VPDES PERMIT FACT SHEET

This document gives pertinent information concerning the reissuance of the VPDES permit listed below. This permit is being processed as a Major Municipal permit. The owner has requested the permit be reissued with tiered limits for the existing 5.0 MGD WWTP and to provide for expansion to 6.5 MGD and 7.0 MGD. The effluent limitations contained in this permit will maintain the Water Quality Standards of 9 VAC 25-260-00 et seq. The existing discharge results from the operation of a bar screen, comminutor, grit removal equipment, oxidation ditch, dual secondary clarifiers, chlorination and dechlorination facilities, post aeration, dual aerobic digesters, and dual belt filter presses. This permit action consists of limiting $cBOD_5$, total suspended solids, ammonia nitrogen, total residual chlorine, bacteria, pH and dissolved oxygen, and includes special conditions requiring water quality criteria monitoring, a significant discharger survey, a toxics monitoring program, and other requirements and special conditions. SIC Code: 4952

1. Facility Name and Address:

Coeburn-Norton-Wise Regional Wastewater Treatment Plant
11550 Pine Camp Road
Coeburn, VA 24230

Owner Name and Address:

Coeburn-Norton-Wise Regional Wastewater Treatment Authority
P.O. Box 1296
Norton, VA 24273

Facility Location: St. Rt. 699, Wise County, VA

2. Permit No.: VA0077828 Existing Permit Expiration Date: February 4, 2013

3. Owner Contact:

Name: Mark S. Hollyfield Title: Executive Director
Telephone No: (276) 679-7236

4. Application Complete Date: May 15, 2012
Permit Drafted By: Clairise R. Shaheen Date: January 24, 2012
DEQ Regional Office: Southwest Regional Office
Reviewed By: Steve E. Arthur Date: 5/17/2012
Public Comment Period Dates: from _____ to _____
Revised:

5. Receiving Waters:

Stream Name: Guest River
Basin: Tennessee Big Sandy River
Section: 2 Class: IV
7-Day, 10-Year Low Flow: 1.33 MGD
1-Day, 10-Year Low Flow: 1.13 MGD
30-Day, 10 Year Low Flow: 1.66 MGD
30-Day, 5-Year Low Flow: 2.59 MGD
High Flow Months are December thru May
Harmonic Mean Flow: 12.99 MGD
Tidal: No On 303(d) list: Yes

River Mile: 6BGUE007.56
Subbasin: Clinch River
Special Standards: None
High 7Q10: 5.23 MGD
High 1Q10: 4.54 MGD
High 30Q10: 13.2 MGD

See Attachment 1 – Flow Frequency Analysis

6. Operator License Requirements: A Class I licensed operator is required.

7. Reliability Class: Class II

8. Permit Characterization:
( ) Private ( ) Federal ( ) State (X) POTW ( ) PVOTW

( ) Possible Interstate Effect ( ) Interim Limits in Other Document

9. Treatment Provided: The existing treatment facilities consist of preliminary treatment using a mechanical fine screen and grit chamber, secondary treatment utilizing an oxidation ditch to treat CBOD, followed by secondary settling in two circular clarifiers. Disinfection is accomplished by chlorination, followed by dechlorination, and reaeration before discharging. Sludge stabilization is through aerobic digestion and dewatered by belt filter presses.

Currently CNW proposes to expand their treatment facilities to accommodate 6.5 MGD. This will include providing additional screening and grit removal equipment at the headworks of the WWTP. IFAS fixed media units will be placed in the middle channel of the oxidation ditch to provide additional biomass to the system. The inner channel of the oxidation ditch will also be modified to handle peak flows by utilizing it as a third secondary clarifier. During peak flows the aeration units in the inner channel will be turned off to allow solids settle. Effluent from the secondary clarifiers will then be pumped into two Aqua Aerobic disk filter units for tertiary treatment. Filtered water will be chlorinated, dechlorinated, and reaerated before discharging to the Guest River. Sludge will be stabilized through aerobic digestors and dewatered by belt filter presses.

Discharge Description

OUTFALL NUMBER	DISCHARGE SOURCE (1)	TREATMENT (2)	FLOW (3)
001	Sewage Treatment Plant	Mechanical Bar Screen, Grit Collector, Oxidation Ditch, Secondary Clarifiers, Chlorination, Dechlorination, Post Aeration, Aerobic Digesters, and Belt Filter Press.	5.0 MGD
001 (after CTO is issued)	Sewage Treatment Plant	Dual Mechanical Bar Screens and Grit Collectors, modified Oxidation Ditch, Secondary Clarifiers, Tertiary Filters, Chlorination, Dechlorination, Post Aeration, Aerobic Digesters, and Belt Filter Presses.	6.5 MGD
001 (after CTO is issued)	Sewage Treatment Plant	Currently not proposed.	7.0 MGD

(1) Operations contributing to flow (2) Treatment units (3) Design flow

10. Sewage Sludge Use or Disposal: Aerobic digestors and belt filter presses are currently utilized to further treat, stabilize, and dewater sludge. The treatment facility generated approximately 172 dry tons of sludge in 2010. The CNW Regional Wastewater Treatment Authority has included three options for sludge management in their application.

Option 1: Class B Biosolids Production – Land Application

Option 2: Class A Biosolids Production - Utilizing landfill methane gas to produce heat for drying sludge. Approval of plans and specifications, issuance of a Certificate to Construct (CTC), and issuance of Certificate to Operate (CTO) of facilities is required

Option 3: Haul dewatered sludge to the Wise County Sanitary Landfill
Currently the Authority has an agreement with Wise County to haul dewatered sludge to the Wise County Sanitary Landfill

The sewage treatment works must achieve Class A or Class B *Pathogen Reduction* by one of the applicable reduction alternatives specified in 9VAC25-31-710 and Title 40 Code of Federal Regulations Part 503.32, and *Vector Attraction Reduction* by one of the applicable alternatives specified in 9VAC25-31-720, or as specified herein.

Land Application of Class B Biosolids:

The CNW Regional Authority has been approved for land application of biosolids as a means of disposal since 2002. The permit authorization includes limits and monitoring requirements for Class B biosolids based on the VPA Permit Regulation (9VAC25-32 Sections 310 through 760) and the VPDES Permit Regulation (9VAC25-31 Sections 420 through 720), and 40 CFR Part 503. Limits and monitoring requirements for Class A biosolids are more stringent. These requirements and the issuance of DMR's, will be addressed with the issuance of the CTO for the Class A biosolids treatment facility.

Pathogen Reduction Limitations:

The biosolids land applied in Virginia shall comply with one of the applicable Class B pathogen reduction alternatives specified in 9 VAC 25-31-710 and Title 40 Code of Federal Regulations Part 503.32. The permittee shall identify the alternative used in the annual report and provide the data that demonstrate compliance with the applicable alternative.

Vector Attraction Reduction Limitations:

The biosolids land applied in Virginia shall comply with one of the applicable vector attraction reduction alternatives specified in 9 VAC 25-31-720. The permittee shall identify the alternative used in the annual report and provide the data that demonstrate compliance with the applicable alternative.

The permit authorizes the land application of biosolids at the following sites:

Vanover Site: Sites S18, S19, S20 are located on a farm owned by Ben Russell. The site is approximately 75.66 acres in size and is located on Route 641, approximately 10 miles north of Wise, Virginia. The area is used for cultivating pasture and fescue grass. It currently does not feed domestic livestock. Biosolids will be applied in accordance with a site-specific Nutrient Management Plan. The Nutrient Management Plan shall be written by a certified Nutrient Management Plan writer in accordance with §10.1-104.2. Common buffers for all three sites identified on this property include 100-foot from the property line, 10-foot from east and west side of Route 641, and 200-foot from the dwelling.

Site S18 is 7.2 acres. There is no designated flood plain within or adjacent to the proposed application area. Slopes vary from 0-5 percent.

Site S19 is 40 acres. A 50-foot buffer surrounding a 0.22 acre saturated area has been identified. There is no designated flood plain within or adjacent to the proposed application area. Slopes vary from 0-15 percent.

Site S20 is 28.46 acres. A 50-foot buffer surrounding a 0.17 acre saturated area has been identified. There is no designated flood plain within or adjacent to the proposed application area. Slopes vary from 0-10 percent.

Vanover Site: Site S21 is located on a farm owned by Jimmy Vanover. This site is approximately 3.14 acres in size and is located north of Route 641, approximately 10 miles north of Wise, Virginia. The area is used for pasture and fescue/red clover grass. Biosolids will be applied in accordance with a site-specific Nutrient Management Plan. The Nutrient Management Plan shall be written by a certified Nutrient Management Plan writer in accordance with §10.1-104.2. There is no designated flood plain within or adjacent to the proposed application area. Slopes vary from 0-10 percent.

Class B Biosolids Characterization:

Biosolids to be land applied under this permit shall be monitored and limited as specified in Table A, Table B, and Table C

The biosolids analyses indicate that all metals concentrations in the sludge are less than the Ceiling Concentration Limits presented in Table 1 of the permit regulation (9VAC25-31-540). Below is an average of three most recent samples:

PARAMETER	CONCENTRATION
Total Arsenic (mg/kg)	<1.65
Total Cadmium (mg/kg)	4.9
Total Copper (mg/kg)	227
Total Lead (mg/kg)	37.2
Total Mercury (mg/kg)	1.67
Total Molybdenum (mg/kg)	5.65
Total Nickel (mg/kg)	20.9
Total Selenium (mg/kg)	3.4
Total Zinc (mg/kg)	652

Therefore, the biosolids meets the land application requirement for the Pollutant Concentration Option (9VAC25-31-540, Table 3) and may only be applied in bulk.

Table A
Limitations and Monitoring requirements for Pollutant Concentrations Biosolids
(PC Biosolids):

PARAMETER	BASIS FOR LIMITS	MONITORING REQUIREMENTS			
		Maximum[1]	Monthly[2]	Frequency[3]	Sample Type
Total Arsenic (mg/kg)	A,B,D,E	75	41	See Footnote [3]	Composite
Total Cadmium (mg/kg)	A,B,D,E	85	39	See Footnote [3]	Composite
Total Copper (mg/kg)	A,B,D,E	4,300	1,500	See Footnote [3]	Composite
Total Lead (mg/kg)	A,B,D,E	840	300	See Footnote [3]	Composite
Total Mercury (mg/kg)	A,B,D,E	57	17	See Footnote [3]	Composite
Total Molybdenum (mg/kg)	A,B,D	75	NA	See Footnote [3]	Composite
Total Nickel (mg/kg)	A,B,D,E	420	420	See Footnote [3]	Composite
Total Selenium (mg/kg)	A,B,D,E	100	100	See Footnote [3]	Composite
Total Zinc (mg/kg)	A,B,D,E	7,500	2,800	See Footnote [3]	Composite
Percent Solids (%)	A,B,C	NA	NL	See Footnote [3]	Composite
Volatile Solids (%)	A,B,C	NA	NL	See Footnote [3]	Composite
TKN (mg/kg)	A,B,	NA	NL	See Footnote [3]	Composite
Ammonium Nitrogen (mg/kg)	A,B,	NA	NL	See Footnote [3]	Composite
Nitrate Nitrogen (mg/kg)	A,B,	NA	NL	See Footnote [3]	Composite
Total P (mg/kg)	A,B,	NA	NL	See Footnote [3]	Composite
Total K (mg/kg)	A,B,	NA	NL	See Footnote [3]	Composite
pH (SU)	A,B,C	NA	NL	See Footnote [3]	Composite

NL = No Limitation, monitoring required
NA = Not Applicable

1. If the concentration of any metal in Table A above exceeds the maximum concentration, for any single sample of biosolids, then the biosolids *shall not* be land applied.
2. If the concentration of any metal in Table A above exceeds the monthly average concentration but is less than the maximum concentration, the cumulative loading of the metals must be tracked. See *Cumulative Pollutant Loading Rate Limitations Table B below.*

3. If the annual amount of biosolids produced at the facility exceeds 290 dry metric tons the facility shall increase the sampling to the monitoring frequency listed below:

Amount of biosolids (dry metric tons per 365-day period)	Frequency
Greater than zero but less than 290	Once per year
Equal to or greater than 290 but less than 1,500	Once per quarter (four times per year)
Equal to or greater than 1,500 but less than 15,000	Once per 60 days (six times per year)
Equal to or greater than 15,000	Per month (12 times per year)

Monitoring Frequency shall be defined as the following:

Once per year: sampling shall be conducted once per calendar year.
Once per quarter: sampling shall be conducted during the periods of 1/1 – 3/31; 4/1 – 6/30; 7/1 – 9/30; 10/1-12/31
Once per 60 days: sampling shall be conducted during the periods of 1/1 – 2/28; 3/1 – 4/30; 5/1 – 6/30; 7/1 – 8/31; 9/1 – 10/31; 11/1 – 12/31.
Once per month: sampling shall be conducted once per calendar month.

Bases for Effluent Limitations, Table A:
A: 9VAC25-31-570
B: 9VAC25-31-490
C: 9VAC25-31-560
D: 9VAC25-31-540, Table 1
E: 9VAC25-31-540, Table 3

Table B
Cumulative Pollutant Loading Rate Limitations (CPLR) Biosolids:

PARAMETER	BASIS FOR LIMITS	LIMITATIONS		MONITORING REQUIREMENTS	
		CPLR[1]		Frequency[2]	Sample Type
		(kg/ha)	(lb/A)		
Total Arsenic (mg/kg)	A	41	36	Each Application	Calculated
Total Cadmium(mg/kg)	A	39	35	Each Application	Calculated
Total Copper(mg/kg)	A	1,500	1,340	Each Application	Calculated
Total Lead(mg/kg)	A	300	270	Each Application	Calculated
Total Mercury (mg/kg)	A	17	16	Each Application	Calculated
Total Nickel(mg/kg)	A	420	375	Each Application	Calculated
Total Selenium(mg/kg)	A	100	89	Each Application	Calculated
Total Zinc(mg/kg)	A	2,800	2,500	Each Application	Calculated

1. Cumulative Pollutant Loading Rates must be tracked *only* if the monthly average concentrations for the metals listed in Table B above are exceeded.
2. Samples shall be collected prior to each land application activity.

Bases for Effluent Limitations, Table B:
A: 9VAC25-31-540, Table 2

Table C
Soils Monitoring Requirements for each Land Application Field:

PARAMETER	BASIS FOR LIMITS	LIMITATIONS	MONITORING REQUIREMENTS	
			Frequency[3]	Sample Type[4]
Soil pH[1](SU)	A,B	NL	Prior to Application	Composite
Cation Exchange Capacity (meq/100 g)	A,B	NL	Prior to Application	Composite
Available Phosphorus[2] (mg/kg)	A,B	NL	Prior to Application	Composite
Exchangeable Potassium (mg/kg)	A,B	NL	Prior to Application	Composite
Exchangeable Magnesium (mg/kg)	A,B	NL	Prior to Application	Composite

NL = No Limitation, monitoring required

1. 9VAC25-32-560.B.3.a. Lime amended biosolids shall be applied at rates that are not expected to result in a target soil pH in the plow layer above a pH of 6.5 for soils located in the coastal plain and above a pH of 6.8 in other areas of the state.

2. 9VAC25-32-660. If soils exhibit very high soil test phosphorus of 55 or more parts per million phosphorus (Mehlich I analytical test procedure or equivalent procedure approved by the Department of Conservation and Recreation), the maximum application rates for phosphorus contained in biosolids together with phosphorus contained in other applied nutrient sources to the site and all applicable phosphorus management practices shall be consistent with the nutrient management plan (prepared by a certified nutrient management planner as stipulated in regulations promulgated pursuant to §10.1-104.2 of the Code of Virginia).

3. Soil samples shall be collected prior to biolsolids application and analyzed no more than 3 years prior to the application. For biosolids with cadmium concentration greater than or equal to 21 mg/kg the soil pH sample must be less than 1 year old.

4. Soil composite samples shall be representative of soil types delineated by the SCS Soil Survey (or the equivalent). Samples shall be taken at 0-6 inches soil depth for each land applications site. Soil testing used to develop a Nutrient Management Plan must be conducted by a DCR approved laboratory in accordance with the Virginia Nutrient Management Standards and Criteria.

Bases for Effluent Limitations, Table C:
A. 9VAC25-32-460
B. 9VAC25-32, Table 5

Land Area Determination:

Nutrients: All nutrient loading issues are addressed in the Nutrient Management Plan. (*See Special Conditions*).

Class A Biosolids-Heat Drying Facility Final Product

By letter dated January 25, 2012, CNW Regional Wastewater Treatment Authority amended their permit application to include a Class A biosolids treatment process. The Authority proposes to construct and operate a biosolids heat treatment facility, located at the existing Wise County Landfill at Blackwood, utilizing methane gas

from the closed cells of the landfill as fuel for the drying operation. All effluent from the facility will be directed to the sewerage collection system that serves the landfill and returned to CNW WWTP for processing.

During the period beginning with the issuance of a Certificate to Operate (CTO) for the biosolids drying facility and lasting until the permit's expiration date, the permittee would be authorized to prepare and manage biosolids in accordance with 9VAC25-31-10 et seq. and as detailed in an approved Operations and Maintenance Manual. All finished products must meet Class A/EQ minimum standards.

Pathogen Reduction Limitations:

Class A-Alternative 5, Pathogen density in conjunction with a process to further reduce pathogens, 9VAC25-31-710.E.2 Heat drying - Sewage sludge is dried by direct or indirect contact with hot gases to reduce the moisture content of the sewage sludge to 10.0% or lower. Either the temperature of the sewage sludge particles exceeds 80°C or the wet bulb temperature of the gas in contact with the sewage sludge as the sewage sludge leaves the dryer exceeds 80°C.

Vector Attraction Reduction Limitations:

Option 8 - The percent solids of the final product shall be equal to or greater than 90% based on moisture content and total solids prior to mixing with other materials.

Class A Biosolids Characterization:

Biosolids to be marketed and distributed under this permit shall be monitored and limited as specified in Table D and Table E

Table D
Limitations and Monitoring requirements for Pollutant Concentrations Biosolids
(Exceptional Quality Biosolids):

PARAMETER [5,6]	BASIS FOR LIMITS	MONITORING REQUIREMENTS			
		Ceiling Concentration Maximum [1,8]	Monthly Average Concentration [1,7]	Frequency [3]	Sample Type
Salmonella (MPN/4g) or Fecal Coliform (MPN/g)	A,B,C	<3 <1000	NA	See Footnote [3]	Grab
Total Arsenic (mg/kg)[2]	A,B,D,E	75	41	See Footnote [3]	Composite
Total Cadmium (mg/kg)[2]	A,B,D,E	85	39	See Footnote [3]	Composite
Total Copper (mg/kg)[2]	A,B,D,E	4,300	1,500	See Footnote [3]	Composite
Total Lead (mg/kg)[2]	A,B,D,E	840	300	See Footnote [3]	Composite
Total Mercury (mg/kg)[2]	A,B,D,E	57	17	See Footnote [3]	Composite
Total Molybdenum (mg/kg)[2]	A,B,D	75	NA	See Footnote [3]	Composite
Total Nickel (mg/kg)[2]	A,B,D,E	420	420	See Footnote [3]	Composite
Total Selenium (mg/kg)[2]	A,B,D,E	100	100	See Footnote [3]	Composite
Total Zinc (mg/kg)[2]	A,B,D,E	7,500	2,800	See Footnote [3]	Composite
Percent Solids (%)	A,B,C	NA	NL	See Footnote [3]	Composite
Volatile Solids (%)	A,B,C	NA	NL	See Footnote [3]	Composite
TKN (mg/kg)	A,B	NA	NL	See Footnote [3]	Composite
Ammonium Nitrogen (mg/kg)	A,B	NA	NL	See Footnote [3]	Composite
Nitrate Nitrogen (mg/kg)	A,B	NA	NL	See Footnote [3]	Composite
Total P (mg/kg)	A,B	NA	NL	See Footnote [3]	Composite
Total K (mg/kg)	A,B	NA	NL	See Footnote [3]	Composite
pH (SU)	A,B,C	NA	NL	See Footnote [3]	Composite

Table E
Additional Limitations and Monitoring Requirements
(Exceptional Quality Biosolids):

PARAMETER[5,6]	BASIS FOR LIMITS	MONITORING REQUIREMENTS			
		Maximum[1,8]	Monthly Average[1,7]	Frequency[3]	Sample Type
Polychlorinated biphenols (PCBs) (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Aldrin/dieldrin (total) (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Benzo (a) pyrene (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Chlordane (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
DDT/DDE/DDD (total)[4]	A,B,F	NL	NL	See Footnote [3]	Composite
Dimethyl nitrosamine (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Heptachlor (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Hexachlorobenzene (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Hexachlorobutadiene (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Lindane(mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Toxaphene(mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Trichloroethylene(mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Aluminum(mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Boron, water soluble (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Calcium (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Chorides (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Manganese (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite
Total Sulfur (mg/kg)	A,B,F	NL	NL	See Footnote [3]	Composite

NL = No Limitation, monitoring required NA = Not Applicable

1. Dry weight basis, unless otherwise stated
2. Constituents subject to pollutant concentrations (PC) and ceiling limits. The biosolids marketed and distributed under this permit shall have concentrations of these constituents less than or equal to the monthly average and maximum limitations specified above.
3. Frequency of sampling biosolids from each generator is based on the amount of biosolids produced by that generator for distribution as a fertilizer or soil amendment as specified below:

Amount of biosolids (dry metric tons per 365-day period)	Frequency
Greater than zero but less than 290	Once per year
Equal to or greater than 290 but less than 1,500	Once per quarter (four times per year)
Equal to or greater than 1,500 but less than 15,000	Once per 60 days (six times per year)
Equal to or greater than 15,000	Once per month (12 times per year)

Monitoring Frequency shall be defined as the following:

Once per year: sampling shall be conducted once per calendar year.
Once per quarter: sampling shall be conducted during the periods of 1/1 – 3/31; 4/1 – 6/30; 7/1 – 9/30; 10/1-12/31
Once per 60 days: sampling shall be conducted during the periods of 1/1 – 2/28; 3/1 – 4/30; 5/1 – 6/30; 7/1 – 8/31; 9/1 – 10/31; 11/1 – 12/31.
Once per month: sampling shall be conducted once per calendar month.

4. DDT = 2,2--Bis (chlorophenyl)--1,1,1—Trichloroethane; DDE = 1,1--Bis (chlorophenyl)--2,2—Dichloroethane; DDD = 1,1--Bis (chlorophenyl)--2,2--Dichloroethane
5. All samples shall be collected and analyzed in accordance with Title 40 Code of Federal Regulations Parts 503 and 136.
6. The results of the biosolids monitoring specified in Tables D and E shall be submitted in the annual report. The report shall include a certification statement signed in accordance with Part II.K of the permit.
7. Monthly average shall be reported as the average of the results of all samples collected within a calendar month and analyzed using an approved method. For monitoring periods which include multiple months, if one sample is collected during the monitoring period, that result shall be reported as the monthly average. If samples are collected in different months during the monitoring period, each monthly average shall be calculated and the highest monthly average reported. Individual results and calculations shall be submitted with the report. If the monthly average concentration of the biosolids exceeds the PC limit for any parameter subject to PC limits, the biosolids shall not be distributed.
8. The maximum concentration shall be reported as the highest single result from sampling during a monitoring period. If the concentration of any single sample of biosolids exceeds the Ceiling Limit for any parameter subject to Ceiling Limits, the biosolids shall not be distributed.

Bases for Effluent Limitations, Tables D, and E
A: 9VAC25-31-570
B: 9VAC25-31-490
C: 9VAC25-31-560
D: 9VAC25-31-540, Table 1
E: 9VAC25-31-540, Table 3
F: 9VAC25-32-660, Table 12A

11. Discharge Location Description:

The facility is located off State Route 699, at 11550 Pine Camp Road, in Wise County, VA.

Plant Location: latitude 36° 55' 37" longitude 82° 28' 44"
Name of Topo: Coeburn, VA Quadrangle No.: 059B

See Attachment 2

12. Materials Storage:

A polymer used at the sludge press when dewatering sludge is the only material stored on site.

13. Ambient Water Quality Information:

The DEQ maintains an ambient monitoring station downstream of the discharge point of the CNW Regional STP at river mile 6.5 at the intersection of the State Route 72 bridge and the Guest River. Samples are collected

bimonthly to run the routine ambient water quality parameters. The 90th percentile pH and temperature values were utilized to establish the water quality criteria for ammonia nitrogen.

The DEQ 2010 Water Quality Assessment Report (303d) lists two impairments in the Guest River in a segment from the Parson Branch confluence downstream to the Bad Branch confluence. The report identifies benthic-macroinvertebrate impairment due to sediment as a result of mining, silviculture and rural activities, and PCB's in edible fish tissue with sources not identified. In addition to benthic and PCB impairments, and pending EPA approval, the DEQ 2012 Water Quality Assessment Report adds E.coli as an impairment. Stressors for the E.coli impairment include failing septic systems and direct dischargers. As a result, the Guest River does not currently support aquatic life, fish consumption and swimmable uses.

The completed TMDL report for benthic-macroinvertebrate will be discussed in further detail under Item 24.

14. Antidegradation Review & Comments: Tier 1 _X_ Tier 2 ____ Tier 3 ____

The State Water Control Board's Water Quality Standards includes an antidegradation policy (9 VAC 25-260-30). All state surface waters are provided one of three levels of antidegradation protection. For Tier 1 or existing use protection, existing uses of the water body and the water quality to protect these uses must be maintained. Tier 2 water bodies have water quality that is better than the water quality standards. Significant lowering of the water quality of Tier 2 waters is not allowed without an evaluation of the economic and social impacts. Tier 3 water bodies are exceptional waters and are so designated by regulatory amendment. The antidegradation policy prohibits new or expanded discharges into exceptional waters.

The antidegradation review begins with a Tier determination. The Guest River is determined to be a Tier 1 waterbody. This determination is based on the impairments identified in the DEQ's Water Quality Assessment reports as described in *Item 13* of this *Fact Sheet*.

15. Site Inspection:

Date: December 6, 2011 Performed by Danny L. Petty

This was a scheduled technical and laboratory inspection. The only issue identified in the technical inspection report was I/I with recommendations to continue addressing sources. The laboratory evaluation indicated that no deficiencies were found.

16. Effluent Screening & Limitation Development:

During the period beginning with the permit's effective date, and lasting until the issuance of the Certificate to Operate (CTO) for the expansion of the sewage treatment plant from 5.0 MGD to 6.5 MGD, the following effluent limitations remain in effect:

PARAMETER	BASIS FOR LIMITS	DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
		Monthly Average	Weekly Average	Minimum	Maximum	Frequency	Sample Type
FLOW (mgd)	NA	NL	NA	NA	NL	Continuous	Totalizing, Indicating, & Recording
$cBOD_5$ June - November	4,5	16 mg/l 300 kg/d	24 mg/l 450 kg/d	NA	NA	3 Days/Week	24 Hr. Comp.
$cBOD_5$ December-May	4,5	20 mg/l 380 kg/d	30 mg/l 580 kg/d	NA	NA	3 Days/Week	24 Hr. Comp.

TOTAL SUSPENDED SOLIDS	1,5	24 mg/l 450 kg/d	36 mg/l 680 kg/d	NA	NA	3 Days/Week	24 Hr. Comp.
AMMONIA NITROGEN June-November	3	1.8 mg/l	2.4 mg/l	NA	NA	3 Days/Week	24 Hr. Comp.
AMMONIA NITROGEN December-May	3	4.0 mg/l	5.4 mg/l	NA	NA	3 Days/Week	24 Hr. Comp.
TOTAL RESIDUAL CHLORINE[1]	3	0.0089 mg/l	0.0094 mg/l	NA	NA	1/2hrs	Grab
Ecoli[2] (N/100ml)	3	126	NA	NA	NA	4/month (1/week 10 am – 4 pm)	Grab
DISSOLVED OXYGEN	3,4	NA	NA	7.0 mg/l	NA	1/Day	Grab
pH (std units)	3	NA	NA	6.0 std. Units	9.0 std. Units	1/Day	Grab

During the period beginning with the permit's issuance of the Certificate to Operate (CTO) for the 6.5 MGD wastewater treatment plant, and lasting until the issuance of the Certificate to Operate (CTO) for the expansion of the sewage treatment plant from 6.5 MGD to 7.0 MGD, the following effluent limitations remain in effect:

PARAMETER	BASIS FOR LIMITS	DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
		Monthly Average	Weekly Average	Minimum	Maximum	Frequency	Sample Type
FLOW (mgd)	NA	NL	NA	NA	NL	Continuous	Totalizing , Indicating, & Recording
$cBOD_5$ June - November	5	12 mg/l 300 kg/d	18 mg/l 450 kg/d	NA	NA	5 Days/Week	24 Hr. Comp.
$cBOD_5$ December-May	5	15 mg/l 380 kg/d	22 mg/l 580 kg/d	NA	NA	5 Days/Week	24 Hr. Comp.
TOTAL SUSPENDED SOLIDS	1,5	18 mg/l 450 kg/d	27 mg/l 680 kg/d	NA	NA	5 Days/Week	24 Hr. Comp.
AMMONIA NITROGEN June-November	3	1.6 mg/l	2.2 mg/l	NA	NA	5 Days/Week	24 Hr. Comp.
AMMONIA NITROGEN December-May	3	3.6 mg/l	4.8 mg/l	NA	NA	5 Days/Week	24 Hr. Comp.
TOTAL RESIDUAL CHLORINE[3]	3	0.0083 mg/l	0.0088 mg/l	NA	NA	1/2hrs	Grab
Ecoli[2] (N/100ml)	3	126	NA	NA	NA	4/month (1/week 10 am – 4 pm)	Grab
DISSOLVED OXYGEN	3,4	NA	NA	7.0 mg/l	NA	1/Day	Grab
pH (std units)	3	NA	NA	6.0 std. Units	9.0 std. Units	1/Day	Grab

During the period beginning with the permit's issuance of the Certificate to Operate (CTO) for the 7.0 MGD wastewater treatment plant, the following effluent limitations remain in effect:

PARAMETER	BASIS FOR LIMITS	DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
		Monthly Average	Weekly Average	Minimum	Maximum	Frequency	Sample Type
FLOW (mgd)	NA	NL	NA	NA	NL	Continuous	Totalizing , Indicating, & Recording

$cBOD_5$ June - November	5	11 mg/l 300 kg/d	16 mg/l 450 kg/d	NA	NA	5 Days/Week	24 Hr. Comp.
$cBOD_5$ December-May	5	14 mg/l 380 kg/d	21 mg/l 580 kg/d	NA	NA	5 Days/Week	24 Hr. Comp.
TOTAL SUSPENDED SOLIDS	1,5	17 mg/l 450 kg/d	26 mg/l 680 kg/d	NA	NA	5 Days/Week	24 Hr. Comp.
AMMONIA NITROGEN June-November	3	1.6 mg/l	2.2 mg/l	NA	NA	5 Days/Week	24 Hr. Comp.
AMMONIA NITROGEN December-May	3	3.5 mg/l	4.7 mg/l	NA	NA	5 Days/Week	24 Hr. Comp.
TOTAL RESIDUAL CHLORINE[3]	3	0.0083 mg/l	0.0088 mg/l	NA	NA	1/2 hrs.	Grab
Ecoli[2] (N/100ml)	3	126	NA	NA	NA	4/month (1/week 10 am – 4 pm)	Grab
DISSOLVED OXYGEN	3,4	NA	NA	7.0 mg/l	NA	1/Day	Grab
pH (std units)	3	NA	NA	6.0 std. Units	9.0 std. Units	1/Day	Grab

NA = Not Applicable NL = No Limitations, Monitoring required

The bases for the Limitations codes are:
1. Federal Effluent Requirements
2. Best Engineering Judgement
3. Water Quality Standard
4. Other (model, WQM Plan, etc)
5. Best Professional Judgement

[1] Additional monitoring requirements for Total Residual Chlorine (TRC): Beginning with the permit's effective date, and lasting until the expiration date, or until the issuance of the Certificate to Operate for the expansion of the WWTP from 5.0 MGD to 6.5 MGD or 7.0 MGD, the following shall apply:

A. TRC shall be monitored at the outlet of the chlorine contact tanks and prior to dechlorination at a frequency of once every 2 hours by grab sample.
B. No more than 36 samples for TRC taken after the chlorine contact tanks and prior to dechlorination shall be less than 1.0 mg/l for any calendar month.
C. No TRC collected prior to dechlorination shall be less than 0.60 mg/l.

[2] Results shall be expressed as a geometric mean.

CNW is currently permitted to operate a 5.0 MGD WWTP with limits included for 6.0 MGD. The Authority is in the design phase of a 6.5 MGD expansion and requests the permit be revoked and reissued with limits for 6.5 MGD and a potential additional increase to 7.0 MGD. Therefore, at the Authority's request, limits for 5.0, 6.5, and 7.0 MGD are included in the permit.

Previously, a demonstration of adequate disinfection allowed the continued use of chlorine as a surrogate parameter for evaluation of compliance with the bacteria standards. In the 2008 reissuance, EPA objected to the use of chlorine as a surrogate without the bacteria monitoring to assure the bacteria standards were met. While the total residual chlorine effluent limits and monitoring requirements are retained in this permit, the addition of an effluent limitation for *E. coli* is intended to confirm adequate disinfection and comply with EPA requirements for disinfection. Monitoring requirements are in accordance with current Water Quality Standards. Chlorine limits were recalculated with the increased monitoring requirements for final effluent monitoring. See Attachment 3 for the complete analysis of chlorine limits for all tiers.

In their VPDES application and their application for a Certificate to Operate the 6.5 MGD or 7.0 MGD, the CNW Regional WWTA requested a design exception under 9VAC 25-790-40, from providing a minimum chlorine contact period of 30 minutes at the average daily flow, or 20 minutes at the maximum daily flow within the chlorine contact basins. The Authority has demonstrated that adequate disinfection at proposed average daily flows and peak flows can be accomplished utilizing the CT approach: the product of chlorine concentration and disinfectant contact time. The use of a higher chlorine concentration at less contact time will provide the same results as the current conventional process. By relocating the chlorine injection point, adding filtration and additional baffling, and utilizing chlorine residual analyzers to continuously monitor the chlorine residual and flowrate, a calculated CT minimum 12 mg–min/l will be insured and thereby, deliver the required disinfection prior to dechlorination.

Therefore, upon issuance of a CTO of the 6.5 or 7.0 MGD WWTP, the following additional monitoring will be required:

D. When instantaneous flows through the WWTP are equal to or less than 10 MGD the following shall apply:

(1) The permittee shall monitor the TRC at the outlet of the chlorine contact tanks, at a frequency of once every 2 hours by grab sample.
(2) The samples above shall be collected prior to dechlorination.
(3) Except as provided in *Item F* below, the minimum TRC at the outlet of the chlorine contact tanks shall be 1.0 mg/l.
(4) No TRC sample collected at the outlet of the chlorine contact tanks shall be less than 0.60 mg/l.

E. When instantaneous flows though the WWTP are equal to 10 MGD the following shall apply:

(1) The permittee shall monitor the TRC at the outlet of the chlorine contact tanks at a frequency of once every 2 hours by grab sample.
(2) The samples above shall be collected prior to dechlorination.
(3) The outlet of the chlorine contact tanks shall be limited and controlled by the product of chlorine concentration and disinfectant contact time (CT); where C shall be the total chlorine residual (mg/l) measured at the effluent of the chlorine contact tank, and T shall be the theoretical disinfectant contact time computed as the volume of the chlorine contact tank divided by the instantaneous flow rate through that volume (T=V/Q).
(4) Except as provided in *Item F* below, for each sample, the minimum calculated CT value at the outlet of the chlorine contacts tanks shall be 20 mg-min/l
(5) No sample shall have a calculated CT value less than 12 mg–min/l at any time.
(6) Bacteria shall be monitored once per day, each day flows through the WWTP are greater than 10 MGD for a period of at least two hours.

F. No more than 36 samples (as specified under *D* and *E* above), taken after the chlorine contact tanks and prior to dechlorination, shall be less than 1.0 mg/l TRC or 20 min- mg/l CT, for any calendar month.

August 27, 2003, the State Water Control board adopted new criteria for ammonia-nitrogen. Under 9VAC 25 260 155, the new criteria is less restrictive than the previous criteria. An acute ammonia nitrogen standard is calculated without consideration of the stream temperature and utilizes the 1Q10 (Q_{s-1}) flow frequency value to calculate the steady state waste load allocations. A chronic ammonia nitrogen standard is calculated by considering whether or not the early life stage of fish are present or absent and considers the pH and temperature of the stream. The 30Q10 (Q_{s-30}) flow frequency is used to calculate the steady state chronic waste load allocations. The ammonia nitrogen analysis utilizes pH and temperature data collected by DEQ as part of the routine monitoring of the Guest River. Results of the analysis indicate limits are required. In addition, as part of the application, the owner submitted documentation that adequately demonstrates that complete mix can be accomplished in accordance with the Water Quality Standards, with a bank based discharge. The CORMIX

Mixing Zone Expert System was utilized to simulate effluent bank discharge at 5.0, 6.5 and 7.0 MGD under three ambient river flow conditions. A summary of the results are as follows:

River Flow	Effluent Flow Rate (MGD)	Effluent Flow Rate (MGD)	Complete Mix - DF (Dilution Factor)[1,2]	Mixing Zone Dimensions (m) Length	Width	Depth
Day of Study (124 cfs)	5.0	7.7	17.0	2,132 [3]	18.44	0.49
	6.5	10.1	13.3	1,940 [3]	18.45	0.49
	7.0	10.8	12.4	1,920 [3]	18.48	0.49
1Q10 (1.8 cfs)	5.0	7.7	1.23	14.13	18.56	0.25
	6.5	10.1	1.18	14.27	18.56	0.25
	7.0	10.8	1.17	14.31	18.56	0.25
7Q10 (2.1 cfs)	5.0	7.7	1.27	14.04	18.56	0.25
	6.5	10.1	1.21	14.20	18.56	0.25
	7.0	10.8	1.19	14.24	18.56	0.25

1 Dilution Factor is the highest theoretically-possible mixing using the ambient and effluent flows
2 DF = (Effluent Flow + Ambient Flow) / Effluent Flow
3 Complete mix location is expected to be much closer to the discharge point due to the presence of turbulent riffle mixing approximately 400 feet downstream of the discharge point.

See Attachment 4 for the complete analysis of ammonia limits for all tiers, including the CORMIX modeling of all flow regimes.

EPA is in the process of updating guidance to protect aquatic life from acute and chronic effects of ammonia. In December, 2009, EPA published *Draft 2009 Update Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater*. This document provides updated guidance to developing ammonia limits and recommends more stringent ammonia limitations be implemented to protect aquatic organisms. The intent is to protect aquatic organisms from unacceptable toxicity during acute (short) and chronic (long) exposures in the water column of a water body. While this criterion has not fully completed the regulatory process, DEQ feels that it is appropriate incorporate these requirements into the design of the proposed facility. Utilizing the acute and chronic criterion recommended in the document, and considering the ultimate design flow of 7.0 MGD, an ammonia level of 0.33 mg/l was calculated. The DEQ cautions that this is a preliminary estimation for adjustment to the acute and chronic criteria as EPA continues to study the relationship and influence pH and temperature has on ammonia toxicity. Therefore, to comply with the intent of the study, a special condition for *Design of Treatment Works* is included in the permit that will require the proposed treatment plant to employ a biological process to be designed to fully nitrify during summertime conditions. The plant shall be operated to support optimal nitrification during cold weather conditions subject to temperature and kinetic limitations of the process.

The solids loading from CNW WWTP at its current permitted capacity is 454 kg/day to the Guest River. As the treatment capacity of this facility is increased to 6.5 and 7.0 MGD, the suspended solids discharged from this facility will be somewhat offset by the decreasing sediment load (suspended solids) directly to the Guest River that results from the number of failing septic systems and direct discharges being eliminated as a result of this expansion. Therefore, it is reasonable to assume that as these sources of solids loads are eliminated, the results will be reflected in the wasteload allocation (WLA) of the TMDL for the Guest River. Under this scenario, cBOD and total suspended solids mass loadings were held constant, and the concentration limits were calculated based on increase flowrates. Therefore, this permit will retain the current wasteload allocation in the TMDL and will retain the cBOD loadings from the cBOD water quality model. A dissolved oxygen limit of 7.0 mg/l was deemed necessary, based

on Water Quality Standards, to prevent degradation in the receiving stream when the permit was first issued in June 1989. The original stream model is included as Attachment 5.

The Certificate to Operate (CTO) the 5.0 MGD WWTP was issued March 11, 2010. The special condition that required *Water Quality Criteria Monitoring* went into effect. A report for one complete analysis was submitted. Nine parameters were evaluated for potential limits in accordance with the Water Quality Standards for the ultimate 7 MGD design flow rate and drought flow conditions. No limits are required. The special condition requiring *Water Quality Criteria Monitoring* will be included in the permit to reevaluate wastewater characteristics once the expansion of the WWTP is completed. The *Water Quality Criteria Analysis* is included as Attachment 6.

CNW currently runs annual acute and chronic toxicity tests that are used to determine the whole effluent toxicity of the discharge. The acute tests are used to determine survival, and chronic tests are used to determine survival, reproduction and growth. Chronic Static Renewal 7-Day Survival and Growth tests are run with *Pimephales promelas*. Acute toxicity is reported from the data generated during the first 48 hours of the chronic toxicity tests. The current permit requires that annual chronic and acute testing continue, however, 2 species will be required. The acute tests required:

48 Hour Static Acute test using *Ceriodaphnia dubia*
48 Hour Static Acute test using *Pimephales promelas*

The chronic tests required:

Chronic 3-Brood Static Renewal Survival and Reproduction Test using *Ceriodaphnia dubia*
Chronic 7-Day Static Renewal Survival and Growth Test using *Pimephales promelas*

In lieu of conducting the 48 hour Static Acute test using Pimephales promelas, the permittee may continue to report acute toxicity results for samples based upon the data generated during the first 48 hours of the chronic toxicity tests, however, static acute test results may not be derived from chronic toxicity tests using *Ceriodaphia dubia* because minimum test requirements are not met. See Attachment 7 for *Toxics Monitoring Program Analysis* including spreadsheets for determining WET test endpoints at all flow tiers.

17. Basis for Sludge Use & Disposal Requirements:

The VPDES Permit Regulation (9 VAC 25-31-10 et seq.), adopted by the SWCB May 22, 1996, became effective on July 24, 1996. The newly adopted regulation incorporated technical standards for the use or disposal of sewage sludge, specifically land application and surface disposal, promulgated under 40 CFR Part 503.

18. Antibacksliding Statement:

For limits included in the permit for the facility's present design flowrate, compliance with antibacksliding provisions of the Permit Regulation, 9 VAC 25-31-220.1, has been achieved since no less stringent limitations are contained in this permit.

19. Compliance Schedules:

The permit specifies a schedule, in accordance with 9VAC25-31-250, to allow the permittee a reasonable period of time, not to exceed the term of the permit, to attain compliance with the more restrictive water quality based effluent limitations. Ammonia nitrogen limits were evaluated using current stream data. Results indicated more stringent limits were required for 5.0 MGD. With the Authority in the progress of designing treatment facilities to accommodate 6.5 MGD, it is reasonable to include a schedule to allow the facility to complete their project and

attain compliance. Therefore, during the period beginning with the permit's effective date and lasting until the commencement of discharge from the 6.5 MGD facility or until the permit's expiration date, whichever occurs first, the permittee is authorized to discharge from outfall 001. This discharge shall be limited and monitored as specified below:

	Discharge Limitations		Monitoring Requirements	
	Monthly Avg.	Weekly Avg.	Frequency	Sample Type
Ammonia Nitrogen (Jun-Nov)	2.1 mg/l	2.8 mg/l	3 Days/Wk	24 Hour Composite
Ammonia Nitrogen (Dec-May)	8.3 mg/l	11 mg/l	3 Days/Wk	24 Hour Composite

20. Special Conditions:

A. Additional Chlorine Limitations and Monitoring Requirements (Part I.B.)
Rationale: Required by Sewage Collection and Treatment Regulations, 9VAC25-790; 9VAC25-260-170 Bacteria standards; also, 40 CFR 122.41(e) requires the permittee, at all times, to properly operate and maintain all facilities and systems of treatment in order to comply with the permit. This ensures proper operation of chlorination equipment to maintain adequate disinfection.

B. 95% Capacity Reopener (Part I.C.1.)
Rationale: Required by VPDES Permit Regulation, 9VAC25-31-200 B 2 for all POTW and PVOTW permits.

C. Indirect Dischargers (Part I.C.2.)
Rationale: Required by VPDES Permit Regulation, 9VAC25-31-200 B 1 for POTWs and PVOTWs that receive waste from someone other than the owner of the treatment works.

D. CTC, CTO Requirement (Part I.C.3.)
Rationale: Required by Code of Virginia § 62.1-44.19; Sewage Collection and Treatment Regulations, 9 VAC 25-790.

E. O&M Manual Requirement (Part I.C.4.)
Rationale: Required by Code of Virginia § 62.1-44.19; Sewage Collection and Treatment Regulations, 9 VAC 25-790; VPDES Permit Regulation, 9VAC25-31-190 E.

F. Licensed Operator Requirement (Part I.C.5.)
Rationale: The VPDES Permit Regulation, 9VAC25-31-200 D and the Code of Virginia § 54.1-2300 et seq, Rules and Regulations for Waterworks and Wastewater Works Operators (18VAC160-20-10 et seq.), require licensure of operators.

G. Reliability Class (Part I.C.6.)
Rationale: Required by Sewage Collection and Treatment Regulations, 9VAC25-790 for all municipal facilities.

H. Treatment Works Closure Plan (Part I.C.7.)
Rationale: State Water Control Law §62.1-44.15:1.1 makes it illegal for an owner to cease operation and fail to implement a closure plan when failure to implement the plan would result in harm to human health or the environment. This condition is used to notify the owner of the need for a closure plan where a treatment works is being replaced or is expected to close.

I. Water Quality Criteria Reopener (Part I.C.8.)
Rationale: VPDES Permit Regulation, 9VAC25-31-220 D requires effluent limitations to be established which will contribute to the attainment or maintenance of water quality criteria.

J. Section 303(d) List (TMDL) Reopener (Part I.C.9.)
Rationale: Section 303(d) of the Clean Water Act requires that total maximum daily loads (TMDLs) be developed for streams listed as impaired. This special condition is to allow the permit to be reopened if necessary to bring it into compliance with any applicable TMDL approved for the receiving stream. The re-opener recognizes that, according to section 402(o)(1) of the Clean Water Act, limits and/or conditions may be either more or less stringent than those contained in this permit. Specifically, they can be relaxed if they are the result of a TMDL, basin plan, or other wasteload allocation prepared under section 303 of the Act.

K. Water Quality Criteria Monitoring (Part I.C.10.)
Rationale: State Water Control Law §62.1-44.21 authorizes the Board to request information needed to determine the discharge's impact on State waters. States are required to review data on discharges to identify actual or potential toxicity problems, or the attainment of water quality goals, according to 40 CFR Part 131, Water Quality Standards, subpart 131.11. To ensure that water quality criteria are maintained, the permittee is required to analyze the facility's effluent for the substances noted in Attachment A of this VPDES permit.

L. Compliance Reporting (Part I.C.11.)
Rationale: Authorized by VPDES Permit Regulation, 9VAC25-31-190 J 4 and 220 I. This condition is necessary when pollutants are monitored by the permittee and a maximum level of quantification and/or a specific analytical method is required in order to assess compliance with a permit limit or to compare effluent quality with a numeric criterion. The condition also establishes protocols for calculation of reported values.

M. Design of 6.5 MGD and 7.0 Treatment Works (Part I.C.12.)
Rationale: Based on toxicity data in recent publications indicating recommended criteria for ammonia concentrations in freshwater that is more protective of the endangered freshwater mussels.

N. Additional Bacteria Monitoring (Part I.C.13.)
Rationale: To insure compliance with the bacteria standards, in accordance with 9VAC 25-260.

O. Compliance Schedule and Interim Effluent Limitations and Monitoring Reporting (Part I.C.14.)
Rationale: 9VAC25-31-250 allows for schedules of compliance, when appropriate, which will lead to compliance with the Clean Water Act, the State Water Control Law and regulations promulgated under them.

P. Sludge Use and Disposal (Part I.D.)
Rationale: VPDES Permit Regulation, 9VAC25-31-100 P; 220 B 2; and 420 through 720, and 40 CFR Part 503 require all treatment works treating domestic sewage to submit information on sludge use and disposal practices and to meet specified standards for sludge use and disposal.

1. Sludge Reopener (Part I.D.2)
Rationale: Required by VPDES Permit Regulation, 9VAC25-31-220 C 4 for all permits issued to treatment works treating domestic sewage.

Class B Biosolids-Land Application (Part I.E.)

2. Nutrient Management Plan Requirement: (Part I.E.2.)
Rationale: State Water Control Law § 62.1-44.19.3.C.8 requires that a NMP be developed by a person certified in accordance with § 10.1-104.2 for each biosolids land application site, prior to application of biosolids at the site. The statute also establishes conditions where the NMP must be approved by the Department of Conservation and Recreation prior to submittal at the time of permit application.

3. Loading Rates: (Part I.E.3)
Rationale: 9VAC25-31-505.A – Site specific nutrient management plans and the cumulative trace element loading rates (9VAC25-32-540 Table 2) 9VAC25-31-220.I.4.a. states that mass or other measurements for each pollutant of concern may be specified in the VPDES Permit. 9VAC25-31-220.I.4.c. allows for other measurements as appropriate.

4. 14 Day Notification: (Part I.E.4.)
Rationale: State Water Control Law § 62.1-44.19.3.L. and 9VAC25-31-485.D. require notification to the Department 14 days prior to land application at a specific site.

5. Signage Requirements: (Part I.E.5.)
Rationale: 9VAC25-32-530.B. requires a sign be posted at a land application site at least 48 hours prior to delivery of biosolids at the site and remain on site until 48 hours after application is complete. 9VAC25-32-530.C-D specifies construction, content and maintenance of the sign.

6. 100 Day Notification to the Locality: (Part I.E.6.)
Rationale: 9VAC25-31-485.C. requires notification to the locality 100 days prior to the initial land application at a specific site.

7. Certified Land Applicator Requirement: (Part I.E.7.)
Rationale: State Water Control Law § 62.1-44.19.3.1.B. states that Class B biosolids shall not be land applied unless a certified land applicator is onsite at all times during the application.

8. Threatened or Endangered Species: (Part I.E.8.)
Rationale: 9VAC25-31-550.A requires that land application of biosolids in accordance with the regulations is not to result in harm to threatened or endangered species listed in 9VAC25-260-320 nor result in the destruction or adverse modification of the critical habitat of a threatened or endangered species.

9. Infrequent Application: (Part I.E.9.)
Rationale: 9VAC25-32-560.B.3.a(1) specifies requirements for infrequent application.

10. Frequent Application Below Agronomic Rate: (Part I.E.10.)
Rationale: 9VAC25-32-560.B.3.a(5) specifies requirements for frequent, below agronomic rate application.

11. Liquid Application Rate Limitation: (Part I.E.11.)
Rationale: 9VAC25-32-560.B.3.c(1) specifies requirements for application of liquid biosolids.

12. Operational Limitations During Periods of Inclement Weather (Part I.E.12.)
Rationale: 9VAC25-31-505.A - NMP specifies requirements for application during inclement weather.

13. Injection or Incorporation Requirements: (Part I.E.13.)
Rationale: 9VAC25-32-560.B.3.b. requires direct injection or incorporation within 48 hours of application on sites with less than 60% uniform residue cover or at times when the site is subject to frequent flooding as defined by soil survey information.

14. Slope Restrictions: (Part I.E.14.)
Rationale: 9VAC25-32-560.B.3.b.c. specifies maximum slope restrictions and management practices to follow when applying on fields with slopes between 5% and 15%.

15. Buffer Zones: (Part I.E.15.)
Rationale: 9VAC25-32-560.B.3.d(1) establishes setback distances.

16. Transport Vehicles: (Part I.E.16.)
Rationale: 9VAC25-32-540.A. requires that vehicles transporting biosolids be sealed and watertight if carrying liquid biosolids.

17. Soil pH and Cadmium: (Part I.E.17.)
Rationale: 9VAC25-32-560.B.2. requires that the biosolids/soil mixture have a final pH of 6.0 S.U. or greater if the soil cadmium concentration is greater than 21 mg/kg.

18. Landowner Consent and Notice: (Part I.E.18.)
Rationale: 9VAC25-32-60.A.1.d. requires the submission of landowner consent forms. 9VAC25-32-80.H.2. requires the consent forms to be maintained for a minimum of 5 years or for the duration of the permit. 9VAC25-32-530.A. requires the permittee to maintain the agreement.

19. Site Restrictions for Land Application of Class B Biosolids: (Part I.E.19.)
Rationale: 9VAC25-31-710.B.5. requires restricted access for sites based on type of food crops, grazing livestock and human access.

20. Depth to Water Table: (Part I.E.20.)
Rationale: Required for biosolids based on 9VAC25-32-560.B.2.

21. Depth to Bedrock: (Part I.E.21.)
Rationale: Required for biosolids based on 9VAC25-32-560.B.2.

22. Restrictions for CPLR Biosolids Application: (Part I.E.22.)
Rationale: 9VAC25-32-640 establishes maximum cumulative pollutant loading of trace elements on soils.

23. Restrictions for CPLR Biosolids Application to Sites Previously Used: (Part I.E.23.)
Rationale: 40 CFR Part 503.12(e)(2)(i-iv), which applies to all biosolids applied in the USA, establishes July 20, 1993 as the date to begin accounting for pollutant loading to soils.

24. CPLR Biosolids Tracking: (Part I.E.24.)
Rationale: Required in order to comply with Part I.E.25.

25. Recordkeeping for PC and CPLR Biosolids: (Part I.E.25.)
Rationale: 9VAC25-31-190.J.2. requires the maintenance of all biosolids monitoring and reporting records for at least 5 years.

26. Additional Recordkeeping for CPLR Biosolids: (Part I.E.26.)
Rationale: 9VAC25-31-580.A.5. requires the maintenance of all biosolids monitoring and reporting records for at least 5 years. Items g through m are required indefinitely in order to comply with Part I.D.24, as identified in 40 CFR Part 503.17(2).

27. Reporting Land Application of Biosolids Upon Attaining 90% of CPLR: (Part I.E.27.)
Rationale: 40 CFR Part 503.18(2), which applies to all biosolids applied in the USA, requires this reporting.

28. Biosolids Reporting Requirements (Part E.28.)

    a. Monitoring Report: (Part I.E.28.a.)
    Rationale: 9VAC25-31-590 states that biosolids monitoring is to be submitted annually unless otherwise required.

    b. Monthly Activity Report: (Part I.E.28.b.)
    Rationale: 9VAC25-32-440–B and Fee Regulation 9VAC25-20-147.B require submittal of a report by the 15th of the month following the month in which land application occurred.

    c. Land Application Fee: (Part I.E.28.c.)
    Rationale: State Water Control Law § 62.1-44.19.3.P. requires that a fee be charged to the generator of biosolids to be land applied in Virginia. The fee of $7.50/dry ton of biosolids applied in the Commonwealth of Virginia is established by the Fee Regulation 9VAC25-20-146 and 9VAC25-20-40 A.3. Exemptions to the fee are provided in 9VAC25-20-50.C. 9VAC20-60.D establishes the due date.

    d. Annual Report: (Part I.E.28.d.)
    Rationale: 9VAC25-31-590 requires the submittal of an annual report postmarked by February 19th for the previous year.

    e. Records Retention: (Part I.E.28.e.)
    Rationale: 9VAC25-31-580 specifies that all records of biosolids activities, monitoring and reporting shall be maintained for at least 5 years.

29. Biosolids Storage (Part E.29.)

    a. Storage Regulatory Basis: (Part E.29.a.)
    Rationale: Requirements pursuant to § 62.1-44.19.3.R. of the Code of Virginia.

    b. Emergency Storage: (Part E.29.b.)
    Rationale: 9VAC25-32-550 B and C require certain conditions to be met for temporary storage of biosolids.

    c. Temporary Storage: (Part E.29.c.)
    Rationale: 9VAC25-32-550 B and D require certain conditions be met for temporary storage of biosolids.

Heat Drying Facility – Class A Biosolids (Part I.F.)

1. Authorization (Part I.F.1.)
   Rationale: This permit is an individual permit. The Class A requirements included in the permit are written specifically for the biosolids heat drying facility owned and operated by the Coeburn Norton Wise Regional Wastewater Treatment Authority.

2. Preliminary Engineering Report (Part I.F.2.)
   Rationale: Sewage Treatment and Collection regulation 9VAC25-790

3. Operations and Maintenance (O&M) Manual (Part I.F.3.)
   Rationale: 9VAC25-32-310 et seq. refers to "operations and maintenance manual, sludge management plan or management practices plan". 9VAC25-32-500 requires submission of a sludge management plan or

management practices plan.

a. A draft Operations and Maintenance manual must be submitted for review and comment based on the proposed facility prior to issuance of the CTC. (Part I.F.3.a.)

b. O&M Manual (Part I.F.3.b.)
Rationale: Required by Code of Virginia § 62.1-44.19; Sewage Collection and Treatment Regulation, 9 VAC 25-790; VPDES Permit Regulation, 9 VAC 25-31-190 E.

4. CTC and CTO Requirements (Part I.F.4.)
Rationale: Sewage Treatment and Collection regulation 9VAC25-790-50 requires the permittee to obtain a CTC and CTO.

5. CTO Procedures (Part I.F.5.)
Rationale: 9VAC25-790-190 allows for the delaying of CTO issuance pending inspection to ensure the work has been satisfactorily completed.

6. Finished Product (Part I.F.6.)

a. Class A Alternative 5 (Part I.F.6.a.)
Rationale: 9VAC25-31-710.A.7 state that Class A pathogen requirements can be met using pathogen density sampling in conjunction with a process to further reduce pathogens(PFRP). 9VAC25-31-710.E.2 lists the description of heat drying as a PFRP.

b. Vector Attraction Reduction (Part I.F.6.b.)
Rationale: 9VAC25-31-720.B.8 states that the necessary vector reduction can be achieved through demonstrating that the solids content in the biosolids is equal to or greater than 90%.

c. Pathogens (Part I.F.6.c.)
Rationale: 9VAC25-31-710 states the pathogen density which must be achieved in order to qualify as Class A biosolids.

d. Minimum Frequency of Analysis (Part I.F.6.d.)
Rationale: The frequency of analysis is based on the amount of biosolids produced in a 365 day period. This table of frequencies is listed in 9VAC25-31-570.

7. Distribution and Marketing of Final Product (Part I.F.7.)

a. Authorization (Part I.F.7.a.)
Rationale: This individual permit is written specifically for the distribution and marketing of the final product produce at the biosolids heat drying facility owned and operated by the Coeburn Norton Wise Regional Wastewater Treatment Authority.

b. Exceptional Quality (Part I.F.7.b.)
Rationale: 9VAC25-32-570 provides the requirements for a product to be classified as an "Exceptional Quality" biosolids and therefore able to be distributed and marketed.

c. Registration with VDACS (Part I.F.7.c.)
Rationale: 9VAC25-32-570.A.3 requires exceptional quality biosolids which are to be distributed to first register with VDACS and acquire the appropriate labeling information.

d. Biosolids Management (Part I.F.7.d.)
Rationale: 9VAC25-32-570.A.2

e. Product Labeling (Part I.F.7.e.)
Rationale: 9VAC25-32-570.C. requires that biosolids distributed for public use be labeled with specific information

8. No Point Source Discharge from Drying Facility (Part I.F.8.)
Rationale: The drying facility shall dispose of any wastewater generated onsite in the sewage collection system, returning it to the wastewater plant for treatment. Given this to be the case, the VPA regulation 9VAC25-32-30 applies that no discharge shall occur except in the event of a 25 year, 24 hour storm event.

9. Material Handling and Storage (Part I.F.9.)
Rationale: 9VAC25-31-50A requires that all materials be handled so as not to permit a discharge to State waters.

10. Closure Plan (Part I.F.10.)
Rationale: State Water Control Law § 62.1-44.19. This condition is used to notify the owner of the need for a closure plan where a treatment works is being replaced or is expected to close.

11. Addition of Sources (Part I.F.11.)
Rationale: Water Control Law and the VPDES regulation do not require a permit modification to add a new source; therefore a source may be added with administrative authorization based on review of the appropriate permit application forms for that source.

12. Record Keeping Requirements (Part I.F.12.)

a-c. Recordkeeping (Part I.F.12.a-c.)
Rationale: 9VAC25-31-580 specifies that all records of biosolids activities, monitoring and reporting shall be maintained for at least 5 years.

d. Distribution Information (Part I.F.12.d.)
Rationale: 9VAC25-32-570.D requires the maintenance of distribution information.

e. Records Retention (Part I.F.12.e.)
Rationale: 9VAC25-31-580 specifies that all records of biosolids activities, monitoring and reporting shall be maintained for at least 5 years.

13. Monitoring Requirements (Part I.F.13.)

a. Monitoring (Part I.F.13.a.)
Rationale: As noted in *Class A Biosolids Characterization* under *Item 10* of this Fact Sheet

b. Monthly activity report (Part I.F.13.b.)
Rationale: 9VAC25-32-440.B9VAC25-32-440–B and Fee Regulation 9VAC25-20-147.B require submittal of a report by the 15th of the month following the month in which land application occurred.

c. Annual Report (Part I.F.13.c.)
Rationale: 9VAC25-31-590 requires the submittal of an annual report.

Q. Pretreatment (Part I.G.)
Rationale: VPDES Permit Regulation, 9VAC25-31-730 through 900, and 40 CFR part 403 require certain existing and new sources of pollution to meet specified regulations.

R. Whole Effluent Toxicity Testing (Part I.H.)
Rationale: VPDES Permit Regulation, 9VAC25-31-210 and 220 I, requires monitoring in the permit to provide for and assure compliance with all applicable requirements of the State Water Control Law and the Clean Water Act.

S. Part II, Conditions Applicable to All Permits
Rationale: VPDES Permit Regulation, 9VAC25-31-190 requires all VPDES permits to contain or specifically cite the conditions listed.

21. Changes to Permit:

A. The permit is being reissued with limits and requirements for the existing 5.0 MGD facility, and provides tiers to accommodate expansion to 6.5, and 7.0 MGD. All reference to a 4 MGD facility is removed.

B. Outfall 002, bypass at the influent manhole, has been removed from the permit and is no longer a permitted outfall.

C. Composting of dewatered sludge has been removed and replaced with requirements and special conditions to construct and operate a Class A biosolids facility utilizing landfill methane gas to produce heat for drying sludge.

D. Requirements for land application of Class B biosolids have been updated.

E. Water quality based effluent limits for 5 MGD were reevaluated in accordance with current water quality standards. Evaluation of ammonia and chlorine limits utilizing current stream data and current monitoring requirements resulted in more stringent limits for the 5 MGD discharge. A schedule for to achieve compliance with these limits has been included. All effluent limits were brought into conformance with existing guidance for Significant Figures.

F. 6.5 and 7 MGD facility: permit includes limits that become effective upon issuance of a CTO for either 6.5 or 7 MGD facility based on model, federal effluent requirements, best engineering judgment, and current guidance.

G. The permit requires annual acute and chronic toxicity testing of two species: Pimephales promelas and Ceriodaphnia dubia.

H. The special condition *Additional Total Residual Chlorine (TRC) Limitations and Monitoring Requirements* includes provisions for a CT approach to disinfection once the CTO is issued for the 6.5 MGD and 7.0 MGD WWTP expansion.

I. The following special conditions have been added to the permit:

(1) Design of 6.5 and 7 MGD Treatment Works
(2) Additional Bacteria Monitoring
(3) Sludge Use and Disposal: includes updated requirements for land application of Class B biosolids, and requirements for a Class A biosolids heat-drying facility.
(4) Compliance Schedule

J. The following special conditions have been removed from the permit:

(1) Bypass

22. Variances/Alternate Limits or Conditions:

By letter dated November 3, 2011, the CNW Regional Wastewater Treatment Authority requested waivers from the following EPA Form 2A Application Requirements:

A. Part A.12 Bacteria Monitoring: The Authority requested the use of E.coli data be accepted in lieu of fecal coliform.

B. Part B.6 Effluent Testing Data Requirements: The Authority ran one scan for TKN, nitrate plus nitrite, oil and grease, total phosphorus, and total dissolved solids and requested the remaining two scans be waived since theses parameters are not required as part of their current sampling.

C. Part D. Expanded Effluent Testing Data Requirements: The Authority ran one scan of parameters that were required by their permit as *Attachment A* to the *Water Quality Criteria Monitoring* special condition and reported the metals data as dissolved. The Authority requested that the one scan of data be accepted in lieu of the three that are required by the application. They also request that the since the standards utilize dissolved, they not be required to report total recoverable metals data, and that they not be required to test for the fifteen parameters that are in the application but not required by the *Water Quality Criteria Monitoring* special condition since DEQ has not developed water quality criteria for these parameters.

D. Part E. Toxicity Test Data: The Authority requested a variance from being required to submit chronic and acute toxicity data on a second species. The CNW Regional WWTP is currently required to run annual acute and chronic toxicity testing on one species: Pimephales promelas and feels that these tests are an adequate representative of the current effluent.

All parameters tested were either below method detection levels or were not of significant levels to require a limit. Because the makeup of wastewater being treated at the facility has remained constant with no significant industrial contributors connecting, the additional information is not necessary to draft permit limitations to protect water quality. DEQ did require the Authority to run scans on the fifteen parameters required by Part D of the EPA Form 2A and the test results have been received. In the transmittal letter for the public notice, DEQ will require they submit chronic and acute toxicity data on a second species when 2012 annual report is due. In addition, the issued permit will required to submit annual toxicity data using two species.

23. Regulation of Users: 9VAC25-31-280 B 9

There are no industrial users contributing to the treatment works.

24. Public Notice Information required by 9VAC25-31-280 B:

All pertinent information is on file and may be inspected, and copied by contacting Clairise R. Shaheen at:

Virginia Department of Environmental Quality
Southwest Regional Office
355-A
Abingdon, VA 24210
Telephone No. (276) 676-4800
Email: clairise.shaheen@deq.virginia.gov

Persons may comment in writing or by email to the DEQ on the proposed permit action, and may request a public hearing, during the comment period. Comments shall include the name, address, and telephone number of the writer and of all persons represented by the commenter/requester, and shall contain a complete, concise statement of the factual basis for comments. Only those comments received within this period will be considered. The DEQ may decide to hold a public hearing, including another comment period, if public response is significant and there are substantial, disputed issues relevant to the permit. Requests for public hearings shall state 1) the reason why a hearing is requested; 2) a brief, informal statement regarding the nature and extent of the interest of the requester or of those represented by the requester, including how and to what extent such interest would be directly and adversely affected by the permit; and 3) specific references, where possible, to terms and conditions of the permit with suggested revisions. Following the comment period, the Board will make a determination regarding the proposed permit action. This determination will become effective, unless the DEQ grants a public hearing. Due notice of any public hearing will be given. The public may review the draft permit and application at the DEQ Southwest Regional Office by appointment.

25. Additional Comments:

Previous Board Action: On February 11, 1989, the Board issued a Consent Decree to the Town of Coeburn, City of Norton, Town of Wise, and the Coeburn-Norton-Wise Regional Wastewater Treatment Authority, to bring them into compliance with the treatment requirements imposed under the Clean Water Act and the State Water Control Law. All requirements of the Decree have been met.

Staff Comments: Once the CTO for the 6.5 MGD WWTP is issued, the CNW Regional WWTA will begin to conduct a study to evaluate the CT disinfection process. The study will evaluate the effectiveness of the alternative CT approach versus the conventional approach to disinfection on bacteria, viruses, and cysts. The CNW Regional WWTA will submit a plan for approval outlining the details of study by March 1, 2014. The study is to be completed and submitted prior to the reissuance of the permit. The CNW Regional WWTA will also develop an I/I abatement plan and schedule to be submitted by June 1, 2014 and commit an expenditure of $1.5 million to abate I/I. The CNW Regional WWTA will submit progress reports annually beginning with the June, 2015 DMR and continuing until the expiration date of the permit.

Stormwater: The permittee submitted a *No Exposure Certification*, Attachment 8, indicating there are no discharges of storm water contaminated by exposure of materials, located at the CNW Regional WWTP site from facility operations.

Public Notice Comments: This section will be updated once the public comment period has passed.

DCR and DGIF Coordination: A two mile search on the DGIF website resulted in no aquatic species found. A search on the DCR website resulted in natural heritage resources found. Consultation with the DCR resulted in no comments received.

26. 303(d) Listed Segments (TMDL):

The CNW Regional WWTP discharges directly into the Guest River that is listed in the current 303(d) list for benthic-macroinvertebrate impairment and PCB's. Upon EPA approval, E.coli will be added. The streambanks of the Guest River are densely populated resulting in many small communities having no access to public sewer or septic systems that have failed. The DEQ aided in funding the CNW Regional WWTP and is currently funding its upgrade/expansion, greatly improving sewage treatment for the towns and surrounding areas; however, there are many small communities yet to be served. As a result, the Guest River does not support aquatic life, fish consumption and swimmable uses.

The DEQ TMDL report for the Guest River, prepared September, 2003, Revised December 1, 2003, approved by

EPA November 13, 2003 and by the State Water Control Board June 27, 2007, includes the CNW discharge. The TMDL addresses a 29.48 mile segment of the Guest River extending from Sepulcher Creek downstream to the confluence with Crab Orchard Creek. The Guest River impairment listing is based on evaluations of biological monitoring data that focus on the benthic-macroinvertibrates. For the Guest River, DEQ biologists conducted the benthic assessments in the watershed and determined that the benthic community was impacted by excessive sedimentation. Excess sediment negatively impacts the benthic community by filling pools and interstitial spaces between gravel and sand that provides habitat for many benthic-macroinvertebrates. Proposed limits, conditions, and monitoring requirements included in the permit took into account all impacts on the receiving stream, and will protect the Guest River from any impairment as a result of the proposed discharge from the wastewater treatment plant. A TMDL reopener condition is contained in the permit, should modification become necessary.

The TMDL for this discharge provides the following permit limitations and waste load allocation for Total Suspended Solids which is in compliance with the approved TMDL.

Permit No.	Receiving Stream	River Mile Location CNW	Maximum Flow Gallon Per Day	TSS Concentration Weekly Avg. (mg/l)	TSS Concentration Monthly Avg. (mg/l)	TSS Permitted Load (Tons/Year)
VA0077828	Guest River	6BGUE007.56	4 MGD	45	30	182

Cartier,Clairise
From: Herman,Paul
Sent: Tuesday, July 02, 2002 3:53 PM
To: Cartier,Clairise
Subject: RE: Flow Frequency data

Clairise,

The flow frequency data provided to you for Holston Regional WWTP (VA0067351), Saltville STP (VA0026808), and CNW Regional WWTP (VA0077828) in memos dated 11/4/98, 11/5/98, and 12/11/98, respectively, have not changed significantly. The gauges referenced for Holston Regional and CNW will not change because those gauges were discontinued in the early 1980's. The gauge used in the Saltville analysis is still active, but the flow frequencies have not changed enough to warrant a new flow memo. Therefore, please continue to use the flow data provided in the 1998 memos.

I will look into the Cross Creek Estates STP analysis and update it as necessary.

Have a nice 4th of July.

Paul

MEMORANDUM

DEPARTMENT OF ENVIRONMENTAL QUALITY - WATER DIVISION
Water Quality Assessments and Planning
629 E. Main Street P.O. Box 10009 Richmond, Virginia 23240

SUBJECT: Flow Frequency Determination
Coeburn-Norton-Wise Regional WWTP - VA#0077828

TO: Clairise Cartier, SWRO

FROM: Paul E. Herman, P.E., WQAP

DATE: December 11, 1998

COPIES: Ron Gregory, Charles Martin, File

This memo supercedes my April 23, 1993 memo to you concerning the subject VPDES permit.

The Coeburn-Norton-Wise Regional WWTP discharges to the Guest River near Coeburn, Virginia. Flow frequencies are required at this site for use by the permit writer in developing the VPDES permit.

The USGS operated a continuous record gage in the Guest River near Coeburn, VA (#03524500) from 1949 to 1959 and from 1978 to 1981. The gage was located approximately 2.0 miles downstream of the discharge point, at the Route 72 bridge, in Wise County, VA. The flow frequencies the discharge point were determined using drainage area proportions and do not address any withdrawals, discharges, or springs which may lie between the gage and the outfall. The flow frequencies for the gage and discharge point are presented below.:

Guest River near Coeburn, VA (#03524500):

Drainage Area = 87.3 mi^2

1Q10 = 1.8 cfs	High Flow 1Q10 = 7.2 cfs
7Q10 = 2.1 cfs	High Flow 7Q10 = 8.3 cfs
30Q5 = 4.1 cfs	HM = 21 cfs

Guest River at discharge point:

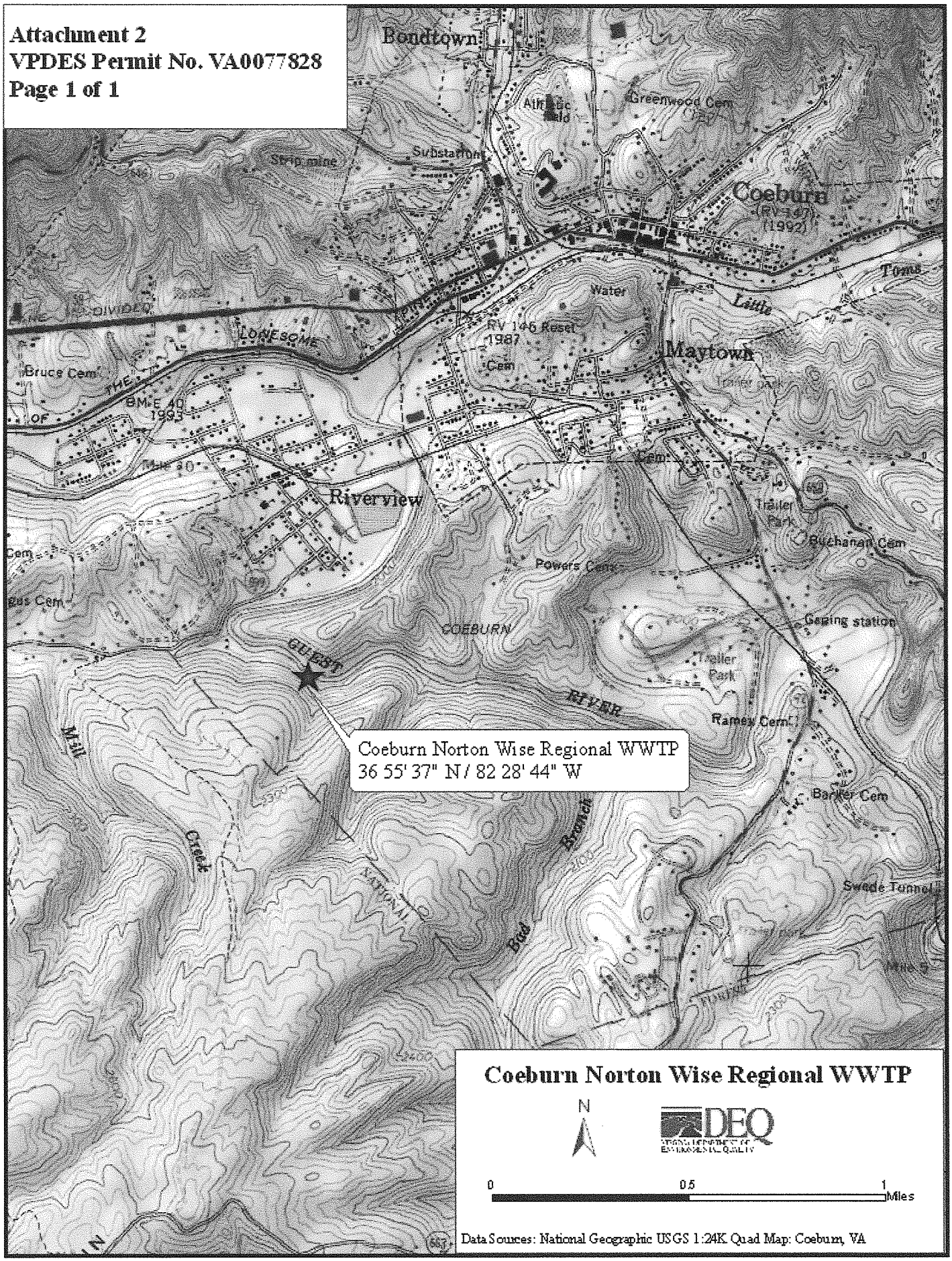
Drainage Area = 85.1 mi^2

1Q10 = 1.75 cfs	High Flow 1Q10 = 7.02 cfs
7Q10 = 2.05 cfs	High Flow 7Q10 = 8.09 cfs
30Q5 = 4.0 cfs	HM = 20.1cfs

The high flow months are December through May.

If you have any questions concerning this analysis, please let me know.

Attachment 2
VPDES Permit No. VA0077828
Page 1 of 1



Chlorine Analysis for Coeburn-Norton-Wise Regional WWTP

Background:

In order to bring chlorine into consistency with the standards for all other toxics materials, the old standard was revoked and chlorine was included in 9 VAC 25-260-140.B, which became effective on 12/10/97.

Standards:

A = Acute = 0.019 mg/l C = Chronic = 0.011 mg/l

Wasteload Allocations:

The wasteload allocations (WLA) are calculated as follows, assuming a background concentration of 0:

Q_{e1} = Design Flow of WWTP = 5.0 MGD
Q_{e2} = Design Flow of WWTP = 6.5 MGD
Q_{e3} = Design Flow of WWTP = 7.0 MGD

Q_{s-1} = 1Q10 Flow = 1.13 MGD (June-Nov) Q_{s-7d} = 7Q10 Flow = 1.33 MGD (June-Nov)

f = decimal fraction of flow to use
= 1.0 (complete mix for 1Q10 and 7Q10)

$$WLA_{Acute} = \frac{\{A[Q_{s-1}(f) + Q_e] - Q_{s-1}\,(background)\}}{Q_e}$$

$$WLA_{chronic} = \frac{\{C[Q_{s-7}\,(f) + Q_e] - Q_{s-7}\,(background)\}}{Q_e}$$

For 5 MGD:

$$WLA_{Acute} = \frac{0.019\,(\,1.13(1.0) + 5.0\,) - 0}{5.0} = 0.023 \text{ mg/l}$$

$$WLA_{chronic} = \frac{0.011\,(\,1.33(1.0) + 5.0\,) - 0}{5.0} = 0.014 \text{ mg/l}$$

For 6.5 MGD:

$$WLA_{Acute} = \frac{0.019\,(\,1.13(1.0) + 6.5\,) - 0}{6.5} = 0.022 \text{ mg/l}$$

$$WLA_{chronic} = \frac{0.011\,(\,1.33(1.0) + 6.5\,) - 0}{6.5} = 0.013 \text{ mg/l}$$

Chlorine Analysis for Coeburn-Norton-Wise Regional WWTP (continued)

For 7 MGD:

$$WLA_{Acute} = \frac{0.019\ (\ 1.13(1.0) + 7.0\ ) - 0}{7.0} = 0.022 \text{ mg/l}$$

$$WLA_{chronic} = \frac{0.011\ (\ 1.33(1.0) + 7.0\ ) - 0}{7.0} = 0.013 \text{ mg/l}$$

Permit Limits:

The above WLA's were entered in the *Virginia DEQ: Statistically Derived Permit Limits Version 2.0.4* with the following results: (program output provided pgs 3-5 of this attachment)

5 MGD: Monthly Average Limit: **0.0089 mg/l**
Weekly Average Limit: **0.0094 mg/l**

6.5 MGD: Monthly Average Limit: **0.0083 mg/l**
Weekly Average Limit: **0.0088 mg/l**

7 MGD: Monthly Average Limit: **0.0083 mg/l**
Weekly Average Limit: **0.0088 mg/l**

Additionally, no more than **36** samples for TRC shall be less than **1.0 mg/l** for any one calendar month and no TRC sample shall be less than **0.60 mg/l**.

Chlorine Analysis for Coeburn-Norton-Wise Regional WWTP (continued)

Limit Derivation:

CNW = 5.0 MGD

Chemical = Chlorine
Chronic averaging period = 4
WLA_a = 0.023
WLA_c = 0.014
Q.L. = 0.1
# samples/mo = 360
# samples/wk = 90

Summary of Statistics:
observations = 1
Expected Value = 5
Variance = 9
C.V. =0.6
97th percentile daily values = 12.1670
97th percentile 4 day average = 8.31895
97th percentile 30 day average = 6.03026
< Q.L. = 0
Model used BPJ Assumptions, type 2 data

A limit is needed based on Acute Toxicity
Maximum Daily Limit = 2.04760469767452E-02
Average Weekly Limit = 9.45751129264051E-03
Average Monthly Limit = 8.91503905218934E-03
The data are: 5

CNW = 6.5 MGD

Chemical = Chlorine
Chronic averaging period = 4
WLA_a = 0.022
WLA_c = 0.013
Q.L. = 0.1
# samples/mo = 360
# samples/wk = 90

Summary of Statistics

observations = 1
Expected Value = 5
Variance = 9
C.V. =0.6
97th percentile daily values = 12.1670
97th percentile 4 day average = 8.31895
97th percentile 30 day average = 6.03026
< Q.L. = 0
Model used BPJ Assumptions, type 2 data

A limit is needed based on Chronic Toxicity
Maximum Daily Limit = 0.019013472192692
Average Weekly Limit = 8.78197477173762E-03
Average Monthly Limit = 8.27825054846153E-03

The data are: 5

CNW = 7.0 MGD

Chemical = Chlorine
Chronic averaging period = 4
WLA_a = 0.022
WLA_c = 0.013
Q.L. = 0.1
# samples/mo = 360
# samples/wk = 90

Summary of Statistics

observations = 1
Expected Value = 5
Variance = 9
C.V. =0.6
97th percentile daily values = 12.1670
97th percentile 4 day average = 8.31895
97th percentile 30 day average = 6.03026
< Q.L. = 0
Model used BPJ Assumptions, type 2 data

A limit is needed based on Chronic Toxicity
Maximum Daily Limit = 0.019013472192692
Average Weekly Limit = 8.78197477173762E-03
Average Monthly Limit = 8.27825054846153E-03

The data are: 5

Virginia DEQ: Statistically Derived Permit Limits Version 2.0.4

Ammonia-Nitrogen Analysis for Coeburn-Norton-Wise Regional WWTP

Background:

NH_3-N limits are derived from the ammonia tables or formulas in the 9 VAC 25 260 *Water Quality Standards*. August 27, 2003 the State Water Control Board adopted new criteria for ammonia nitrogen. Under 9VAC 25 260 155, the new criteria is less restrictive than the previous criteria. The acute ammonia nitrogen standard for freshwater only considers instream pH and utilizes the 1Q10 instream flow value for calculating steady state wasteload allocations. Chronic ammonia criteria can be based on total ammonia nitrogen (mg/l) in freshwater where the early life stages of fish are present or absent, and vary with instream temperature and pH values. Steady state wasteload allocations are calculated utilizing the 30Q10. Human Health standards are not applicable for ammonia nitrogen.

Standards:

Ammonia standards were calculated for a dry season and wet season and assume early life stages of fish are present for chronic criteria values.

Dry Season (June-Nov) pH = 8.1
Wet Season (Dec-May) pH = 8.4

Dry Season (June-Nov) Temperature = 23.2°
Wet Season (Dec-May) Temperature = 15.1°

The ammonia-nitrogen water quality standards (WQS) based on tables from 9VAC 25-260-155 are as follows:

$Acute_{dry}$ = 6.95 mg/l
$Acute_{wet}$ = 3.88 mg/l

$Chronic_{dry}$ = 1.20 mg/l
$Chronic_{wet}$ = 1.22 mg/l

Wasteload Allocations:

Q_{e1} = Design Flow of WWTP = 5.0 MGD
Q_{e3} = Design Flow of WWTP = 6.5 MGD
Q_{e4} = Design Flow of WWTP = 7.0 MGD

Q_s = Critical Flow (1Q10 for Acute, 30Q10 for Chronic Ammonia)

$Q_{s\text{-}1d}$ = 1Q10 Flow = 1.13 MGD (June-Nov)
$Q_{s\text{-}1w}$ =1Q10 High Flow = 4.54 MGD (Dec-May)

$Q_{s\text{-}30d}$ = 30Q10 Flow = 1.66 MGD (June-Nov)
$Q_{s\text{-}30w}$ = 30Q10 High Flow (MGD) = 13.2 MGD (Dec-May)

f = decimal fraction of flow to use
= 1.0 (complete mix for 1Q10 and 3Q10)

The calculated water quality wasteload allocations (WQ-WLAs), assuming a background concentration of 0, are as follows:

Acute:

$$WQ\text{-}WLA_{ad} = \text{acute dry WQ-WLA} = \frac{\{A_d[Qs\text{-}1_d\,(f) + Qe] - Q_{s\text{-}1d}\text{background}\}}{Qe}$$

$$WQ\text{-}WLA_{aw} = \text{acute wet WQ-WLA} = \frac{\{A_w[Qs\text{-}1_w\,(f) + Qe] - Q_{s\text{-}1w}\text{background}\}}{Qe}$$

Ammonia-Nitrogen Analysis for Coeburn-Norton-Wise Regional WWTP (continued)

Chronic:

$$WQ\text{-}WLA_{cd} = \text{chronic dry WQ-WLA} = \frac{\{C_d[Qs\text{-}30_d\,(f) + Qe]\text{-}Q_{s\text{-}30d}\text{background}\}}{Qe}$$

$$WQ\text{-}WLA_{cw} = \text{chronic wet WQ-WLA} = \frac{\{C_w[Qs\text{-}30_w\,(f) + Qe]\text{-}Q_{s\text{-}30w}\text{background}\}}{Qe}$$

For 5 MGD:

$$WQ\text{-}WLA_{ad} = \frac{6.95[1.13(1.0) + 5]}{5} = 8.52 \text{ mg/l}$$

$$WQ\text{-}WLA_{aw} = \frac{3.88[4.54(1.0) + 5]}{5} = 7.4 \text{ mg/l}$$

$$WQ\text{-}WLA_{cd} = \frac{1.20[1.66(1.0) + 5]}{5} = 1.6 \text{ mg/l}$$

$$WQ\text{-}WLA_{cw} = \frac{1.22\,[13.2(1.0) + 5]}{5} = 4.44 \text{ mg/l}$$

For 6.5 MGD:

$$WQ\text{-}WLA_{ad} = \frac{6.95[1.13(1.0) + 6.5]}{6.5} = 8.16 \text{ mg/l}$$

$$WQ\text{-}WLA_{aw} = \frac{3.88[4.54(1.0) + 6.5]}{6.5} = 6.59 \text{ mg/l}$$

$$WQ\text{-}WLA_{cd} = \frac{1.20[1.66(1.0) + 6.5]}{6.5} = 1.51 \text{ mg/l}$$

$$WQ\text{-}WLA_{cw} = \frac{1.22\,[13.2(1.0) + 6.5]}{6.5} = 3.7 \text{ mg/l}$$

For 7 MGD:

$$WQ\text{-}WLA_{ad} = \frac{6.95[1.13(1.0) + 7]}{7} = 8.07 \text{ mg/l}$$

$$WQ\text{-}WLA_{aw} = \frac{3.88[4.54(1.0) + 7]}{7} = 6.4 \text{ mg/l}$$

$$WQ\text{-}WLA_{cd} = \frac{1.2[1.66(1.0) + 7]}{7} = 1.48 \text{ mg/l}$$

$$WQ\text{-}WLA_{cw} = \frac{1.22\,[13.2(1.0) + 7]}{7} = 3.52 \text{ mg/l}$$

Ammonia-Nitrogen Analysis for Coeburn-Norton-Wise Regional WWTP (continued)

The following is a summary of the water quality wasteload allocations:

For 5 MGD: $WQ\text{-}WLA_{ad}$ = 8.52 mg/l
$WQ\text{-}WLA_{aw}$ = 7.4 mg/l
$WQ\text{-}WLA_{cd}$ = 1.6 mg/l
$WQ\text{-}WLA_{cw}$ = 4.44 mg/l

For 6.5 MGD: $WQ\text{-}WLA_{ad}$ = 8.16 mg/l
$WQ\text{-}WLA_{aw}$ = 6.59 mg/l
$WQ\text{-}WLA_{cd}$ = 1.51 mg/l
$WQ\text{-}WLA_{cw}$ = 3.7 mg/l

For 7 MGD: $WQ\text{-}WLA_{ad}$ = 8.07 mg/l
$WQ\text{-}WLA_{aw}$ = 6.4 mg/l
$WQ\text{-}WLA_{cd}$ = 1.48 mg/l
$WQ\text{-}WLA_{cw}$ = 3.52 mg/l

Permit Limits:

The above WLA's were entered in the *Virginia DEQ: Statistically Derived Permit Limits Version 2.0.4* with the following results: (program output provided pages 5 and 6 of this attachment)

5 MGD (Jun-Nov): Monthly Average Limit: **1.8 mg/l**
Weekly Average Limit: **2.4 mg/l**
(Dec-May): Monthly Average Limit: **4.0 mg/l**
Weekly Average Limit: **5.4 mg/l**

6.5 MGD (Jun-Nov): Monthly Average Limit: **1.6 mg/l**
Weekly Average Limit: **2.2 mg/l**
(Dec-May): Monthly Average Limit: **3.6 mg/l**
Weekly Average Limit: **4.8mg/l**

7 MGD (Jun-Nov): Monthly Average Limit: **1.6 mg/l**
Weekly Average Limit: **2.2 mg/l**
(Dec-May): Monthly Average Limit: **3.5 mg/l**
Weekly Average Limit: **4.7 mg/l**

Limit Derivation:

CNW = 5.0 MGD (Jun-Nov)

Chemical = Ammonia
Chronic averaging period = 30
WLA_a = 8.52
WLA_c = 1.6
Q.L. = 0.2
# samples/mo = 12
# samples/wk = 3
Summary of Statistics:
observations = 1
Expected Value = 9
Variance = 29.16
C.V. = 0.6
97th percentile daily values = 21.9007
97th percentile 4 day average = 14.9741
97th percentile 30 day average = 10.8544
< Q.L. = 0
Model used =BPJ Assumptions, type 2 data
A limit is needed based on Chronic Toxicity
Maximum Daily Limit = 3.2282721494661
Average Weekly Limit = 2.36129932535956
Average Monthly Limit = 1.75885936464567
The data are: 9

CNW = 5.0 MGD (Dec-May)

Chemical = Ammonia
Chronic averaging period = 30
WLA_a = 7.4
WLA_c = 4.44
Q.L. = 0.2
# samples/mo = 12
# samples/wk = 3
Summary of Statistics:
observations = 1
Expected Value = 9
Variance = 29.16
C.V. =0.6
97th percentile daily values = 21.9007
97th percentile 4 day average = 14.9741
97th percentile 30 day average = 10.8544
< Q.L. = 0
Model used = BPJ Assumptions, type 2 data
A limit is needed based on Acute Toxicity
Maximum Daily Limit = 7.4
Average Weekly Limit = 5.41268337942035
Average Monthly Limit= 4.0317416549068
The data are: 9

CNW = 6.5 MGD (Jun-Nov)

Chemical = Ammonia
Chronic averaging period = 30
WLA_a = 8.16
WLA_c = 1.51
Q.L. = 0.2
# samples/mo = 12
# samples/wk = 3
Summary of Statistics:
observations = 1
Expected Value = 9
Variance = 29.16
C.V. = 0.6
97th percentile daily values = 21.9007
97th percentile 4 day average = 14.9741
97th percentile 30 day average = 10.8544
< Q.L. = 0
Model used = BPJ Assumptions, type 2 data
A limit is needed based on Chronic Toxicity
Maximum Daily Limit = 3.04668184105863
Average Weekly Limit = 2.22847623830809
Average Monthly Limit = 1.65992352538435
The data are: 9

CNW = 6.5 MGD (Dec-May)

Chemical = Ammonia
Chronic averaging period = 30
WLA_a = 6.59
WLA_c = 3.7
Q.L. = 0.2
# samples/mo = 12
# samples/wk = 3
Summary of Statistics:
observations = 1
Expected Value = 9
Variance = 29.16
C.V. = 0.6
97th percentile daily values = 21.9007
97th percentile 4 day average = 14.9741
97th percentile 30 day average = 10.8544
< Q.L. = 0
Model used = BPJ Assumptions, type 2 data
A limit is needed based on Acute Toxicity
Maximum Daily Limit = 6.59
Average Weekly Limit = 4.8202139824838
Average Monthly Limit = 3.59042939268051
The data are: 9

CNW = 7.0 MGD (Jun-Nov)

Chemical = Ammonia
Chronic averaging period = 30
WLA_a = 8.07
WLA_c = 1.48
Q.L. = 0.2
# samples/mo = 20
# samples/wk = 5
Summary of Statistics:
observations = 1
Expected Value = 9
Variance = 29.16
C.V. = 0.6
97th percentile daily values = 21.9007
97th percentile 4 day average = 14.9741
97th percentile 30 day average = 10.8544
< Q.L. = 0
Model used = BPJ Assumptions, type 2 data
A limit is needed based on Chronic Toxicity
Maximum Daily Limit = 2.98615173825614
Average Weekly Limit = 2.18420187595759
Average Monthly Limit = 1.62694491229724
The data are: 9

CNW = 7.0 MGD (Dec-May)

Chemical = Ammonia
Chronic averaging period = 30
WLA_a = 6.4
WLA_c = 3.52
Q.L. = 0.2
# samples/mo = 20
# samples/wk = 5
Summary of Statistics:
observations = 1
Expected Value = 9
Variance = 29.16
C.V. = 0.6
97th percentile daily values = 21.9007
97th percentile 4 day average = 14.9741
97th percentile 30 day average = 10.8544
< Q.L. = 0
Model used = BPJ Assumptions, type 2 data
A limit is needed based on Acute Toxicity
Maximum Daily Limit = 6.4
Average Weekly Limit = 4.68123967949868
Average Monthly Limit = 3.48691170154101
The data are: 9

Ammonia-Nitrogen Analysis for Coeburn-Norton-Wise Regional WWTP (continued)

The following instream pH and temperature monitoring data was obtained by DEQ as part of routine monitoring of the Guest River at river mile 6.5, below the WWTP discharge. The STP discharge is at river mile 7.56.

June thru November:

DATE	Temp (°C)	pH (S.U.)
06-28-07	23	**8.1***
07-18-07	21.8	8.3
08-20-07	23.8	8.1
09-18-07	16.1	8.1
10-02-07	15.3	8.0
11-05-07	6.2	7.8
06-25-09	18.3	7.7
08-03-09	19	7.6
10-05-09	13.6	7.8
07-01-10	20.2	7.8
08-12-10	**23.2***	7.9
10-27-10	14.7	7.6

December thru May:

DATE	Temp (°C)	pH (S.U.)
01-18-07	4.2	7.5
02-12-07	1.3	**8.4***
03-28-07	14.4	8.0
04-30-07	**15.1***	7.8
05-29-07	18.7	7.8
12-03-07	6.8	7.8
02-11-09	7.4	7.8
04-09-09	9.7	8.0
12-14-09	6.6	7.0
02-16-10	2.0	7.5
04-07-10	14.8	8.4

* 90th percentile value

```
CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333333333:
                    CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX3: Buoyant Surface Discharges
                          CORMIX Version 7.0E
                     HYDRO3 Version 7.0.0.0 April 2011
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:
 Design case:        Measured river flow, 5.0 MGD Effluent Flow, CORMIX-3
 FILE NAME:          C:\...m Files (x86)\CORMIX 7.0\Sample Files\Sample2.prd
 Time stamp:         Thu Feb 23 10:09:35 2012

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =     18.56  AS    =      9.11  QA    =      3.51  ICHREG= 2
 HA    =      0.49  HD    =      0.34
 UA    =      0.385 F     =      0.249 USTAR =0.6795E-01
 UW    =      0.894 UWSTAR=0.9551E-03
 Uniform density environment
 STRCND=  U          RHOAM =  999.8568

DISCHARGE PARAMETERS (metric units)
 BANK  =  LEFT       DISTB =      0.00  Configuration: flush_discharge
 SIGMA =     90.00   HDO   =      0.21  SLOPE =   13.40 deg.
 Rectangular channel geometry:
 BO    =      2.170 HO    =      0.210 AO    =0.4564E+00  AR    =      0.097
 UO    =      0.480 QO    =      0.219       =0.2191E+00
 RHOO  =  999.4645  DRHOO =0.3923E+00  GPO   =0.3847E-02
 CO    =0.8000E+01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 QO    =0.2191E+00  MO    =0.1051E+00  JO    =0.8428E-03
 Associated length scales (meters)
 LQ    =      0.68  LM    =      6.36  Lm    =      0.84  Lb    =      0.01

NON-DIMENSIONAL PARAMETERS
 FRO   =      9.41  FRCH  =     16.87  R     =      1.25

FLOW CLASSIFICATION
 333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    SA1    3
 3  Applicable layer depth HS =     0.34  3
 333333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 CO    =0.8000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
 XINT  =   5000.00  XMAX  =   5000.00
```

```
X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.00 m  from the LEFT  bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  40 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
      X        Y        Z        S        C       BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.21     1.09 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
      X        Y        Z        S        C       BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.21     1.09 .00000E+00

 VERTICAL MIXING occurs in the initial zone of flow establishment.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=    295.44
      X        Y        Z        S        C       BV       BH        TT
     0.31    -0.46     0.00     1.0 0.800E+01   0.32     1.24 .11652E+01
 Cumulative travel time =          1.1652 sec  (    0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in deep crossflow with shoreline-attachment.

 Profile definitions:
   BV = water depth (vertically mixed)
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

X	Y	Z	S	C	BV	BH	TT
0.31	-0.46	0.00	1.0	0.800E+01	0.32	1.24	.11652E+01
0.55	-0.86	0.00	1.2	0.666E+01	0.34	1.25	.23797E+01
0.76	-1.12	0.00	1.2	0.648E+01	0.34	1.26	.33165E+01
0.99	-1.37	0.00	1.3	0.634E+01	0.34	1.26	.42981E+01
1.09	-1.46	0.00	1.3	0.629E+01	0.34	1.26	.42981E+01

Jet/plume RESTRATIFIES at the above position.
BV = Gaussian 1/e (37%) vertical thickness

1.24	-1.59	0.00	1.3	0.613E+01	0.34	1.32	.55447E+01
1.51	-1.78	0.00	1.4	0.589E+01	0.34	1.38	.69776E+01
1.81	-1.94	0.00	1.4	0.567E+01	0.34	1.44	.85065E+01
2.11	-2.09	0.00	1.5	0.540E+01	0.34	1.50	.10091E+02
2.42	-2.21	0.00	1.6	0.514E+01	0.34	1.55	.11697E+02
2.74	-2.31	0.00	1.6	0.491E+01	0.34	1.60	.13303E+02
3.06	-2.40	0.00	1.7	0.471E+01	0.34	1.65	.14892E+02
3.39	-2.48	0.00	1.8	0.452E+01	0.34	1.70	.16459E+02
3.72	-2.54	0.00	1.8	0.435E+01	0.34	1.75	.17999E+02
4.05	-2.60	0.00	1.9	0.420E+01	0.34	1.79	.19513E+02
4.38	-2.65	0.00	2.0	0.406E+01	0.34	1.84	.21000E+02
4.71	-2.69	0.00	2.0	0.393E+01	0.34	1.88	.22462E+02
5.04	-2.72	0.00	2.1	0.382E+01	0.34	1.92	.23900E+02
5.38	-2.75	0.00	2.2	0.372E+01	0.34	1.96	.25316E+02
5.71	-2.77	0.00	2.2	0.362E+01	0.34	2.00	.26712E+02
6.05	-2.78	0.00	2.3	0.353E+01	0.34	2.03	.28089E+02
6.38	-2.79	0.00	2.3	0.345E+01	0.34	2.07	.29449E+02
6.71	-2.79	0.00	2.4	0.338E+01	0.34	2.10	.30792E+02

Maximum lateral extent of recirculation bubble.

7.05	-2.79	0.00	2.4	0.331E+01	0.34	2.14	.32121E+02
7.38	-2.79	0.00	2.5	0.325E+01	0.34	2.17	.33435E+02
7.72	-2.78	0.00	2.5	0.318E+01	0.34	2.21	.34736E+02
8.05	-2.76	0.00	2.6	0.312E+01	0.34	2.24	.36023E+02
8.39	-2.75	0.00	2.6	0.306E+01	0.34	2.27	.37298E+02
8.72	-2.72	0.00	2.7	0.301E+01	0.34	2.31	.38561E+02
9.06	-2.70	0.00	2.7	0.295E+01	0.34	2.34	.39812E+02
9.39	-2.67	0.00	2.8	0.290E+01	0.34	2.38	.41052E+02
9.72	-2.64	0.00	2.8	0.285E+01	0.34	2.41	.42281E+02
10.05	-2.60	0.00	2.9	0.280E+01	0.34	2.44	.43500E+02
10.39	-2.56	0.00	2.9	0.276E+01	0.34	2.48	.44709E+02
10.72	-2.52	0.00	2.9	0.271E+01	0.34	2.51	.45908E+02
10.79	-2.51	0.00	2.9	0.271E+01	0.34	2.52	.45908E+02

End of recirculation bubble at the above position.
Dilution in recirculation bubble = 4.1
Corresponding concentration = 0.197E+01
Flow continues as WALL JET/PLUME.

11.05	0.00	0.00	3.0	0.268E+01	0.21	8.19	.47116E+02
11.39	0.00	0.00	3.0	0.265E+01	0.21	8.27	.48318E+02
11.72	0.00	0.00	3.1	0.262E+01	0.21	8.35	.49516E+02
12.06	0.00	0.00	3.1	0.259E+01	0.21	8.43	.50708E+02
12.39	0.00	0.00	3.1	0.256E+01	0.21	8.50	.51896E+02
12.73	0.00	0.00	3.2	0.254E+01	0.21	8.58	.53080E+02
12.99	0.00	0.00	3.2	0.252E+01	0.21	8.63	.54023E+02

Cumulative travel time = 54.0232 sec (0.02 hrs)

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

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--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
--------------------------------------------------------------------------------

 Some bank/shore interaction occurs at end of near-field.

 In the next prediction module, the jet/plume centerline will be set
   to follow the bank/shore.
--------------------------------------------------------------------------------
BEGIN MOD341: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to LEFT  bank/shore.
   Plume width is now determined from LEFT  bank/shore.

 Plume condition is non-buoyant or weakly buoyant, or, at the end of the NFR
   it is governed by full vertical mixing over the ambient depth,
   or by complete lateral mixing over the channel width.
 Thus, the BUOYANT SPREADING REGIME is ABSENT.

END OF MOD341: BUOYANT AMBIENT SPREADING
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.667E-02 m^2/s
  Horizontal diffusivity (initial value) = 0.167E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to water depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y        Z        S        C        BV       BH        TT
    12.99     0.00     0.00      3.2 0.252E+01   0.20     8.29 .54023E+02
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
   137.67     0.00     0.00      8.4 0.947E+00   0.49     9.21 .35846E+03
   262.35     0.00     0.00      9.2 0.869E+00   0.49    10.03 .66291E+03
   387.02     0.00     0.00      9.9 0.807E+00   0.49    10.80 .96735E+03
   511.70     0.00     0.00     10.6 0.757E+00   0.49    11.51 .12718E+04
   636.37     0.00     0.00     11.2 0.716E+00   0.49    12.19 .15762E+04
   761.05     0.00     0.00     11.8 0.680E+00   0.49    12.83 .18807E+04
   885.72     0.00     0.00     12.3 0.649E+00   0.49    13.43 .21851E+04
  1010.40     0.00     0.00     12.9 0.622E+00   0.49    14.01 .24896E+04
  1135.07     0.00     0.00     13.4 0.598E+00   0.49    14.57 .27940E+04
  1259.75     0.00     0.00     13.9 0.577E+00   0.49    15.11 .30984E+04
```

```
  1384.42     0.00     0.00    14.3 0.558E+00   0.49    15.63 .34029E+04
  1509.10     0.00     0.00    14.8 0.541E+00   0.49    16.13 .37073E+04
  1633.77     0.00     0.00    15.2 0.525E+00   0.49    16.62 .40118E+04
  1758.45     0.00     0.00    15.7 0.510E+00   0.49    17.09 .43162E+04
  1883.12     0.00     0.00    16.1 0.497E+00   0.49    17.55 .46206E+04
  2007.80     0.00     0.00    16.5 0.484E+00   0.49    18.00 .49251E+04
  2132.47     0.00     0.00    16.9 0.473E+00   0.49    18.44 .52295E+04
The passive diffusion plume becomes LATERALLY FULLY MIXED over the channel
  width during the current prediction interval.
  2257.15     0.00     0.00    17.3 0.462E+00   0.49    18.56 .55340E+04
Effluent is FULLY MIXED over the entire channel cross-section.
Except for possible far-field decay or reaction processes, there are
  NO FURTHER CHANGES with downstream direction.
  2381.82     0.00     0.00    17.0 0.470E+00   0.49    18.56 .58384E+04
  2506.50     0.00     0.00    17.0 0.470E+00   0.49    18.56 .61428E+04
  2631.17     0.00     0.00    17.0 0.470E+00   0.49    18.56 .64473E+04
  2755.85     0.00     0.00    17.0 0.470E+00   0.49    18.56 .67517E+04
  2880.52     0.00     0.00    17.0 0.470E+00   0.49    18.56 .70562E+04
  3005.20     0.00     0.00    17.0 0.470E+00   0.49    18.56 .73606E+04
  3129.87     0.00     0.00    17.0 0.470E+00   0.49    18.56 .76650E+04
  3254.55     0.00     0.00    17.0 0.470E+00   0.49    18.56 .79695E+04
  3379.22     0.00     0.00    17.0 0.470E+00   0.49    18.56 .82739E+04
  3503.90     0.00     0.00    17.0 0.470E+00   0.49    18.56 .85784E+04
  3628.57     0.00     0.00    17.0 0.470E+00   0.49    18.56 .88828E+04
  3753.25     0.00     0.00    17.0 0.470E+00   0.49    18.56 .91872E+04
  3877.92     0.00     0.00    17.0 0.470E+00   0.49    18.56 .94917E+04
  4002.60     0.00     0.00    17.0 0.470E+00   0.49    18.56 .97961E+04
  4127.27     0.00     0.00    17.0 0.470E+00   0.49    18.56 .10101E+05
  4251.95     0.00     0.00    17.0 0.470E+00   0.49    18.56 .10405E+05
  4376.62     0.00     0.00    17.0 0.470E+00   0.49    18.56 .10709E+05
  4501.30     0.00     0.00    17.0 0.470E+00   0.49    18.56 .11014E+05
  4625.97     0.00     0.00    17.0 0.470E+00   0.49    18.56 .11318E+05
  4750.65     0.00     0.00    17.0 0.470E+00   0.49    18.56 .11623E+05
  4875.33     0.00     0.00    17.0 0.470E+00   0.49    18.56 .11927E+05
  5000.00     0.00     0.00    17.0 0.470E+00   0.49    18.56 .12232E+05
Cumulative travel time =       12231.6621 sec  (    3.40 hrs)

Simulation limit based on maximum specified distance =   5000.00 m.
  This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                 End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333333
```

Complete Mix

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                        CORMIX MIXING ZONE EXPERT SYSTEM
                            CORMIX Version 7.0E
                         HYDRO3:Version-7.0.0.0  April,2011
SITE NAME/LABEL:
  DESIGN CASE:                Measured river flow, 5.0MGD Effluent Flow, CORMIX-3
  FILE NAME:                   C:\Program Files (x86)\CORMIX 7.0\Sample Files\Sample2.p
  Using subsystem CORMIX3:    Buoyant Surface Discharges
  Start of session:            02/23/2012--10:09:35
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 18.56 m
  Channel regularity              ICHREG = 2
  Ambient flowrate                QA      = 3.51 m^3/s
  Average depth                   HA      = 0.49 m
  Depth at discharge              HD      = 0.34 m
  Ambient velocity                UA      = 0.3855 m/s
  Darcy-Weisbach friction factor  F       = 0.2486
    Calculated from Manning's n           = 0.05
  Wind velocity                   UW      = 0.89 m/s
  Stratification Type             STRCND = U
  Surface temperature                     = 7.9 degC
  Bottom temperature                      = 7.9 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                 RHOAS  = 999.8568 kg/m^3
  Bottom density                  RHOAB  = 999.8568 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Surface Discharge
  Discharge located on                    = left bank/shoreline
  Discharge configuration                 = flush discharge
  Distance from bank to outlet    DISTB  = 0 m
  Discharge angle                 SIGMA  = 90 deg
  Depth near discharge outlet     HD0    = 0.21 m
  Bottom slope at discharge       SLOPE  = 13.4 deg
  Rectangular discharge:
    Discharge cross-section area  A0      = 0.456414 m^2
    Discharge channel width       B0      = 2.170176 m
    Discharge channel depth       H0      = 0.210312 m
    Discharge aspect ratio        AR      = 0.096910
  Discharge flowrate              Q0      = 0.219063 m^3/s
  Discharge velocity              U0      = 0.48 m/s
  Discharge temperature (freshwater)      = 12.30 degC
  Corresponding density           RHO0   = 999.4645 kg/m^3
  Density difference              DRHO   = 0.3923 kg/m^3
  Buoyant acceleration            GP0    = 0.0038 m/s^2
  Discharge concentration         C0      = 8 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
```

```
  LQ  = 0.68 m          Lm  = 0.84 m          Lbb = 0.01 m
  LM  = 6.36 m
--------------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number        FRO     = 9.41 (based on LQ)
  Channel densimetric Froude no.   FRCH    = 16.87 (based on HO)
  Velocity ratio                   R       = 1.25
--------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                          = no
  Water quality standard specified         = no
  Regulatory mixing zone                   = no
  Region of interest                       = 5000 m downstream
********************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  | FLOW CLASS    = SA1 |
  *-------------------------*
********************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

--------------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0 m from the left bank/shore.
  Number of display steps NSTEP = 40 per module.
--------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 2.5177 mg/l
  Dilution at edge of NFR              s = 3.2
  NFR Location:                        x = 12.99 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 8.63 m
                         thickness (bv) = 0.21 m
Cumulative travel time:       54.0232 sec.
--------------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
--------------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
  but RE-STRATIFIES LATER.
  Plume becomes vertically fully mixed again at 137.67 m downstream.
--------------------------------------------------------------------------------
```

```
--------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 0 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY **********************
No RMZ and no ambient water quality standard have been specified.
******************** FINAL DESIGN ADVICE AND COMMENTS ********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333333333
                    CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX3: Buoyant Surface Discharges
                          CORMIX Version 7.0E
                     HYDRO3 Version 7.0.0.0 April 2011
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:
 Design case:       1Q10 river flow, 5.0 MGD Effluent Flow, CORMIX-3
 FILE NAME:         C:\...m Files (x86)\CORMIX 7.0\Sample Files\Sample2.prd
 Time stamp:        Thu Feb 23 10:49:03 2012

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =     18.56  AS    =      4.58  QA    =      0.05  ICHREG= 2
 HA    =      0.25  HD    =      0.17
 UA    =     0.011  F     =     0.028 USTAR =0.6595E-03
 UW    =     0.894 UWSTAR=0.9551E-03
 Uniform density environment
 STRCND=  U         RHOAM =  998.4062

DISCHARGE PARAMETERS (metric units)
 BANK  =  LEFT      DISTB =      0.00  Configuration: flush_discharge
 SIGMA =     90.00  HDO   =      0.17  SLOPE =    0.00 deg.
 Rectangular channel geometry:
 BO    =     2.621 HO    =     0.174 AO    =0.4554E+00  AR    =      0.066
 UO    =     0.481 QO    =     0.219       =0.2191E+00
 RHOO  =  998.2051  DRHOO =0.2012E+00  GPO   =0.1976E-02
 CO    =0.8000E+01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 QO    =0.2191E+00  MO    =0.1054E+00  JO    =0.4329E-03
 Associated length scales (meters)
 LQ    =      0.67  LM    =      8.89  Lm    =     29.19  Lb    =    314.62
 LQ2D  =      2.62  LM2D  =     33.00  Lm2D  =   4903.15

NON-DIMENSIONAL PARAMETERS
 FRO   =     13.17  FRCH  =     25.96  R     =     43.25

FLOW CLASSIFICATION
 3333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    SA2    3
 3  Applicable layer depth HS =     0.17  3
 3333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 CO    =0.8000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
 XINT  =   2000.00  XMAX  =   2000.00
```

```
X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.00 m  from the LEFT  bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  50 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

 VERTICAL MIXING occurs in the initial zone of flow establishment.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=    270.55
      X        Y        Z        S        C        BV       BH        TT
     0.75    -0.51     0.00     1.0 0.800E+01   0.17     2.33 .18774E+01
 Cumulative travel time =           1.8774 sec  (    0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in shallow crossflow with shoreline-attachment.

 Profile definitions:
   BV = water depth (vertically mixed)
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

X	Y	Z	S	C	BV	BH	IT
0.75	-0.51	0.00	1.0	0.800E+01	0.17	2.33	.18774E+01

Maximum lateral extent of recirculation bubble.

0.76	-0.53	0.00	1.0	0.800E+01	0.17	2.33	.18774E+01

End of recirculation bubble at the above position.

Dilution in recirculation bubble = 1.5

Corresponding concentration = 0.542E+01

Flow continues as WALL JET/PLUME.

1.03	0.00	0.00	1.2	0.653E+01	0.17	4.67	.19068E+01
1.30	0.00	0.00	1.3	0.617E+01	0.17	4.67	.19375E+01
1.57	0.00	0.00	1.4	0.590E+01	0.17	4.67	.19743E+01
1.83	0.00	0.00	1.4	0.569E+01	0.17	4.67	.20170E+01
2.10	0.00	0.00	1.5	0.551E+01	0.17	4.68	.20652E+01
2.37	0.00	0.00	1.5	0.537E+01	0.17	4.68	.21189E+01
2.63	0.00	0.00	1.5	0.524E+01	0.17	4.68	.21779E+01
2.90	0.00	0.00	1.6	0.513E+01	0.17	4.69	.22421E+01
3.17	0.00	0.00	1.6	0.503E+01	0.17	4.69	.23114E+01
3.44	0.00	0.00	1.6	0.494E+01	0.17	4.70	.23856E+01
3.70	0.00	0.00	1.6	0.485E+01	0.17	4.70	.24647E+01
3.97	0.00	0.00	1.7	0.478E+01	0.17	4.71	.25487E+01
4.24	0.00	0.00	1.7	0.471E+01	0.17	4.71	.26374E+01
4.50	0.00	0.00	1.7	0.465E+01	0.17	4.72	.27308E+01
4.77	0.00	0.00	1.7	0.459E+01	0.17	4.73	.28288E+01
5.04	0.00	0.00	1.8	0.454E+01	0.17	4.74	.29314E+01
5.31	0.00	0.00	1.8	0.449E+01	0.17	4.74	.30385E+01
5.57	0.00	0.00	1.8	0.444E+01	0.17	4.75	.31501E+01
5.84	0.00	0.00	1.8	0.439E+01	0.17	4.76	.32661E+01
6.11	0.00	0.00	1.8	0.435E+01	0.17	4.77	.33865E+01
6.38	0.00	0.00	1.9	0.431E+01	0.17	4.78	.35113E+01
6.64	0.00	0.00	1.9	0.427E+01	0.17	4.79	.36404E+01
6.91	0.00	0.00	1.9	0.424E+01	0.17	4.80	.37738E+01
7.18	0.00	0.00	1.9	0.420E+01	0.17	4.81	.39115E+01
7.44	0.00	0.00	1.9	0.417E+01	0.17	4.82	.40534E+01
7.71	0.00	0.00	1.9	0.414E+01	0.17	4.83	.41995E+01
7.98	0.00	0.00	1.9	0.411E+01	0.17	4.85	.43498E+01
8.25	0.00	0.00	2.0	0.408E+01	0.17	4.86	.45043E+01
8.51	0.00	0.00	2.0	0.405E+01	0.17	4.87	.46629E+01
8.78	0.00	0.00	2.0	0.402E+01	0.17	4.89	.48256E+01
9.05	0.00	0.00	2.0	0.400E+01	0.17	4.90	.49925E+01
9.32	0.00	0.00	2.0	0.397E+01	0.17	4.91	.51634E+01
9.58	0.00	0.00	2.0	0.395E+01	0.17	4.93	.53383E+01
9.85	0.00	0.00	2.0	0.393E+01	0.17	4.94	.55174E+01
10.12	0.00	0.00	2.0	0.390E+01	0.17	4.96	.57004E+01
10.38	0.00	0.00	2.1	0.388E+01	0.17	4.97	.58875E+01
10.65	0.00	0.00	2.1	0.386E+01	0.17	4.99	.60786E+01
10.92	0.00	0.00	2.1	0.384E+01	0.17	5.00	.62736E+01
11.19	0.00	0.00	2.1	0.382E+01	0.17	5.02	.64727E+01
11.45	0.00	0.00	2.1	0.380E+01	0.17	5.04	.66757E+01
11.72	0.00	0.00	2.1	0.378E+01	0.17	5.05	.68827E+01
11.99	0.00	0.00	2.1	0.377E+01	0.17	5.07	.70936E+01
12.25	0.00	0.00	2.1	0.375E+01	0.17	5.09	.73085E+01
12.52	0.00	0.00	2.1	0.373E+01	0.17	5.11	.75273E+01
12.79	0.00	0.00	2.2	0.371E+01	0.17	5.13	.77500E+01
13.06	0.00	0.00	2.2	0.370E+01	0.17	5.15	.79766E+01

```
    13.32     0.00     0.00     2.2 0.368E+01   0.17     5.17 .82072E+01
    13.59     0.00     0.00     2.2 0.367E+01   0.17     5.18 .84416E+01
    13.86     0.00     0.00     2.2 0.365E+01   0.17     5.20 .86800E+01
    14.13     0.00     0.00     2.2 0.364E+01   0.17     5.22 .89222E+01
 Cumulative travel time =          8.9222 sec  (    0.00 hrs)

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
-------------------------------------------------------------------------------

 The initial plume WIDTH/THICKNESS VALUE in the next far-field module will be
  CORRECTED by a factor  6.34 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
 Flow appears highly UNSTEADY and prediction results are UNRELIABLE!
   SIMULATION STOPS!

 Some bank/shore interaction occurs at end of near-field.


 The LIMITING DILUTION (given by ambient flow/discharge ratio) is:    1.23
 This value is below the computed dilution of    2.20 at the end
 of the NFR.
 Mixing for this discharge configuration is constrained by LOW AMBIENT FLOW!

 The previous module predictions are UNRELIABLE since the limiting dilution
   cannot be exceeded for this shallow water discharge configuration.

 A subsequent module (MOD381) will predict the properties of the
   cross-sectionally fully mixed plume with limiting dilution and will
   compute a POSSIBLE UPSTREAM WEDGE INTRUSION.
-------------------------------------------------------------------------------
BEGIN MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION

 The DOWNSTREAM flow field for this unstable shallow water discharge is
     VERTICALLY FULLY MIXED.
 The mixing is controlled by the limiting dilution =      1.2

 Channel DENSIMETRIC FROUDE NUMBER (FCHAN) for this mixed flow =     0.56

 An UPSTREAM INTRUDING WEDGE is formed along the surface.

 UPSTREAM WEDGE INTRUSION PROPERTIES in bounded channel (laterally uniform):
        Wedge length                          =       3.34 m
        X-Position of wedge tip               =      10.79 m
        Thickness at discharge (end of NFR)   =       0.08 m
         (Wedge thickness gradually decreases to zero at wedge tip.)
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
```

```
This may be caused by a very small ambient velocity, perhaps in combination
  with large discharge buoyancy.
If the ambient conditions are strongly transient (e.g. tidal), then the
  CORMIX steady-state predictions of upstream intrusion are probably
  unrealistic.
The plume predictions prior to boundary impingement and wedge formation
 will be acceptable, however.

      X        Y        Z        S        C        BV       BH        TT
   14.13     0.00     0.00     1.2 0.649E+01   0.25    18.56 .89222E+01
 Cumulative travel time =          8.9222 sec  (    0.00 hrs)

 Vertically and laterally fully mixed over layer depth: END OF SIMULATION!

END OF MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                 End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333333
```

Complete Mix

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 7.0E
                      HYDRO3:Version-7.0.0.0  April,2011
SITE NAME/LABEL:
  DESIGN CASE:                  1Q10 river flow, 5.0 MGD Effluent Flow, CORMIX-3
  FILE NAME:                    C:\Program Files (x86)\CORMIX 7.0\Sample Files\Sample
  Using subsystem CORMIX3:      Buoyant Surface Discharges
  Start of session:             02/23/2012--10:49:03
**************************************************************************
SUMMARY OF INPUT DATA:
--------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                            = bounded
  Width                           BS       = 18.56 m
  Channel regularity              ICHREG = 2
  Ambient flowrate                QA       = 0.05 m^3/s
  Average depth                   HA       = 0.25 m
  Depth at discharge              HD       = 0.17 m
  Ambient velocity                UA       = 0.0111 m/s
  Darcy-Weisbach friction factor  F        = 0.0281
    Calculated from Manning's n            = 0.015
  Wind velocity                   UW       = 0.89 m/s
  Stratification Type             STRCND = U
  Surface temperature                      = 19 degC
  Bottom temperature                       = 19 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                 RHOAS  = 998.4063 kg/m^3
  Bottom density                  RHOAB  = 998.4063 kg/m^3
--------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Surface Discharge
  Discharge located on                     = left bank/shoreline
  Discharge configuration                  = flush discharge
  Distance from bank to outlet    DISTB  = 0 m
  Discharge angle                 SIGMA  = 90 deg
  Depth near discharge outlet     HD0    = 0.17 m
  Bottom slope at discharge       SLOPE  = 0 deg
  Rectangular discharge:
    Discharge cross-section area  A0     = 0.455411 m^2
    Discharge channel width       B0     = 2.62128 m
    Discharge channel depth       H0     = 0.173736 m
    Discharge aspect ratio        AR     = 0.066279
  Discharge flowrate              Q0     = 0.219063 m^3/s
  Discharge velocity              U0     = 0.48 m/s
  Discharge temperature (freshwater)     = 20 degC
  Corresponding density           RHO0   = 998.2051 kg/m^3
  Density difference              DRHO   = 0.2012 kg/m^3
  Buoyant acceleration            GP0    = 0.002 m/s^2
  Discharge concentration         C0     = 8 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
--------------------------------------------------------------------------
```

```
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.67 m          Lm  = 29.19 m          Lbb = 314.62 m
  LM  = 8.89 m
-------------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number        FRO    = 13.17 (based on LQ)
  Channel densimetric Froude no.   FRCH   = 25.96 (based on H0)
  Velocity ratio                   R      = 43.25
-------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                          = no
  Water quality standard specified         = no
  Regulatory mixing zone                   = no
  Region of interest                       = 2000 m downstream
*******************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  | FLOW CLASS   = SA2 |
  *-------------------------*
*******************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-------------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0 m from the left bank/shore.
  Number of display steps NSTEP = 50 per module.
-------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 3.637 mg/l
  Dilution at edge of NFR              s = 2.2
  NFR Location:                        x = 14.13 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 5.22 m
                         thickness (bv) = 0.17 m
Cumulative travel time:       8.9222 sec.

WARNING:
 The LIMITING DILUTION (given by ambient flow/discharge ratio) is = 1.23
 This value is below the computed dilution of 2.20 at the end of the
 Near Field Region (NFR). Mixing for this discharge configuration is
 constrained by the ambient flow.
 Please carefully review the prediction file for additional warnings and information.
-------------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
```

```
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed ALREADY IN NEAR-FIELD at 0 m
  downstream and continues as vertically mixed into the far-field.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 0 m downstream.
  Plume contacts second bank at 0 m downstream.
************************* TOXIC DILUTION ZONE SUMMARY *************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY **********************
No RMZ and no ambient water quality standard have been specified.
********************** FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333333333333
                        CORMIX MIXING ZONE EXPERT SYSTEM
                 Subsystem CORMIX3: Buoyant Surface Discharges
                              CORMIX Version 7.0E
                       HYDRO3 Version 7.0.0.0 April 2011
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:
 Design case:        7Q10 river flow, 5.0 MGD Effluent Flow, CORMIX-3
 FILE NAME:          C:\...m Files (x86)\CORMIX 7.0\Sample Files\Sample2.prd
 Time stamp:         Thu Feb 23 11:49:22 2012

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =     18.56  AS    =      4.58  QA    =      0.06  ICHREG= 2
 HA    =      0.25  HD    =      0.17
 UA    =     0.013  F     =     0.028  USTAR =0.7694E-03
 UW    =     0.894  UWSTAR=0.9551E-03
 Uniform density environment
 STRCND=  U         RHOAM =  998.4062

DISCHARGE PARAMETERS (metric units)
 BANK  =  LEFT      DISTB =      0.00  Configuration: flush_discharge
 SIGMA =     90.00  HDO   =      0.17  SLOPE =    0.00 deg.
 Rectangular channel geometry:
 B0    =     2.621  H0    =     0.174  A0    =0.4554E+00  AR    =      0.066
 U0    =     0.481  Q0    =     0.219        =0.2191E+00
 RHO0  =  998.2051  DRHO0 =0.2012E+00  GP0   =0.1976E-02
 C0    =0.8000E+01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.2191E+00  M0    =0.1054E+00  J0    =0.4329E-03
 Associated length scales (meters)
 LQ    =     0.67  LM    =      8.89  Lm    =     25.02  Lb    =    198.13
 LQ2D  =     2.62  LM2D  =     33.00  Lm2D  =   3602.32

NON-DIMENSIONAL PARAMETERS
 FR0   =    13.17  FRCH  =     25.96  R     =     37.07

FLOW CLASSIFICATION
 333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    SA2    3
 3  Applicable layer depth HS =     0.17  3
 333333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =   2000.00  XMAX  =   2000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.00 m  from the LEFT  bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  50 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

 VERTICAL MIXING occurs in the initial zone of flow establishment.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=    270.65
      X        Y        Z        S        C        BV       BH        TT
     0.65    -0.46     0.00     1.0 0.800E+01   0.17     2.33 .16656E+01
 Cumulative travel time =           1.6656 sec  (     0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in shallow crossflow with shoreline-attachment.

 Profile definitions:
   BV = water depth (vertically mixed)
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

X	Y	Z	S	C	BV	BH	TT
0.65	-0.46	0.00	1.0	0.800E+01	0.17	2.33	.16656E+01

Maximum lateral extent of recirculation bubble.

0.68	-0.48	0.00	1.0	0.800E+01	0.17	2.33	.16656E+01

End of recirculation bubble at the above position.

Dilution in recirculation bubble = 1.4

Corresponding concentration = 0.552E+01

Flow continues as WALL JET/PLUME.

0.95	0.00	0.00	1.2	0.677E+01	0.17	4.67	.17043E+01
1.21	0.00	0.00	1.2	0.646E+01	0.17	4.67	.17428E+01
1.48	0.00	0.00	1.3	0.622E+01	0.17	4.67	.17876E+01
1.75	0.00	0.00	1.3	0.602E+01	0.17	4.68	.18386E+01
2.02	0.00	0.00	1.4	0.585E+01	0.17	4.68	.18955E+01
2.28	0.00	0.00	1.4	0.571E+01	0.17	4.68	.19582E+01
2.55	0.00	0.00	1.4	0.558E+01	0.17	4.69	.20266E+01
2.82	0.00	0.00	1.5	0.547E+01	0.17	4.69	.21005E+01
3.08	0.00	0.00	1.5	0.537E+01	0.17	4.70	.21798E+01
3.35	0.00	0.00	1.5	0.528E+01	0.17	4.70	.22644E+01
3.62	0.00	0.00	1.5	0.520E+01	0.17	4.71	.23543E+01
3.89	0.00	0.00	1.6	0.513E+01	0.17	4.71	.24493E+01
4.15	0.00	0.00	1.6	0.506E+01	0.17	4.72	.25494E+01
4.42	0.00	0.00	1.6	0.499E+01	0.17	4.73	.26546E+01
4.69	0.00	0.00	1.6	0.493E+01	0.17	4.74	.27647E+01
4.96	0.00	0.00	1.6	0.488E+01	0.17	4.74	.28797E+01
5.22	0.00	0.00	1.7	0.483E+01	0.17	4.75	.29996E+01
5.49	0.00	0.00	1.7	0.478E+01	0.17	4.76	.31243E+01
5.76	0.00	0.00	1.7	0.473E+01	0.17	4.77	.32538E+01
6.02	0.00	0.00	1.7	0.469E+01	0.17	4.78	.33880E+01
6.29	0.00	0.00	1.7	0.464E+01	0.17	4.79	.35269E+01
6.56	0.00	0.00	1.7	0.460E+01	0.17	4.80	.36705E+01
6.83	0.00	0.00	1.8	0.457E+01	0.17	4.81	.38187E+01
7.09	0.00	0.00	1.8	0.453E+01	0.17	4.82	.39715E+01
7.36	0.00	0.00	1.8	0.449E+01	0.17	4.83	.41289E+01
7.63	0.00	0.00	1.8	0.446E+01	0.17	4.84	.42908E+01
7.89	0.00	0.00	1.8	0.443E+01	0.17	4.86	.44572E+01
8.16	0.00	0.00	1.8	0.440E+01	0.17	4.87	.46281E+01
8.43	0.00	0.00	1.8	0.437E+01	0.17	4.88	.48034E+01
8.70	0.00	0.00	1.8	0.434E+01	0.17	4.90	.49832E+01
8.96	0.00	0.00	1.9	0.431E+01	0.17	4.91	.51675E+01
9.23	0.00	0.00	1.9	0.429E+01	0.17	4.92	.53561E+01
9.50	0.00	0.00	1.9	0.426E+01	0.17	4.94	.55491E+01
9.77	0.00	0.00	1.9	0.424E+01	0.17	4.95	.57465E+01
10.03	0.00	0.00	1.9	0.421E+01	0.17	4.97	.59483E+01
10.30	0.00	0.00	1.9	0.419E+01	0.17	4.98	.61543E+01
10.57	0.00	0.00	1.9	0.417E+01	0.17	5.00	.63647E+01
10.83	0.00	0.00	1.9	0.415E+01	0.17	5.02	.65795E+01
11.10	0.00	0.00	1.9	0.413E+01	0.17	5.03	.67985E+01
11.37	0.00	0.00	1.9	0.411E+01	0.17	5.05	.70218E+01
11.64	0.00	0.00	2.0	0.409E+01	0.17	5.07	.72493E+01
11.90	0.00	0.00	2.0	0.407E+01	0.17	5.09	.74812E+01
12.17	0.00	0.00	2.0	0.405E+01	0.17	5.10	.77173E+01
12.44	0.00	0.00	2.0	0.403E+01	0.17	5.12	.79576E+01

```
    12.71     0.00     0.00     2.0 0.401E+01   0.17     5.14 .82022E+01
    12.97     0.00     0.00     2.0 0.400E+01   0.17     5.16 .84510E+01
    13.24     0.00     0.00     2.0 0.398E+01   0.17     5.18 .87040E+01
    13.51     0.00     0.00     2.0 0.396E+01   0.17     5.20 .89612E+01
    13.77     0.00     0.00     2.0 0.395E+01   0.17     5.22 .92227E+01
    14.04     0.00     0.00     2.0 0.393E+01   0.17     5.24 .94883E+01
 Cumulative travel time =           9.4883 sec  (    0.00 hrs)

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
-----------------------------------------------------------------------------

 The initial plume WIDTH/THICKNESS VALUE in the next far-field module will be
  CORRECTED by a factor  5.67 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
 Flow appears highly UNSTEADY and prediction results are UNRELIABLE!
   SIMULATION STOPS!

 Some bank/shore interaction occurs at end of near-field.


 The LIMITING DILUTION (given by ambient flow/discharge ratio) is:    1.27
 This value is below the computed dilution of    2.04 at the end
 of the NFR.
 Mixing for this discharge configuration is constrained by LOW AMBIENT FLOW!

 The previous module predictions are UNRELIABLE since the limiting dilution
   cannot be exceeded for this shallow water discharge configuration.

 A subsequent module (MOD381) will predict the properties of the
   cross-sectionally fully mixed plume with limiting dilution and will
   compute a POSSIBLE UPSTREAM WEDGE INTRUSION.
-----------------------------------------------------------------------------
BEGIN MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION

 The DOWNSTREAM flow field for this unstable shallow water discharge is
     VERTICALLY FULLY MIXED.
 The mixing is controlled by the limiting dilution =      1.3

 Channel DENSIMETRIC FROUDE NUMBER (FCHAN) for this mixed flow =     0.66

 An UPSTREAM INTRUDING WEDGE is formed along the surface.

 UPSTREAM WEDGE INTRUSION PROPERTIES in bounded channel (laterally uniform):
        Wedge length                          =       1.21 m
        X-Position of wedge tip               =      12.83 m
        Thickness at discharge (end of NFR)   =       0.06 m
         (Wedge thickness gradually decreases to zero at wedge tip.)
       X        Y        Z        S        C       BV       BH        TT
    14.04     0.00     0.00     1.3 0.629E+01   0.25    18.56 .94883E+01
```

Complete Mix

```
 Cumulative travel time =          9.4883 sec  (    0.00 hrs)

 Vertically and laterally fully mixed over layer depth: END OF SIMULATION!

END OF MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333333
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                        CORMIX MIXING ZONE EXPERT SYSTEM
                            CORMIX Version 7.0E
                         HYDRO3:Version-7.0.0.0  April,2011
SITE NAME/LABEL:
  DESIGN CASE:                 7Q10 river flow, 5.0 MGD Effluent Flow, CORMIX-3
  FILE NAME:                    C:\Program Files (x86)\CORMIX 7.0\Sample Files
  Using subsystem CORMIX3:     Buoyant Surface Discharges
  Start of session:             02/23/2012--11:49:22
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                          BS      = 18.56 m
  Channel regularity             ICHREG  = 2
  Ambient flowrate               QA      = 0.06 m^3/s
  Average depth                  HA      = 0.25 m
  Depth at discharge             HD      = 0.17 m
  Ambient velocity               UA      = 0.0130 m/s
  Darcy-Weisbach friction factor F       = 0.0281
    Calculated from Manning's n          = 0.015
  Wind velocity                  UW      = 0.89 m/s
  Stratification Type            STRCND  = U
  Surface temperature                    = 19 degC
  Bottom temperature                     = 19 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                RHOAS   = 998.4063 kg/m^3
  Bottom density                 RHOAB   = 998.4063 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:            Surface Discharge
  Discharge located on                   = left bank/shoreline
  Discharge configuration                = flush discharge
  Distance from bank to outlet   DISTB   = 0 m
  Discharge angle                SIGMA   = 90 deg
  Depth near discharge outlet    HD0     = 0.17 m
  Bottom slope at discharge      SLOPE   = 0 deg
  Rectangular discharge:
    Discharge cross-section area A0      = 0.455411 m^2
    Discharge channel width      B0      = 2.62128 m
    Discharge channel depth      H0      = 0.173736 m
    Discharge aspect ratio       AR      = 0.066279
  Discharge flowrate             Q0      = 0.219063 m^3/s
  Discharge velocity             U0      = 0.48 m/s
  Discharge temperature (freshwater)     = 20 degC
  Corresponding density          RHO0    = 998.2051 kg/m^3
  Density difference             DRHO    = 0.2012 kg/m^3
  Buoyant acceleration           GP0     = 0.002 m/s^2
  Discharge concentration        C0      = 8 mg/l
  Surface heat exchange coeff.   KS      = 0 m/s
  Coefficient of decay           KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
```

```
  LQ  = 0.67 m          Lm  = 25.02 m          Lbb = 198.13 m
  LM  = 8.89 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number        FRO    = 13.17 (based on LQ)
  Channel densimetric Froude no.   FRCH   = 25.96 (based on H0)
  Velocity ratio                   R      = 37.07
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                          = no
  Water quality standard specified         = no
  Regulatory mixing zone                   = no
  Region of interest                       = 2000 m downstream
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  | FLOW CLASS   = SA2 |
  *-------------------------*
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0 m from the left bank/shore.
  Number of display steps NSTEP = 50 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 3.9308 mg/l
  Dilution at edge of NFR              s = 2.0
  NFR Location:                        x = 14.04 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 5.24 m
                          thickness (bv) = 0.17 m
Cumulative travel time:       9.4883 sec.

WARNING:
 The LIMITING DILUTION (given by ambient flow/discharge ratio) is = 1.27
 This value is below the computed dilution of 2.04 at the end of the
 Near Field Region (NFR). Mixing for this discharge configuration is
 constrained by the ambient flow.
 Please carefully review the prediction file for additional warnings and information.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
```

```
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed ALREADY IN NEAR-FIELD at 0 m
  downstream and continues as vertically mixed into the far-field.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 0 m downstream.
  Plume contacts second bank at 0 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY **********************
No RMZ and no ambient water quality standard have been specified.
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
333333333333333333333333333333333333333333333333333333333333333333333333333333333333
                        CORMIX MIXING ZONE EXPERT SYSTEM
                 Subsystem CORMIX3: Buoyant Surface Discharges
                              CORMIX Version 7.0E
                       HYDRO3 Version 7.0.0.0 April 2011
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:
 Design case:       Measured river flow, 6.5 MGD Effluent Flow, CORMIX-3
 FILE NAME:         C:\...m Files (x86)\CORMIX 7.0\Sample Files\Sample2.prd
 Time stamp:        Thu Feb 23 10:22:13 2012

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =      13.56  AS    =      9.11  QA    =      3.51  ICHREG= 2
 HA    =       0.49  HD    =      0.34
 UA    =      0.385  F     =      0.249 USTAR =0.6795E-01
 UW    =      0.894  UWSTAR=0.9551E-03
 Uniform density environment
 STRCND=  U          RHOAM =  999.8568

DISCHARGE PARAMETERS (metric units)
 BANK  =  LEFT       DISTB =      0.00  Configuration: flush_discharge
 SIGMA =     90.00   HDO   =      0.21  SLOPE =   13.40 deg.
 Rectangular channel geometry:
 B0    =      2.170 H0    =      0.210 A0    =0.4564E+00  AR    =      0.097
 U0    =      0.624 Q0    =      0.285       =0.2848E+00
 RHO0  =  999.4645  DRHO0 =0.3923E+00  GP0   =0.3847E-02
 C0    =0.8000E+01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.2848E+00  M0    =0.1777E+00  J0    =0.1096E-02
 Associated length scales (meters)
 LQ    =      0.68  LM    =      8.27  Lm    =      1.09  Lb    =      0.02
 LQ2D  =      0.93  LM2D  =     21.19  Lm2D  =      2.44

NON-DIMENSIONAL PARAMETERS
 FR0   =     12.24  FRCH  =     21.93  R     =      1.62

FLOW CLASSIFICATION
 3333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    SA2    3
 3  Applicable layer depth HS =     0.34  3
 3333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =   2020.00  XMAX  =   2020.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.00 m  from the LEFT  bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  50 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.21     1.09 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.21     1.09 .00000E+00

 VERTICAL MIXING occurs in the initial zone of flow establishment.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=    287.64
      X        Y        Z        S        C        BV       BH        TT
     0.21    -0.37     0.00     1.0 0.800E+01   0.30     1.35 .67661E+00
 Cumulative travel time =          0.6766 sec  (    0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in shallow crossflow with shoreline-attachment.

 Profile definitions:
   BV = water depth (vertically mixed)
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

X	Y	Z	S	C	BV	BH	TT
0.21	-0.37	0.00	1.0	0.800E+01	0.30	1.35	.67661E+00
0.42	-0.85	0.00	1.2	0.680E+01	0.34	1.37	.16953E+01
0.64	-1.23	0.00	1.2	0.656E+01	0.34	1.39	.26001E+01
0.90	-1.58	0.00	1.3	0.636E+01	0.34	1.41	.35735E+01
1.18	-1.90	0.00	1.3	0.619E+01	0.34	1.42	.46047E+01
1.50	-2.20	0.00	1.3	0.606E+01	0.34	1.43	.56830E+01
1.83	-2.47	0.00	1.3	0.595E+01	0.34	1.43	.67994E+01
2.18	-2.72	0.00	1.4	0.587E+01	0.34	1.44	.79459E+01
2.36	-2.84	0.00	1.4	0.583E+01	0.34	1.44	.79459E+01

Jet/plume RESTRATIFIES at the above position.
BV = Gaussian 1/e (37%) vertical thickness

2.55	-2.96	0.00	1.4	0.574E+01	0.34	1.63	.93602E+01
2.93	-3.16	0.00	1.4	0.560E+01	0.34	1.68	.10925E+02
3.32	-3.35	0.00	1.5	0.546E+01	0.34	1.73	.12538E+02
3.72	-3.51	0.00	1.5	0.531E+01	0.34	1.78	.14186E+02
4.13	-3.66	0.00	1.6	0.515E+01	0.34	1.83	.15854E+02
4.54	-3.78	0.00	1.6	0.499E+01	0.34	1.88	.17533E+02
4.96	-3.90	0.00	1.7	0.484E+01	0.34	1.93	.19215E+02
5.38	-3.99	0.00	1.7	0.469E+01	0.34	1.97	.20894E+02
5.81	-4.08	0.00	1.8	0.456E+01	0.34	2.02	.22567E+02
6.23	-4.16	0.00	1.8	0.443E+01	0.34	2.07	.24230E+02
6.66	-4.22	0.00	1.9	0.432E+01	0.34	2.11	.25882E+02
7.09	-4.28	0.00	1.9	0.421E+01	0.34	2.16	.27523E+02
7.52	-4.32	0.00	1.9	0.411E+01	0.34	2.20	.29151E+02
7.95	-4.36	0.00	2.0	0.401E+01	0.34	2.24	.30768E+02
8.39	-4.39	0.00	2.0	0.393E+01	0.34	2.28	.32372E+02
8.82	-4.41	0.00	2.1	0.385E+01	0.34	2.32	.33965E+02
9.25	-4.43	0.00	2.1	0.377E+01	0.34	2.36	.35546E+02
9.68	-4.44	0.00	2.2	0.370E+01	0.34	2.39	.37117E+02
10.12	-4.44	0.00	2.2	0.364E+01	0.34	2.43	.38678E+02

Maximum lateral extent of recirculation bubble.

10.55	-4.44	0.00	2.2	0.358E+01	0.34	2.46	.40228E+02
10.98	-4.43	0.00	2.3	0.352E+01	0.34	2.50	.41768E+02
11.42	-4.42	0.00	2.3	0.347E+01	0.34	2.53	.43299E+02
11.85	-4.40	0.00	2.3	0.341E+01	0.34	2.56	.44820E+02
12.28	-4.37	0.00	2.4	0.336E+01	0.34	2.60	.46331E+02
12.71	-4.34	0.00	2.4	0.331E+01	0.34	2.63	.47832E+02
13.14	-4.30	0.00	2.5	0.326E+01	0.34	2.66	.49325E+02
13.58	-4.26	0.00	2.5	0.321E+01	0.34	2.70	.50808E+02
14.01	-4.21	0.00	2.5	0.317E+01	0.34	2.73	.52283E+02
14.44	-4.16	0.00	2.6	0.313E+01	0.34	2.76	.53749E+02
14.87	-4.11	0.00	2.6	0.308E+01	0.34	2.80	.55207E+02
15.29	-4.05	0.00	2.6	0.304E+01	0.34	2.83	.56656E+02
15.72	-3.98	0.00	2.7	0.300E+01	0.34	2.86	.58098E+02
16.15	-3.91	0.00	2.7	0.297E+01	0.34	2.89	.59531E+02
16.58	-3.84	0.00	2.7	0.293E+01	0.34	2.92	.60958E+02
17.00	-3.76	0.00	2.8	0.290E+01	0.34	2.95	.62376E+02
17.43	-3.68	0.00	2.8	0.286E+01	0.34	2.98	.63788E+02
17.85	-3.59	0.00	2.8	0.283E+01	0.34	3.02	.65193E+02
18.28	-3.50	0.00	2.9	0.280E+01	0.34	3.05	.66590E+02
18.70	-3.40	0.00	2.9	0.277E+01	0.34	3.08	.67981E+02
19.12	-3.31	0.00	2.9	0.274E+01	0.34	3.11	.69366E+02

```
    19.54    -3.20    0.00     3.0 0.271E+01   0.34     3.14 .70744E+02
    19.75    -3.15    0.00     3.0 0.270E+01   0.34     3.15 .70744E+02
  End of recirculation bubble at the above position.
   Dilution in recirculation bubble =    4.1
   Corresponding concentration      =    0.196E+01
  Flow continues as WALL JET/PLUME.
    19.97     0.00    0.00     3.0 0.268E+01   0.21    10.22 .72156E+02
    20.40     0.00    0.00     3.0 0.266E+01   0.21    10.29 .73579E+02
 Cumulative travel time =          73.5787 sec  (    0.02 hrs)

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
-----------------------------------------------------------------------------

 Some bank/shore interaction occurs at end of near-field.

 In the next prediction module, the jet/plume centerline will be set
   to follow the bank/shore.
-----------------------------------------------------------------------------
BEGIN MOD341: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to LEFT  bank/shore.
   Plume width is now determined from LEFT  bank/shore.

 Plume condition is non-buoyant or weakly buoyant, or, at the end of the NFR
   it is governed by full vertical mixing over the ambient depth,
   or by complete lateral mixing over the channel width.
 Thus, the BUOYANT SPREADING REGIME is ABSENT.

END OF MOD341: BUOYANT AMBIENT SPREADING
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.667E-02 m^2/s
  Horizontal diffusivity (initial value) = 0.167E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to water depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y        Z        S        C        BV       BH        TT
    20.40     0.00     0.00     3.0 0.266E+01   0.21     9.95 .73579E+02
 Plume interacts with BOTTOM.
```

The passive diffusion plume becomes VERTICALLY FULLY MIXED within this prediction interval.

60.39	0.00	0.00	7.3	0.109E+01	0.49	10.20	.16954E+03
100.38	0.00	0.00	7.5	0.107E+01	0.49	10.45	.26551E+03
140.38	0.00	0.00	7.7	0.104E+01	0.49	10.68	.36147E+03
180.37	0.00	0.00	7.8	0.102E+01	0.49	10.92	.45744E+03
220.36	0.00	0.00	8.0	0.100E+01	0.49	11.14	.55340E+03
260.35	0.00	0.00	8.2	0.980E+00	0.49	11.37	.64937E+03
300.34	0.00	0.00	8.3	0.961E+00	0.49	11.59	.74533E+03
340.34	0.00	0.00	8.5	0.944E+00	0.49	11.80	.84130E+03
380.33	0.00	0.00	8.6	0.927E+00	0.49	12.01	.93726E+03
420.32	0.00	0.00	8.8	0.912E+00	0.49	12.22	.10332E+04
460.31	0.00	0.00	8.9	0.897E+00	0.49	12.42	.11292E+04
500.30	0.00	0.00	9.1	0.882E+00	0.49	12.63	.12252E+04
540.30	0.00	0.00	9.2	0.869E+00	0.49	12.82	.13211E+04
580.29	0.00	0.00	9.3	0.856E+00	0.49	13.02	.14171E+04
620.28	0.00	0.00	9.5	0.843E+00	0.49	13.21	.15131E+04
660.27	0.00	0.00	9.6	0.831E+00	0.49	13.40	.16090E+04
700.26	0.00	0.00	9.8	0.820E+00	0.49	13.58	.17050E+04
740.26	0.00	0.00	9.9	0.809E+00	0.49	13.77	.18009E+04
780.25	0.00	0.00	10.0	0.799E+00	0.49	13.95	.18969E+04
820.24	0.00	0.00	10.1	0.788E+00	0.49	14.13	.19929E+04
860.23	0.00	0.00	10.3	0.779E+00	0.49	14.31	.20888E+04
900.22	0.00	0.00	10.4	0.769E+00	0.49	14.48	.21848E+04
940.22	0.00	0.00	10.5	0.760E+00	0.49	14.65	.22808E+04
980.21	0.00	0.00	10.6	0.752E+00	0.49	14.82	.23767E+04
1020.20	0.00	0.00	10.8	0.743E+00	0.49	14.99	.24727E+04
1060.19	0.00	0.00	10.9	0.735E+00	0.49	15.16	.25687E+04
1100.18	0.00	0.00	11.0	0.727E+00	0.49	15.32	.26646E+04
1140.18	0.00	0.00	11.1	0.719E+00	0.49	15.49	.27606E+04
1180.17	0.00	0.00	11.2	0.712E+00	0.49	15.65	.28566E+04
1220.16	0.00	0.00	11.4	0.705E+00	0.49	15.81	.29525E+04
1260.15	0.00	0.00	11.5	0.698E+00	0.49	15.97	.30485E+04
1300.14	0.00	0.00	11.6	0.691E+00	0.49	16.12	.31445E+04
1340.14	0.00	0.00	11.7	0.684E+00	0.49	16.28	.32404E+04
1380.13	0.00	0.00	11.8	0.678E+00	0.49	16.43	.33364E+04
1420.12	0.00	0.00	11.9	0.672E+00	0.49	16.58	.34323E+04
1460.11	0.00	0.00	12.0	0.666E+00	0.49	16.74	.35283E+04
1500.10	0.00	0.00	12.1	0.660E+00	0.49	16.88	.36243E+04
1540.10	0.00	0.00	12.2	0.654E+00	0.49	17.03	.37202E+04
1580.09	0.00	0.00	12.3	0.648E+00	0.49	17.18	.38162E+04
1620.08	0.00	0.00	12.4	0.643E+00	0.49	17.33	.39122E+04
1660.07	0.00	0.00	12.5	0.638E+00	0.49	17.47	.40081E+04
1700.06	0.00	0.00	12.6	0.632E+00	0.49	17.61	.41041E+04
1740.06	0.00	0.00	12.8	0.627E+00	0.49	17.76	.42001E+04
1780.05	0.00	0.00	12.9	0.622E+00	0.49	17.90	.42960E+04
1820.04	0.00	0.00	13.0	0.618E+00	0.49	18.04	.43920E+04
1860.03	0.00	0.00	13.1	0.613E+00	0.49	18.18	.44880E+04
1900.02	0.00	0.00	13.2	0.608E+00	0.49	18.31	.45839E+04
1940.01	0.00	0.00	13.2	0.604E+00	0.49	18.45	.46799E+04

Complete Mix

The passive diffusion plume becomes LATERALLY FULLY MIXED over the channel width during the current prediction interval.

1980.01	0.00	0.00	13.3	0.599E+00	0.49	18.56	.47759E+04

```
Effluent is FULLY MIXED over the entire channel cross-section.
Except for possible far-field decay or reaction processes, there are
  NO FURTHER CHANGES with downstream direction.
  2020.00      0.00     0.00     13.3 0.600E+00    0.49     18.56 .48718E+04
Cumulative travel time =        4871.8179 sec  (     1.35 hrs)

Simulation limit based on maximum specified distance =   2020.00 m.
  This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
-----------------------------------------------------------------------------------
-----------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333333333
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 7.0E
                      HYDRO3:Version-7.0.0.0  April,2011
SITE NAME/LABEL:
  DESIGN CASE:                Measured river flow, 6.5 MGD Effluent Flow, CORMIX-3
  FILE NAME:                  C:\Program Files (x86)\CORMIX 7.0\Sample Files\Samp
  Using subsystem CORMIX3:    Buoyant Surface Discharges
  Start of session:           02/23/2012--10:22:13
****************************************************************************
SUMMARY OF INPUT DATA:
----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                         = bounded
  Width                        BS       = 18.56 m
  Channel regularity           ICHREG = 2
  Ambient flowrate             QA       = 3.51 m^3/s
  Average depth                HA       = 0.49 m
  Depth at discharge           HD       = 0.34 m
  Ambient velocity             UA       = 0.3855 m/s
  Darcy-Weisbach friction factor  F     = 0.2486
    Calculated from Manning's n         = 0.05
  Wind velocity                UW       = 0.89 m/s
  Stratification Type          STRCND = U
  Surface temperature                   = 7.9 degC
  Bottom temperature                    = 7.9 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density              RHOAS  = 999.8568 kg/m^3
  Bottom density               RHOAB  = 999.8568 kg/m^3
----------------------------------------------------------------------------
DISCHARGE PARAMETERS:          Surface Discharge
  Discharge located on                  = left bank/shoreline
  Discharge configuration               = flush discharge
  Distance from bank to outlet DISTB  = 0 m
  Discharge angle              SIGMA  = 90 deg
  Depth near discharge outlet  HD0    = 0.21 m
  Bottom slope at discharge    SLOPE  = 13.4 deg
  Rectangular discharge:
    Discharge cross-section area  A0    = 0.456414 m^2
    Discharge channel width    B0     = 2.170176 m
    Discharge channel depth    H0     = 0.210312 m
    Discharge aspect ratio     AR     = 0.096910
  Discharge flowrate           Q0     = 0.284782 m^3/s
  Discharge velocity           U0     = 0.62 m/s
  Discharge temperature (freshwater)  = 12.30 degC
  Corresponding density        RHO0   = 999.4645 kg/m^3
  Density difference           DRHO   = 0.3923 kg/m^3
  Buoyant acceleration         GP0    = 0.0038 m/s^2
  Discharge concentration      C0     = 8 mg/l
  Surface heat exchange coeff. KS     = 0 m/s
  Coefficient of decay         KD     = 0 /s
----------------------------------------------------------------------------
```

```
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.68 m          Lm  = 1.09 m          Lbb = 0.02 m
  LM  = 8.27 m
--------------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number        FRO    = 12.24 (based on LQ)
  Channel densimetric Froude no.   FRCH   = 21.93 (based on H0)
  Velocity ratio                   R      = 1.62
--------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                          = no
  Water quality standard specified         = no
  Regulatory mixing zone                   = no
  Region of interest                       = 2020 m downstream
********************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  | FLOW CLASS   = SA2 |
  *-------------------------*
********************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

--------------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0 m from the left bank/shore.
  Number of display steps NSTEP = 50 per module.
--------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 2.6624 mg/l
  Dilution at edge of NFR              s = 3.0
  NFR Location:                        x = 20.40 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 10.29 m
                          thickness (bv) = 0.21 m
Cumulative travel time:       73.5787 sec.
--------------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
--------------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
  but RE-STRATIFIES LATER.
  Plume becomes vertically fully mixed again at 60.39 m downstream.
--------------------------------------------------------------------------------
```

```
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 0 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY ***********************
No RMZ and no ambient water quality standard have been specified.
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333333333
                        CORMIX MIXING ZONE EXPERT SYSTEM
                 Subsystem CORMIX3: Buoyant Surface Discharges
                              CORMIX Version 7.0E
                       HYDRO3 Version 7.0.0.0 April 2011
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:
 Design case:        1Q10 river flow, 6.5 MGD Effluent Flow, CORMIX-3
 FILE NAME:          C:\...m Files (x86)\CORMIX 7.0\Sample Files\Sample2.prd
 Time stamp:         Thu Feb 23 11:27:47 2012

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =     18.56  AS    =      4.58  QA    =      0.05  ICHREG= 2
 HA    =      0.25  HD    =      0.17
 UA    =     0.011  F     =     0.028  USTAR =0.6595E-03
 UW    =     0.894  UWSTAR=0.9551E-03
 Uniform density environment
 STRCND=  U         RHOAM =  998.4062

DISCHARGE PARAMETERS (metric units)
 BANK  =  LEFT      DISTB =      0.00  Configuration: flush_discharge
 SIGMA =     90.00  HDO   =      0.17  SLOPE =    0.00 deg.
 Rectangular channel geometry:
 BO    =     2.621  HO    =     0.174  AO    =0.4554E+00  AR    =      0.066
 UO    =     0.625  QO    =     0.285        =0.2848E+00
 RHOO  =  998.2051  DRHOO =0.2012E+00  GPO   =0.1976E-02
 CO    =0.8000E+01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 QO    =0.2848E+00  MO    =0.1781E+00  JO    =0.5627E-03
 Associated length scales (meters)
 LQ    =      0.67  LM    =     11.56  Lm    =     37.94  Lb    =    409.01
 LQ2D  =      2.62  LM2D  =     46.82  Lm2D  =   8286.33

NON-DIMENSIONAL PARAMETERS
 FRO   =     17.12  FRCH  =     33.75  R     =     56.22

FLOW CLASSIFICATION
 3333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    SA2    3
 3  Applicable layer depth HS =     0.17  3
 3333333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 CO    =0.8000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
 XINT  =   2000.00  XMAX  =   2000.00
```

```
X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.00 m  from the LEFT  bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  50 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

 VERTICAL MIXING occurs in the initial zone of flow establishment.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=    270.42
      X        Y        Z        S        C        BV       BH        TT
     0.87    -0.56     0.00     1.0 0.800E+01   0.17     2.34 .16598E+01
 Cumulative travel time =          1.6598 sec  (    0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in shallow crossflow with shoreline-attachment.

 Profile definitions:
   BV = water depth (vertically mixed)
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

      X        Y        Z        S        C        BV       BH        TT
     0.87    -0.56     0.00     1.0 0.800E+01   0.17     2.34 .16598E+01
```

```
Maximum lateral extent of recirculation bubble.
    0.87    -0.59    0.00     1.0 0.800E+01   0.17     2.34 .16598E+01
End of recirculation bubble at the above position.
 Dilution in recirculation bubble =     1.6
 Corresponding concentration      =     0.501E+01
Flow continues as WALL JET/PLUME.
    1.14     0.00     0.00     1.4 0.573E+01   0.17     4.69 .16722E+01
    1.41     0.00     0.00     1.5 0.529E+01   0.17     4.69 .16870E+01
    1.68     0.00     0.00     1.6 0.499E+01   0.17     4.69 .17059E+01
    1.95     0.00     0.00     1.7 0.477E+01   0.17     4.69 .17286E+01
    2.21     0.00     0.00     1.7 0.460E+01   0.17     4.70 .17549E+01
    2.48     0.00     0.00     1.8 0.446E+01   0.17     4.70 .17848E+01
    2.75     0.00     0.00     1.8 0.434E+01   0.17     4.70 .18181E+01
    3.02     0.00     0.00     1.9 0.423E+01   0.17     4.71 .18547E+01
    3.28     0.00     0.00     1.9 0.414E+01   0.17     4.71 .18946E+01
    3.55     0.00     0.00     2.0 0.406E+01   0.17     4.72 .19377E+01
    3.82     0.00     0.00     2.0 0.399E+01   0.17     4.72 .19838E+01
    4.09     0.00     0.00     2.0 0.392E+01   0.17     4.73 .20331E+01
    4.36     0.00     0.00     2.1 0.386E+01   0.17     4.73 .20854E+01
    4.62     0.00     0.00     2.1 0.381E+01   0.17     4.74 .21406E+01
    4.89     0.00     0.00     2.1 0.376E+01   0.17     4.75 .21988E+01
    5.16     0.00     0.00     2.2 0.371E+01   0.17     4.75 .22599E+01
    5.43     0.00     0.00     2.2 0.366E+01   0.17     4.76 .23239E+01
    5.70     0.00     0.00     2.2 0.362E+01   0.17     4.77 .23907E+01
    5.96     0.00     0.00     2.2 0.359E+01   0.17     4.78 .24603E+01
    6.23     0.00     0.00     2.3 0.355E+01   0.17     4.79 .25328E+01
    6.50     0.00     0.00     2.3 0.351E+01   0.17     4.79 .26079E+01
    6.77     0.00     0.00     2.3 0.348E+01   0.17     4.80 .26858E+01
    7.04     0.00     0.00     2.3 0.345E+01   0.17     4.81 .27665E+01
    7.30     0.00     0.00     2.3 0.342E+01   0.17     4.83 .28498E+01
    7.57     0.00     0.00     2.4 0.339E+01   0.17     4.84 .29358E+01
    7.84     0.00     0.00     2.4 0.337E+01   0.17     4.85 .30245E+01
    8.11     0.00     0.00     2.4 0.334E+01   0.17     4.86 .31158E+01
    8.38     0.00     0.00     2.4 0.332E+01   0.17     4.87 .32097E+01
    8.64     0.00     0.00     2.4 0.329E+01   0.17     4.88 .33063E+01
    8.91     0.00     0.00     2.4 0.327E+01   0.17     4.90 .34054E+01
    9.18     0.00     0.00     2.5 0.325E+01   0.17     4.91 .35072E+01
    9.45     0.00     0.00     2.5 0.323E+01   0.17     4.92 .36115E+01
    9.71     0.00     0.00     2.5 0.321E+01   0.17     4.94 .37184E+01
    9.98     0.00     0.00     2.5 0.319E+01   0.17     4.95 .38278E+01
   10.25     0.00     0.00     2.5 0.317E+01   0.17     4.97 .39398E+01
   10.52     0.00     0.00     2.5 0.315E+01   0.17     4.98 .40543E+01
   10.79     0.00     0.00     2.6 0.314E+01   0.17     5.00 .41713E+01
   11.05     0.00     0.00     2.6 0.312E+01   0.17     5.01 .42909E+01
   11.32     0.00     0.00     2.6 0.310E+01   0.17     5.03 .44130E+01
   11.59     0.00     0.00     2.6 0.309E+01   0.17     5.05 .45375E+01
   11.86     0.00     0.00     2.6 0.307E+01   0.17     5.06 .46646E+01
   12.13     0.00     0.00     2.6 0.306E+01   0.17     5.08 .47942E+01
   12.39     0.00     0.00     2.6 0.304E+01   0.17     5.10 .49262E+01
   12.66     0.00     0.00     2.6 0.303E+01   0.17     5.12 .50607E+01
   12.93     0.00     0.00     2.7 0.301E+01   0.17     5.14 .51977E+01
   13.20     0.00     0.00     2.7 0.300E+01   0.17     5.15 .53372E+01
   13.47     0.00     0.00     2.7 0.299E+01   0.17     5.17 .54791E+01
   13.73     0.00     0.00     2.7 0.298E+01   0.17     5.19 .56235E+01
```

```
    14.00     0.00     0.00     2.7 0.296E+01   0.17     5.21 .57703E+01
    14.27     0.00     0.00     2.7 0.295E+01   0.17     5.23 .59196E+01
 Cumulative travel time =          5.9196 sec  (    0.00 hrs)

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
-----------------------------------------------------------------------------

 The initial plume WIDTH/THICKNESS VALUE in the next far-field module will be
  CORRECTED by a factor  8.16 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
 Flow appears highly UNSTEADY and prediction results are UNRELIABLE!
   SIMULATION STOPS!

 Some bank/shore interaction occurs at end of near-field.


 The LIMITING DILUTION (given by ambient flow/discharge ratio) is:     1.18
 This value is below the computed dilution of     2.71 at the end
 of the NFR.
 Mixing for this discharge configuration is constrained by LOW AMBIENT FLOW!

 The previous module predictions are UNRELIABLE since the limiting dilution
   cannot be exceeded for this shallow water discharge configuration.

 A subsequent module (MOD381) will predict the properties of the
   cross-sectionally fully mixed plume with limiting dilution and will
   compute a POSSIBLE UPSTREAM WEDGE INTRUSION.
-----------------------------------------------------------------------------
BEGIN MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION

 The DOWNSTREAM flow field for this unstable shallow water discharge is
     VERTICALLY FULLY MIXED.
 The mixing is controlled by the limiting dilution =       1.2

 Channel DENSIMETRIC FROUDE NUMBER (FCHAN) for this mixed flow =      0.55

 An UPSTREAM INTRUDING WEDGE is formed along the surface.

 UPSTREAM WEDGE INTRUSION PROPERTIES in bounded channel (laterally uniform):
        Wedge length                          =       3.73 m
        X-Position of wedge tip               =      10.54 m
        Thickness at discharge (end of NFR)   =       0.08 m
         (Wedge thickness gradually decreases to zero at wedge tip.)
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
 This may be caused by a very small ambient velocity, perhaps in combination
   with large discharge buoyancy.
 If the ambient conditions are strongly transient (e.g. tidal), then the
```

```
CORMIX steady-state predictions of upstream intrusion are probably
unrealistic.
The plume predictions prior to boundary impingement and wedge formation
 will be acceptable, however.

     X        Y        Z        S        C        BV       BH       TT
  14.27     0.00     0.00      1.2 0.679E+01   0.25    18.56 .59196E+01
Cumulative travel time =          5.9196 sec  (    0.00 hrs)

Vertically and laterally fully mixed over layer depth: END OF SIMULATION!

END OF MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333333333
```

Complete Mix

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                        CORMIX MIXING ZONE EXPERT SYSTEM
                            CORMIX Version 7.0E
                         HYDRO3:Version-7.0.0.0  April,2011
SITE NAME/LABEL:
  DESIGN CASE:                  1Q10 river flow, 6.5 MGD Effluent Flow, CORMIX-3
  FILE NAME:                     C:\Program Files (x86)\CORMIX 7.0\Sample Files\S
  Using subsystem CORMIX3:     Buoyant Surface Discharges
  Start of session:             02/23/2012--11:27:47
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                          BS      = 18.56 m
  Channel regularity             ICHREG = 2
  Ambient flowrate               QA      = 0.05 m^3/s
  Average depth                  HA      = 0.25 m
  Depth at discharge             HD      = 0.17 m
  Ambient velocity               UA      = 0.0111 m/s
  Darcy-Weisbach friction factor F       = 0.0281
    Calculated from Manning's n          = 0.015
  Wind velocity                  UW      = 0.89 m/s
  Stratification Type            STRCND = U
  Surface temperature                    = 19 degC
  Bottom temperature                     = 19 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                RHOAS   = 998.4063 kg/m^3
  Bottom density                 RHOAB   = 998.4063 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:            Surface Discharge
  Discharge located on                   = left bank/shoreline
  Discharge configuration                = flush discharge
  Distance from bank to outlet   DISTB   = 0 m
  Discharge angle                SIGMA   = 90 deg
  Depth near discharge outlet    HD0     = 0.17 m
  Bottom slope at discharge      SLOPE   = 0 deg
  Rectangular discharge:
    Discharge cross-section area A0      = 0.455411 m^2
    Discharge channel width      B0      = 2.62128 m
    Discharge channel depth      H0      = 0.173736 m
    Discharge aspect ratio       AR      = 0.066279
  Discharge flowrate             Q0      = 0.284782 m^3/s
  Discharge velocity             U0      = 0.63 m/s
  Discharge temperature (freshwater)     = 20 degC
  Corresponding density          RHO0    = 998.2051 kg/m^3
  Density difference             DRHO    = 0.2012 kg/m^3
  Buoyant acceleration           GP0     = 0.002 m/s^2
  Discharge concentration        C0      = 8 mg/l
  Surface heat exchange coeff.   KS      = 0 m/s
  Coefficient of decay           KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
```

```
  LQ  = 0.67 m          Lm  = 37.94 m          Lbb = 409.01 m
  LM  = 11.56 m
-------------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number        FRO    = 17.12 (based on LQ)
  Channel densimetric Froude no.   FRCH   = 33.75 (based on H0)
  Velocity ratio                   R      = 56.22
-------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                          = no
  Water quality standard specified         = no
  Regulatory mixing zone                   = no
  Region of interest                       = 2000 m downstream
*******************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  | FLOW CLASS   = SA2 |
  *-------------------------*
*******************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-------------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0 m from the left bank/shore.
  Number of display steps NSTEP = 50 per module.
-------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 2.9509 mg/l
  Dilution at edge of NFR              s = 2.7
  NFR Location:                        x = 14.27 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 5.23 m
                          thickness (bv) = 0.17 m
Cumulative travel time:       5.9196 sec.

WARNING:
 The LIMITING DILUTION (given by ambient flow/discharge ratio) is = 1.18
 This value is below the computed dilution of 2.71 at the end of the
 Near Field Region (NFR). Mixing for this discharge configuration is
 constrained by the ambient flow.
 Please carefully review the prediction file for additional warnings and information.
-------------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-------------------------------------------------------------------------------
```

```
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed ALREADY IN NEAR-FIELD at 0 m
  downstream and continues as vertically mixed into the far-field.
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 0 m downstream.
  Plume contacts second bank at 0 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
************************ REGULATORY MIXING ZONE SUMMARY *********************
No RMZ and no ambient water quality standard have been specified.
********************** FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333333333333
                        CORMIX MIXING ZONE EXPERT SYSTEM
                 Subsystem CORMIX3: Buoyant Surface Discharges
                              CORMIX Version 7.0E
                       HYDRO3 Version 7.0.0.0 April 2011
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:
 Design case:        7Q10 river flow, 6.5 MGD Effluent Flow, CORMIX-3
 FILE NAME:          C:\...m Files (x86)\CORMIX 7.0\Sample Files\Sample2.prd
 Time stamp:         Thu Feb 23 12:57:39 2012

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =     12.56  AS    =      4.58  QA    =      0.06  ICHREG= 2
 HA    =      0.25  HD    =      0.17
 UA    =     0.013  F     =     0.028  USTAR =0.7694E-03
 UW    =     0.894  UWSTAR=0.9551E-03
 Uniform density environment
 STRCND=  U         RHOAM =  998.4062

DISCHARGE PARAMETERS (metric units)
 BANK  =  LEFT      DISTB =      0.00  Configuration: flush_discharge
 SIGMA =     90.00  HDO   =      0.17  SLOPE =    0.00 deg.
 Rectangular channel geometry:
 B0    =     2.621  H0    =     0.174  A0    =0.4554E+00  AR    =      0.066
 U0    =     0.625  Q0    =     0.285        =0.2848E+00
 RHO0  =  998.2051  DRHO0 =0.2012E+00  GP0   =0.1976E-02
 C0    =0.8000E+01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.2848E+00  M0    =0.1781E+00  J0    =0.5627E-03
 Associated length scales (meters)
 LQ    =     0.67  LM    =     11.56  Lm    =     32.52  Lb    =    257.57
 LQ2D  =     2.62  LM2D  =     46.82  Lm2D  =   6087.91

NON-DIMENSIONAL PARAMETERS
 FR0   =     17.12  FRCH  =     33.75  R     =     48.19

FLOW CLASSIFICATION
 3333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    SA2    3
 3  Applicable layer depth HS =     0.17  3
 3333333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =   2000.00  XMAX  =   2000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.00 m  from the LEFT  bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  50 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

 VERTICAL MIXING occurs in the initial zone of flow establishment.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=    270.50
      X        Y        Z        S        C        BV       BH        TT
     0.80    -0.53     0.00     1.0 0.800E+01   0.17     2.34 .15364E+01
 Cumulative travel time =          1.5364 sec  (    0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in shallow crossflow with shoreline-attachment.

 Profile definitions:
   BV = water depth (vertically mixed)
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

X	Y	Z	S	C	BV	BH	TT
0.80	-0.53	0.00	1.0	0.800E+01	0.17	2.34	.15364E+01

Maximum lateral extent of recirculation bubble.

0.81	-0.56	0.00	1.0	0.800E+01	0.17	2.34	.15364E+01

End of recirculation bubble at the above position.

Dilution in recirculation bubble = 1.5

Corresponding concentration = 0.529E+01

Flow continues as WALL JET/PLUME.

1.07	0.00	0.00	1.3	0.617E+01	0.17	4.69	.15518E+01
1.34	0.00	0.00	1.4	0.575E+01	0.17	4.69	.15695E+01
1.61	0.00	0.00	1.5	0.545E+01	0.17	4.69	.15916E+01
1.88	0.00	0.00	1.5	0.522E+01	0.17	4.69	.16178E+01
2.15	0.00	0.00	1.6	0.504E+01	0.17	4.70	.16481E+01
2.41	0.00	0.00	1.6	0.489E+01	0.17	4.70	.16822E+01
2.68	0.00	0.00	1.7	0.476E+01	0.17	4.70	.17201E+01
2.95	0.00	0.00	1.7	0.465E+01	0.17	4.71	.17616E+01
3.22	0.00	0.00	1.8	0.455E+01	0.17	4.71	.18067E+01
3.49	0.00	0.00	1.8	0.446E+01	0.17	4.72	.18553E+01
3.75	0.00	0.00	1.8	0.439E+01	0.17	4.72	.19073E+01
4.02	0.00	0.00	1.9	0.432E+01	0.17	4.73	.19627E+01
4.29	0.00	0.00	1.9	0.425E+01	0.17	4.73	.20214E+01
4.56	0.00	0.00	1.9	0.419E+01	0.17	4.74	.20834E+01
4.83	0.00	0.00	1.9	0.414E+01	0.17	4.75	.21486E+01
5.09	0.00	0.00	2.0	0.409E+01	0.17	4.75	.22171E+01
5.36	0.00	0.00	2.0	0.404E+01	0.17	4.76	.22887E+01
5.63	0.00	0.00	2.0	0.399E+01	0.17	4.77	.23634E+01
5.90	0.00	0.00	2.0	0.395E+01	0.17	4.78	.24412E+01
6.17	0.00	0.00	2.0	0.391E+01	0.17	4.79	.25221E+01
6.43	0.00	0.00	2.1	0.388E+01	0.17	4.80	.26061E+01
6.70	0.00	0.00	2.1	0.384E+01	0.17	4.81	.26930E+01
6.97	0.00	0.00	2.1	0.381E+01	0.17	4.82	.27830E+01
7.24	0.00	0.00	2.1	0.377E+01	0.17	4.83	.28759E+01
7.50	0.00	0.00	2.1	0.374E+01	0.17	4.84	.29718E+01
7.77	0.00	0.00	2.2	0.371E+01	0.17	4.85	.30706E+01
8.04	0.00	0.00	2.2	0.369E+01	0.17	4.86	.31723E+01
8.31	0.00	0.00	2.2	0.366E+01	0.17	4.87	.32770E+01
8.58	0.00	0.00	2.2	0.363E+01	0.17	4.89	.33845E+01
8.84	0.00	0.00	2.2	0.361E+01	0.17	4.90	.34948E+01
9.11	0.00	0.00	2.2	0.359E+01	0.17	4.91	.36081E+01
9.38	0.00	0.00	2.2	0.356E+01	0.17	4.93	.37242E+01
9.65	0.00	0.00	2.3	0.354E+01	0.17	4.94	.38430E+01
9.92	0.00	0.00	2.3	0.352E+01	0.17	4.96	.39648E+01
10.18	0.00	0.00	2.3	0.350E+01	0.17	4.97	.40893E+01
10.45	0.00	0.00	2.3	0.348E+01	0.17	4.99	.42166E+01
10.72	0.00	0.00	2.3	0.346E+01	0.17	5.00	.43467E+01
10.99	0.00	0.00	2.3	0.344E+01	0.17	5.02	.44796E+01
11.26	0.00	0.00	2.3	0.343E+01	0.17	5.03	.46152E+01
11.52	0.00	0.00	2.3	0.341E+01	0.17	5.05	.47536E+01
11.79	0.00	0.00	2.4	0.339E+01	0.17	5.07	.48948E+01
12.06	0.00	0.00	2.4	0.337E+01	0.17	5.08	.50387E+01
12.33	0.00	0.00	2.4	0.336E+01	0.17	5.10	.51853E+01
12.60	0.00	0.00	2.4	0.334E+01	0.17	5.12	.53347E+01
12.86	0.00	0.00	2.4	0.333E+01	0.17	5.14	.54868E+01

```
    12.86     0.00     0.00     2.4 0.333E+01   0.17     5.14 .54868E+01
    13.13     0.00     0.00     2.4 0.331E+01   0.17     5.16 .56417E+01
    13.40     0.00     0.00     2.4 0.330E+01   0.17     5.18 .57992E+01
    13.67     0.00     0.00     2.4 0.328E+01   0.17     5.20 .59595E+01
    13.93     0.00     0.00     2.4 0.327E+01   0.17     5.22 .61224E+01
    14.20     0.00     0.00     2.5 0.326E+01   0.17     5.24 .62881E+01
Cumulative travel time =           6.2881 sec  (     0.00 hrs)

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
-----------------------------------------------------------------------------

 The initial plume WIDTH/THICKNESS VALUE in the next far-field module will be
  CORRECTED by a factor  7.20 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
 Flow appears highly UNSTEADY and prediction results are UNRELIABLE!
   SIMULATION STOPS!

 Some bank/shore interaction occurs at end of near-field.


 The LIMITING DILUTION (given by ambient flow/discharge ratio) is:    1.21
 This value is below the computed dilution of    2.46 at the end
 of the NFR.
 Mixing for this discharge configuration is constrained by LOW AMBIENT FLOW!

 The previous module predictions are UNRELIABLE since the limiting dilution
   cannot be exceeded for this shallow water discharge configuration.

 A subsequent module (MOD381) will predict the properties of the
   cross-sectionally fully mixed plume with limiting dilution and will
   compute a POSSIBLE UPSTREAM WEDGE INTRUSION.
-----------------------------------------------------------------------------
BEGIN MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION

 The DOWNSTREAM flow field for this unstable shallow water discharge is
     VERTICALLY FULLY MIXED.
 The mixing is controlled by the limiting dilution =      1.2

 Channel DENSIMETRIC FROUDE NUMBER (FCHAN) for this mixed flow =     0.65

 An UPSTREAM INTRUDING WEDGE is formed along the surface.

 UPSTREAM WEDGE INTRUSION PROPERTIES in bounded channel (laterally uniform):
        Wedge length                          =       1.44 m
        X-Position of wedge tip               =      12.76 m
        Thickness at discharge (end of NFR)   =       0.06 m
         (Wedge thickness gradually decreases to zero at wedge tip.)
       X        Y        Z        S        C       BV       BH        TT
  14.20     0.00     0.00     1.2 0.662E+01   0.25    18.56 .62881E+01
```

Complete Mix

```
 Cumulative travel time =          6.2881 sec  (     0.00 hrs)

 Vertically and laterally fully mixed over layer depth: END OF SIMULATION!

END OF MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333333
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 7.0E
                       HYDRO3:Version-7.0.0.0  April,2011
SITE NAME/LABEL:
  DESIGN CASE:                   7Q10 river flow, 6.5 MGD Effluent Flow, CORMIX-3
  FILE NAME:                     C:\Program Files (x86)\CORMIX 7.0\Sample Files\San
  Using subsystem CORMIX3:      Buoyant Surface Discharges
  Start of session:              02/23/2012--12:57:39
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                            = bounded
  Width                           BS       = 18.56 m
  Channel regularity              ICHREG = 2
  Ambient flowrate                QA       = 0.06 m^3/s
  Average depth                   HA       = 0.25 m
  Depth at discharge              HD       = 0.17 m
  Ambient velocity                UA       = 0.0130 m/s
  Darcy-Weisbach friction factor  F        = 0.0281
    Calculated from Manning's n            = 0.015
  Wind velocity                   UW       = 0.89 m/s
  Stratification Type             STRCND = U
  Surface temperature                      = 19 degC
  Bottom temperature                       = 19 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                 RHOAS  = 998.4063 kg/m^3
  Bottom density                  RHOAB  = 998.4063 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Surface Discharge
  Discharge located on                     = left bank/shoreline
  Discharge configuration                  = flush discharge
  Distance from bank to outlet    DISTB  = 0 m
  Discharge angle                 SIGMA  = 90 deg
  Depth near discharge outlet     HD0    = 0.17 m
  Bottom slope at discharge       SLOPE  = 0 deg
  Rectangular discharge:
    Discharge cross-section area  A0       = 0.455411 m^2
    Discharge channel width       B0       = 2.62128 m
    Discharge channel depth       H0       = 0.173736 m
    Discharge aspect ratio        AR       = 0.066279
  Discharge flowrate              Q0       = 0.284782 m^3/s
  Discharge velocity              U0       = 0.63 m/s
  Discharge temperature (freshwater)       = 20 degC
  Corresponding density           RHO0     = 998.2051 kg/m^3
  Density difference              DRHO     = 0.2012 kg/m^3
  Buoyant acceleration            GP0      = 0.002 m/s^2
  Discharge concentration         C0       = 8 mg/l
  Surface heat exchange coeff.    KS       = 0 m/s
  Coefficient of decay            KD       = 0 /s
-----------------------------------------------------------------------------
```

```
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.67 m          Lm  = 32.52 m          Lbb = 257.57 m
  LM  = 11.56 m
--------------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number       FRO    = 17.12 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 33.75 (based on HO)
  Velocity ratio                  R      = 48.19
--------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = no
  Water quality standard specified       = no
  Regulatory mixing zone                 = no
  Region of interest                     = 2000 m downstream
********************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  | FLOW CLASS   = SA2 |
  *-------------------------*
********************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

--------------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0 m from the left bank/shore.
  Number of display steps NSTEP = 50 per module.
--------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 3.2579 mg/l
  Dilution at edge of NFR              s = 2.5
  NFR Location:                        x = 14.20 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 5.24 m
                         thickness (bv) = 0.17 m
Cumulative travel time:       6.2881 sec.

WARNING:
 The LIMITING DILUTION (given by ambient flow/discharge ratio) is = 1.21
 This value is below the computed dilution of 2.46 at the end of the
 Near Field Region (NFR). Mixing for this discharge configuration is
 constrained by the ambient flow.
 Please carefully review the prediction file for additional warnings and information.
--------------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
```

```
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed ALREADY IN NEAR-FIELD at 0 m
  downstream and continues as vertically mixed into the far-field.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 0 m downstream.
  Plume contacts second bank at 0 m downstream.
************************* TOXIC DILUTION ZONE SUMMARY *************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY **********************
No RMZ and no ambient water quality standard have been specified.
********************** FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
333333333333333333333333333333333333333333333333333333333333333333333333333333333333
                    CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX3: Buoyant Surface Discharges
                          CORMIX Version 7.0E
                     HYDRO3 Version 7.0.0.0 April 2011
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:
 Design case:       Measured river flow, 7.0 MGD Effluent Flow, CORMIX-3
 FILE NAME:         C:\...m Files (x86)\CORMIX 7.0\Sample Files\Sample2.prd
 Time stamp:        Thu Feb 23 10:29:55 2012

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =     18.56  AS    =      9.11  QA    =      3.51  ICHREG= 2
 HA    =      0.49  HD    =      0.34
 UA    =      0.385 F     =      0.249 USTAR =0.6795E-01
 UW    =      0.894 UWSTAR=0.9551E-03
 Uniform density environment
 SIRCND=  U         RHOAM =  999.8568

DISCHARGE PARAMETERS (metric units)
 BANK  =  LEFT      DISTB =      0.00  Configuration: flush_discharge
 SIGMA =     90.00  HDO   =      0.21  SLOPE =   13.40 deg.
 Rectangular channel geometry:
 BO    =      2.170 HO    =      0.210 AO    =0.4564E+00  AR    =      0.097
 UO    =      0.672 QO    =      0.307       =0.3067E+00
 RHOO  =  999.4645  DRHOO =0.3923E+00  GPO   =0.3847E-02
 CO    =0.8000E+01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 QO    =0.3067E+00  MO    =0.2061E+00  JO    =0.1180E-02
 Associated length scales (meters)
 LQ    =      0.68  LM    =      8.90  Lm    =      1.18  Lb    =      0.02
 LQ2D  =      0.93  LM2D  =     23.40  Lm2D  =      2.83

NON-DIMENSIONAL PARAMETERS
 FRO   =     13.18  FRCH  =     23.62  R     =      1.74

FLOW CLASSIFICATION
 3333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)       =    SA2    3
 3  Applicable layer depth HS =     0.34  3
 3333333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 CO    =0.8000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINI  =   2000.00  XMAX  =   2000.00

X-Y-Z COORDINATE SYSTEM:
   ORIGIN is located at the WATER SURFACE and at center of discharge
     channel/outlet:       0.00 m  from the LEFT  bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  50 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
      X        Y        Z        S        C       BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.21     1.09 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
      X        Y        Z        S        C       BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.21     1.09 .00000E+00

 VERTICAL MIXING occurs in the initial zone of flow establishment.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=    286.01
      X        Y        Z        S        C       BV       BH        TT
     0.19    -0.34     0.00     1.0 0.800E+01   0.30     1.37 .58430E+00
 Cumulative travel time =           0.5843 sec  (    0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in shallow crossflow with shoreline-attachment.

 Profile definitions:
   BV = water depth (vertically mixed)
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

X	Y	Z	S	C	BV	BH	TT
0.19	-0.34	0.00	1.0	0.800E+01	0.30	1.37	.58430E+00
0.46	-0.98	0.00	1.2	0.674E+01	0.34	1.41	.18290E+01
0.70	-1.39	0.00	1.2	0.650E+01	0.34	1.43	.27671E+01
0.98	-1.77	0.00	1.3	0.630E+01	0.34	1.45	.37793E+01
1.30	-2.11	0.00	1.3	0.613E+01	0.34	1.46	.48540E+01
1.64	-2.44	0.00	1.3	0.600E+01	0.34	1.47	.59802E+01
2.01	-2.73	0.00	1.4	0.589E+01	0.34	1.48	.71479E+01
2.39	-3.00	0.00	1.4	0.580E+01	0.34	1.49	.83491E+01
2.89	-3.31	0.00	1.4	0.571E+01	0.34	1.49	.83491E+01

Jet/plume RESTRATIFIES at the above position.
BV = Gaussian 1/e (37%) vertical thickness

2.89	-3.31	0.00	1.4	0.571E+01	0.34	1.69	.99641E+01
3.31	-3.53	0.00	1.4	0.556E+01	0.34	1.77	.11582E+02
3.74	-3.73	0.00	1.5	0.544E+01	0.34	1.81	.13248E+02
4.17	-3.91	0.00	1.5	0.532E+01	0.34	1.86	.14947E+02
4.62	-4.07	0.00	1.5	0.521E+01	0.34	1.90	.16671E+02
5.07	-4.21	0.00	1.6	0.506E+01	0.34	1.95	.18409E+02
5.52	-4.33	0.00	1.6	0.493E+01	0.34	2.00	.20155E+02
6.09	-4.46	0.00	1.7	0.476E+01	0.34	2.05	.22339E+02
6.56	-4.56	0.00	1.7	0.464E+01	0.34	2.10	.24083E+02
7.02	-4.64	0.00	1.8	0.453E+01	0.34	2.14	.25821E+02
7.49	-4.71	0.00	1.8	0.442E+01	0.34	2.19	.27552E+02
7.95	-4.77	0.00	1.9	0.432E+01	0.34	2.23	.29274E+02
8.42	-4.82	0.00	1.9	0.422E+01	0.34	2.27	.30987E+02
8.89	-4.86	0.00	1.9	0.413E+01	0.34	2.31	.32690E+02
9.48	-4.90	0.00	2.0	0.403E+01	0.34	2.36	.34805E+02
9.95	-4.92	0.00	2.0	0.396E+01	0.34	2.40	.36485E+02
10.42	-4.93	0.00	2.1	0.389E+01	0.34	2.43	.38156E+02
10.89	-4.94	0.00	2.1	0.382E+01	0.34	2.47	.39818E+02

Maximum lateral extent of recirculation bubble.

11.36	-4.94	0.00	2.1	0.377E+01	0.34	2.50	.41470E+02
11.83	-4.94	0.00	2.2	0.371E+01	0.34	2.53	.43113E+02
12.30	-4.92	0.00	2.2	0.365E+01	0.34	2.57	.44748E+02
12.89	-4.90	0.00	2.2	0.358E+01	0.34	2.61	.46777E+02
13.36	-4.87	0.00	2.3	0.353E+01	0.34	2.64	.48391E+02
13.83	-4.84	0.00	2.3	0.348E+01	0.34	2.67	.49995E+02
14.30	-4.80	0.00	2.3	0.343E+01	0.34	2.70	.51590E+02
14.77	-4.76	0.00	2.4	0.339E+01	0.34	2.74	.53177E+02
15.24	-4.70	0.00	2.4	0.334E+01	0.34	2.77	.54755E+02
15.71	-4.65	0.00	2.4	0.330E+01	0.34	2.80	.56324E+02
16.29	-4.57	0.00	2.5	0.324E+01	0.34	2.84	.58274E+02
16.76	-4.50	0.00	2.5	0.320E+01	0.34	2.87	.59825E+02
17.22	-4.43	0.00	2.5	0.317E+01	0.34	2.90	.61368E+02
17.69	-4.35	0.00	2.6	0.313E+01	0.34	2.93	.62903E+02
18.15	-4.27	0.00	2.6	0.309E+01	0.34	2.96	.64430E+02
18.61	-4.18	0.00	2.6	0.306E+01	0.34	2.99	.65950E+02
19.08	-4.09	0.00	2.6	0.302E+01	0.34	3.02	.67462E+02
19.65	-3.97	0.00	2.7	0.298E+01	0.34	3.06	.69343E+02
20.11	-3.87	0.00	2.7	0.295E+01	0.34	3.09	.70839E+02
20.57	-3.76	0.00	2.7	0.292E+01	0.34	3.12	.72329E+02
21.03	-3.65	0.00	2.8	0.289E+01	0.34	3.15	.73812E+02
21.49	-3.53	0.00	2.8	0.286E+01	0.34	3.18	.75288E+02

```
    21.94    -3.41    0.00     2.8 0.283E+01   0.34     3.21 .76757E+02
    22.40    -3.29    0.00     2.9 0.280E+01   0.34     3.24 .78220E+02
    22.62    -3.23    0.00     2.9 0.280E+01   0.34     3.25 .78220E+02
  End of recirculation bubble at the above position.
   Dilution in recirculation bubble =     4.0
   Corresponding concentration      =     0.202E+01
  Flow continues as WALL JET/PLUME.
    22.86     0.00    0.00     2.9 0.278E+01   0.21    10.55 .79729E+02
 Cumulative travel time =          79.7287 sec  (    0.02 hrs)

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
-----------------------------------------------------------------------------

 Some bank/shore interaction occurs at end of near-field.

 In the next prediction module, the jet/plume centerline will be set
   to follow the bank/shore.
-----------------------------------------------------------------------------
BEGIN MOD341: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to LEFT  bank/shore.
   Plume width is now determined from LEFT  bank/shore.

 Plume condition is non-buoyant or weakly buoyant, or, at the end of the NFR
   it is governed by full vertical mixing over the ambient depth,
   or by complete lateral mixing over the channel width.
 Thus, the BUOYANT SPREADING REGIME is ABSENT.

END OF MOD341: BUOYANT AMBIENT SPREADING
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)    = 0.667E-02 m^2/s
  Horizontal diffusivity (initial value) = 0.167E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to water depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
      X        Y        Z        S        C        BV       BH        TT
    22.86     0.00    0.00     2.9 0.278E+01   0.21    10.21 .79729E+02
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
```

prediction interval.

62.40	0.00	0.00	7.0	0.114E+01	0.49	10.45	.17407E+03
101.94	0.00	0.00	7.2	0.112E+01	0.49	10.68	.26841E+03
141.49	0.00	0.00	7.3	0.109E+01	0.49	10.91	.36276E+03
181.03	0.00	0.00	7.5	0.107E+01	0.49	11.13	.45710E+03
220.57	0.00	0.00	7.6	0.105E+01	0.49	11.35	.55144E+03
260.11	0.00	0.00	7.8	0.103E+01	0.49	11.57	.64578E+03
299.66	0.00	0.00	7.9	0.101E+01	0.49	11.78	.74013E+03
339.20	0.00	0.00	8.0	0.995E+00	0.49	11.99	.83447E+03
378.74	0.00	0.00	8.2	0.978E+00	0.49	12.19	.92881E+03
418.29	0.00	0.00	8.3	0.962E+00	0.49	12.39	.10232E+04
457.83	0.00	0.00	8.4	0.947E+00	0.49	12.59	.11175E+04
497.37	0.00	0.00	8.6	0.933E+00	0.49	12.79	.12118E+04
536.91	0.00	0.00	8.7	0.919E+00	0.49	12.98	.13062E+04
576.46	0.00	0.00	8.8	0.906E+00	0.49	13.17	.14005E+04
616.00	0.00	0.00	9.0	0.893E+00	0.49	13.35	.14949E+04
655.54	0.00	0.00	9.1	0.881E+00	0.49	13.54	.15892E+04
695.09	0.00	0.00	9.2	0.869E+00	0.49	13.72	.16836E+04
734.63	0.00	0.00	9.3	0.858E+00	0.49	13.90	.17779E+04
774.17	0.00	0.00	9.4	0.847E+00	0.49	14.08	.18722E+04
813.71	0.00	0.00	9.6	0.837E+00	0.49	14.25	.19666E+04
853.26	0.00	0.00	9.7	0.827E+00	0.49	14.42	.20609E+04
892.80	0.00	0.00	9.8	0.817E+00	0.49	14.59	.21553E+04
932.34	0.00	0.00	9.9	0.808E+00	0.49	14.76	.22496E+04
971.89	0.00	0.00	10.0	0.799E+00	0.49	14.93	.23440E+04
1011.43	0.00	0.00	10.1	0.790E+00	0.49	15.09	.24383E+04
1050.97	0.00	0.00	10.2	0.782E+00	0.49	15.25	.25326E+04
1090.51	0.00	0.00	10.3	0.774E+00	0.49	15.42	.26270E+04
1130.06	0.00	0.00	10.4	0.766E+00	0.49	15.58	.27213E+04
1169.60	0.00	0.00	10.6	0.758E+00	0.49	15.73	.28157E+04
1209.14	0.00	0.00	10.7	0.751E+00	0.49	15.89	.29100E+04
1248.69	0.00	0.00	10.8	0.743E+00	0.49	16.04	.30043E+04
1288.23	0.00	0.00	10.9	0.736E+00	0.49	16.20	.30987E+04
1327.77	0.00	0.00	11.0	0.730E+00	0.49	16.35	.31930E+04
1367.31	0.00	0.00	11.1	0.723E+00	0.49	16.50	.32874E+04
1406.86	0.00	0.00	11.2	0.716E+00	0.49	16.65	.33817E+04
1446.40	0.00	0.00	11.3	0.710E+00	0.49	16.80	.34761E+04
1485.94	0.00	0.00	11.4	0.704E+00	0.49	16.94	.35704E+04
1525.49	0.00	0.00	11.5	0.698E+00	0.49	17.09	.36647E+04
1565.03	0.00	0.00	11.6	0.692E+00	0.49	17.23	.37591E+04
1604.57	0.00	0.00	11.7	0.687E+00	0.49	17.38	.38534E+04
1644.11	0.00	0.00	11.7	0.681E+00	0.49	17.52	.39478E+04
1683.66	0.00	0.00	11.8	0.676E+00	0.49	17.66	.40421E+04
1723.20	0.00	0.00	11.9	0.670E+00	0.49	17.80	.41365E+04
1762.74	0.00	0.00	12.0	0.665E+00	0.49	17.94	.42308E+04
1802.29	0.00	0.00	12.1	0.660E+00	0.49	18.07	.43251E+04
1841.83	0.00	0.00	12.2	0.655E+00	0.49	18.21	.44195E+04
1881.37	0.00	0.00	12.3	0.650E+00	0.49	18.34	.45138E+04
1920.91	0.00	0.00	12.4	0.646E+00	0.49	18.48	.46082E+04

Complete Mi

The passive diffusion plume becomes LATERALLY FULLY MIXED over the channel width during the current prediction interval.

1960.46	0.00	0.00	12.5	0.641E+00	0.49	18.56	.47025E+04

Effluent is FULLY MIXED over the entire channel cross-section.

```
Except for possible far-field decay or reaction processes, there are
  NO FURTHER CHANGES with downstream direction.
  2000.00     0.00     0.00     12.4 0.643E+00    0.49     18.56 .47969E+04
Cumulative travel time =        4796.8564 sec  (     1.33 hrs)

Simulation limit based on maximum specified distance =   2000.00 m.
  This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333333
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                        CORMIX MIXING ZONE EXPERT SYSTEM
                            CORMIX Version 7.0E
                         HYDRO3:Version-7.0.0.0  April,2011
SITE NAME/LABEL:
  DESIGN CASE:                  Measured river flow, 7.0 MGD Effluent Flow, CORMIX-3
  FILE NAME:                     C:\Program Files (x86)\CORMIX 7.0\Sample Files\Sample2
  Using subsystem CORMIX3:      Buoyant Surface Discharges
  Start of session:              02/23/2012--10:29:55
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                            BS     = 18.56 m
  Channel regularity               ICHREG = 2
  Ambient flowrate                 QA     = 3.51 m^3/s
  Average depth                    HA     = 0.49 m
  Depth at discharge               HD     = 0.34 m
  Ambient velocity                 UA     = 0.3855 m/s
  Darcy-Weisbach friction factor   F      = 0.2436
    Calculated from Manning's n           = 0.05
  Wind velocity                    UW     = 0.89 m/s
  Stratification Type              STRCND = U
  Surface temperature                     = 7.9 degC
  Bottom temperature                      = 7.9 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                  RHOAS  = 999.8568 kg/m^3
  Bottom density                   RHOAB  = 999.8568 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:              Surface Discharge
  Discharge located on                    = left bank/shoreline
  Discharge configuration                 = flush discharge
  Distance from bank to outlet     DISTB  = 0 m
  Discharge angle                  SIGMA  = 90 deg
  Depth near discharge outlet      HD0    = 0.21 m
  Bottom slope at discharge        SLOPE  = 13.4 deg
  Rectangular discharge:
    Discharge cross-section area   A0     = 0.456414 m^2
    Discharge channel width        B0     = 2.170176 m
    Discharge channel depth        H0     = 0.210312 m
    Discharge aspect ratio         AR     = 0.096910
  Discharge flowrate               Q0     = 0.306688 m^3/s
  Discharge velocity               U0     = 0.67 m/s
  Discharge temperature (freshwater)      = 12.30 degC
  Corresponding density            RHO0   = 999.4645 kg/m^3
  Density difference               DRHO   = 0.3923 kg/m^3
  Buoyant acceleration             GP0    = 0.0038 m/s^2
  Discharge concentration          C0     = 8 mg/l
  Surface heat exchange coeff.     KS     = 0 m/s
  Coefficient of decay             KD     = 0 /s
-----------------------------------------------------------------------------
```

```
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.68 m          Lm  = 1.18 m          Lbb = 0.02 m
  LM  = 8.90 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number        FRO    = 13.18 (based on LQ)
  Channel densimetric Froude no.   FRCH   = 23.62 (based on HO)
  Velocity ratio                   R      = 1.74
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                          = no
  Water quality standard specified         = no
  Regulatory mixing zone                   = no
  Region of interest                       = 2000 m downstream
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  ! FLOW CLASS    = SA2 !
  *-------------------------*
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0 m from the left bank/shore.
  Number of display steps NSTEP = 50 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 2.7789 mg/l
  Dilution at edge of NFR              s = 2.9
  NFR Location:                        x = 22.86 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 10.55 m
                          thickness (bv) = 0.21 m
Cumulative travel time:       79.7287 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
  but RE-STRATIFIES LATER.
  Plume becomes vertically fully mixed again at 62.40 m downstream.
-----------------------------------------------------------------------------
```

```
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 0 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY **********************
No RMZ and no ambient water quality standard have been specified.
******************** FINAL DESIGN ADVICE AND COMMENTS ********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333333:
                    CORMIX MIXING ZONE EXPERT SYSTEM
            Subsystem CORMIX3: Buoyant Surface Discharges
                          CORMIX Version 7.0E
                     HYDRO3 Version 7.0.0.0 April 2011
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:
 Design case:        1Q10 river flow, 7.0 MGD Effluent Flow, CORMIX-3
 FILE NAME:          C:\...m Files (x86)\CORMIX 7.0\Sample Files\Sample2.prd
 Time stamp:         Thu Feb 23 11:34:10 2012

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =     18.56  AS    =      4.58  QA    =      0.05  ICHREG= 2
 HA    =      0.25  HD    =      0.17
 UA    =     0.011  F     =     0.028 USTAR =0.6595E-03
 UW    =     0.894 UWSTAR=0.9551E-03
 Uniform density environment
 STRCND=  U          RHOAM =  998.4062

DISCHARGE PARAMETERS (metric units)
 BANK  =  LEFT       DISTB =      0.00  Configuration: flush_discharge
 SIGMA =     90.00   HDO   =      0.17  SLOPE =    0.00 deg.
 Rectangular channel geometry:
 B0    =     2.621 H0    =     0.174 A0    =0.4554E+00  AR    =      0.066
 U0    =     0.673 Q0    =     0.307       =0.3067E+00
 RHO0  =  998.2051  DRHO0 =0.2012E+00  GP0   =0.1976E-02
 C0    =0.8000E+01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.3067E+00  M0    =0.2065E+00  J0    =0.6060E-03
 Associated length scales (meters)
 LQ    =      0.67  LM    =     12.45  Lm    =     40.86  Lb    =    440.47
 LQ2D  =      2.62  LM2D  =     51.68  Lm2D  =   9610.18

NON-DIMENSIONAL PARAMETERS
 FR0   =     18.44  FRCH  =     36.35  R     =     60.55

FLOW CLASSIFICATION
 333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)       =    SA2    3
 3  Applicable layer depth HS =     0.17   3
 333333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =   2000.00  XMAX  =   2000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.00 m  from the LEFT  bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  50 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

 VERTICAL MIXING occurs in the initial zone of flow establishment.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=    270.39
      X        Y        Z        S        C        BV       BH        TT
     0.90    -0.58     0.00     1.0 0.800E+01   0.17     2.34 .15891E+01
 Cumulative travel time =           1.5891 sec  (    0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in shallow crossflow with shoreline-attachment.

 Profile definitions:
   BV = water depth (vertically mixed)
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

X	Y	Z	S	C	BV	BH	TT
0.90	-0.58	0.00	1.0	0.800E+01	0.17	2.34	.15891E+01

Maximum lateral extent of recirculation bubble.

0.91	-0.60	0.00	1.0	0.800E+01	0.17	2.35	.15891E+01

End of recirculation bubble at the above position.

Dilution in recirculation bubble = 1.7

Corresponding concentration = 0.484E+01

Flow continues as WALL JET/PLUME.

1.17	0.00	0.00	1.4	0.559E+01	0.17	4.69	.16011E+01
1.44	0.00	0.00	1.5	0.518E+01	0.17	4.70	.16153E+01
1.71	0.00	0.00	1.6	0.490E+01	0.17	4.70	.16331E+01
1.98	0.00	0.00	1.7	0.469E+01	0.17	4.70	.16544E+01
2.25	0.00	0.00	1.8	0.453E+01	0.17	4.70	.16791E+01
2.52	0.00	0.00	1.8	0.439E+01	0.17	4.71	.17070E+01
2.78	0.00	0.00	1.9	0.427E+01	0.17	4.71	.17380E+01
3.05	0.00	0.00	1.9	0.417E+01	0.17	4.71	.17721E+01
3.32	0.00	0.00	2.0	0.408E+01	0.17	4.72	.18091E+01
3.59	0.00	0.00	2.0	0.400E+01	0.17	4.72	.18491E+01
3.86	0.00	0.00	2.0	0.393E+01	0.17	4.73	.18920E+01
4.12	0.00	0.00	2.1	0.387E+01	0.17	4.73	.19376E+01
4.39	0.00	0.00	2.1	0.381E+01	0.17	4.74	.19861E+01
4.66	0.00	0.00	2.1	0.376E+01	0.17	4.74	.20372E+01
4.93	0.00	0.00	2.2	0.371E+01	0.17	4.75	.20911E+01
5.20	0.00	0.00	2.2	0.366E+01	0.17	4.76	.21476E+01
5.46	0.00	0.00	2.2	0.362E+01	0.17	4.77	.22068E+01
5.73	0.00	0.00	2.2	0.358E+01	0.17	4.77	.22686E+01
6.00	0.00	0.00	2.3	0.354E+01	0.17	4.78	.23330E+01
6.27	0.00	0.00	2.3	0.350E+01	0.17	4.79	.23999E+01
6.54	0.00	0.00	2.3	0.347E+01	0.17	4.80	.24694E+01
6.80	0.00	0.00	2.3	0.344E+01	0.17	4.81	.25414E+01
7.07	0.00	0.00	2.3	0.341E+01	0.17	4.82	.26158E+01
7.34	0.00	0.00	2.4	0.338E+01	0.17	4.83	.26928E+01
7.61	0.00	0.00	2.4	0.335E+01	0.17	4.84	.27722E+01
7.88	0.00	0.00	2.4	0.333E+01	0.17	4.85	.28541E+01
8.14	0.00	0.00	2.4	0.330E+01	0.17	4.87	.29384E+01
8.41	0.00	0.00	2.4	0.328E+01	0.17	4.88	.30251E+01
8.68	0.00	0.00	2.5	0.325E+01	0.17	4.89	.31142E+01
8.95	0.00	0.00	2.5	0.323E+01	0.17	4.90	.32057E+01
9.22	0.00	0.00	2.5	0.321E+01	0.17	4.92	.32996E+01
9.48	0.00	0.00	2.5	0.319E+01	0.17	4.93	.33959E+01
9.75	0.00	0.00	2.5	0.317E+01	0.17	4.95	.34945E+01
10.02	0.00	0.00	2.5	0.315E+01	0.17	4.96	.35955E+01
10.29	0.00	0.00	2.6	0.313E+01	0.17	4.97	.36988E+01
10.56	0.00	0.00	2.6	0.312E+01	0.17	4.99	.38044E+01
10.83	0.00	0.00	2.6	0.310E+01	0.17	5.01	.39124E+01
11.09	0.00	0.00	2.6	0.308E+01	0.17	5.02	.40226E+01
11.36	0.00	0.00	2.6	0.307E+01	0.17	5.04	.41352E+01
11.63	0.00	0.00	2.6	0.305E+01	0.17	5.05	.42501E+01
11.90	0.00	0.00	2.6	0.304E+01	0.17	5.07	.43673E+01
12.17	0.00	0.00	2.6	0.302E+01	0.17	5.09	.44868E+01
12.43	0.00	0.00	2.7	0.301E+01	0.17	5.11	.46085E+01
12.70	0.00	0.00	2.7	0.299E+01	0.17	5.13	.47326E+01

```
    12.97     0.00     0.00     2.7 0.298E+01   0.17     5.14 .48589E+01
    13.24     0.00     0.00     2.7 0.297E+01   0.17     5.16 .49874E+01
    13.51     0.00     0.00     2.7 0.295E+01   0.17     5.18 .51183E+01
    13.77     0.00     0.00     2.7 0.294E+01   0.17     5.20 .52514E+01
    14.04     0.00     0.00     2.7 0.293E+01   0.17     5.22 .53868E+01
    14.31     0.00     0.00     2.7 0.292E+01   0.17     5.24 .55244E+01
 Cumulative travel time =            5.5244 sec  (     0.00 hrs)

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
-----------------------------------------------------------------------------

 The initial plume WIDTH/THICKNESS VALUE in the next far-field module will be
  CORRECTED by a factor  8.33 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
 Flow appears highly UNSTEADY and prediction results are UNRELIABLE!
   SIMULATION STOPS!

 Some bank/shore interaction occurs at end of near-field.


 The LIMITING DILUTION (given by ambient flow/discharge ratio) is:    1.17
 This value is below the computed dilution of    2.74 at the end
 of the NFR.
 Mixing for this discharge configuration is constrained by LOW AMBIENT FLOW!

 The previous module predictions are UNRELIABLE since the limiting dilution
   cannot be exceeded for this shallow water discharge configuration.

 A subsequent module (MOD381) will predict the properties of the
   cross-sectionally fully mixed plume with limiting dilution and will
   compute a POSSIBLE UPSTREAM WEDGE INTRUSION.
-----------------------------------------------------------------------------
BEGIN MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION

 The DOWNSTREAM flow field for this unstable shallow water discharge is
     VERTICALLY FULLY MIXED.
 The mixing is controlled by the limiting dilution =      1.2

 Channel DENSIMETRIC FROUDE NUMBER (FCHAN) for this mixed flow =     0.54

 An UPSTREAM INTRUDING WEDGE is formed along the surface.

 UPSTREAM WEDGE INTRUSION PROPERTIES in bounded channel (laterally uniform):
        Wedge length                          =       3.83 m
        X-Position of wedge tip               =      10.48 m
        Thickness at discharge (end of NFR)   =       0.08 m
         (Wedge thickness gradually decreases to zero at wedge tip.)
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
```

```
  the local water depth.
This may be caused by a very small ambient velocity, perhaps in combination
  with large discharge buoyancy.
If the ambient conditions are strongly transient (e.g. tidal), then the
  CORMIX steady-state predictions of upstream intrusion are probably
  unrealistic.
The plume predictions prior to boundary impingement and wedge formation
 will be acceptable, however.

      X        Y        Z        S        C        BV       BH        TT
    14.31     0.00     0.00     1.2 0.686E+01   0.25     18.56 .55244E+01
Cumulative travel time =          5.5244 sec  (    0.00 hrs)

Vertically and laterally fully mixed over layer depth: END OF SIMULATION!

END OF MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333333
```

Complete Mix

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                        CORMIX MIXING ZONE EXPERT SYSTEM
                            CORMIX Version 7.0E
                       HYDRO3:Version-7.0.0.0  April,2011
SITE NAME/LABEL:
  DESIGN CASE:                  1Q10 river flow, 7.0 MGD Effluent Flow, CORMIX-3
  FILE NAME:                     C:\Program Files (x86)\CORMIX 7.0\Sample Files\5
  Using subsystem CORMIX3:     Buoyant Surface Discharges
  Start of session:             02/23/2012--11:34:10
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                          BS      = 18.56 m
  Channel regularity             ICHREG  = 2
  Ambient flowrate               QA      = 0.05 m^3/s
  Average depth                  HA      = 0.25 m
  Depth at discharge             HD      = 0.17 m
  Ambient velocity               UA      = 0.0111 m/s
  Darcy-Weisbach friction factor F       = 0.0281
    Calculated from Manning's n          = 0.015
  Wind velocity                  UW      = 0.89 m/s
  Stratification Type            STRCND  = U
  Surface temperature                    = 19 degC
  Bottom temperature                     = 19 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                RHOAS   = 998.4063 kg/m^3
  Bottom density                 RHOAB   = 998.4063 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:            Surface Discharge
  Discharge located on                   = left bank/shoreline
  Discharge configuration                = flush discharge
  Distance from bank to outlet   DISTB   = 0 m
  Discharge angle                SIGMA   = 90 deg
  Depth near discharge outlet    HDO     = 0.17 m
  Bottom slope at discharge      SLOPE   = 0 deg
  Rectangular discharge:
    Discharge cross-section area A0      = 0.455411 m^2
    Discharge channel width      B0      = 2.62128 m
    Discharge channel depth      H0      = 0.173736 m
    Discharge aspect ratio       AR      = 0.066279
  Discharge flowrate             Q0      = 0.306688 m^3/s
  Discharge velocity             U0      = 0.67 m/s
  Discharge temperature (freshwater)     = 20 degC
  Corresponding density          RHO0    = 998.2051 kg/m^3
  Density difference             DRHO    = 0.2012 kg/m^3
  Buoyant acceleration           GP0     = 0.002 m/s^2
  Discharge concentration        C0      = 8 mg/l
  Surface heat exchange coeff.   KS      = 0 m/s
  Coefficient of decay           KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
```

```
  LQ  = 0.67 m          Lm  = 40.86 m          Lbb = 440.47 m
  LM  = 12.45 m
-------------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number        FRO    = 18.44 (based on LQ)
  Channel densimetric Froude no.   FRCH   = 36.35 (based on H0)
  Velocity ratio                   R      = 60.55
-------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                          = no
  Water quality standard specified         = no
  Regulatory mixing zone                   = no
  Region of interest                       = 2000 m downstream
*******************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  | FLOW CLASS   = SA2 |
  *-------------------------*
*******************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-------------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0 m from the left bank/shore.
  Number of display steps NSTEP = 50 per module.
-------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 2.9163 mg/l
  Dilution at edge of NFR              s = 2.7
  NFR Location:                        x = 14.31 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 5.24 m
                          thickness (bv) = 0.17 m
Cumulative travel time:       5.5244 sec.

WARNING:
 The LIMITING DILUTION (given by ambient flow/discharge ratio) is = 1.17
 This value is below the computed dilution of 2.74 at the end of the
 Near Field Region (NFR). Mixing for this discharge configuration is
 constrained by the ambient flow.
 Please carefully review the prediction file for additional warnings and informatio
-------------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-------------------------------------------------------------------------------
```

```
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed ALREADY IN NEAR-FIELD at 0 m
  downstream and continues as vertically mixed into the far-field.
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 0 m downstream.
  Plume contacts second bank at 0 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY **********************
No RMZ and no ambient water quality standard have been specified.
********************** FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333333
                        CORMIX MIXING ZONE EXPERT SYSTEM
                 Subsystem CORMIX3: Buoyant Surface Discharges
                              CORMIX Version 7.0E
                       HYDRO3 Version 7.0.0.0 April 2011
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:
 Design case:        7Q10 river flow, 7.0 MGD Effluent Flow, CORMIX-3
 FILE NAME:          C:\...m Files (x86)\CORMIX 7.0\Sample Files\Sample2.prd
 Time stamp:         Thu Feb 23 13:06:30 2012

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =     18.56  AS    =      4.58  QA    =      0.06  ICHREG= 2
 HA    =      0.25  HD    =      0.17
 UA    =     0.013  F     =     0.028  USTAR =0.7694E-03
 UW    =     0.894  UWSTAR=0.9551E-03
 Uniform density environment
 STRCND=  U         RHOAM =  998.4062

DISCHARGE PARAMETERS (metric units)
 BANK  =  LEFT      DISTB =      0.00  Configuration: flush_discharge
 SIGMA =     90.00  HDO   =      0.17  SLOPE =    0.00 deg.
 Rectangular channel geometry:
 BO    =     2.621  HO    =     0.174  AO    =0.4554E+00  AR    =      0.066
 UO    =     0.673  QO    =     0.307        =0.3067E+00
 RHOO  =  998.2051  DRHOO =0.2012E+00  GPO   =0.1976E-02
 CO    =0.8000E+01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 QO    =0.3067E+00  MO    =0.2065E+00  JO    =0.6060E-03
 Associated length scales (meters)
 LQ    =     0.67  LM    =     12.45  Lm    =     35.02  Lb    =    277.38
 LQ2D  =     2.62  LM2D  =     51.68  Lm2D  =   7060.54

NON-DIMENSIONAL PARAMETERS
 FRO   =     18.44  FRCH  =     36.35  R     =     51.90

FLOW CLASSIFICATION
 333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)       =    SA2    3
 3  Applicable layer depth HS =     0.17  3
 333333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 CO    =0.8000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =   2000.00  XMAX  =   2000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.00 m  from the LEFT  bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  50 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
      X        Y        Z        S        C        BV       BH        TT
     0.00     0.00     0.00     1.0 0.800E+01   0.17     1.31 .00000E+00

 VERTICAL MIXING occurs in the initial zone of flow establishment.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=    270.46
      X        Y        Z        S        C        BV       BH        TT
     0.83    -0.55     0.00     1.0 0.800E+01   0.17     2.34 .14831E+01
 Cumulative travel time =           1.4831 sec  (    0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in shallow crossflow with shoreline-attachment.

 Profile definitions:
   BV = water depth (vertically mixed)
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

X	Y	Z	S	C	BV	BH	TT
0.83	-0.55	0.00	1.0	0.800E+01	0.17	2.34	.14831E+01

Maximum lateral extent of recirculation bubble.

0.84	-0.57	0.00	1.0	0.800E+01	0.17	2.35	.14831E+01

End of recirculation bubble at the above position.

Dilution in recirculation bubble = 1.5

Corresponding concentration = 0.517E+01

Flow continues as WALL JET/PLUME.

1.11	0.00	0.00	1.3	0.594E+01	0.17	4.69	.14954E+01
1.37	0.00	0.00	1.5	0.550E+01	0.17	4.69	.15100E+01
1.64	0.00	0.00	1.5	0.519E+01	0.17	4.70	.15285E+01
1.91	0.00	0.00	1.6	0.497E+01	0.17	4.70	.15507E+01
2.18	0.00	0.00	1.7	0.479E+01	0.17	4.70	.15765E+01
2.45	0.00	0.00	1.7	0.464E+01	0.17	4.70	.16057E+01
2.71	0.00	0.00	1.8	0.452E+01	0.17	4.71	.16381E+01
2.98	0.00	0.00	1.8	0.441E+01	0.17	4.71	.16739E+01
3.25	0.00	0.00	1.9	0.431E+01	0.17	4.72	.17127E+01
3.52	0.00	0.00	1.9	0.423E+01	0.17	4.72	.17547E+01
3.79	0.00	0.00	1.9	0.416E+01	0.17	4.73	.17996E+01
4.05	0.00	0.00	2.0	0.409E+01	0.17	4.73	.18476E+01
4.32	0.00	0.00	2.0	0.403E+01	0.17	4.74	.18985E+01
4.59	0.00	0.00	2.0	0.397E+01	0.17	4.74	.19523E+01
4.86	0.00	0.00	2.0	0.392E+01	0.17	4.75	.20089E+01
5.13	0.00	0.00	2.1	0.387E+01	0.17	4.76	.20683E+01
5.40	0.00	0.00	2.1	0.382E+01	0.17	4.76	.21305E+01
5.66	0.00	0.00	2.1	0.378E+01	0.17	4.77	.21955E+01
5.93	0.00	0.00	2.1	0.374E+01	0.17	4.78	.22632E+01
6.20	0.00	0.00	2.2	0.370E+01	0.17	4.79	.23336E+01
6.47	0.00	0.00	2.2	0.366E+01	0.17	4.80	.24067E+01
6.74	0.00	0.00	2.2	0.363E+01	0.17	4.81	.24824E+01
7.00	0.00	0.00	2.2	0.360E+01	0.17	4.82	.25608E+01
7.27	0.00	0.00	2.2	0.357E+01	0.17	4.83	.26418E+01
7.54	0.00	0.00	2.3	0.354E+01	0.17	4.84	.27254E+01
7.81	0.00	0.00	2.3	0.351E+01	0.17	4.85	.28115E+01
8.08	0.00	0.00	2.3	0.349E+01	0.17	4.86	.29003E+01
8.34	0.00	0.00	2.3	0.346E+01	0.17	4.88	.29915E+01
8.61	0.00	0.00	2.3	0.344E+01	0.17	4.89	.30854E+01
8.88	0.00	0.00	2.3	0.341E+01	0.17	4.90	.31817E+01
9.15	0.00	0.00	2.4	0.339E+01	0.17	4.91	.32805E+01
9.42	0.00	0.00	2.4	0.337E+01	0.17	4.93	.33819E+01
9.68	0.00	0.00	2.4	0.335E+01	0.17	4.94	.34857E+01
9.95	0.00	0.00	2.4	0.333E+01	0.17	4.96	.35920E+01
10.22	0.00	0.00	2.4	0.331E+01	0.17	4.97	.37008E+01
10.49	0.00	0.00	2.4	0.329E+01	0.17	4.99	.38120E+01
10.76	0.00	0.00	2.4	0.327E+01	0.17	5.00	.39257E+01
11.02	0.00	0.00	2.5	0.325E+01	0.17	5.02	.40418E+01
11.29	0.00	0.00	2.5	0.324E+01	0.17	5.03	.41604E+01
11.56	0.00	0.00	2.5	0.322E+01	0.17	5.05	.42813E+01
11.83	0.00	0.00	2.5	0.320E+01	0.17	5.07	.44047E+01
12.10	0.00	0.00	2.5	0.319E+01	0.17	5.09	.45306E+01
12.36	0.00	0.00	2.5	0.317E+01	0.17	5.10	.46588E+01
12.63	0.00	0.00	2.5	0.316E+01	0.17	5.12	.47894E+01
12.90	0.00	0.00	2.5	0.314E+01	0.17	5.14	.49224E+01
13.17	0.00	0.00	2.6	0.313E+01	0.17	5.16	.50578E+01

```
    13.44     0.00     0.00     2.6 0.312E+01   0.17     5.18 .51957E+01
    13.71     0.00     0.00     2.6 0.310E+01   0.17     5.20 .53358E+01
    13.97     0.00     0.00     2.6 0.309E+01   0.17     5.22 .54784E+01
    14.24     0.00     0.00     2.6 0.308E+01   0.17     5.24 .56234E+01
 Cumulative travel time =           5.6234 sec  (    0.00 hrs)

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
-------------------------------------------------------------------------------

 The initial plume WIDTH/THICKNESS VALUE in the next far-field module will be
  CORRECTED by a factor  7.72 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
 Flow appears highly UNSTEADY and prediction results are UNRELIABLE!
   SIMULATION STOPS!

 Some bank/shore interaction occurs at end of near-field.


 The LIMITING DILUTION (given by ambient flow/discharge ratio) is:    1.19
 This value is below the computed dilution of    2.60 at the end
 of the NFR.
 Mixing for this discharge configuration is constrained by LOW AMBIENT FLOW!

 The previous module predictions are UNRELIABLE since the limiting dilution
   cannot be exceeded for this shallow water discharge configuration.

 A subsequent module (MOD381) will predict the properties of the
   cross-sectionally fully mixed plume with limiting dilution and will
   compute a POSSIBLE UPSTREAM WEDGE INTRUSION.
-------------------------------------------------------------------------------
BEGIN MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION

 The DOWNSTREAM flow field for this unstable shallow water discharge is
     VERTICALLY FULLY MIXED.
 The mixing is controlled by the limiting dilution =      1.2

 Channel DENSIMETRIC FROUDE NUMBER (FCHAN) for this mixed flow =     0.64

 An UPSTREAM INTRUDING WEDGE is formed along the surface.

 UPSTREAM WEDGE INTRUSION PROPERTIES in bounded channel (laterally uniform):
        Wedge length                          =       1.51 m
        X-Position of wedge tip               =      12.74 m
        Thickness at discharge (end of NFR)   =       0.06 m
         (Wedge thickness gradually decreases to zero at wedge tip.)
       X        Y        Z        S        C       BV       BH        TT
    14.24     0.00     0.00     1.2 0.670E+01   0.25    18.56 .56234E+01
```

Complete Mix

```
 Cumulative travel time =          5.6234 sec  (    0.00 hrs)

 Vertically and laterally fully mixed over layer depth: END OF SIMULATION!

END OF MOD381: MIXED PLUME/BOUNDED CHANNEL/POSSIBLE UPSTREAM WEDGE INTRUSION
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333333
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 7.0E
                       HYDRO3:Version-7.0.0.0  April,2011
SITE NAME/LABEL:
  DESIGN CASE:                 7Q10 river flow, 7.0 MGD Effluent Flow, CORMIX-3
  FILE NAME:                    C:\Program Files (x86)\CORMIX 7.0\Sample Files\
  Using subsystem CORMIX3:     Buoyant Surface Discharges
  Start of session:             02/23/2012--13:06:30
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                              = bounded
  Width                          BS          = 18.56 m
  Channel regularity             ICHREG      = 2
  Ambient flowrate               QA          = 0.06 m^3/s
  Average depth                  HA          = 0.25 m
  Depth at discharge             HD          = 0.17 m
  Ambient velocity               UA          = 0.0130 m/s
  Darcy-Weisbach friction factor F           = 0.0281
    Calculated from Manning's n              = 0.015
  Wind velocity                  UW          = 0.89 m/s
  Stratification Type            STRCND      = U
  Surface temperature                        = 19 degC
  Bottom temperature                         = 19 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                RHOAS       = 998.4063 kg/m^3
  Bottom density                 RHOAB       = 998.4063 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:            Surface Discharge
  Discharge located on                       = left bank/shoreline
  Discharge configuration                    = flush discharge
  Distance from bank to outlet   DISTB       = 0 m
  Discharge angle                SIGMA       = 90 deg
  Depth near discharge outlet    HD0         = 0.17 m
  Bottom slope at discharge      SLOPE       = 0 deg
  Rectangular discharge:
    Discharge cross-section area A0          = 0.455411 m^2
    Discharge channel width      B0          = 2.62128 m
    Discharge channel depth      H0          = 0.173736 m
    Discharge aspect ratio       AR          = 0.066279
  Discharge flowrate             Q0          = 0.306688 m^3/s
  Discharge velocity             U0          = 0.67 m/s
  Discharge temperature (freshwater)         = 20 degC
  Corresponding density          RHO0        = 998.2051 kg/m^3
  Density difference             DRHO        = 0.2012 kg/m^3
  Buoyant acceleration           GP0         = 0.002 m/s^2
  Discharge concentration        C0          = 8 mg/l
  Surface heat exchange coeff.   KS          = 0 m/s
  Coefficient of decay           KD          = 0 /s
-----------------------------------------------------------------------------
```

```
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.67 m          Lm  = 35.02 m          Lbb = 277.38 m
  LM  = 12.45 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number        FRO    = 18.44 (based on LQ)
  Channel densimetric Froude no.   FRCH   = 36.35 (based on H0)
  Velocity ratio                   R      = 51.90
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                          = no
  Water quality standard specified         = no
  Regulatory mixing zone                   = no
  Region of interest                       = 2000 m downstream
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  | FLOW CLASS   = SA2 |
  *-------------------------*
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0 m from the left bank/shore.
  Number of display steps NSTEP = 50 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 3.078 mg/l
  Dilution at edge of NFR              s = 2.6
  NFR Location:                        x = 14.24 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 5.24 m
                          thickness (bv) = 0.17 m
Cumulative travel time:       5.6234 sec.

WARNING:
 The LIMITING DILUTION (given by ambient flow/discharge ratio) is = 1.19
 This value is below the computed dilution of 2.60 at the end of the
 Near Field Region (NFR). Mixing for this discharge configuration is
 constrained by the ambient flow.
 Please carefully review the prediction file for additional warnings and information.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
```

```
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed ALREADY IN NEAR-FIELD at 0 m
  downstream and continues as vertically mixed into the far-field.
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 0 m downstream.
  Plume contacts second bank at 0 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY ***********************
No RMZ and no ambient water quality standard have been specified.
********************** FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

MEMORANDUM

State Water Control Board

2111 North Hamilton Street P. O. Box 11143 Richmond, VA. 23230

SUBJECT: Revised Winter Tier Wasteload Allocation and Revised Draft Permit for Coeburn-Norton-Wise

TO: Martin G. Ferguson, Jr.

FROM: Dallas R. Sizemore Dallas R. Sizemore

DATE: November 23, 1988

COPIES: A. J. Newman, D. R. Sizemore, L. K. Owens

Attached are the revised winter tier wasteload allocation calculations, revised ammonia calculations, revised draft permit effluent limitations pages, and revised fact sheet, which contains revised effluent limitations based on the "seasonal low flow." When a seasonal low flow of 5.84 MGD and a tier temperature of 15° (based on STORET data for the months under consideration) were used, the model indicated that the following effluent limitations are appropriate for the months of December 1 through May 31:

Flow = 4.0 MGD
$CBOD_5$ = 30 mg/l (monthly average)
TKN = no limit needed
Total NH_3 Ammonia = 5.4 mg/l (monthly average)
D.O. = 7.0 mg/l

The revised wasteload allocation also includes a sensitivity analysis in which K_2 was halved, K_1 was doubled, and K_n was doubled, while the other two K values were kept constant. In all the sensitivity tests, the lowest dissolved oxygen remained well above stream standards, indicating that the risk of error in the model is not great and that the model should be accepted.

This allocation was performed after having talked your initial disapproval over with Larry Lawson. Larry gave us the O.K. to proceed in accordance with his earlier guidance memo which allows the region to tier both BOD and ammonia according to flow. Since the pathway we have chosen is in accordance with Agency policy, we would hope that you will support our direction and solicit a speedy EPA approval of the model and effluent limitations.

/dh
Attachments

By memo dated 12/22/88, Martin G. Ferguson, Jr., from SWCB-OWRM, stated that due to CFR Part 133, P. 36999 L.1., $CBOD_5$ can not exceed 25 mg/l (monthly average) and 40 mg/l (weekly average). Therefore, the "wet season" limits derived from the model were reduced accordingly.

Winter Tier Model
Revised 11/4/88
with effluent D.O.
of 7.0 mg/l

MODEL SIMULATION FOR THE COEBURN-NORTON-WISE STP DISCHARGE TO GUEST RIVER

THE BACKGROUND CONDITIONS ARE:

FLOW= 5.8400 MGD D.O.= 8.437 MG/L CBODu= 3.00 MG/L NBODu= 0.00 MG/L

OUTPUT WILL BE GENERATED EVERY 0.25 MILE FROM THE BEGINNING OF A SEGMENT

****

THE VARIABLES FOR SECTION 1 ARE:

SEGMENT LENGTH = 1.40 MI VELOCITY = 2.209 MI/D
TEMP. = 15.0 °C ELEV = 1950.00 FT SATURATION D.O. = 9.374 MG/L
Ka = 15.000 /DAY Kr = 0.500 /DAY Kn = 0.500 /DAY

The k rates shown are at 20 degrees C. The model corrects them.

FOR THE DISCHARGE AT THE BEGINNING OF THE SEGMENT:

FLOW= 4.0000 MGD D.O.= 7.00 MG/L CBODu= 75.00 MG/L NBODu= 86.60 MG/L

THE RESULTS FOR SECTION 1 ARE:

DISTANCE (MI) FROM HEAD OF SEGMENT	TOTAL DISTANCE (MI) FROM BEGINNING	D.O. (mg/l)	CBODu (mg/l)	NBODu (mg/l)
0.000	0.000	7.853	32.268	35.203
0.250	0.250	7.625	30.849	33.873
0.500	0.500	7.632	29.493	32.594
0.750	0.750	7.689	28.196	31.362
1.000	1.000	7.755	26.956	30.178
1.250	1.250	7.821	25.770	29.037
1.400	1.400	7.859	25.084	28.374

****

THE VARIABLES FOR SECTION 2 ARE:

SEGMENT LENGTH = 1.20 MI VELOCITY = 2.209 MI/D
TEMP. = 15.0 °C ELEV = 1920.00 FT SATURATION D.O. = 9.385 MG/L
Ka = 15.000 /DAY Kr = 0.500 /DAY Kn = 0.500 /DAY

The k rates shown are at 20 degrees C. The model corrects them.

FOR THE DISCHARGE AT THE BEGINNING OF THE SEGMENT:

FLOW= 0.0000 MGD D.O.= 0.00 MG/L CBODu= 0.00 MG/L NBODu= 0.00 MG/L

DISTANCE (MI) FROM HEAD OF SEGMENT	TOTAL DISTANCE (MI) FROM BEGINNING	D.O. (mg/l)	CBODu (mg/l)	NBODu (mg/l)
0.000	1.400	7.859	25.084	28.374
0.250	1.650	7.929	23.981	27.302
0.500	1.900	7.991	22.926	26.271
0.750	2.150	8.048	21.918	25.278
1.000	2.400	8.103	20.954	24.323
1.200	2.600	8.145	20.214	23.585

****

THE VARIABLES FOR SECTION 3 ARE:

SEGMENT LENGTH = 1.00 MI VELOCITY = 3.191 MI/D
TEMP. = 15.0 °C ELEV = 1850.00 FT SATURATION D.O. = 9.409 MG/L
Ka = 30.000 /DAY Kr = 2.000 /DAY Kn = 2.000 /DAY

The k rates shown are at 20 degrees C. The model corrects them.

FOR THE DISCHARGE AT THE BEGINNING OF THE SEGMENT:

FLOW= 0.0000 MGD D.O.= 0.00 MG/L CBODu= 0.00 MG/L NBODu= 0.00 MG/L

. . . . . .

THE RESULTS FOR SECTION 3 ARE:

DISTANCE (MI) FROM HEAD OF SEGMENT	TOTAL DISTANCE (MI) FROM BEGINNING	D.O. (mg/l)	CBODu (mg/l)	NBODu (mg/l)
0.000	2.600	8.145	20.214	23.585
0.250	2.850	7.295	17.847	21.200
0.500	3.100	7.404	15.757	19.055
0.750	3.350	7.607	13.912	17.128
1.000	3.600	7.802	12.283	15.395

****

THE VARIABLES FOR SECTION 4 ARE:

SEGMENT LENGTH = 1.50 MI VELOCITY = 3.191 MI/D
TEMP. = 15.0 °C ELEV = 1680.00 FT SATURATION D.O. = 9.469 MG/L
Ka = 50.000 /DAY Kr = 3.000 /DAY Kn = 3.000 /DAY

The k rates shown are at 20 degrees C. The model corrects them.

FOR THE DISCHARGE AT THE BEGINNING OF THE SEGMENT:

FLOW= 0.0000 MGD D.O.= 0.00 MG/L CBODu= 0.00 MG/L NBODu= 0.00 MG/L

THE RESULTS FOR SECTION 4 ARE:

DISTANCE (MI) FROM HEAD OF SEGMENT	TOTAL DISTANCE (MI) FROM BEGINNING	D.O. (mg/l)	CBODu (mg/l)	NBODu (mg/l)
0.000	3.600	7.802	12.283	15.395
0.250	3.850	8.252	10.190	13.119
0.500	4.100	8.451	8.453	11.180
0.750	4.350	8.612	7.013	9.527
1.000	4.600	8.748	5.818	8.119
1.250	4.850	8.862	4.826	6.919
1.500	5.100	8.958	4.004	5.896

****

THE VARIABLES FOR SECTION 5 ARE:

SEGMENT LENGTH = 2.50 MI VELOCITY = 3.191 MI/D
TEMP. = 15.0 °C ELEV = 1500.00 FT SATURATION D.O. = 9.533 MG/L
Ka = 30.000 /DAY Kr = 2.000 /DAY Kn = 2.000 /DAY

The k rates shown are at 20 degrees C. The model corrects them.

FOR THE DISCHARGE AT THE BEGINNING OF THE SEGMENT:

FLOW= 0.0000 MGD D.O.= 0.00 MG/L CBODu= 0.00 MG/L NBODu= 0.00 MG/L

THE RESULTS FOR SECTION 5 ARE:

DISTANCE (MI) FROM HEAD OF SEGMENT	TOTAL DISTANCE (MI) FROM BEGINNING	D.O. (mg/l)	CBODu (mg/l)	NBODu (mg/l)
0.000	5.100	8.958	4.004	5.896
0.250	5.350	9.023	3.535	5.300
0.500	5.600	9.078	3.121	4.763
0.750	5.850	9.127	2.756	4.282
1.000	6.100	9.171	2.433	3.848
1.250	6.350	9.210	2.148	3.459
1.500	6.600	9.245	1.897	3.109
1.750	6.850	9.276	1.674	2.795
2.000	7.100	9.304	1.478	2.512
2.250	7.350	9.328	1.305	2.25A

4

****

SIMULATION COMPLETED

11-03-1988 14:12:26

Permit No. VA0077828

17. List the type and quantity of wastes, fluids, or pollutants being stored at this facility. Briefly describe the storage facilities and list, if any, measures taken to prevent the stored material from reaching State waters.

18. Table VI is to be used to record changes in the permit (1) from the previously issued permit and/or (2) during the permit processing period.

Special Conditions: (List any changes associated with the special conditions and the reasons for the changes).

Permit No. VA0077828

Table I

NUMBER AND DESCRIPTION OF OUTFALLS
(Complete this item or attach page one of Form 2C)

Outfall Number	Source of Discharge (List Operations Contributing Flow).	Treatment (Brief Description Unit by Unit)	Flow Average/Maximum (Give Avg and Max for Industry and Design for Municipal)
P.S.001	Sewage Treatment Plant	See Attachment	4.0 MGD

EFFLUENT LIMITATIONS

Permit No. VA0077828

MUNICIPAL
OUTFALL P.S. 001

( ) Interim Limitations
(X) Final Limitations
Effective Dates: From December 1
TO November 30

Parameter	Federal Effluent (X)	Professional Judgement (X)	Water* Quality (X)	Minimum	Maximum	mg/l Monthly Average	mg/l Weekly Average	Quantity** (kg/d) Monthly Average	Quantity** (kg/d) Weekly Average	Frequency	Sample Type
$CBOD_5$			5	–	–	20	30	303	454	7 Days/Wk.	24 Hr. Comp.
TSS	X			–	–	30	45	454	681	7 Days/Wk.	24 Hr. Comp.
pH			4	6.0 (S.U.)	9.0 (S.U.)	–	–	–	–	1/Day	Grab
Fecal *** Coliform			4	–	–	200 N/100 ml ****	400 N/100 ml ****	–	–	3/Week at 48 Hr. Int.	***** Grab
Dissolved Oxygen			4,5	7.0 mg/l	–	–	–	–	–	1/Day	Grab
Chlorine Residual			4,5	1.0 mg/l Before Dechlor.	Non-detect after dechlor.	–	–	–	–	Every 2 Hours	Grab
Total Kjeldahl Nitrogen			5	–	–	8	12	121	182	7 Days/Wk	24 Hr. Comp
Total Ammonia			4,5	–	–	13	20	197	303	7 Days/Wk	24 Hr. Comp.

*Key
1. Per 208 Plan and Date
2. Per 303(e) Plan and Date
3. Per 401 Certification and Date
4. SWCB Water Quality Standards
5. Other (e.g. Wasteload Allocation Model; Chlorination)

**Based on a Design Flow of 4.0 MGD

*** Only applies if alternate disinfection facilities are installed
**** Geometric Mean
***** Between 10 a.m. & 4 p.m.

Rev. 2/1/87

TABLE IV

EFFLUENT LIMITATIONS

Permit No. VA0077828

MUNICIPAL
OUTFALL P.S. 001

( ) Interim Limitations
(X) Final Limitations
Effective Dates: From December 1
TO May 31

Parameter	Federal Effluent (X)	Professional Judgement (X)	Water* Quality (X)	Minimum	Maximum	Monthly Average (mg/l)	Weekly Average (mg/l)	Quantity** (kg/d) Monthly Average	Quantity** (kg/d) Weekly Average	Frequency	Sample Type
$CBOD_5$			5			25	37.5	379	568	7 Days/Week	24 Hr. Comp
TSS	X					30	45	454	681	7 Days/Week	24 Hr. Comp.
pH (Standard units)			4	6.0	9.0	—	—	—	—	1/Day	Grab
Fecal *** Coliform			4	—	—	200**** N/100ml	400**** N/100ml	—	—	3/week at 48 Hr Int.	**** Grab
Dissolved Oxygen (mg/l)			4,5	7.0	—	—	—	—	—	1/Day	Grab
Chlorine Residual			4,5	1.0 Before Dechlor.	Non-detect after dechlor	—	—	—	—	Every 2 Hours	Grab
Total NH_3 Ammonia			4,5	—	—	5.4	8.1	82	123	7 Days/Week	24 Hour Comp.

*Key
1. Per 208 Plan and Date
2. Per 303(e) Plan and Date
3. Per 401 Certification and Date
4. SWCB Water Quality Standards
5. Other (e.g. Wasteload Allocation Model; Chlorination)

**Based on a Design Flow of 4.0 MGD

*** Applies only if alternate disinfection facilities are installed
**** Geometric Mean
***** Between 10am. & 4 pm.

Table VI

VPDES PERMIT PROGRAM
Permit Processing Change Sheet

1. Effluent Limits and Monitoring Schedule: (List any changes and give a brief rationale for the change).

Outfall No.	Parameter Changed	Monitoring Requirements Changed From	Monitoring Requirements Changed To	Effluent Limits Changed From	Effluent Limits Changed To	Rationale	Date and Initial
P.S.001	$CBOD_5$ (December - May 31)			20 mg/l (monthly ave)	30 mg/l (monthly ave)	Wasteload allocation model was revised using "seasonal low flow"	10/24/88 FMW
"	"			303 kg/d monthly ave	454 kg/d monthly ave		
"	"			30 mg/l (weekly ave)	45 mg/l (weekly ave)		
"	"			454 kg/d (weekly ave)	681 kg/d (weekly ave)		
P.S.001	Total NH_3 Ammonia (December 1-May 31)			2.8 mg/l (monthly ave)	5.4 mg/l (monthly ave)	Effluent limitations were recalculated using "seasonal low flow"	10/24/88 FMW
"	"			42.4 kg/d (monthly ave)	82 kg/d (monthly ave)		
"	"			4.2 mg/l (weekly ave)	8.1 mg/l (weekly ave)		
"	"			63.6 kg/d (weekly ave)	123 kg/d (weekly ave)		

Water Quality Criteria Analysis for Coeburn-Norton-Wise Regional WWTP

The Certificate to Operate (CTO) the 5.0 MGD WWTP was issued in March 11, 2010. The current permit includes a Special Condition that required *Water Quality Criteria Monitoring* once the CTO for the 5 or 6 MGD was issued. The report, which included scans for metals, pesticides, PCBs, Herbicides, Organic Compounds and other miscellaneous chemicals was received February 1, 2011. Concentrations for all parameters tested below detection levels with the exception of the following that were evaluated for potential limits in accordance with the Water Quality Standards, 9VAC 25-260 et seq. The ultimate permitted design flow of 7 MGD was evaluated during low flow conditions. Considering this the most conservative scenario, no limits were required.

Effluent Flow: 7 MGD

Stream Flows:

1Q10:	1.13 MGD
7Q10:	1.33 MGD
30Q5 (Human Health):	2.59 MGD
Harmonic Mean (carcinogens):	12.99 MGD

Stream Data:

Mean Hardness: 120 mg/l
Trout Not Present
Not a Public Water Supply
Early Stages of Life Present

Mixing Information:

Acute (1Q10):	100%
Chronic (7Q10)	100%

Parameter	Results	Water Quality Criteria (Standards)			Wasteload Allocations (WLA)		
		Acute Stnd	Chronic Stnd	Human Health Stnd	Acute WLA	Chronic WLA	Human Health WLA
	(µ/l)	(µ/l)	(µ/l)	(µ/l)	(µ/l)	(µ/l)	(µ/l)
Antimony[1]	2.6	---	---	640	---	---	880
Chloroform	14	---	---	11,000	---	---	15,000
Chromium III[1]	<30	660	86	---	770	100	---
Lead[1]	3.5	150	17	---	170	20	---
Nickel[1]	1.3	210	24	4600	2530	28	6300
Selenium[1]	.803	20[3]	5[3]	4200[3]	23[3]	6[3]	5800[3]
Tetrachloro-Ethylene[2]	3.4	---	---	33	---	---	94
Toulene	1.4	---	---	6000	---	---	8200
Zinc[1]	26	140	140	26000	160	160	36000

1 - metals are measured as Dissolved unless otherwise indicated
2 - carcinogen
3 – Total Recoverable

FRESHWATER
WATER QUALITY CRITERIA / WASTELOAD ALLOCATION ANALYSIS

Facility Name: Coeburn-Norton-Wise WWTP-7 MGD Permit No.: VA0077828

Receiving Stream: Guest River Version: OWP Guidance Memo 00-2011 (8/24/00)

Stream Information

Mean Hardness (as CaCO3) =	120	mg/L
90% Temperature (Annual) =	23.2	deg C
90% Temperature (Wet season) =	15.1	deg C
90% Maximum pH =	8.1	SU
10% Maximum pH =	7.6	SU
Tier Designation (1 or 2) =	2	
Public Water Supply (PWS) Y/N? =	n	
Trout Present Y/N? =	n	
Early Life Stages Present Y/N? =	y	

Stream Flows

1Q10 (Annual) =	1.13	MGD
7Q10 (Annual) =	1.33	MGD
30Q10 (Annual) =	1.66	MGD
1Q10 (Wet season) =	4.54	MGD
30Q10 (Wet season)	13.2	MGD
30Q5 =	2.59	MGD
Harmonic Mean =	12.99	MGD

Mixing Information

Annual - 1Q10 Mix =	100	%
- 7Q10 Mix =	100	%
- 30Q10 Mix =	100	%
Wet Season - 1Q10 Mix =	100	%
- 30Q10 Mix =	100	%

Effluent Information

Mean Hardness (as CaCO3) =	120	mg/L
90% Temp (Annual) =	23.2	deg C
90% Temp (Wet season) =	15.1	deg C
90% Maximum pH =	8.1	SU
10% Maximum pH =	7.6	SU
Discharge Flow =	7	MGD

Parameter	Background	Water Quality Criteria				Wasteload Allocations				Antidegradation Baseline				Antidegradation Allocations				**Most Limiting Allocations**			
(ug/l unless noted)	Conc.	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	**Acute**	**Chronic**	**HH (PWS)**	**HH**
Acenapthene	5	--	--	na	9.9E+02	--	--	na	1.4E+03	--	--	na	1.0E+02	--	--	na	1.4E+02	--	--	na	**1.4E+02**
Acrolein	0	--	--	na	9.3E+00	--	--	na	1.3E+01	--	--	na	9.3E-01	--	--	na	1.3E+00	--	--	na	**1.3E+00**
Acrylonitrile[c]	0	--	--	na	2.5E+00	--	--	na	7.1E+00	--	--	na	2.5E-01	--	--	na	7.1E-01	--	--	na	**7.1E-01**
Aldrin [c]	0	3.0E+00	--	na	5.0E-04	3.5E+00	--	na	1.4E-03	7.5E-01	--	na	5.0E-05	8.7E-01	--	na	1.4E-04	**8.7E-01**	--	na	**1.4E-04**
Ammonia-N (mg/l) (Yearly)	0	6.95E+00	1.20E+00	na	--	8.07E+00	1.48E+00	na	--	1.74E+00	3.00E-01	na	--	2.02E+00	3.71E-01	na	--	**2.02E+00**	**3.71E-01**	na	--
Ammonia-N (mg/l) (High Flow)	0	6.95E+00	2.02E+00	na	--	1.15E+01	5.83E+00	na	--	1.74E+00	5.05E-01	na	--	2.86E+00	1.46E+00	na	--	**2.86E+00**	**1.46E+00**	na	--
Anthracene	0	--	--	na	4.0E+04	--	--	na	5.5E+04	--	--	na	4.0E+03	--	--	na	5.5E+03	--	--	na	**5.5E+03**
Antimony	0	--	--	na	6.4E+02	--	--	na	8.8E+02	--	--	na	6.4E+01	--	--	na	8.8E+01	--	--	na	**8.8E+01**
Arsenic	0	3.4E+02	1.5E+02	na	--	3.9E+02	1.8E+02	na	--	8.5E+01	3.8E+01	na	--	9.9E+01	4.5E+01	na	--	**9.9E+01**	**4.5E+01**	na	--
Barium	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
Benzene [c]	0	--	--	na	5.1E+02	--	--	na	1.5E+03	--	--	na	5.1E+01	--	--	na	1.5E+02	--	--	na	**1.5E+02**
Benzidine[c]	0	--	--	na	2.0E-03	--	--	na	5.7E-03	--	--	na	2.0E-04	--	--	na	5.7E-04	--	--	na	**5.7E-04**
Benzo (a) anthracene[c]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	na	1.8E-02	--	--	na	5.1E-02	--	--	na	**5.1E-02**
Benzo (b) fluoranthene[c]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	na	1.8E-02	--	--	na	5.1E-02	--	--	na	**5.1E-02**
Benzo (k) fluoranthene[c]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	na	1.8E-02	--	--	na	5.1E-02	--	--	na	**5.1E-02**
Benzo (a) pyrene[c]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	na	1.8E-02	--	--	na	5.1E-02	--	--	na	**5.1E-02**
Bis2-Chloroethyl Ether[c]	0	--	--	na	5.3E+00	--	--	na	1.5E+01	--	--	na	5.3E-01	--	--	na	1.5E+00	--	--	na	**1.5E+00**
Bis2-Chloroisopropyl Ether	0	--	--	na	6.5E+04	--	--	na	8.9E+04	--	--	na	6.5E+03	--	--	na	8.9E+03	--	--	na	**8.9E+03**
Bis 2-Ethylhexyl Phthalate[c]	0	--	--	na	2.2E+01	--	--	na	6.3E+01	--	--	na	2.2E+00	--	--	na	6.3E+00	--	--	na	**6.3E+00**
Bromoform [c]	0	--	--	na	1.4E+03	--	--	na	4.0E+03	--	--	na	1.4E+02	--	--	na	4.0E+02	--	--	na	**4.0E+02**
Butylbenzylphthalate	0	--	--	na	1.9E+03	--	--	na	2.6E+03	--	--	na	1.9E+02	--	--	na	2.6E+02	--	--	na	**2.6E+02**
Cadmium	0	4.8E+00	1.3E+00	na	--	5.6E+00	1.6E+00	na	--	1.2E+00	3.3E-01	na	--	1.4E+00	3.9E-01	na	--	**1.4E+00**	**3.9E-01**	na	--
Carbon Tetrachloride[c]	0	--	--	na	1.6E+01	--	--	na	4.6E+01	--	--	na	1.6E+00	--	--	na	4.6E+00	--	--	na	**4.6E+00**
Chlordane [c]	0	2.4E+00	4.3E-03	na	8.1E-03	2.8E+00	5.1E-03	na	2.3E-02	6.0E-01	1.1E-03	na	8.1E-04	7.0E-01	1.3E-03	na	2.3E-03	**7.0E-01**	**1.3E-03**	na	**2.3E-03**
Chloride	0	8.6E+05	2.3E+05	na	--	1.0E+06	2.7E+05	na	--	2.2E+05	5.8E+04	na	--	2.5E+05	6.8E+04	na	--	**2.5E+05**	**6.8E+04**	na	--
TRC	0	1.9E+01	1.1E+01	na	--	2.2E+01	1.3E+01	na	--	4.8E+00	2.8E+00	na	--	5.5E+00	3.3E+00	na	--	**5.5E+00**	**3.3E+00**	na	--
Chlorobenzene	0	--	--	na	1.6E+03	--	--	na	2.2E+03	--	--	na	1.6E+02	--	--	na	2.2E+02	--	--	na	**2.2E+02**
Chlorodibromomethane[c]	0	--	--	na	1.3E+02	--	--	na	3.7E+02	--	--	na	1.3E+01	--	--	na	3.7E+01	--	--	na	**3.7E+01**

Parameter	Background	Water Quality Criteria				Wasteload Allocations				Antidegradation Baseline				Antidegradation Allocations				Most Limiting Allocations			
(ug/l unless noted)	Conc.	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH
Chloroform	0	--	--	na	1.1E+04	--	--	na	1.5E+04	--	--	na	1.1E+03	--	--	na	1.5E+03	--	--	na	1.5E+03
2-Chloronaphthalene	0	--	--	na	1.6E+03	--	--	na	2.2E+03	--	--	na	1.6E+02	--	--	na	2.2E+02	--	--	na	2.2E+02
2-Chlorophenol	0	--	--	na	1.5E+02	--	--	na	2.1E+02	--	--	na	1.5E+01	--	--	na	2.1E+01	--	--	na	2.1E+01
Chlorpyrifos	0	8.3E-02	4.1E-02	na	--	9.6E-02	4.9E-02	na	--	2.1E-02	1.0E-02	na	--	2.4E-02	1.2E-02	na	--	2.4E-02	1.2E-02	na	--
Chromium III	0	6.6E+02	8.6E+01	na	--	7.7E+02	1.0E+02	na	--	1.7E+02	2.2E+01	na	--	1.9E+02	2.6E+01	na	--	1.9E+02	2.6E+01	na	--
Chromium VI	0	1.6E+01	1.1E+01	na	--	1.9E+01	1.3E+01	na	--	4.0E+00	2.8E+00	na	--	4.6E+00	3.3E+00	na	--	4.6E+00	3.3E+00	na	--
Chromium, Total	0	--	--	1.0E+02	--	--	--	na	--	--	--	1.0E+01	--	--	--	1.4E+01	--	--	--	na	--
Chrysene[c]	0	--	--	na	1.8E-02	--	--	na	5.1E-02	--	--	na	1.8E-03	--	--	na	5.1E-03	--	--	na	5.1E-03
Copper	0	1.6E+01	1.0E+01	na	--	1.9E+01	1.2E+01	na	--	4.0E+00	2.6E+00	na	--	4.6E+00	3.1E+00	na	--	4.6E+00	3.1E+00	na	--
Cyanide, Free	0	2.2E+01	5.2E+00	na	1.6E+04	2.6E+01	6.2E+00	na	2.2E+04	5.5E+00	1.3E+00	na	1.6E+03	6.4E+00	1.5E+00	na	2.2E+03	6.4E+00	1.5E+00	na	2.2E+03
DDD[c]	0	--	--	na	3.1E-03	--	--	na	8.9E-03	--	--	na	3.1E-04	--	--	na	8.9E-04	--	--	na	8.9E-04
DDE[c]	0	--	--	na	2.2E-03	--	--	na	6.3E-03	--	--	na	2.2E-04	--	--	na	6.3E-04	--	--	na	6.3E-04
DDT[c]	0	1.1E+00	1.0E-03	na	2.2E-03	1.3E+00	1.2E-03	na	6.3E-03	2.8E-01	2.5E-04	na	2.2E-04	3.2E-01	3.0E-04	na	6.3E-04	3.2E-01	3.0E-04	na	6.3E-04
Demeton	0	--	1.0E-01	na	--	--	1.2E-01	na	--	--	2.5E-02	na	--	--	3.0E-02	na	--	--	3.0E-02	na	--
Diazinon	0	1.7E-01	1.7E-01	na	--	2.0E-01	2.0E-01	na	--	4.3E-02	4.3E-02	na	--	4.9E-02	5.1E-02	na	--	4.9E-02	5.1E-02	na	--
Dibenz(a,h)anthracene[c]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	na	1.8E-02	--	--	na	5.1E-02	--	--	na	5.1E-02
1,2-Dichlorobenzene	0	--	--	na	1.3E+03	--	--	na	1.8E+03	--	--	na	1.3E+02	--	--	na	1.8E+02	--	--	na	1.8E+02
1,3-Dichlorobenzene	0	--	--	na	9.6E+02	--	--	na	1.3E+03	--	--	na	9.6E+01	--	--	na	1.3E+02	--	--	na	1.3E+02
1,4-Dichlorobenzene	0	--	--	na	1.9E+02	--	--	na	2.6E+02	--	--	na	1.9E+01	--	--	na	2.6E+01	--	--	na	2.6E+01
3,3-Dichlorobenzidine[c]	0	--	--	na	2.8E-01	--	--	na	8.0E-01	--	--	na	2.8E-02	--	--	na	8.0E-02	--	--	na	8.0E-02
Dichlorobromomethane[c]	0	--	--	na	1.7E+02	--	--	na	4.9E+02	--	--	na	1.7E+01	--	--	na	4.9E+01	--	--	na	4.9E+01
1,2-Dichloroethane[c]	0	--	--	na	3.7E+02	--	--	na	1.1E+03	--	--	na	3.7E+01	--	--	na	1.1E+02	--	--	na	1.1E+02
1,1-Dichloroethylene	0	--	--	na	7.1E+03	--	--	na	9.7E+03	--	--	na	7.1E+02	--	--	na	9.7E+02	--	--	na	9.7E+02
1,2-trans-dichloroethylene	0	--	--	na	1.0E+04	--	--	na	1.4E+04	--	--	na	1.0E+03	--	--	na	1.4E+03	--	--	na	1.4E+03
2,4-Dichlorophenol	0	--	--	na	2.9E+02	--	--	na	4.0E+02	--	--	na	2.9E+01	--	--	na	4.0E+01	--	--	na	4.0E+01
2,4-Dichlorophenoxy acetic acid (2,4-D)	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
1,2-Dichloropropane[c]	0	--	--	na	1.5E+02	--	--	na	4.3E+02	--	--	na	1.5E+01	--	--	na	4.3E+01	--	--	na	4.3E+01
1,3-Dichloropropene[c]	0	--	--	na	2.1E+02	--	--	na	6.0E+02	--	--	na	2.1E+01	--	--	na	6.0E+01	--	--	na	6.0E+01
Dieldrin[c]	0	2.4E-01	5.6E-02	na	5.4E-04	2.8E-01	6.7E-02	na	1.5E-03	6.0E-02	1.4E-02	na	5.4E-05	7.0E-02	1.7E-02	na	1.5E-04	7.0E-02	1.7E-02	na	1.5E-04
Diethyl Phthalate	0	--	--	na	4.4E+04	--	--	na	6.0E+04	--	--	na	4.4E+03	--	--	na	6.0E+03	--	--	na	6.0E+03
2,4-Dimethylphenol	0	--	--	na	8.5E+02	--	--	na	1.2E+03	--	--	na	8.5E+01	--	--	na	1.2E+02	--	--	na	1.2E+02
Dimethyl Phthalate	0	--	--	na	1.1E+06	--	--	na	1.5E+06	--	--	na	1.1E+05	--	--	na	1.5E+05	--	--	na	1.5E+05
Di-n-Butyl Phthalate	0	--	--	na	4.5E+03	--	--	na	6.2E+03	--	--	na	4.5E+02	--	--	na	6.2E+02	--	--	na	6.2E+02
2,4 Dinitrophenol	0	--	--	na	5.3E+03	--	--	na	7.3E+03	--	--	na	5.3E+02	--	--	na	7.3E+02	--	--	na	7.3E+02
2-Methyl-4,6-Dinitrophenol	0	--	--	na	2.8E+02	--	--	na	3.8E+02	--	--	na	2.8E+01	--	--	na	3.8E+01	--	--	na	3.8E+01
2,4-Dinitrotoluene[c]	0	--	--	na	3.4E+01	--	--	na	9.7E+01	--	--	na	3.4E+00	--	--	na	9.7E+00	--	--	na	9.7E+00
Dioxin 2,3,7,8-tetrachlorodibenzo-p-dioxin	0	--	--	na	5.1E-08	--	--	na	7.0E-08	--	--	na	5.1E-09	--	--	na	7.0E-09	--	--	na	7.0E-09
1,2-Diphenylhydrazine[c]	0	--	--	na	2.0E+00	--	--	na	5.7E+00	--	--	na	2.0E-01	--	--	na	5.7E-01	--	--	na	5.7E-01
Alpha-Endosulfan	0	2.2E-01	5.6E-02	na	8.9E+01	2.6E-01	6.7E-02	na	1.2E+02	5.5E-02	1.4E-02	na	8.9E+00	6.4E-02	1.7E-02	na	1.2E+01	6.4E-02	1.7E-02	na	1.2E+01
Beta-Endosulfan	0	2.2E-01	5.6E-02	na	8.9E+01	2.6E-01	6.7E-02	na	1.2E+02	5.5E-02	1.4E-02	na	8.9E+00	6.4E-02	1.7E-02	na	1.2E+01	6.4E-02	1.7E-02	na	1.2E+01
Alpha + Beta Endosulfan	0	2.2E-01	5.6E-02	--	--	2.6E-01	6.7E-02	--	--	5.5E-02	1.4E-02	--	--	6.4E-02	1.7E-02	--	--	6.4E-02	1.7E-02	--	--
Endosulfan Sulfate	0	--	--	na	8.9E+01	--	--	na	1.2E+02	--	--	na	8.9E+00	--	--	na	1.2E+01	--	--	na	1.2E+01
Endrin	0	8.6E-02	3.6E-02	na	6.0E-02	1.0E-01	4.3E-02	na	8.2E-02	2.2E-02	9.0E-03	na	6.0E-03	2.5E-02	1.1E-02	na	8.2E-03	2.5E-02	1.1E-02	na	8.2E-03
Endrin Aldehyde	0	--	--	na	3.0E-01	--	--	na	4.1E-01	--	--	na	3.0E-02	--	--	na	4.1E-02	--	--	na	4.1E-02
Ethylbenzene	0	--	--	na	2.1E+03	--	--	na	2.9E+03	--	--	na	2.1E+02	--	--	na	2.9E+02	--	--	na	2.9E+02
Fluoranthene	0	--	--	na	1.4E+02	--	--	na	1.9E+02	--	--	na	1.4E+01	--	--	na	1.9E+01	--	--	na	1.9E+01
Fluorene	0	--	--	na	5.3E+03	--	--	na	7.3E+03	--	--	na	5.3E+02	--	--	na	7.3E+02	--	--	na	7.3E+02
Foaming Agents	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--

Parameter	Background	Water Quality Criteria				Wasteload Allocations				Antidegradation Baseline				Antidegradation Allocations				Most Limiting Allocations			
(ug/l unless noted)	Conc.	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH
Guthion	0	--	1.0E-02	na	--	--	1.2E-02	na	--	--	2.5E-03	na	--	--	3.0E-03	na	--	--	3.0E-03	na	--
Heptachlor[c]	0	5.2E-01	3.8E-03	na	7.9E-04	6.0E-01	4.5E-03	na	2.3E-03	1.3E-01	9.5E-04	na	7.9E-05	1.5E-01	1.1E-03	na	2.3E-04	1.5E-01	1.1E-03	na	2.3E-04
Heptachlor Epoxide[c]	0	5.2E-01	3.8E-03	na	3.9E-04	6.0E-01	4.5E-03	na	1.1E-03	1.3E-01	9.5E-04	na	3.9E-05	1.5E-01	1.1E-03	na	1.1E-04	1.5E-01	1.1E-03	na	1.1E-04
Hexachlorobenzene[c]	0	--	--	na	2.9E-03	--	--	na	8.3E-03	--	--	na	2.9E-04	--	--	na	8.3E-04	--	--	na	8.3E-04
Hexachlorobutadiene[c]	0	--	--	na	1.8E+02	--	--	na	5.1E+02	--	--	na	1.8E+01	--	--	na	5.1E+01	--	--	na	5.1E+01
Hexachlorocyclohexane Alpha-BHC[c]	0	--	--	na	4.9E-02	--	--	na	1.4E-01	--	--	na	4.9E-03	--	--	na	1.4E-02	--	--	na	1.4E-02
Hexachlorocyclohexane Beta-BHC[c]	0	--	--	na	1.7E-01	--	--	na	4.9E-01	--	--	na	1.7E-02	--	--	na	4.9E-02	--	--	na	4.9E-02
Hexachlorocyclohexane Gamma-BHC[c] (Lindane)	0	9.5E-01	na	na	1.8E+00	1.1E+00	--	na	5.1E+00	2.4E-01	--	na	1.8E-01	2.8E-01	--	na	5.1E-01	2.8E-01	--	na	5.1E-01
Hexachlorocyclopentadiene	0	--	--	na	1.1E+03	--	--	na	1.5E+03	--	--	na	1.1E+02	--	--	na	1.5E+02	--	--	na	1.5E+02
Hexachloroethane[c]	0	--	--	na	3.3E+01	--	--	na	9.4E+01	--	--	na	3.3E+00	--	--	na	9.4E+00	--	--	na	9.4E+00
Hydrogen Sulfide	0	--	2.0E+00	na	--	--	2.4E+00	na	--	--	5.0E-01	na	--	--	6.0E-01	na	--	--	6.0E-01	na	--
Indeno (1,2,3-cd) pyrene[c]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	na	1.8E-02	--	--	na	5.1E-02	--	--	na	5.1E-02
Iron	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
Isophorone[c]	0	--	--	na	9.6E+03	--	--	na	2.7E+04	--	--	na	9.6E+02	--	--	na	2.7E+03	--	--	na	2.7E+03
Kepone	0	--	0.0E+00	na	--	--	0.0E+00	na	--	--	0.0E+00	na	--	--	0.0E+00	na	--	--	0.0E+00	na	--
Lead	0	1.5E+02	1.7E+01	na	--	1.7E+02	2.0E+01	na	--	3.7E+01	4.3E+00	na	--	4.4E+01	5.1E+00	na	--	4.4E+01	5.1E+00	na	--
Malathion	0	--	1.0E-01	na	--	--	1.2E-01	na	--	--	2.5E-02	na	--	--	3.0E-02	na	--	--	3.0E-02	na	--
Manganese	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
Mercury	0	1.4E+00	7.7E-01	--	--	1.6E+00	9.2E-01	--	--	3.5E-01	1.9E-01	--	--	4.1E-01	2.3E-01	--	--	4.1E-01	2.3E-01	--	--
Methyl Bromide	0	--	--	na	1.5E+03	--	--	na	2.1E+03	--	--	na	1.5E+02	--	--	na	2.1E+02	--	--	na	2.1E+02
Methylene Chloride[c]	0	--	--	na	5.9E+03	--	--	na	1.7E+04	--	--	na	5.9E+02	--	--	na	1.7E+03	--	--	na	1.7E+03
Methoxychlor	0	--	3.0E-02	na	--	--	3.6E-02	na	--	--	7.5E-03	na	--	--	8.9E-03	na	--	--	8.9E-03	na	--
Mirex	0	--	0.0E+00	na	--	--	0.0E+00	na	--	--	0.0E+00	na	--	--	0.0E+00	na	--	--	0.0E+00	na	--
Nickel	0	2.1E+02	2.4E+01	na	4.6E+03	2.5E+02	2.8E+01	na	6.3E+03	5.3E+01	5.9E+00	na	4.6E+02	6.2E+01	7.0E+00	na	6.3E+02	6.2E+01	7.0E+00	na	6.3E+02
Nitrate (as N)	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
Nitrobenzene	0	--	--	na	6.9E+02	--	--	na	9.5E+02	--	--	na	6.9E+01	--	--	na	9.5E+01	--	--	na	9.5E+01
N-Nitrosodimethylamine[c]	0	--	--	na	3.0E+01	--	--	na	8.6E+01	--	--	na	3.0E+00	--	--	na	8.6E+00	--	--	na	8.6E+00
N-Nitrosodiphenylamine[c]	0	--	--	na	6.0E+01	--	--	na	1.7E+02	--	--	na	6.0E+00	--	--	na	1.7E+01	--	--	na	1.7E+01
N-Nitrosodi-n-propylamine[c]	0	--	--	na	5.1E+00	--	--	na	1.5E+01	--	--	na	5.1E-01	--	--	na	1.5E+00	--	--	na	1.5E+00
Nonylphenol	0	2.8E+01	6.6E+00	--	--	3.3E+01	7.9E+00	na	--	7.0E+00	1.7E+00	--	--	8.1E+00	2.0E+00	--	--	8.1E+00	2.0E+00	na	--
Parathion	0	6.5E-02	1.3E-02	na	--	7.5E-02	1.5E-02	na	--	1.6E-02	3.3E-03	na	--	1.9E-02	3.9E-03	na	--	1.9E-02	3.9E-03	na	--
PCB Total[c]	0	--	1.4E-02	na	6.4E-04	--	1.7E-02	na	1.8E-03	--	3.5E-03	na	6.4E-05	--	4.2E-03	na	1.8E-04	--	4.2E-03	na	1.8E-04
Pentachlorophenol[c]	0	1.6E+01	1.2E+01	na	3.0E+01	1.9E+01	1.5E+01	na	8.6E+01	4.0E+00	3.1E+00	na	3.0E+00	4.6E+00	3.6E+00	na	8.6E+00	4.6E+00	3.6E+00	na	8.6E+00
Phenol	0	--	--	na	8.6E+05	--	--	na	1.2E+06	--	--	na	8.6E+04	--	--	na	1.2E+05	--	--	na	1.2E+05
Pyrene	0	--	--	na	4.0E+03	--	--	na	5.5E+03	--	--	na	4.0E+02	--	--	na	5.5E+02	--	--	na	5.5E+02
Radionuclides	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
Gross Alpha Activity (pCi/L)	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
Beta and Photon Activity (mrem/yr)	0	--	--	na	4.0E+00	--	--	na	5.5E+00	--	--	na	4.0E-01	--	--	na	5.5E-01	--	--	na	5.5E-01
Radium 226 + 228 (pCi/L)	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
Uranium (ug/l)	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
Selenium, Total Recoverable	0	2.0E+01	5.0E+00	na	4.2E+03	2.3E+01	6.0E+00	na	5.8E+03	5.0E+00	1.3E+00	na	4.2E+02	5.8E+00	1.5E+00	na	5.8E+02	5.8E+00	1.5E+00	na	5.8E+02
Silver	0	4.7E+00	--	na	--	5.5E+00	--	na	--	1.2E+00	--	na	--	1.4E+00	--	na	--	1.4E+00	--	na	--
Sulfate	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
1,1,2,2-Tetrachloroethane[c]	0	--	--	na	4.0E+01	--	--	na	1.1E+02	--	--	na	4.0E+00	--	--	na	1.1E+01	--	--	na	1.1E+01
Tetrachloroethylene[c]	0	--	--	na	3.3E+01	--	--	na	9.4E+01	--	--	na	3.3E+00	--	--	na	9.4E+00	--	--	na	9.4E+00
Thallium	0	--	--	na	4.7E-01	--	--	na	6.4E-01	--	--	na	4.7E-02	--	--	na	6.4E-02	--	--	na	6.4E-02

Parameter	Background	Water Quality Criteria				Wasteload Allocations				Antidegradation Baseline				Antidegradation Allocations				**Most Limiting Allocations**			
(ug/l unless noted)	Conc.	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	**Acute**	**Chronic**	**HH (PWS)**	**HH**
Toluene	0	--	--	na	6.0E+03	--	--	na	8.2E+03	--	--	na	6.0E+02	--	--	na	8.2E+02	--	--	na	**8.2E+02**
Total dissolved solids	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
Toxaphene[c]	0	7.3E-01	2.0E-04	na	2.8E-03	8.5E-01	2.4E-04	na	8.0E-03	1.8E-01	5.0E-05	na	2.8E-04	2.1E-01	6.0E-05	na	8.0E-04	**2.1E-01**	**6.0E-05**	na	**8.0E-04**
Tributyltin	0	4.6E-01	7.2E-02	na	--	5.3E-01	8.6E-02	na	--	1.2E-01	1.8E-02	na	--	1.3E-01	2.1E-02	na	--	**1.3E-01**	**2.1E-02**	na	--
1,2,4-Trichlorobenzene	0	--	--	na	7.0E+01	--	--	na	9.6E+01	--	--	na	7.0E+00	--	--	na	9.6E+00	--	--	na	**9.6E+00**
1,1,2-Trichloroethane[c]	0	--	--	na	1.6E+02	--	--	na	4.6E+02	--	--	na	1.6E+01	--	--	na	4.6E+01	--	--	na	**4.6E+01**
Trichloroethylene[c]	0	--	--	na	3.0E+02	--	--	na	8.6E+02	--	--	na	3.0E+01	--	--	na	8.6E+01	--	--	na	**8.6E+01**
2,4,6-Trichlorophenol[c]	0	--	--	na	2.4E+01	--	--	na	6.9E+01	--	--	na	2.4E+00	--	--	na	6.9E+00	--	--	na	**6.9E+00**
2-(2,4,5-Trichlorophenoxy) propionic acid (Silvex)	0	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--	--	--	na	--
Vinyl Chloride[c]	0	--	--	na	2.4E+01	--	--	na	6.9E+01	--	--	na	2.4E+00	--	--	na	6.9E+00	--	--	na	**6.9E+00**
Zinc	0	1.4E+02	1.4E+02	na	2.6E+04	1.6E+02	1.6E+02	na	3.6E+04	3.4E+01	3.4E+01	na	2.6E+03	4.0E+01	4.1E+01	na	3.6E+03	**4.0E+01**	**4.1E+01**	na	**3.6E+03**

Notes:

1. All concentrations expressed as micrograms/liter (ug/l), unless noted otherwise
2. Discharge flow is highest monthly average or Form 2C maximum for Industries and design flow for Municipals
3. Metals measured as Dissolved, unless specified otherwise
4. "C" indicates a carcinogenic parameter
5. Regular WLAs are mass balances (minus background concentration) using the % of stream flow entered above under Mixing Information. Antidegradation WLAs are based upon a complete mix.
6. Antideg. Baseline = (0.25(WQC - background conc.) + background conc.) for acute and chronic
   = (0.1(WQC - background conc.) + background conc.) for human health
7. WLAs established at the following stream flows: 1Q10 for Acute, 30Q10 for Chronic Ammonia, 7Q10 for Other Chronic, 30Q5 for Non-carcinogens and Harmonic Mean for Carcinogens. To apply mixing ratios from a model set the stream flow equal to (mixing ratio - 1), effluent flow equal to 1 and 100% mix.

Metal	Target Value (SSTV)
Antimony	8.8E+01
Arsenic	2.7E+01
Barium	na
Cadmium	2.3E-01
Chromium III	1.5E+01
Chromium VI	1.9E+00
Copper	1.9E+00
Iron	na
Lead	3.0E+00
Manganese	na
Mercury	1.4E-01
Nickel	4.2E+00
Selenium	8.9E-01
Silver	5.5E-01
Zinc	1.6E+01

Note: do not use QL's lower than the minimum QL's provided in agency guidance

Toxics Management Program Analysis for Coeburn-Norton Wise Regional WWTP

Summary Test Results
02/05/08 - 02/04/13 Report Due by October 10th each year
NOEC Criteria is 52% or TU_c 1.92

Test Date	Year	Test Type/Organism	LC_{50}	NOEC	%Survival	Notes	Lab
08/18/09-08/25/09 Received 09/14/09	AN-1	Chronic P. promelas	NA	100% S 100% G	98%	Pass	CBI/EMI
08/18/09-08/20/09 Received 09/14/09	AN-1	Acute P. promelas	>100%	NA	100%	Pass	CBI/EMI
08/17/10-08/24/10 Received 09/16/10	AN-2	Chronic P. promelas	NA	100% S 100% G	100%	Pass	CBI/EMI
08/17/10-08/19/10 Received 09/16/10	AN-2	Acute P. promelas	>100%	NA	100%	Pass	CBI/EMI
08/16/11-08/23/11 Received 10/06/11	AN-3	Chronic P. promelas	NA	100% S 100% G	100%	Pass	CBI/EMI
08/16/11-08/18/11 Received 10/06/11	AN-3	Acute P. promelas	>100%	NA	100%	Pass	CBI/EMI

% Survival is the percent survival in 100% effluent at the end of the test period.
All samples are 24 hour flow proportional composites.

Abbreviations:

AN = Annual tests
QT = Quarterly test
Olver = Olver Laboratories
R = Reproduction
G = Growth
S = Survival

Spreadsheet for determination of WET test endpoints or WET limits

4		Excel 97			Acute Endpoint/Permit Limit			Use as LC_{50} in Special Condition, as TUa on DMR							
5		Revision Date: 01/10/05													
6		File: WETLIM10.xls			ACUTE	100% =	NOAEC	LC_{50} =	NA	% Use as	NA	TUa			
7		(MIX.EXE required also)													
8					ACUTE WLAa		0.3678	Note: Inform the permittee that if the mean of the data exceeds							
9								this TUa:	1.0	a limit may result using WLA.EXE					
10															
11					Chronic Endpoint/Permit Limit			Use as NOEC in Special Condition, as TUc on DMR							
12															
13					CHRONIC	1.85161955	TU_c	NOEC =	55	% Use as	1.81	TU_c			
14					BOTH*	3.67800009	TU_c	NOEC =	28	% Use as	3.67	TU_c			
15	Enter data in the cells with blue type:				AML	1.85161955	TU_c	NOEC =	55	% Use as	1.81	TU_c			
16															
17	Entry Date:		04/10/12		ACUTE WLAa,c		3.678		Note: Inform the permittee that if the mean						
18	Facility Name:				CHRONIC WLAc		1.266		of the data exceeds this TUc:			1.0			
19	VPDES Number:		VA0077828		* Both means acute expressed as chronic				a limit may result using WLA.EXE						
20	Outfall Number:		1												
21					% Flow to be used from MIX.EXE				Difuser /modeling study?						
22	Plant Flow:		5	MGD					Enter Y/N	N					
23	Acute 1Q10:		1.13	MGD	100	%			Acute	1	:1				
24	Chronic 7Q10:		1.33	MGD	100	%			Chronic	1	:1				
25															
26	Are data available to calculate CV? (Y/N)				N	(Minimum of 10 data points, same species, needed)					Go to Page 2				
27	Are data available to calculate ACR? (Y/N)				N	(NOEC<LC50, do not use greater/less than data)					Go to Page 3				
28															
29															
30	IWC_a		81.56606852	%	Plant flow/plant flow + 1Q10		NOTE: If the IWCa is >33%, specify the								
31	IWC_c		78.98894155	%	Plant flow/plant flow + 7Q10		NOAEC = 100% test/endpoint for use								
32															
33	Dilution, acute		1.226		100/IWCa										
	Dilution, chronic		1.266		100/IWCc										
35															
35	WLA_a		0.3678	Instream criterion (0.3 TUa) X's Dilution, acute											
37	WLA_c		1.266	Instream criterion (1.0 TUc) X's Dilution, chronic											
38	$WLA_{a,c}$		3.678	ACR X's WLA_a - converts acute WLA to chronic units											
39															
40	ACR -acute/chronic ratio		10	LC50/NOEC (Default is 10 - if data are available, use tables Page 3)											
41	CV-Coefficient of variation		0.6	Default of 0.6 - if data are available, use tables Page 2)											
42	Constants	eA	0.4109447	Default = 0.41											
43		eB	0.6010373	Default = 0.60											
44		eC	2.4334175	Default = 2.43											
45		eD	2.4334175	Default = 2.43 (1 samp)	No. of sample		1	**The Maximum Daily Limit is calculated from the lowest							
46								LTA, X's eC. The LTAa,c and MDL using it are driven by the ACR.							
47	$LTA_{a,c}$		1.511454607	WLAa,c X's eA											
48	LTA_c		0.760913222	WLAc X's eB							Rounded NOEC's		%		
49	MDL** with $LTA_{a,c}$		3.67800009	TU_c	NOEC =	27.188689	(Protects from acute/chronic toxicity)				NOEC =	28	%		
50	MDL** with LTA_c		1.85161955	TU_c	NOEC =	54.006775	(Protects from chronic toxicity)				NOEC =	55	%		
51	AML with lowest LTA		1.85161955	TU_c	NOEC =	54.006775	Lowest LTA X's eD				NOEC =	55			
52															
53	IF ONLY ACUTE ENDPOINT/LIMIT IS NEEDED, CONVERT MDL FROM TU_c to TU_a														
54											Rounded LC50's		%		
55	MDL with $LTA_{a,c}$		0.367800009	TU_a	LC50 =	271.886888	%	Use NOAEC=100%			LC50 =	NA	%		
56	MDL with LTA_c		0.185161955	TU_a	LC50 =	540.067748	%	Use NOAEC=100%			LC50 =	NA			
57															
58															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
59															
60		**Page 2 - Follow the directions to develop a site specific CV (coefficient of variation)**													
61															
62		IF YOU HAVE AT LEAST 10 DATA POINTS THAT					Vertebrate			Invertebrate					
63		ARE QUANTIFIABLE (NOT "<" OR ">")					IC_{25} Data			IC_{25} Data					
64		FOR A SPECIES, ENTER THE DATA IN EITHER					or			or					
65		COLUMN "G" (VERTEBRATE) OR COLUMN					LC_{50} Data	LN of data		LC_{50} Data	LN of data				
66		"J" (INVERTEBRATE). THE 'CV' WILL BE					**********			**********					
67		PICKED UP FOR THE CALCULATIONS				1	0		1	0					
68		BELOW. THE DEFAULT VALUES FOR eA,				2			2						
69		eB, AND eC WILL CHANGE IF THE 'CV' IS				3			3						
70		ANYTHING OTHER THAN 0.6.				4			4						
71						5			5						
72						6			6						
73						7			7						
74		Coefficient of Variation for effluent tests				8			8						
75						9			9						
76		CV =	0.6	(Default 0.6)		10			10						
77						11			11						
78		δ^2 =	0.3074847			12			12						
79		δ =	0.554513029			13			13						
80						14			14						
81		Using the log variance to develop eA				15			15						
82			(P. 100, step 2a of TSD)			16			16						
83		Z = 1.881 (97% probability stat from table				17			17						
84		A =	-0.889296666			18			18						
85		eA =	0.410944686			19			19						
86						20			20						
87		Using the log variance to develop eB													
88			(P. 100, step 2b of TSD)			St Dev	NEED DATA	NEED DATA	St Dev	NEED DATA	NEED DATA				
89		δ_4^2 =	0.086177696			Mean	0	0	Mean	0	0				
90		δ_4 =	0.293560379			Variance	0	0.000000	Variance	0	0.000000				
91		B =	-0.50909823			CV	0		CV	0					
92		eB =	0.601037335												
93															
94		Using the log variance to develop eC													
95			(P. 100, step 4a of TSD)												
96															
97		δ^2 =	0.3074847												
98		δ =	0.554513029												
99		C =	0.889296658												
100		eC =	2.433417525												
101															
102		Using the log variance to develop eD													
103			(P. 100, step 4b of TSD)												
104		n =	1	This number will most likely stay as "1", for 1 sample/month.											
105		δ_n^2 =	0.3074847												
106		δ_n =	0.554513029												
107		D =	0.889296658												
108		eD =	2.433417525												
109															

Page 3 - Follow directions to develop a site specific ACR (Acute to Chronic Ratio)

To determine Acute/Chronic Ratio (ACR), insert usable data below. Usable data is defined as valid paired test results, acute and chronic, tested at the same temperature, same species. The chronic NOEC must be less than the acute LC_{50}, since the ACR divides the LC_{50} by the NOEC. LC_{50}'s >100% should not be used.

Table 1. ACR using Vertebrate data

Set #	LC_{50}	NOEC	Test ACR	Logarithm	Geomean	Antilog	ACR to Use
1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
3	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
6	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
10	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA

ACR for vertebrate data:	0
Table 1. Result: Vertebrate ACR	0
Table 2. Result: Invertebrate ACR	0
Lowest ACR	Default to 10

Table 2. ACR using Invertebrate data

Set #	LC_{50}	NOEC	Test ACR	Logarithm	Geomean	Antilog	ACR to Use
1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
3	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
6	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
10	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA

ACR for vertebrate data:	0

Convert LC_{50}'s and NOEC's to Chronic TU's for use in WLA.EXE

Table 3. ACR used: 10

	Enter LC_{50}	TUc	Enter NOEC	TUc
1		NO DATA		NO DATA
2		NO DATA		NO DATA
3		NO DATA		NO DATA
4		NO DATA		NO DATA
5		NO DATA		NO DATA
6		NO DATA		NO DATA
7		NO DATA		NO DATA
8		NO DATA		NO DATA
9		NO DATA		NO DATA
10		NO DATA		NO DATA
11		NO DATA		NO DATA
12		NO DATA		NO DATA
13		NO DATA		NO DATA
14		NO DATA		NO DATA
15		NO DATA		NO DATA
16		NO DATA		NO DATA
17		NO DATA		NO DATA
18		NO DATA		NO DATA
19		NO DATA		NO DATA
20		NO DATA		NO DATA

If WLA.EXE determines that an acute limit is needed, you need to convert the TUc answer you get to TUa and then an LC50, enter it here: NO DATA $\%LC_{50}$ NO DATA TUa

DILUTION SERIES TO RECOMMEND

Table 4.

	Monitoring % Effluent	Monitoring TUc	Limit % Effluent	Limit TUc
Dilution series based on data mean	100	1.0		
Dilution series to use for limit			55	1.8181818
Dilution factor to recommend:	0.5		0.7416198	
Dilution series to recommend:	100.0	1.00	100.0	1.00
	50.0	2.00	74.2	1.35
	25.0	4.00	55.0	1.82
	12.5	8.00	40.8	2.45
	6.25	16.00	30.3	3.31
Extra dilutions if needed	3.12	32.05	22.4	4.46
	1.56	64.10	16.6	6.01

Cell: I9
Comment:
This is assuming that the data are Type 2 data (none of the data in the data set are censored - "<" or ">").

Cell: K18
Comment: This is assuming that the data are Type 2 data (none of the data in the data set are censored - "<" or ">").

Cell: J22
Comment: Remember to change the "N" to "Y" if you have ratios entered, otherwise, they won't be used in the calculations.

Cell: C40
Comment:
If you have entered data to calculate an ACR on page 3, and this is still defaulted to "10", make sure you have selected "Y" in cell E21

Cell: C41
Comment: If you have entered data to calculate an effluent specific CV on page 2, and this is still defaulted to "0.6", make sure you have selected "Y" in cell E20

Cell: L48
Comment:
See Row 151 for the appropriate dilution series to use for these NOEC's

Cell: G62
Comment:
Vertebrates are:
Pimephales promelas
Oncorhynchus mykiss
Cyprinodon variegatus

Cell: J62
Comment:
Invertebrates are:
Ceriodaphnia dubia
Mysidopsis bahia

Cell: C117
Comment: Vertebrates are:

Pimephales promelas
Cyprinodon variegatus

Cell: M119
Comment: The ACR has been picked up from cell C34 on Page 1. If you have paired data to calculate an ACR, enter it in the tables to the left, and make sure you have a "Y" in cell E21 on Page 1. Otherwise, the default of 10 will be used to convert your acute data.

Cell: M121
Comment: If you are only concerned with acute data, you can enter it in the NOEC column for conversion and the number calculated will be equivalent to the TUa. The calculation is the same: 100/NOEC = TUc or 100/LC50 = TUa.

Cell: C136
Comment: Invertebrates are:

Ceriodaphnia dubia
Mysidopsis bahia

Spreadsheet for determination of WET test endpoints or WET limits

4		Excel 97			Acute Endpoint/Permit Limit			Use as LC_{50} in Special Condition, as TUa on DMR							
5		Revision Date: 01/10/05													
6		File: WETLIM10.xls			ACUTE	100% =	NOAEC	LC_{50} =	NA	% Use as	NA	TUa			
7		(MIX.EXE required also)													
8					ACUTE WLAa		0.352153855	Note: Inform the permittee that if the mean of the data exceeds							
9								this TUa:	1.0	a limit may result using WLA.EXE					
11					Chronic Endpoint/Permit Limit			Use as NOEC in Special Condition, as TUc on DMR							
13					CHRONIC	1.76183997	TU_c	NOEC =	57	% Use as	1.75	TU_c			
14					BOTH*	3.52153855	TU_c	NOEC =	29	% Use as	3.44	TU_c			
15	Enter data in the cells with blue type:				AML	1.76183997	TU_c	NOEC =	57	% Use as	1.75	TU_c			
17	Entry Date:		04/10/12		ACUTE WLAa,c		3.52153846		Note: Inform the permittee that if the mean						
18	Facility Name:				CHRONIC WLAc		1.20461538		of the data exceeds this TUc:			1.0			
19	VPDES Number:		VA0077828		* Both means acute expressed as chronic				a limit may result using WLA.EXE						
20	Outfall Number:		1												
21					% Flow to be used from MIX.EXE				Difuser /modeling study?						
22	Plant Flow:		6.5	MGD					Enter Y/N	N					
23	Acute 1Q10:		1.13	MGD	100	%			Acute	1	:1				
24	Chronic 7Q10:		1.33	MGD	100	%			Chronic	1	:1				
26	Are data available to calculate CV? (Y/N)				N	(Minimum of 10 data points, same species, needed)					Go to Page 2				
27	Are data available to calculate ACR? (Y/N)				N	(NOEC<LC50, do not use greater/less than data)					Go to Page 3				
30	IWC_a		85.19003932	%	Plant flow/plant flow + 1Q10		NOTE: If the IWCa is >33%, specify the								
31	IWC_c		83.01404853	%	Plant flow/plant flow + 7Q10		NOAEC = 100% test/endpoint for use								
33	Dilution, acute		1.173846154		100/IWCa										
34	Dilution, chronic		1.204615385		100/IWCc										
36	WLA_a		0.352153846	Instream criterion (0.3 TUa) X's Dilution, acute											
37	WLA_c		1.204615385	Instream criterion (1.0 TUc) X's Dilution, chronic											
38	$WLA_{a,c}$		3.521538462	ACR X's WLA_a - converts acute WLA to chronic units											
40	ACR -acute/chronic ratio		10	LC50/NOEC (Default is 10 - if data are available, use tables Page 3)											
41	CV-Coefficient of variation		0.6	Default of 0.6 - if data are available, use tables Page 2)											
42	Constants	eA	0.4109447	Default = 0.41											
43		eB	0.6010373	Default = 0.60											
44		eC	2.4334175	Default = 2.43											
45		eD	2.4334175	Default = 2.43 (1 samp)	No. of sample		1	**The Maximum Daily Limit is calculated from the lowest							
46								LTA, X's eC. The LTAa,c and MDL using it are driven by the ACR.							
47	$LTA_{a,c}$		1.447157567	WLAa,c X's eA											
48	LTA_c		0.724018778	WLAc X's eB							Rounded NOEC's		%		
49	MDL** with $LTA_{a,c}$		3.521538548	TU_c	NOEC =	28.396679	(Protects from acute/chronic toxicity)				NOEC =	29	%		
50	MDL** with LTA_c		1.761839965	TU_c	NOEC =	56.758844	(Protects from chronic toxicity)				NOEC =	57	%		
51	AML with lowest LTA		1.761839965	TU_c	NOEC =	56.758844	Lowest LTA X's eD				NOEC =	57			
53	IF ONLY ACUTE ENDPOINT/LIMIT IS NEEDED, CONVERT MDL FROM TU to TU_a														
54											Rounded LC50's		%		
55	MDL with $LTA_{a,c}$		0.352153855	TU_a	LC50 =	283.966791	%	Use NOAEC=100%			LC50 =	NA	%		
56	MDL with LTA_c		0.176183997	TU_a	LC50 =	567.588441	%	Use NOAEC=100%			LC50 =	NA			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
59															
60		**Page 2 - Follow the directions to develop a site specific CV (coefficient of variation)**													
61															
62		IF YOU HAVE AT LEAST 10 DATA POINTS THAT					Vertebrate			Invertebrate					
63		ARE QUANTIFIABLE (NOT "<" OR ">")					IC_{25} Data			IC_{25} Data					
64		FOR A SPECIES, ENTER THE DATA IN EITHER					or			or					
65		COLUMN "G" (VERTEBRATE) OR COLUMN					LC_{50} Data	LN of data		LC_{50} Data	LN of data				
66		"J" (INVERTEBRATE). THE 'CV' WILL BE					**********			**********					
67		PICKED UP FOR THE CALCULATIONS				1	0		1	0					
68		BELOW. THE DEFAULT VALUES FOR eA,				2			2						
69		eB, AND eC WILL CHANGE IF THE 'CV' IS				3			3						
70		ANYTHING OTHER THAN 0.6.				4			4						
71						5			5						
72						6			6						
73						7			7						
74		Coefficient of Variation for effluent tests				8			8						
75						9			9						
76		CV =	0.6	(Default 0.6)		10			10						
77						11			11						
78		δ^2 =	0.3074847			12			12						
79		δ =	0.554513029			13			13						
80						14			14						
81		Using the log variance to develop eA				15			15						
82			(P. 100, step 2a of TSD)			16			16						
83		Z = 1.881	(97% probability stat from table			17			17						
84		A =	-0.88929666			18			18						
85		eA =	0.410944686			19			19						
86						20			20						
87		Using the log variance to develop eB													
88			(P. 100, step 2b of TSD)			St Dev	NEED DATA	NEED DATA	St Dev	NEED DATA	NEED DATA				
89		δ_4^2 =	0.086177696			Mean	0	0	Mean	0	0				
90		δ_4 =	0.293560379			Variance	0	0.000000	Variance	0	0.000000				
91		B =	-0.50909823			CV	0		CV	0					
92		eB =	0.601037335												
93															
94		Using the log variance to develop eC													
95			(P. 100, step 4a of TSD)												
96															
97		δ^2 =	0.3074847												
98		δ =	0.554513029												
99		C =	0.889296658												
100		eC =	2.433417525												
101															
102		Using the log variance to develop eD													
103			(P. 100, step 4b of TSD)												
104		n =	1	This number will most likely stay as "1", for 1 sample/month.											
105		δ_n^2 =	0.3074847												
106		δ_n =	0.554513029												
107		D =	0.889296658												
108		eD =	2.433417525												
109															

Page 3 - Follow directions to develop a site specific ACR (Acute to Chronic Ratio)

To determine Acute/Chronic Ratio (ACR), insert usable data below. Usable data is defined as valid paired test results, acute and chronic, tested at the same temperature, same species. The chronic NOEC must be less than the acute LC_{50}, since the ACR divides the LC_{50} by the NOEC. LC_{50}'s >100% should not be used.

Table 1. ACR using Vertebrate data

Set #	LC_{50}	NOEC	Test ACR	Logarithm	Geomean	Antilog	ACR to Use
1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
3	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
6	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
10	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA

ACR for vertebrate data: 0

Table 1. Result:	Vertebrate ACR
Table 2. Result:	Invertebrate ACR
	Lowest ACR

0	
0	
Default to 10	

Table 2. ACR using Invertebrate data

Set #	LC_{50}	NOEC	Test ACR	Logarithm	Geomean	Antilog	ACR to Use
1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
3	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
6	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
10	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA

ACR for vertebrate data: 0

DILUTION SERIES TO RECOMMEND

Table 4.

	Monitoring % Effluent	Monitoring TUc	Limit % Effluent	Limit TUc
Dilution series based on data mean	100	1.0		
Dilution series to use for limit			57	1.754386
Dilution factor to recommend:	0.5		0.7549834	
Dilution series to recommend:	100.0	1.00	100.0	1.00
	50.0	2.00	75.5	1.32
	25.0	4.00	57.0	1.75
	12.5	8.00	43.0	2.32
	6.25	16.00	32.5	3.08
Extra dilutions if needed	3.12	32.05	24.5	4.08
	1.56	64.10	18.5	5.40

Convert LC_{50}'s and NOEC's to Chronic TU's

Table 3.

for use in WLA.EXE
ACR used: 10

	Enter LC_{50}	TUc	Enter NOEC	TUc
1		NO DATA		NO DATA
2		NO DATA		NO DATA
3		NO DATA		NO DATA
4		NO DATA		NO DATA
5		NO DATA		NO DATA
6		NO DATA		NO DATA
7		NO DATA		NO DATA
8		NO DATA		NO DATA
9		NO DATA		NO DATA
10		NO DATA		NO DATA
11		NO DATA		NO DATA
12		NO DATA		NO DATA
13		NO DATA		NO DATA
14		NO DATA		NO DATA
15		NO DATA		NO DATA
16		NO DATA		NO DATA
17		NO DATA		NO DATA
18		NO DATA		NO DATA
19		NO DATA		NO DATA
20		NO DATA		NO DATA

If WLA.EXE determines that an acute limit is needed, you need to convert the TUc answer you get to TUa and then an LC50, enter it here:

NO DATA	%LC_{50}
NO DATA	TUa

Cell: I9
Comment:
This is assuming that the data are Type 2 data (none of the data in the data set are censored - "<" or ">").

Cell: K18
Comment: This is assuming that the data are Type 2 data (none of the data in the data set are censored - "<" or ">").

Cell: J22
Comment: Remember to change the "N" to "Y" if you have ratios entered, otherwise, they won't be used in the calculations.

Cell: C40
Comment:
If you have entered data to calculate an ACR on page 3, and this is still defaulted to "10", make sure you have selected "Y" in cell E21

Cell: C41
Comment: If you have entered data to calculate an effluent specific CV on page 2, and this is still defaulted to "0.6", make sure you have selected "Y" in cell E20

Cell: L48
Comment:
See Row 151 for the appropriate dilution series to use for these NOEC's

Cell: G62
Comment:
Vertebrates are:
Pimephales promelas
Oncorhynchus mykiss
Cyprinodon variegatus

Cell: J62
Comment:
Invertebrates are:
Ceriodaphnia dubia
Mysidopsis bahia

Cell: C117
Comment: Vertebrates are:

Pimephales promelas
Cyprinodon variegatus

Cell: M119
Comment: The ACR has been picked up from cell C34 on Page 1. If you have paired data to calculate an ACR, enter it in the tables to the left, and make sure you have a "Y" in cell E21 on Page 1. Otherwise, the default of 10 will be used to convert your acute data.

Cell: M121
Comment: If you are only concerned with acute data, you can enter it in the NOEC column for conversion and the number calculated will be equivalent to the TUa. The calculation is the same: 100/NOEC = TUc or 100/LC50 = TUa.

Cell: C138
Comment: Invertebrates are:

Ceriodaphnia dubia
Mysidopsis bahia

Spreadsheet for determination of WET test endpoints or WET limits

4		Excel 97			Acute Endpoint/Permit Limit			Use as LC_{50} in Special Condition, as TUa on DMR							
5		Revision Date: 01/10/05													
6		File: WETLIM10.xls			ACUTE	100% =	NOAEC	LC_{50} =	NA	% Use as	NA	TUa			
7		(MIX.EXE required also)													
8					ACUTE WLAa		0.34842857	Note: Inform the permittee that if the mean of the data exceeds							
9								this TUa:	1.0	a limit may result using WLA.EXE					
10															
11					Chronic Endpoint/Permit Limit			Use as NOEC in Special Condition, as TUc on DMR							
12															
13					CHRONIC	1.74046387	TU_c	NOEC =	58	% Use as	1.72	TU_c			
14					BOTH*	3.4842858	TU_c	NOEC =	29	% Use as	3.44	TU_c			
15	Enter data in the cells with blue type:				AML	1.74046387	TU_c	NOEC =	58	% Use as	1.72	TU_c			
16															
17	Entry Date:		04/10/12		ACUTE WLAa,c		3.48428571		Note: Inform the permittee that if the mean						
18	Facility Name:				CHRONIC WLAc		1.19		of the data exceeds this TUc:			1.0			
19	VPDES Number:		VA0077828		* Both means acute expressed as chronic				a limit may result using WLA.EXE						
20	Outfall Number:		1												
21					% Flow to be used from MIX.EXE				Difuser /modeling study?						
22	Plant Flow:		7	MGD					Enter Y/N	N					
23	Acute 1Q10:		1.13	MGD	100	%			Acute	1	:1				
24	Chronic 7Q10:		1.33	MGD	100	%			Chronic	1	:1				
25															
26	Are data available to calculate CV? (Y/N)				N	(Minimum of 10 data points, same species, needed)					Go to Page 2				
27	Are data available to calculate ACR? (Y/N)				N	(NOEC<LC50, do not use greater/less than data)					Go to Page 3				
28															
29															
30	IWC_a		86.10086101	%	Plant flow/plant flow + 1Q10		NOTE: If the IWCa is >33%, specify the								
31	IWC_c		84.03361345	%	Plant flow/plant flow + 7Q10		NOAEC = 100% test/endpoint for use								
32															
33	Dilution, acute		1.161428571		100/IWCa										
34	Dilution, chronic		1.19		100/IWCc										
35															
36	WLA_a		0.348428571	Instream criterion (0.3 TUa) X's Dilution, acute											
37	WLA_c		1.19	Instream criterion (1.0 TUc) X's Dilution, chronic											
38	$WLA_{a,c}$		3.484285714	ACR X's WLA_a - converts acute WLA to chronic units											
39															
40	ACR -acute/chronic ratio		10	LC50/NOEC (Default is 10 - if data are available, use tables Page 3)											
41	CV-Coefficient of variatio		0.6	Default of 0.6 - if data are available, use tables Page 2)											
42	Constants	eA	0.4109447	Default = 0.41											
43		eB	0.6010373	Default = 0.60											
44		eC	2.4334175	Default = 2.43											
45		eD	2.4334175	Default = 2.43 (1 samp)	No. of sample		1	**The Maximum Daily Limit is calculated from the lowest							
46								LTA, X's eC. The LTAa,c and MDL using it are driven by the ACR.							
47	$LTA_{a,c}$		1.431848748	WLAa,c X's eA											
48	LTA_c		0.715234387	WLAc X's eB							Rounded NOEC's		%		
49	MDL** with $LTA_{a,c}$		3.4842858	TU_c	NOEC =	28.700286	(Protects from acute/chronic toxicity)				NOEC =	29	%		
50	MDL** with LTA_c		1.740463874	TU_c	NOEC =	57.455947	(Protects from chronic toxicity)				NOEC =	58	%		
51	AML with lowest LTA		1.740463674	TU_c	NOEC =	57.455947	Lowest LTA X's eD				NOEC =	58			
52															
53	IF ONLY ACUTE ENDPOINT/LIMIT IS NEEDED, CONVERT MDL FROM TU_c to TU_a														
54											Rounded LC50's		%		
55	MDL with $LTA_{a,c}$		0.34842858	TU_a	LC50 =	287.002863	%	Use NOAEC=100%			LC50 =	NA	%		
56	MDL with LTA_c		0.174046387	TU_a	LC50 =	574.559469	%	Use NOAEC=100%			LC50 =	NA			
57															
58															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
59															
60		**Page 2 - Follow the directions to develop a site specific CV (coefficient of variation)**													
61															
62		IF YOU HAVE AT LEAST 10 DATA POINTS THAT					Vertebrate			Invertebrate					
63		ARE QUANTIFIABLE (NOT "<" OR ">")					IC_{25} Data			IC_{25} Data					
64		FOR A SPECIES, ENTER THE DATA IN EITHER					or			or					
65		COLUMN "G" (VERTEBRATE) OR COLUMN					LC_{50} Data	LN of data		LC_{50} Data	LN of data				
66		"J" (INVERTEBRATE). THE 'CV' WILL BE					**********			**********					
67		PICKED UP FOR THE CALCULATIONS				1	0		1	0					
68		BELOW. THE DEFAULT VALUES FOR eA,				2			2						
69		eB, AND eC WILL CHANGE IF THE 'CV' IS				3			3						
70		ANYTHING OTHER THAN 0.6.				4			4						
71						5			5						
72						6			6						
73						7			7						
74		Coefficient of Variation for effluent tests				8			8						
75						9			9						
76		CV =	0.6	(Default 0.6)		10			10						
77						11			11						
78		δ^2 =	0.3074847			12			12						
79		δ =	0.554513029			13			13						
80						14			14						
81		Using the log variance to develop eA				15			15						
82			(P. 100, step 2a of TSD)			16			16						
83		Z = 1.881 (97% probability stat from table				17			17						
84		A =	-0.88929666			18			18						
85		eA =	0.410944686			19			19						
86						20			20						
87		Using the log variance to develop eB													
88			(P. 100, step 2b of TSD)			St Dev	NEED DATA	NEED DATA	St Dev	NEED DATA	NEED DATA				
89		δ_4^2 =	0.086177696			Mean	0	0	Mean	0	0				
90		δ_4 =	0.293560379			Variance	0	0.000000	Variance	0	0.000000				
91		B =	-0.50909823			CV	0		CV	0					
92		eB =	0.601037335												
93															
94		Using the log variance to develop eC													
95			(P. 100, step 4a of TSD)												
96															
97		δ^2 =	0.3074847												
98		δ =	0.554513029												
99		C =	0.889296658												
100		eC =	2.433417525												
101															
102		Using the log variance to develop eD													
103			(P. 100, step 4b of TSD)												
104		n =	1	This number will most likely stay as "1", for 1 sample/month.											
105		δ_n^2 =	0.3074847												
106		δ_n =	0.554513029												
107		D =	0.889296658												
108		eD =	2.433417525												
109															

Page 3 - Follow directions to develop a site specific ACR (Acute to Chronic Ratio)

To determine Acute/Chronic Ratio (ACR), insert usable data below. Usable data is defined as valid paired test results, acute and chronic, tested at the same temperature, same species. The chronic NOEC must be less than the acute LC_{50}, since the ACR divides the LC_{50} by the NOEC. LC_{50}'s >100% should not be used.

Table 1. ACR using Vertebrate data

Set #	LC_{50}	NOEC	Test ACR	Logarithm	Geomean	Antilog	ACR to Use
1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
3	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
6	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
10	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA

ACR for vertebrate data: 0

Table 1. Result:	Vertebrate ACR	0
Table 2. Result:	Invertebrate ACR	0
	Lowest ACR	Default to 10

Table 2. ACR using Invertebrate data

Set #	LC_{50}	NOEC	Test ACR	Logarithm	Geomean	Antilog	ACR to Use
1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
3	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
6	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA
10	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	NO DATA

ACR for vertebrate data: 0

DILUTION SERIES TO RECOMMEND

Table 4.

	Monitoring % Effluent	Monitoring TUc	Limit % Effluent	Limit TUc
Dilution series based on data mean	100	1.0		
Dilution series to use for limit			58	1.7241379
Dilution factor to recommend:	0.5		0.7615773	
Dilution series to recommend:	100.0	1.00	100.0	1.00
	50.0	2.00	76.2	1.31
	25.0	4.00	58.0	1.72
	12.5	8.00	44.2	2.26
	6.25	16.00	33.6	2.97
Extra dilutions if needed	3.12	32.05	25.6	3.90
	1.56	64.10	19.5	5.13

Convert LC_{50}'s and NOEC's to Chronic TU's

Table 3.

for use in WLA.EXE
ACR used: 10

	Enter LC_{50}	TUc	Enter NOEC	TUc
1		NO DATA		NO DATA
2		NO DATA		NO DATA
3		NO DATA		NO DATA
4		NO DATA		NO DATA
5		NO DATA		NO DATA
6		NO DATA		NO DATA
7		NO DATA		NO DATA
8		NO DATA		NO DATA
9		NO DATA		NO DATA
10		NO DATA		NO DATA
11		NO DATA		NO DATA
12		NO DATA		NO DATA
13		NO DATA		NO DATA
14		NO DATA		NO DATA
15		NO DATA		NO DATA
16		NO DATA		NO DATA
17		NO DATA		NO DATA
18		NO DATA		NO DATA
19		NO DATA		NO DATA
20		NO DATA		NO DATA

If WLA.EXE determines that an acute limit is needed, you need to convert the TUc answer you get to TUa and then an LC50, enter it here:

NO DATA	%LC_{50}	
NO DATA	TUa	

Cell: I9
Comment:
This is assuming that the data are Type 2 data (none of the data in the data set are censored - "<" or ">").

Cell: K18
Comment: This is assuming that the data are Type 2 data (none of the data in the data set are censored - "<" or ">").

Cell: J22
Comment: Remember to change the "N" to "Y" if you have ratios entered, otherwise, they won't be used in the calculations.

Cell: C40
Comment:
If you have entered data to calculate an ACR on page 3, and this is still defaulted to "10", make sure you have selected "Y" in cell E21

Cell: C41
Comment: If you have entered data to calculate an effluent specific CV on page 2, and this is still defaulted to "0.6", make sure you have selected "Y" in cell E20

Cell: L48
Comment:
See Row 151 for the appropriate dilution series to use for these NOEC's

Cell: G62
Comment:
Vertebrates are:
Pimephales promelas
Oncorhynchus mykiss
Cyprinodon variegatus

Cell: J62
Comment:
Invertebrates are:
Ceriodaphnia dubia
Mysidopsis bahia

Cell: C117
Comment: Vertebrates are:

Pimephales promelas
Cyprinodon variegatus

Cell: M119
Comment: The ACR has been picked up from cell C34 on Page 1. If you have paired data to calculate an ACR, enter it in the tables to the left, and make sure you have a "Y" in cell E21 on Page 1. Otherwise, the default of 10 will be used to convert your acute data.

Cell: M121
Comment: If you are only concerned with acute data, you can enter it in the NOEC column for conversion and the number calculated will be equivalent to the TUa. The calculation is the same: 100/NOEC = TUc or 100/LC50 = TUa.

Cell: C138
Comment: Invertebrates are:

Ceriodaphnia dubia
Mysidopsis bahia

VIRGINIA DEQ NO EXPOSURE CERTIFICATION FOR EXCLUSION FROM VPDES STORM WATER PERMITTING

Submission of this **No Exposure Certification** constitutes notice that the entity identified below does not require permit authorization for its storm water discharges associated with industrial activity under the VPDES Permit Program due to the existence of a condition of **No Exposure.**

A condition of **No Exposure** exists at an industrial facility when all industrial materials and activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff. Industrial materials or activities include, but are not limited to, material handling equipment or activities, industrial machinery, raw materials, intermediate products, by-products, final products, or waste products. Material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, final product or waste product. A storm resistant shelter is not required for the following industrial materials and activities:

- drums, barrels, tanks, and similar containers that are tightly sealed, provided those containers are not deteriorated and do not leak. "Sealed" means banded or otherwise secured and without operational taps or valves;
- adequately maintained vehicles used in material handling; and
- final products, other than products that would be mobilized in storm water discharges (e.g., rock salt).

A No Exposure Certification must be provided for each facility qualifying for the No Exposure exclusion. In addition, the exclusion from VPDES permitting is available on a facility-wide basis only, not for individual outfalls. If any industrial activities or materials are or will be exposed to precipitation, the facility is not eligible for the No Exposure exclusion.

By signing and submitting this No Exposure Certification form, the entity below is certifying that a condition of No Exposure exists at its facility or site, and is obligated to comply with the terms and conditions at 9 VAC 25-31-120 E (the VPDES Permit Regulation).

Please Type or Print All Information. ALL INFORMATION ON THIS FORM MUST BE PROVIDED.

1. **Facility Operator Information**

Name: Coeburn-Norton-Wise Regional Wastewater Treatment Authority

Mailing Address: P.O. Box 1296

City: Norton State: VA Zip: 24273 Phone: (276) 679-7236

2. **Facility/Site Location Information**

Facility Name: Coeburn-Norton-Wise Regional Wastewater Treatment Plant

Address: 11550 Pine Camp Road

City: Coeburn State: VA Zip: 24230

County Name: Wise

Latitude: 36° 55' 37" Longitude: 82° 28' 16"

3. **Was the facility or site previously covered under a VPDES storm water permit?** Yes ☐ No X

If "Yes", enter the VPDES permit number: _____

4. **SIC/Activity Codes:** Primary: 4952 Secondary (if applicable): _____

5. **Total size of facility/site associated with industrial activity:** ~1 acres

6. **Have you paved or roofed over a formerly exposed pervious area in order to qualify for the No Exposure exclusion?** Yes ☐ No X

If "Yes", please indicate approximately how much area was paved or roofed. Completing this question does not disqualify you for the No Exposure exclusion. However, DEQ may use this information in considering whether storm water discharges from your site are likely to have an adverse impact on water quality, in which case you could be required to obtain permit coverage.

Less than one acre ☐ One to five acres ☐ More than five acres ☐

7. Exposure Checklist

Are any of the following materials or activities exposed to precipitation, now or in the foreseeable future? (Please check either "Yes" or "No" in the appropriate box.) **If you answer "Yes" to any of these questions (1) through (11), you are not eligible for the No Exposure exclusion.**

	Yes	No
(1) Using, storing or cleaning industrial machinery or equipment, and areas where residuals from using, storing or cleaning industrial machinery or equipment remain and are exposed to storm water	☐	X
(2) Materials or residuals on the ground or in storm water inlets from spill/leaks	☐	X
(3) Materials or products from past industrial activity	☐	X
(4) Material handling equipment (except adequately maintained vehicles)	☐	X
(5) Materials or products during loading/unloading or transporting activities	☐	X
(6) Materials or products stored outdoors (except final products intended for outside use [e.g., new cars] where exposure to storm water does not result in the discharge of pollutants)	☐	X
(7) Materials contained in open, deteriorated or leaking storage drums, barrels, tanks, and similar containers	☐	X
(8) Materials or products handled/stored on roads or railways owned or maintained by the discharger	☐	X
(9) Waste material (except waste in covered, non-leaking containers [e.g., dumpsters])	☐	X
(10) Application or disposal of process wastewater (unless otherwise permitted)	☐	X
(11) Particulate matter or visible deposits of residuals from roof stacks and/or vents not otherwise regulated (i.e., under an air quality control permit) and evident in the storm water outflow	☐	X

8. Certification Statement

I certify under penalty of law that I have read and understand the eligibility requirements for claiming a condition of no exposure and obtaining an exclusion from VPDES storm water permitting; and that there are no discharges of storm water contaminated by exposure to industrial activities or materials from the industrial facility identified in this document (except as allowed under 9 VAC 25-31-120 E 2).

I understand that I am obligated to submit a No Exposure Certification form once every five years to the Department of Environmental Quality and, if requested, to the operator of the local MS4 into which this facility discharges (where applicable). I understand that I must allow the Department, or MS4 operator where the discharge is into the local MS4, to perform inspections to confirm the condition of no exposure and to make such inspection reports publicly available upon request. I understand that I must obtain coverage under a VPDES permit prior to any point source discharge of storm water associated with industrial activity from the facility.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons directly involved in gathering the information, the information submitted is to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Print Name: Mark S. Hollyfield

Print Title: Executive Director

Signature: Mark Hollyfield

Date: 10/28/2011

For Department of Environmental Quality Use Only

Accepted/Not Accepted by: _____ Date : _____