.269	0.11	0.04	0.28
Endrin (µg/L)	0.036	0.024	0.173	0.086	0.024	0.238
Heptachlor & H. epoxide (µg/L)	0.0038	0.0025	0.0183	0.26	0.00	0.99
Lindane (µg/L)	0.08	0.05	0.38	1.0	0.1	3.6
Methoxychlor (µg/L)				0.03	0.02	0.04
Mirex (µg/L)				0.001	0.001	0.001
Nonylphenol (µg/L)	6.6	4.4	31.7	28.0	4.4	90.6
Parathion (µg/L)	0.0130	0.0087	0.0625	0.066	0.009	0.220
PCB's (µg/L)	0.014	0.009	0.067			
Pentachlorophenol (µg/L)	15.0	10.1	72.1	19.0	10.1	34.4
Toxephene (µg/L)	0.0002	0.0001	0.0010	0.73	0.00	2.81

1: Background concentration assumed 67% of chronic standard

Radiological	Maximum Concentration		
Parameter	Standard	Background[1]	Limit
Gross Alpha (pCi/L)	15	10.1	72.1

1: Background concentration assumed 67% of chronic standard