State Form 4336

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

INDIANAPOLIS

OFFICE MEMORANDUM

Date: December 30, 2015

To: Jason House
Municipal Permits Section

From: John Elliott
Permits Branch

Subject: Wasteload Allocation Report for Carriage Estates III in Tippecanoe County (IN0043273, WLA002167)

Water quality-based effluent limitations (WQBELs) for CBOD5, dissolved oxygen (DO) and ammonia-N were determined and an antidegradation significant lowering analysis was done for the upgrade of the Carriage Estates III WWTP from 1.5 mgd to 4.0 mgd. Discharge through Outfall 001 is to Indian Creek, a tributary of Wabash River. Therefore, the discharge is covered under the rules for the non-Great Lakes system.

Indian Creek is designated for full-body contact recreation and shall be capable of supporting a well-balanced, warm water aquatic community. Indian Creek (assessment unit INB0851_01) is not on the 2012 303(d) list. A TMDL for the above assessment unit has not been completed and a TMDL is not in progress. The Q7,10 of Indian Creek upstream of the Carriage Estates III WWTP outfall is 0.0 cfs.

The WQBELs for CBOD5, DO and ammonia-N are included in Table 1. Ammonia-N is considered a regulated pollutant for antidegradation purposes and the WQBELs for ammonia-N in Table 1 will result in an increased loading to Indian Creek. Indian Creek is a high quality water for ammonia-N so antidegradation for high quality waters applies to ammonia-N. The results of the antidegradation significant lowering analysis are included in Table 2. The results show that the WQBELs for ammonia-N cause a significant lowering of water quality for ammonia-N. Therefore, an antidegradation demonstration for ammonia-N is required if the WQBELs for ammonia-N in Table 1 are pursued. Effluent limits for ammonia-N that do not cause a significant lowering of water quality are also included in Table 2. An antidegradation demonstration for ammonia-N is not required if these limits are accepted. The documentation of the wasteload allocation analysis is included as an attachment.

Attachment

TABLE 1
Water Quality-based Effluent Limitations
For Carriage Estates III in Tippecanoe County
Outfall 001 to Indian Creek
(IN0043273, WLA002167)

Parameter	Quality or Concentration*				Quantity or Loading*			Monthly Sampling Frequency
	Monthly Average	Daily Maximum	Daily Average	Units	Monthly Average	Daily Maximum	Units	
CBOD5								
Summer	20			mg/l	670		lbs/day	
Winter	25			mg/l	830		lbs/day	
Dissolved Oxygen								
Summer			6.0	mg/l				
Winter			5.0	mg/l				
Total Ammonia (as N)								
Summer	1.6			mg/l	53		lbs/day	30
Winter	3.0			mg/l	100		lbs/day	30

* Based on an effluent flow of 4 mgd.

12/30/2015

TABLE 2
Results of Antidegradation Procedure
For Carriage Estates III in Tippecanoe County
Outfall 001 to Indian Creek
(IN0043273, WLA002167)

Parameter	High Quality Water?	Proposed Effluent Limits Cause a Significant Lowering?	Benchmark Available Loading Capacity (lbs/day)	Effluent Limits that Do Not Require an Antidegradation Demonstration					
				Quality or Concentration*			Quantity or Loading*		
				Monthly Average	Daily Maximum	Units	Monthly Average	Daily Maximum	Units
Total Ammonia (as N)									
Summer	Yes	Yes	38	1.3		mg/l	43		lbs/day
Winter	Yes	Yes	76	1.9		mg/l	63		lbs/day

* Based on an effluent flow of 4 mgd.

12/30/2015

Documentation of Wasteload Allocation Analysis For Discharges in the Non-Great Lakes System

Analysis By: John Elliott
Date: December 30, 2015
WLA Number: 002167

Facility Information

- **Name:** Carriage Estates III
- **NPDES Permit Number:** IN0043273
- **Permit Expiration Date:** January 31, 2016
- **County:** Tippecanoe
- **Purpose of Analysis:** Calculation of water quality-based effluent limitations and antidegradation significant lowering analysis for upgrade of the WWTP
- **Outfall Number:** 001
- **Type of Treatment:** Sequential batch reactor system for carbonaceous oxidation, nitrification and organic phosphorus removal and UV disinfection
- **Current Average Design Flow:** 1.5 mgd
- **Average Design Flow for WLA Analysis:** 4.0 mgd
- **Current Effluent Limits:** (The following table only includes pollutants for which WQBELs were developed.)

Parameter	Monthly Average		Weekly Average		Daily Average	Measurement Frequency
	(mg/l)	(lbs/day)	(mg/l)	(lbs/day)	(mg/l)	
CBOD5 (summer)	14	175.2	21	262.9	--	5 x Weekly
CBOD5 (winter)	25	312.9	40	500.7	--	5 x Weekly
Ammonia-N (summer)	1.3	16.3	2.0	25.0	--	5 x Weekly
Ammonia-N (winter)	1.9	23.8	2.9	36.3	--	5 x Weekly
DO (summer)	--	--	--	--	6.0	5 x Weekly
DO (winter)	--	--	--	--	5.0	5 x Weekly

Pollutants of Concern and Type of WLA Analysis

Pollutants of Concern and Type of WLA Analysis		
Parameter	**Type of Analysis**	**Reason for Inclusion on Pollutants of Concern List**
CBOD5, DO	DO model	Discharge of sanitary wastewater.
Ammonia-N	WQBEL	Discharge of sanitary wastewater.

Receiving Stream Information

- **Receiving Stream:** Indian Creek to Wabash River (see Attachment 1)
- **Public Water System Intakes Downstream:** None
- **Designated Stream Use:** Indian Creek and Wabash River are designated for full-body contact recreation and shall be capable of supporting a well-balanced, warm water aquatic community
- **12 Digit HUC:** 051201080501
- **Assessment Unit (2012):** INB0851_01
- **303(d) List (2012):** The above Assessment Unit is not on the 2012 303(d) list.
- **TMDL Status:** A TMDL for the above assessment unit has not been completed and a TMDL is not in progress.
- **Q1,10 (Outfall):** 0.0 cfs
- **Q7,10 (Outfall):** 0.0 cfs
- **Q30,10 (Outfall):** 0.1 cfs
  (USGS partial record gaging station 03335682 Indian Creek near Green Hill is downstream of the outfall. The drainage area at this gage is 29.0 mi^2, the Q7,10 is 0.0 cfs, the Q1,10 is 0.0 cfs, and the Q30,10 is 0.1 cfs. The drainage area and stream design flows were obtained from the book Low-Flow Characteristics for Selected Streams in Indiana by Kathleen K. Fowler and John T. Wilson, published in 2015 by the USGS. The drainage area upstream of the outfall is 16.3 mi^2 and was determined using the USGS StreamStats website. The stream design flows were determined using the ratio of drainage areas.)
- **Nearby Dischargers:** None

Calculation of Water Quality-based Effluent Limitations

There are no instream data available to calculate the 75th percentile downstream pH and temperature. Therefore, summer/winter default pH values of 7.8/7.8 s.u. were used and typical central Indiana summer/winter temperatures of 24°C/10°C were used for the determination of the ammonia-N criteria. There are also no instream data available to calculate the geometric mean background ammonia-N concentrations. Therefore, summer/winter default values of 0.05/0.05 mg/l were used.

The coefficient of variation used to calculate WQBELs was set equal to the default value of 0.6. The number of samples per month used to calculate monthly average WQBELs for ammonia-N was set equal to 30 based on the expected monitoring frequency. The spreadsheet used to calculate WQBELs for an average design flow of 4.0 mgd is included in Attachment 2.

Dissolved Oxygen Analysis

The U.S. EPA Simplified Method was used to model the average instream DO concentration in Indiana Creek from the Carriage Estates III WWTP to a point 3.0 miles downstream (confluence with Goose Creek).

The slope of Indian Creek was measured to be 22 ft/mile (60 ft (630-570) over 2.7 miles) using a USGS topographical map.

Dissolved Oxygen Criteria
The following dissolved oxygen criteria for warm water fish apply outside the mixing zone:

Concentrations of dissolved oxygen shall average at least five (5.0) milligrams per liter per calendar day and shall not be less than four (4.0) milligrams per liter at any time.
(327 IAC 2-1-6(b)(3))

Hydraulic Data
A time-of-travel (TOT) study has not been done on Indian Creek. Time-of-travel studies have been done on other streams in Indiana. Data from a TOT study on a stream with similar flow and physical characteristics were obtained.

There are slope and TOT data available for Yellow Creek in Fulton County from the Mentone survey conducted by the Surveys Section in July 1987. The TOT measured for the 1.2 mile segment between stations 5 and 6 was used. The TOT was 0.39 ft/sec. The average flow between stations 5 and 6 was 3.8 cfs, the average width for the segment was 19 ft for a calculated average depth of 0.51 ft. The slope was 8.8 ft/mile.

Hydraulic Data Converted to Modeled Flow

$\text{Velocity}_2 = \text{Velocity}_1 \times (\text{Flow}_2/\text{Flow}_1)^{0.4}$

$\text{Depth}_2 = \text{Depth}_1 \times (\text{Flow}_2/\text{Flow}_1)^{0.6}$

Flow = Carriage Estates III (6.2 cfs (4.0 mgd)) + Q7,10 (0.0 cfs) = 6.2 cfs
Velocity = 0.39 ft/sec x $(6.2 \text{ cfs}/3.8 \text{ cfs})^{0.4}$ = 0.47 ft/sec
Depth = 0.51 ft x $(6.2 \text{ cfs}/3.8 \text{ cfs})^{0.6}$ = 0.68 ft

Reaction Rates at 20°C
- **CBOD Decay Rate (k_1):** 0.3 1/day (default value)
- **Reaeration Rate (k_2):** 6.9 1/day (Parkhurst-Pomeroy equation; one of the equations recommended by the Ohio EPA for the flow and slope used in this study; the reaeration rate calculated using this equation is consistent with reaeration data from streams in other states)
- **NBOD Decay Rate (k_n):** 0.4 1/day (default value)
- **Benthic Oxygen Demand (S):** 0.2 gm/m^2/day (USEPA Simplified Method guidance document recommendation for greater than secondary treatment)

Effluent Data (summer/winter)
- **Temperature:** 24/10 °C (default values)
- **CBOD5:** varied
- **CBODU:** varied (equal to 2.3 times CBOD5)
- **Ammonia-N:** 1.6/3.0 mg/l
- **NBODU:** 7.312/13.71 mg/l (equal to 4.57 times ammonia-N)
- **DO:** varied

Modeling Results
The summer and winter dissolved oxygen analyses are included in Attachments 3 and 4, respectively.

Water Quality-based Effluent Limitations Protective of Instream Dissolved Oxygen at an Average Design Flow of 4.0 mgd				
Parameter	**Monthly Average (mg/l)**		**Daily Average (mg/l)**	
	summer	**winter**	**summer**	**winter**
Ammonia-N	1.6	3.0	--	--
CBOD5	20	25	--	--
DO	--	--	6.0	5.0

Antidegradation Analysis for Non-BCCs
The increase in average design flow will result in an increase in the loading of the regulated pollutant ammonia-N. Therefore, antidegradation was considered for ammonia-N.

High Quality Water Determination

High Quality Water Determination		
Pollutant	**High Quality Water? Yes/No**	**Rationale for Determination**
Ammonia-N	Yes	Water quality data are not available for Indian Creek, so it is assumed that Indian Creek is a high quality water for ammonia-N.

Significant Lowering Determination
A determination was made whether the proposed increased loading would cause a significant lowering of water quality based on the definition in 327 IAC 2-1.3-2(50). To cause a significant lowering, the proposed increased loading would have to result in an increase in the ambient concentration of the regulated pollutant in the receiving stream and be greater than a de minimis lowering of water quality, unless an exemption other than de minimis under 2-1.3-4 applies.

Increase in Ambient Concentration
An increase in the ambient concentration of the regulated pollutant in the receiving stream will occur if the increased loading results in a proposed ambient concentration of the regulated pollutant (C_{sp}) that is greater than the existing ambient concentration of the regulated pollutant (C_{se}). The following calculation was used to make this determination:

If $C_{sp} > C_{se}$, then there is an increase in the ambient concentration of the regulated pollutant.

$$C_{sp} = \frac{(C_p * Q_p) + (C_{b1} * Q_{s1})}{Q_p + Q_{s1}}$$ (Proposed ambient concentration of the regulated pollutant (in mg/l).)

$$C_{se} = \frac{(C_e * Q_e) + (C_{b1} * Q_{s1})}{Q_e + Q_{s1}}$$ (Existing ambient concentration of the regulated pollutant (in mg/l).)

C_p = Proposed monthly average concentration limit (in mg/l).
C_e = Existing monthly average concentration limit (in mg/l).
Q_p = Proposed average design flow (in mgd).
Q_e = Existing average design flow (in mgd).
Q_{s1} = The Q7,10 low-flow of the receiving stream (in mgd).
C_{b1} = Background concentration of the receiving stream (in mg/l).

If $C_p = C_{se} + [(Q_{s1}/Q_p) * (C_{se} - C_{b1})]$, then there is not an increase in the ambient concentration of the regulated pollutant.

De minimis Equations:

Total Loading Capacity (TLC) = (Stream Design Flow (mgd) + Existing Effluent Flow (mgd) + Proposed increase in Effluent Flow (mgd)) * Water Quality Criterion (mg/l) * 8.345

Used Loading Capacity (ULC) = Stream Design Flow (mgd) * Background Conc. (mg/l) * 8.345 + Existing Monthly Average Mass Limit (lbs/day)

Available Loading Capacity (ALC) = Total Loading Capacity – Used Loading Capacity

Benchmark Available Loading Capacity = 0.9 * (ALC established at the time of the request for the initial increase in the loading of the regulated pollutant); this is the first increase under the new antidegradation rule so the Benchmark ALC was not used in the de minimis determination, but will be documented for any future increase of the regulated pollutant.

Results for Ammonia-N:

- **Ambient Concentration Increase for Summer:**

C_p = 1.6 mg/l; C_e = 1.3 mg/l; Q_p = 4.0 mgd; Q_e = 1.5 mgd; Q_{s1} = 0 mgd; C_{b1} = 0.05 mg/l

C_{sp} = 1.6 mg/l

C_{se} = 1.3 mg/l

$C_{sp} > C_{se}$ so there is an ambient increase.

Ambient Concentration Increase for Winter:

C_p = 3.0 mg/l; C_e = 1.9 mg/l; Q_p = 4.0 mgd; Q_e = 1.5 mgd; Q_{s1} = 0 mgd; C_{b1} = 0.05 mg/l

C_{sp} = 3.0 mg/l

C_{se} = 1.9 mg/l

$C_{sp} > C_{se}$ so there is an ambient increase.

De minimis Lowering of Water Quality:

Total Loading Capacity
A stream design flow for acute criteria is not specified in 327 IAC 5-2-11.1 so the Q1,10 flow was used. The Q30,10 is the stream design flow for the chronic ammonia-N criterion.

Summer
Chronic Aquatic TLC = (1.5 mgd + 2.5 mgd + 0.0646 mgd) * 1.727 mg/l * 8.345
= 58.6 lbs/day
Acute Aquatic TLC = (1.5 mgd + 2.5 mgd + 0.0 mgd) * 12.139 mg/l * 8.345
= 405 lbs/day

Winter
Chronic Aquatic TLC = (1.5 mgd + 2.5 mgd + 0.0646 mgd) * 3.182 mg/l * 8.345
= 108 lbs/day
Acute Aquatic TLC = (1.5 mgd + 2.5 mgd + 0.0 mgd) * 12.139 mg/l * 8.345
= 405 lbs/day

Used Loading Capacity
The minimum ALC will be based on the chronic criterion so only the Q30,10 was used.

Summer ULC = 0.0646 mgd * 0.05 mg/l * 8.345 + 16.3 lbs/day = 16.3 lbs/day

Winter ULC = 0.0646 mgd * 0.05 mg/l * 8.345 + 23.8 lbs/day = 23.8 lbs/day

Available Loading Capacity
Summer ALC = 58.6 lbs/day – 16.3 lbs/day = 42.3 lbs/day

Winter ALC = 108 lbs/day – 23.8 lbs/day = 84.2 lbs/day

10 % of Available Loading Capacity
Summer: 0.1 * 42.3 lbs/day = 4.2 lbs/day

Winter: 0.1 * 84.2 lbs/day = 8.4 lbs/day

Proposed Increase in Mass
Summer: 53 lbs/day – 16.3 lbs/day = 36.7 lbs/day

Winter: 100 lbs/day – 23.8 lbs/day = 76.2 lbs/day

The proposed increase is greater than 10% of the Available Loading Capacity for both summer and winter.

Conclusion: The proposed increased loading will result in an increase in the ambient concentration of ammonia-N in the receiving stream and be greater that a de minimis lowering of water quality. Therefore, it will cause a significant lowering of water quality.

Calculation of Limits that Do Not Cause a Significant Lowering of Water Quality

Concentration in the Receiving Water Body Does Not Increase

If $C_p = C_{se} + [(Q_{s1}/Q_p) * (C_{se} - C_{b1})]$, then there is not an increase in the ambient concentration of the regulated pollutant.

Summer
$C_p = 1.3$ mg/l + [(0.0/4.0) * (1.3 – 0.05)] = 1.3 mg/l
$M_p = 1.3$ mg/l * 4.0 mgd * 8.345 = 43 lbs/day

Winter
$C_p = 1.9$ mg/l + [(0.0/4.0) * (1.9 – 0.05)] = 1.9 mg/l
$M_p = 1.9$ mg/l * 4.0 mgd * 8.345 = 63 lbs/day

De minimis Lowering of Water Quality

If $M_p = M_e + 0.1 * (ALC)$, then the net increase in loading is equal to 10% of the available loading capacity.

Where,

M_p = Proposed monthly average mass limit (in lbs/day)
M_e = Existing monthly average mass limit (in lbs/day)

To be a de minimis lowering of water quality, the following mass and concentration limits would be required:

Summer Mass: $= M_e + 0.1 * ALC = 16.3 + 0.1 * 42.3$ lbs/day = 20.5 lbs/day
Summer Mass (rounded down) = 20 lbs/day
Summer Concentration: 0.60 mg/l

Winter Mass: $= M_e + 0.1 * ALC = 23.8 + 0.1 * 84.2$ lbs/day = 32.2 lbs/day
Winter Mass (rounded down) = 32 lbs/day
Winter Concentration: 0.96 mg/l

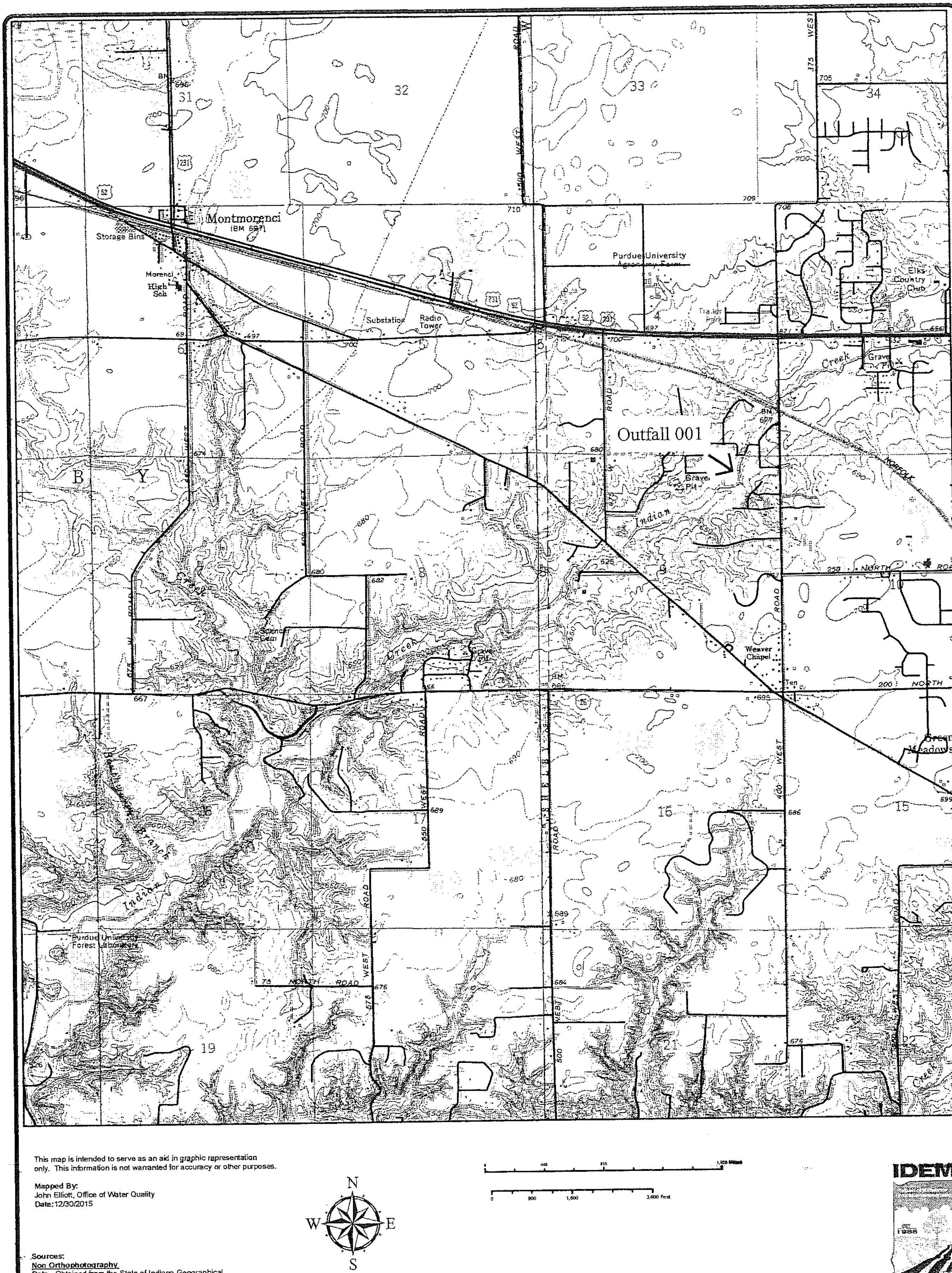
- **Limits that Do Not Cause a Significant Lowering:** The less stringent of the limits that do not cause an increase in the ambient concentration and the de minimis limits can be accepted to not cause a significant lowering of water quality. In this case the limits that do not cause an increase in the ambient concentration are less stringent.

  Monthly Average Summer Concentration: 1.3 mg/I
  Monthly Average Summer Mass: 43 lbs/day
  Monthly Average Winter Concentration: 1.9 mg/I
  Monthly Average Winter Mass: 63 lbs/day

  Benchmark Available Loading Capacity
  Summer: 0.9 * 42.3 lbs/day = 38 lbs/day
  Winter: 0.9 * 84.2 lbs/day = 76 lbs/day

<u>List of Attachments</u>
Attachment 1: Map of Outfall Location
Attachment 2: Calculation of Water Quality-based Effluent Limitations
Attachment 3: Summer Dissolved Oxygen Model
Attachment 4: Winter Dissolved Oxygen Model

ATTACHMENT 1
Carriage Estates III Oufall Location



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By:
John Elliott, Office of Water Quality
Date:12/30/2015

Sources:
<u>Non Orthophotography</u>
<u>Data</u> - Obtained from the State of Indiana Geographical Information Office Library
<u>Orthophotography</u> - Obtained from Indiana Map Framework Data (www.indianamap.org)
<u>Map Projection:</u> UTM Zone 16 N <u>Map Datum:</u> NAD83

ATTACHMENT 2

Calculation of Preliminary Effluent Limitations for Discharges in the Non-Great Lakes System (Excluding Discharges to the Ohio River)

General Information	
Facility Name:	Carriage Estates III
County:	Tippecanoe
NPDES Number:	IN0043273
WLA Number:	002167
WLA Report Date:	12/30/2015
Outfall:	001
Receiving Stream:	Indian Creek

Receiving Stream Questions (Yes or No)	
Acute Mixing Zone Allowed?	No
Public Water System (PWS) Intake Downstream?	No
Put-and-Take Trout Fishing?	No
Fish Early Life Stages Present?	Yes

Effluent Flow	=	4 mgd

Receiving Stream Design Flows		
Q7,10 (Outfall)	=	0 cfs
Q7,10 (Public Water System Intake)	=	cfs
Q30,10 (Outfall)	=	0.1 cfs
Q50 (Outfall)	=	cfs
Q50 (Public Water System Intake)	=	cfs

Ambient Downstream Water Quality Characteristics		
Acute Ammonia-N		
Summer pH (75th percentile)	=	7.8 s.u.
Winter pH (75th percentile)	=	7.8 s.u.
Chronic Ammonia-N		
Summer Temperature (75th percentile)	=	24 C
Summer pH (75th percentile)	=	7.8 s.u.
Winter Temperature (75th percentile)	=	10 C
Winter pH (75th percentile)	=	7.8 s.u.

Mixing Zone Dilution

Dilution Factor (for acute mixing zone)	=			
		Dilution Fraction	**Flow**	**Location**
Chronic Aquatic Life (Except Ammonia)	=	50%	Q7,10	Outfall
Chronic Aquatic Life (Ammonia Only)	=	50%	Q30,10	Outfall
Human Noncancer Drinking Water	=	100%	Q7,10	PWS Intake
Human Noncancer Nondrinking Water	=	50%	Q7,10	Outfall
Human Cancer Drinking Water	=	100%	Q50	PWS Intake
Human Cancer Nondrinking Water	=	25%	Q50	Outfall
Public Water Supply	=	100%	Q7,10	PWS Intake

Source of Criteria [1] A	B	C	D	E	F	G	Background (Outfall) (ug/l)	Background (Intake) (ug/l)	Remove Mixing Zone? (Yes or Blank)	Samples/ Month	CV	Facility Specific CV? (Yes or No)	CAS Number	Parameters
													7664417	Total Ammonia (as N)
2	2						50			30	0.6	No		Summer
2	2						50			30	0.6	No		Winter

Parameters	Indiana Water Quality Criteria for the Non-Great Lakes System (ug/l): A – Aquatic Life Criteria, Acute (AAC)	B – Aquatic Life Criteria, Chronic (CAC)	C – Human Health Noncancer Criteria, Drinking (HNC-D)	D – Human Health Noncancer Criteria, Nondrinking (HNC-N)	E – Human Health Cancer Criteria, Drinking (HCC-D)	F – Human Health Cancer Criteria, Nondrinking (HCC-N)	G – Add. PWS Criteria (WC)	Preliminary Effluent Limitations: Concentration (ug/l) Average	Concentration (ug/l) Maximum	Mass (lbs/day) Average	Mass (lbs/day) Maximum	Criteria Type	Basis
Total Ammonia (as N)													
Summer	12138.81	1726.88						1600	4200	53	140	Tier I	CAC
Winter	12138.81	3182.28						3000	7800	100	260	Tier I	CAC

[1] Source of Criteria
1) Indiana numeric water quality criterion in 327 IAC 2-1-6(a)(3), Table 6-1.
2) Acute (1-hour average) and chronic (30-day average) criteria for total ammonia nitrogen in "1999 Update of Ambient Water Quality Criteria for Ammonia," EPA-822-R-99-014, December 1999.

[2] The monthly average PEL was set equal to the most stringent WLA because the calculated monthly average PEL exceeded the most stringent WLA and a facility specific CV was not determined.

Last revised: October 15, 2009

ATTACHMENT 3

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER QUALITY

SUMMER WASTELOAD ALLOCATION ANALYSIS

Treatment Facility : **Carriage Estates III**
County : **Tippecanoe** Design Flow **4.0** mgd

Receiving Stream(s) : **Indian Creek**
:

Wasteload Allocation Analysis performed by : **John Elliott**
Date : **30-Dec-15**

STREAM WATER QUALITY STANDARDS

INSTREAM DISSOLVED OXYGEN = 5.0 mg/l
Ammonia-N Standard is based on the RULE 327 IAC 2-1

HEADWATER AND EFFLUENT WATER QUALITY INPUT DATA

	FLOW cfs	cBODU mg/l	NBODU mg/l	D.O. mg/l	TEMP CG
HEADWATER QUALITY	0.0000				
EFFLUENT WATER QUALITY	6.2000	46.0000	7.3120	6.0000	24.00
Downstream of FACILITY	*6.2000*	*46.00*	*7.3100*	*6.00*	*24.00*

HYDRAULIC CHARACTERISTICS DOWNSTREAM OF THE TREATMENT PLANT

VELOCITY - DEPTH OPTIONS:
CALCULATED VELOCITY - DEPTH DATA USED

OPTION - 1 COMPUTED VELOCITY and DEPTH

VELOCITY	DEPTH
0.4700	0.6800

HYDRAULIC SURVEY COMMENTS:

STREAM HYDRAULIC DATA DOWNSTREAM OF STP	VELOCITY ft/sec	DEPTH ft.	SLOPE ft/mile	MANNING'S
	0.4700	*0.6800*	22.0000	0.04

REACH or SEGMENT DATA	Reach HEAD	Reach END
	3.0000 mile	0.0000 mile
	Computational ELEMENT	0.0600 mile

Reach or Segment No. : 1 **Indian Creek**

REAERATION AND REACTION RATES

	TEMPERATURE At 20 CG	INSTREAM 24.0000	REMARK
REAERATION RATE [1/DAY]	6.8778	*7.56*	PARKHURST - POMEROY
CBOD DECAY RATE [1/DAY]	0.3000	*0.3605*	
NBOD DECAY RATE [1/DAY]	0.4000	*0.5442*	
SEDIMENTATION [1/DAY]	0.0000	*0.0000*	"-" SUSPENSION "+" SEDIMENTATION
BENTHIC OXYGEN DEMAND	0.2000	*0.2573*	IN GM/SQ.M/DAY

SIMULATED INSTREAM WATER QUALITY : DOWNSTREAM OF A DISCHARGER OR BELOW JUNCTION

TIME DAYS	DISTANCE MILE	D.O. mg/l	cBODU mg/l	NBODU mg/l
0.0000	0.0000	6.0000	46.0000	7.3120
0.0078	0.0600	5.9691	45.8708	7.2810
0.0156	0.1200	5.9404	45.7420	7.2502
0.0234	0.1800	5.9138	45.6135	7.2195
0.0312	0.2400	5.8892	45.4854	7.1889
0.0390	0.3000	5.8665	45.3577	7.1584
0.0468	0.3600	5.8456	45.2303	7.1281
0.0546	0.4200	5.8264	45.1033	7.0979
0.0624	0.4800	5.8087	44.9766	7.0678
0.0702	0.5400	5.7925	44.8503	7.0379
0.0780	0.6000	5.7777	44.7243	7.0081
0.0858	0.6600	5.7642	44.5987	6.9784
0.0936	0.7200	5.7520	44.4734	6.9488
0.1014	0.7800	5.7409	44.3485	6.9194
0.1092	0.8400	5.7309	44.2240	6.8901
0.1170	0.9000	5.7220	44.0998	6.8609
0.1248	0.9600	5.7140	43.9759	6.8318
0.1326	1.0200	5.7069	43.8524	6.8029
0.1404	1.0800	5.7007	43.7293	6.7740
0.1482	1.1400	5.6953	43.6065	6.7453
0.1560	1.2000	5.6907	43.4840	6.7168
0.1638	1.2600	5.6868	43.3619	6.6883
0.1716	1.3200	5.6836	43.2401	6.6600
0.1794	1.3800	5.6809	43.1186	6.6318
0.1872	1.4400	5.6789	42.9975	6.6037
0.1950	1.5000	5.6775	42.8768	6.5757

TIME DAYS	DISTANCE MILE	D.O. mg/l	cBODU mg/l	NBODU mg/l
0.2028	1.5600	5.6766	42.7564	6.5478
0.2106	1.6200	5.6761	42.6363	6.5201
0.2184	1.6800	5.6762	42.5165	6.4925
0.2262	1.7400	5.6767	42.3971	6.4650
0.2340	1.8000	5.6776	42.2781	6.4376
0.2418	1.8600	5.6788	42.1593	6.4103
0.2496	1.9200	5.6805	42.0409	6.3831
0.2574	1.9800	5.6824	41.9229	6.3561
0.2652	2.0400	5.6847	41.8051	6.3292
0.2730	2.1000	5.6873	41.6877	6.3024
0.2809	2.1600	5.6902	41.5706	6.2757
0.2887	2.2200	5.6934	41.4539	6.2491
0.2965	2.2800	5.6968	41.3375	6.2226
0.3043	2.3400	5.7004	41.2214	6.1962
0.3121	2.4000	5.7042	41.1056	6.1700
0.3199	2.4600	5.7083	40.9902	6.1438
0.3277	2.5200	5.7125	40.8750	6.1178
0.3355	2.5800	5.7169	40.7602	6.0919
0.3433	2.6400	5.7215	40.6458	6.0661
0.3511	2.7000	5.7262	40.5316	6.0404
0.3589	2.7600	5.7311	40.4178	6.0148
0.3667	2.8200	5.7362	40.3043	5.9893
0.3745	2.8800	5.7413	40.1911	5.9639
0.3823	2.9400	5.7466	40.0782	5.9387
0.3901	3.0000	5.7519	39.9656	5.9135

MINIMUM INSTREAM DISSOLVED OXYGEN 5.6761 mg/l OCCURS AT 0.2126 DAYS AND 1.6350 MILES BELOW DISCHARGER OR JUNCTION

ATTACHMENT 4

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER QUALITY

WINTER WASTELOAD ALLOCATION ANALYSIS

Treatment Facility : **Carriage Estates III**
County : **Tippecanoe** Design Flow **4.0** mgd

Receiving Stream(s) : **Indian Creek**
:

Wasteload Allocation Analysis performed by : **John Elliott**
Date : **30-Dec-15**

STREAM WATER QUALITY STANDARDS

INSTREAM DISSOLVED OXYGEN = 5.0 mg/l
Ammonia-N Standard is based on the RULE 327 IAC 2-1

HEADWATER AND EFFLUENT WATER QUALITY INPUT DATA

	FLOW cfs	cBODU mg/l	NBODU mg/l	D.O. mg/l	TEMP CG
HEADWATER QUALITY	0.0000				
EFFLUENT WATER QUALITY	6.2000	57.5000	13.7100	5.0000	10.00
Downstream of FACILITY	*6.2000*	*57.50*	*13.7100*	*5.00*	*10.00*

HYDRAULIC CHARACTERISTICS DOWNSTREAM OF THE TREATMENT PLANT

VELOCITY - DEPTH OPTIONS:

CALCULATED VELOCITY - DEPTH DATA USED

OPTION - 1 COMPUTED VELOCITY and DEPTH

VELOCITY	DEPTH
0.4700	0.6800

HYDRAULIC SURVEY COMMENTS:

STREAM HYDRAULIC DATA DOWNSTREAM OF STP	VELOCITY ft/sec	DEPTH ft.	SLOPE ft/mile	MANNING'S
	0.4700	*0.6800*	22.0000	0.04

REACH or SEGMENT DATA

	Reach HEAD	Reach END
	3.0000 mile	**0.0000** mile
Computational ELEMENT		**0.0600** mile

Reach or Segment No. : 1 **Indian Creek**

REAERATION AND REACTION RATES

	TEMPERATURE At 20 CG	INSTREAM 10.0000	REMARK
REAERATION RATE [1/DAY]	6.8778	*5.43*	PARKHURST - POMEROY
CBOD DECAY RATE [1/DAY]	0.3000	*0.1895*	
NBOD DECAY RATE [1/DAY]	0.4000	*0.1853*	
SEDIMENTATION [1/DAY]	0.0000	*0.0000*	"-" SUSPENSION "+" SEDIMENTATION
BENTHIC OXYGEN DEMAND	0.2000	*0.1065*	IN GM/SQ.M/DAY

SIMULATED INSTREAM WATER QUALITY : DOWNSTREAM OF A DISCHARGER OR BELOW JUNCTION

TIME DAYS	DISTANCE MILE	D.O. mg/l	cBODU mg/l	NBODU mg/l
0.0000	0.0000	5.0000	57.5000	13.7100
0.0078	0.0600	5.1536	57.4150	13.6902
0.0156	0.1200	5.3009	57.3302	13.6704
0.0234	0.1800	5.4423	57.2455	13.6507
0.0312	0.2400	5.5780	57.1609	13.6310
0.0390	0.3000	5.7083	57.0765	13.6113
0.0468	0.3600	5.8332	56.9922	13.5916
0.0546	0.4200	5.9532	56.9080	13.5720
0.0624	0.4800	6.0683	56.8239	13.5524
0.0702	0.5400	6.1788	56.7399	13.5328
0.0780	0.6000	6.2849	56.6561	13.5133
0.0858	0.6600	6.3867	56.5724	13.4937
0.0936	0.7200	6.4844	56.4888	13.4742
0.1014	0.7800	6.5783	56.4054	13.4548
0.1092	0.8400	6.6684	56.3220	13.4354
0.1170	0.9000	6.7549	56.2388	13.4159
0.1248	0.9600	6.8380	56.1557	13.3966
0.1326	1.0200	6.9178	56.0728	13.3772
0.1404	1.0800	6.9944	55.9899	13.3579
0.1482	1.1400	7.0680	55.9072	13.3386
0.1560	1.2000	7.1387	55.8246	13.3193
0.1638	1.2600	7.2066	55.7421	13.3001
0.1716	1.3200	7.2719	55.6598	13.2809
0.1794	1.3800	7.3346	55.5775	13.2617
0.1872	1.4400	7.3948	55.4954	13.2426
0.1950	1.5000	7.4527	55.4134	13.2234

TIME DAYS	DISTANCE MILE	D.O. mg/l	cBODU mg/l	NBODU mg/l
0.2028	1.5600	7.5083	55.3316	13.2043
0.2106	1.6200	7.5618	55.2498	13.1853
0.2184	1.6800	7.6132	55.1682	13.1662
0.2262	1.7400	7.6626	55.0867	13.1472
0.2340	1.8000	7.7101	55.0053	13.1282
0.2418	1.8600	7.7558	54.9240	13.1092
0.2496	1.9200	7.7997	54.8429	13.0903
0.2574	1.9800	7.8420	54.7618	13.0714
0.2652	2.0400	7.8826	54.6809	13.0525
0.2730	2.1000	7.9218	54.6002	13.0337
0.2809	2.1600	7.9594	54.5195	13.0148
0.2887	2.2200	7.9956	54.4389	12.9960
0.2965	2.2800	8.0305	54.3585	12.9773
0.3043	2.3400	8.0640	54.2782	12.9585
0.3121	2.4000	8.0963	54.1980	12.9398
0.3199	2.4600	8.1275	54.1179	12.9211
0.3277	2.5200	8.1574	54.0380	12.9025
0.3355	2.5800	8.1863	53.9581	12.8838
0.3433	2.6400	8.2141	53.8784	12.8652
0.3511	2.7000	8.2409	53.7988	12.8466
0.3589	2.7600	8.2667	53.7193	12.8281
0.3667	2.8200	8.2916	53.6400	12.8095
0.3745	2.8800	8.3157	53.5607	12.7910
0.3823	2.9400	8.3388	53.4816	12.7726
0.3901	3.0000	8.3612	53.4026	12.7541

MINIMUM INSTREAM DISSOLVED OXYGEN 5.0000 mg/l OCCURS AT
0.0000 DAYS AND 0.0000 MILES BELOW DISCHARGER OR JUNCTION