

WASTELOAD ALLOCATION

OUTLET CREEK

Proposed Facility in Buena Vista County
near Storm Lake

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This Package Contains

WASTELOAD ALLOCATION CALCULATIONS & NOTES

Please Do Not Separate

**ENVIRONMENTAL SERVICES DIVISION
WATER QUALITY BASED PERMIT LIMITS**

SECTION VI: WATER QUALITY-BASED PERMIT LIMITS

Facility Name: Proposed Facility in Buena Vista County near Storm Lake - Controlled Discharge Lagoon

Proposed Facility

Parameters	Ave. Conc. (mg/l)	Max Conc. (mg/l)	Ave. Mass (lbs/d)	Max Mass (lbs/d)	Sampling Frequency
Outfall No. 001	Drawdown Rate: 0.58 mgd				
CBOD	Secondary Treatment Levels Will Not Violate WQS				
TDS	If TDS > 1,261 mg/l, an acute WET test is required If TDS > 1,305 mg/l, a chronic WET test is required				
Chloride	If chloride > 1,170 mg/l, an acute WET test is required If chloride > 317 mg/l, a chronic WET test is required				
	If no WET tests are done, the following limits apply				
	Ave. Conc. (mg/l)	Max Conc. (mg/l)	Ave. Mass (lbs/d)	Max Mass (lbs/d)	
TDS	1,261	1,261	6,101	6,101	1/ month
Stream Network/Classification of Receiving Stream: Outlet Creek (A1 and B(WW-1))					Date Done: January 7, 2009

Fall seasonal critical low flow in Outlet Creek at the discharge point
30Q10 flow 0.810 cfs, 7Q10 flow 0.391 cfs, 1Q10 flow 0.335 cfs

Excel Spreadsheet calculations []

Qual II E Model []

Qual II E Modeling date[]

Performed by: Xiaojian Gao

Approved By: Connie Dou

If WET tests are required due to high effluent TDS and/or chloride concentration, the following dilution ratio may apply:

For the acute WET test, use 72.8% effluent and 27.2% dilution water
For the chronic WET test, use 69.6% effluent and 30.4% dilution water

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**ENVIRONMENTAL SERVICES DIVISION
WATER QUALITY BASED PERMIT LIMITS**

SECTION VI: WATER QUALITY-BASED PERMIT LIMITS

Facility Name: Proposed Facility in Buena Vista County Near Storm Lake - Recycling Media Filter

Proposed Facility

Parameters	Ave. Conc. (mg/l)	Max Conc. (mg/l)	Ave. Mass (lbs/d)	Max Mass (lbs/d)	Sampling Frequency
Outfall No. 001	ADW = 0.04375 mgd & AWW = 0.05800 mgd				
CBOD	Secondary Treatment Levels Will Not Violate WQS				
January - December					
Ammonia - Nitrogen					
January	11.9	15.9	7.4	7.9	--
February	13.5	15.1	7.5	7.5	--
March	6.1	15.3	3.8	7.6	--
April	4.4	16.2	2.7	8.0	--
May	3.8	15.7	2.3	7.7	--
June	2.6	14.9	1.5	7.3	--
July	2.6	18.2	1.7	8.9	--
August	2.4	16.7	1.5	8.2	--
September	2.9	17.1	1.8	8.4	--
October	6.1	16.3	3.8	8.0	--
November	7.6	15.2	4.7	7.4	--
December	8.9	16.5	5.5	8.1	--
Bacteria	Geomean (#org/100ml)	Sample Max. (#org/100ml)	March 15 th - November 15 th		
<i>E. coli</i>	126	235			
TDS	If TDS > 1,044 mg/l, an acute WET test is required If TDS > 1,520 mg/l, a chronic WET test is required				
Chloride	If chloride > 912 mg/l, an acute WET test is required If chloride > 378 mg/l, a chronic WET test is required If no WET tests are done, the following limits apply				
	Ave. Conc. (mg/l)	Max Conc. (mg/l)	Ave. Mass (lbs/d)	Max Mass (lbs/d)	
TDS	1,044	1,044	500	500	1/ month
TRC	0.319	0.320	0.153	0.155	1/week
Stream Network/Classification of Receiving Stream: Outlet Creek (A1 and B(WW-1))					Date Done: January 7, 2009
Annual critical low flow in Outlet Creek at the discharge point 30Q10 flow <u>0.391</u> cfs, 7Q10 flow <u>0.201</u> cfs, 1Q10 flow <u>0.170</u> cfs					
Excel Spreadsheet calculations []		Qual II E Model []		Qual II E Modeling date []	
Performed by: <u>Xiaojian Gao</u>			Approved By: <u>Connie Dou</u>		
If WET tests are required due to high effluent TDS and/or chloride levels, the following dilution ratios may apply:					
For the acute WET test, use <u>94.1%</u> effluent and <u>5.9%</u> dilution water					
For the chronic WET test, use <u>57.4%</u> effluent and <u>42.6%</u> dilution water					

WLA/permit limits for the Proposed Facility in Buena Vista County near Storm Lake

These wasteload allocations and water quality based permit limitations are for the proposed facility in Buena Vista County near Storm. The wasteload allocations/permit limits are based on the Year 2006 revised Water Quality Standards, the 2002 Permit Derivation Procedure, the 2000 ammonia criteria and the 2007 chemical criteria. The TDS wasteload allocation/permit limits are based on the site-specific approach that became effective on June 16, 2004.

1. BACKGROUND: A controlled discharge lagoon and a Recirculating media filter treatment facility have been proposed to serve the unsewered homes on the south side of Storm Lake in Buena Vista County. The proposed facility will discharge to Outlet Creek. Based on the Year 2006 revised water quality standards, the receiving reach of Outlet Creek is an A1 and B(WW-1) stream unless a field Use Attainability Assessment (UAA) proves otherwise. As indicated on the map attached to the request form, downstream Outlet Creek has been assessed. However, no UAA has been conducted on the receiving segment. The WLA results presented in this report are based on the presumed designation of A1 and B(WW-1) for the receiving segment of Outlet Creek.

The fall seasonal and annual critical low flows in Outlet Creek at the discharge point were estimated based on the annual 7Q10 ratio method and flow statistic data obtained at USGS gage station 05482135, located on North Raccoon River near Newell, Iowa.

Table 1: Fall Seasonal Critical Low Flows

Location	7Q10 Coeff. in Plate_4 (cfs/mi2)	D.A. (mi2)	Annual 7Q10 (cfs)	Fall seasonal critical low flows (cfs)		
				1Q10	7Q10	30Q10
Outfall	0.007	28.74	0.201*	0.335 [@]	0.391 [@]	0.810 [@]
USGS Gage (05482135)	0.007	233	0.72 ^s	1.20 ^s	1.40 ^s	2.90 ^s

^s: USGS gage station statistic data

*: Based on 7Q10 coefficient in Plate_4 and drainage area value

[@]: Estimated based on annual 7Q10 ratio method

Table 1b: Annual Critical Low Flows

Location	7Q10 Coeff. in Plate_4 (cfs/mi2)	D.A. (mi2)	Annual 7Q10 (cfs)	Annual critical low flows (cfs)		
				1Q10	7Q10	30Q10
Outfall	0.007	28.74	0.201*	0.170 [@]	0.201*	0.391 [@]
USGS Gage (05482135)	0.007	233	0.72 ^s	0.61 ^s	0.72 ^s	1.40 ^s

^s: USGS gage station statistic data

*: Based on 7Q10 coefficient in Plate_4 and drainage area value

[@]: Estimated based on annual 7Q10 ratio method

Downstream the discharge route, a segment of Raccoon River is impaired for bacteria and nitrate. A TMDL has been developed and approved by the EPA on June 24, 2008. The proposed facility is in the watershed that has been addressed in the TMDL. However, the unsewered communities in the watershed have not been addressed in the TMDL.

2. CALCULATIONS:

Controlled Discharge Lagoon

The wasteload allocations / permit limits for the proposed controlled discharge lagoon were calculated based on a drawdown rate of 0.58 mgd, which is 10 times of the facility's 180-day Average Wet Weather (AWW) design flow of 0.058 mgd.

CBOD₅, Ammonia-nitrogen, E. coli, TRC, pH and Temperature: Per current WLA rules, only TDS limits are required for controlled discharge lagoons that treat domestic wastewater. It is assumed that effluents from well-designed and well-operated controlled discharge lagoons will not violate water quality standards for CBOD₅, ammonia nitrogen, *E. coli*, TRC, pH and temperature.

Current WLA rules also allow 100% mixing of effluent and receiving stream flow in the Zone of Initial Dilution (ZID) and the Mixing Zone (MZ).

TDS:

The new site-specific TDS standard was adopted on June 16, 2004. The site-specific TDS approach would first consider a guideline value of 1,000 mg/l as a threshold in-stream level at which negative impacts to the uses of the receiving stream may begin to occur. Sources of TDS potentially elevating a receiving stream above 1,000 mg/l (TDS) would be required, upon application for a discharge permit or permit renewal, to clearly demonstrate that their discharge will not result in toxicity to the receiving stream. The guideline value applies to both the ZID and the MZ for designated streams. Using 100.0% of the fall seasonal 7Q10 flow and 100.0% of the fall seasonal 1Q10 flow in Outlet Creek as the MZ and the ZID, respectively, the allowed effluent TDS concentration to meet the 1,000 mg/l of TDS threshold value at the boundary of the ZID is 1,261 mg/l and the allowed effluent TDS concentration to meet the 1,000 mg/l threshold value at the boundary of the MZ is 1,305 mg/l. If the effluent TDS levels are greater than 1,261 mg/l, an acute WET is required and if greater than 1,305 mg/l, a chronic WET test is required. The background TDS concentration is assumed as 300 mg/l.

Chloride:

Chloride is a constituent of TDS. At higher levels, chloride could cause toxicity to aquatic life. Thus, the WLA_{acute} and $WLA_{chronic}$ are calculated to evaluate the potential negative impacts. The acute and chronic threshold values for chloride for aquatic life protection are 860 mg/l and 230 mg/l, respectively. Since the receiving stream, Outlet Creek, is a designated stream, it is afforded protection against both acutely and chronically toxic conditions. Using 100.0% of the fall seasonal 7Q10 flow and 100.0% of the fall seasonal 1Q10 flow in Outlet Creek as the MZ and the ZID, respectively, the allowed effluent chloride concentration to meet the 860 mg/l of chloride threshold value at the boundary of the ZID is 1,170 mg/l and the allowed effluent chloride concentration to meet the 230 mg/l threshold value at the boundary of the MZ is 317 mg/l. If the effluent chloride level is greater than 1,170 mg/l, an acute WET is required and if greater than 317 mg/l, a chronic WET test is required. The background chloride concentration is assumed as 30 mg/l.

Recirculating Media Filter

The wasteload allocations / permit limits for the proposed facility were calculated based on the facility's Average Dry Weather (ADW) design flow of 0.04375 mgd and its Average Wet Weather (AWW) design flow of 0.05800 mgd.

The water quality based permit concentration limits are derived using the allowed stream flow and the ADW design flow, while loading limits are derived using the allowed stream flow and the AWW design flow.

TRC: The Toxics wasteload allocations will consider the procedures included in the 2000 revised WQS and the 2007 chemical criteria. Important to toxics is the use of the 1Q10 stream flow in association with the acute wasteload allocation calculation. The chronic WLA will continue to use the 7Q10 stream flow in its calculations. In this case, 25.0% of the annual 7Q10 flow and 2.5% of the annual 1Q10 flow in Outlet Creek were used as the MZ and ZID, respectively

Ammonia: Standard stream background temperatures, pH's, and concentrations of NH3-N were mixed with the discharge from the facility's effluent pH and temperature values to calculate the applicable instream WQS criteria for the protection of the Outlet Creek. The Outlet Creek is a B(WW-1) stream, therefore, early life protection will begin in March and run through September.

The monthly background temperatures, pH, and NH3-N concentrations shown in Table 2 were used for the wasteload allocation/permit limits calculations based on the Year 2000 ammonia criteria. Table 3 shows the statewide monthly effluent pH and temperature values for mechanical facilities (for WLA calculation purpose, recirculating media filter is considered as a mechanical facility). Table 4 shows the calculated ammonia nitrogen limits for this facility.

Table 2: Background Temperature, pH and NH3-N Concentrations For Use with Year 2000 Ammonia Criteria

Months	pH	Temperature (°C)	NH ₃ -N (mg/l)
Jan.	7.8	0.6	0.5
Feb.	7.7	1.2	0.5
March	7.9	4.3	0.5
April	8.1	11.7	0.5
May	8.1	16.6	0.5
June	8.1	21.4	0.5
July	8.1	24.8	0.0
August	8.2	23.8	0.0
Sept.	8	22.2	0.5
October	8	12.3	0.5
November	8.1	6	0.5
December	8	1.6	0.5

Table 3: Standard Effluent pH & Temperature Values for Mechanical Facilities

Months	pH	Temperature (°C)
Jan.	7.67	12.4
Feb.	7.71	11.3
March	7.69	13.1
April	7.65	16.2
May	7.67	19.3
June	7.7	22.1
July	7.58	24.1
August	7.63	24.4
Sept.	7.62	22.8
October	7.65	20.2
November	7.69	17.1
December	7.64	14.1

Table 4: Water Quality Based Limits for Ammonia Nitrogen

Months	Ave. Conc. (mg/l)	Max Conc. (mg/l)	Ave. Mass (lbs/d)	Max Mass (lbs/d)
January	11.9	15.9	7.4	7.9
February	13.5	15.1	7.5	7.5
March	6.1	15.3	3.8	7.6
April	4.4	16.2	2.7	8.0
May	3.8	15.7	2.3	7.7
June	2.6	14.9	1.5	7.3
July	2.6	18.2	1.7	8.9
August	2.4	16.7	1.5	8.2
Sept.	2.9	17.1	1.8	8.4
October	6.1	16.3	3.8	8.0
November	7.6	15.2	4.7	7.4
December	8.9	16.5	5.5	8.1

CBOD5/Total Dissolved Oxygen:

Streeter-Phelps DO Sag Model was used to simulate the decay of CBOD and dispersion of total Dissolved Oxygen (DO) in the receiving water downstream from the outfall. The criterion is that the discharge cannot cause the DO level in the receiving stream below 5.0 mg/l.

The parameters used in the Streeter-Phelps model are: a water channel slope of 0.0013 (the water channel descends 10 feet over a distance of approximately 1.46 miles), a flow velocity of 0.1 fps in Outlet Creek (conservatively assumed). The background temperature and ammonia nitrogen values are shown in Table 2. The background CBOD5 and DO level are assumed to be 8.0 and 6.0 mg/l. The effluent temperatures are shown in Table 3. The effluent ammonia nitrogen values used are the calculated water quality based maximum limits shown in Table 4. The USGS Pool-riffle equation (Melching and Flores 1999) was used as the re-aeration model.

The modeling results show that effluent from this facility, which has an allowed maximum CBOD5 level of 40 mg/l (technology based limits for secondary treatment), will not cause D.O level in the receiving stream below 5.0 mg/l.

E. coli: The facility discharges into a Class (A1) water body. The water quality standard for *E. coli* in a Class (A1) water body is a Geometric Mean of 126 org./100 ml and a Sample Maximum of 235 org./100 ml from March 15th through November 15th. The criteria apply at “end-of-pipe”.

TDS:

Using 25.0% of the annual 7Q10 flow and 2.5% of the annual 1Q10 flow in Outlet Creek as the MZ and the ZID, respectively, the allowed effluent TDS concentration to meet the 1,000 mg/l of TDS threshold value at the boundary of the ZID is 1,044 mg/l and the allowed effluent TDS concentration to meet the 1,000 mg/l threshold value at the boundary of the MZ is 1,520 mg/l. If the effluent TDS levels are greater than 1,044 mg/l, an acute WET is required and if greater than 1,520 mg/l, a chronic WET test is required. The background TDS concentration is assumed as 300 mg/l.

Chloride:

Since the receiving stream, Outlet Creek, is a designated stream, it is afforded protection against both acutely and chronically toxic conditions. Using 25% of the annual 7Q10 flow and 2.5% of the annual 1Q10 flow in Outlet Creek as the MZ and the ZID, respectively, the allowed effluent chloride concentration to meet the 860 mg/l of chloride threshold value at the boundary of the ZID is 912 mg/l and the allowed effluent chloride concentration to meet the 230 mg/l threshold value at the boundary of the

MZ is 378 mg/l. If the effluent chloride level is greater than 912 mg/l, an acute WET is required and if greater than 378 mg/l, a chronic WET test is required. The background chloride concentration is assumed as 30 mg/l.

3. PERMIT LIMITATIONS: - *Based on the Year 2006 Water Quality Standards & 2002 Permit Derivation Procedure.*

The acute and chronic WLAs are used as the values for input into the current permit derivation procedure. Under the 2002 permit derivation procedure, only for toxic parameters is the monitoring frequency considered in the calculation of final limits. The limits are presented on Page 1-2.

4. WET TEST RATIOS

If WET tests are required due to high effluent TDS and chloride levels, the dilutions shown in Table 5 are allowed for a pass/fail test. However, the department prefers that the facility conduct the WET test with 100% effluent and the test be done at a series of different dilutions according to EPA guidance. The NOAEC and the LC50 for the acute test and the NOAEC and IC25 for the chronic test should be reported.

Table 5: Wet Test Dilution Ratio

Treatment Type	WET test	Effluent (%)	Dilution Water (%)
Controlled Discharge Lagoon	Acute	72.8	27.2
	Chronic	69.6	30.4
Mechanical Facility	Acute	94.1	5.9
	Chronic	57.4	42.6