APPENDIX H

SEWRPC Technical Memorandum –December 7, 2005- Point Source Loadings Calculations for Purposes of Watercourse Modeling-Addendum No. 3: Consideration of Chicago, Illinois CSO Concentration Data, Nitrogen Concentrations to be Used for Point Sources, and LeSaffre Yeast Corporation Loads.

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MEMORANDUM

TO: MMSD 2020 Facilities Planning Team

FROM: SEWRPC Staff

DATE: December 7, 2005

SUBJECT: **POINT SOURCE LOADINGS CALCULATIONS FOR PURPOSES OF WATERCOURSE MODELING—ADDENDUM NO 3: CONSIDERATION OF CHICAGO, ILLINOIS CSO CONCENTRATION DATA, NITROGEN CONCENTRATIONS TO BE USED FOR POINT SOURCES, AND LESAFFRE YEAST CORPORATION LOADS**

Please find enclosed a copy of the subject technical memorandum. Should you have any questions on the memorandum, please contact Mr. Michael G. Hahn of the Commission staff at (262) 547-6722, extension 243.

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#113366 V1 - RWQMP UPDATE TECH MEMO ON PSL 11/07/05 TRANSMIT
MGH/pk

Enclosure (#113365)

cc: Mr. Timothy R. Bate, MMSD
Mr. William Krill, HNTB Corporation
Dr. Leslie Shoemaker, Tetra Tech, Inc.
Mr. Joshua M. Kasun, Tetra Tech MPS
Mr. Kevin Kratt, Tetra Tech, Inc.
Ms. Mary Recktenwalt, Triad Engineering, Inc.

SEWRPC Technical Memorandum

POINT SOURCE LOADINGS CALCULATIONS FOR PURPOSES OF WATERCOURSE MODELING—ADDENDUM NO 3: CONSIDERATION OF CHICAGO, ILLINOIS CSO CONCENTRATION DATA, NITROGEN CONCENTRATIONS TO BE USED FOR POINT SOURCES, AND LESAFFRE YEAST CORPORATION LOADS

Prepared by the

Southeastern Wisconsin Regional Planning Commission

December 6, 2005

SEWRPC Technical Memorandum

POINT SOURCE LOADINGS CALCULATIONS FOR PURPOSES OF WATERCOURSE MODELING—ADDENDUM NO 3: CONSIDERATION OF CHICAGO, ILLINOIS CSO CONCENTRATION DATA, NITROGEN CONCENTRATIONS TO BE USED FOR POINT SOURCES, AND LESAFFRE YEAST CORPORATION LOADS

PREVIOUS POINT SOURCE MEMORANDA

Watercourse computer modeling is currently underway to evaluate the instream water quality conditions within the entirety of the Kinnickinnic River, Menomonee River, Milwaukee River, Oak Creek, and Root River watersheds. This modeling is intended to serve as a planning tool as part of the cooperative and coordinated efforts by the Milwaukee Metropolitan Sewerage District (MMSD) for its 2020 facilities planning effort and the Southeastern Wisconsin Regional Planning Commission (SEWRPC) for its update of the Regional Water Quality Management Plan. The technical work on the water quality modeling is being conducted by the MMSD 2020 facilities plan technical consulting team and is being overseen by SEWRPC staff.

A previous technical memorandum prepared by the MMSD 2020 Facilities Planning Team and dated December 2004, summarized the types of point source pollutant discharges to waterways within the MMSD planning area and identified the sources of data, assumptions, protocols, and methodologies used to calculate the point source pollutant loadings.[1] A May 28, 2005, SEWRPC technical memorandum was prepared to provide additional information regarding point sources of water pollution for those portions of the watersheds being modeled that are outside of the MMSD planning area. That addendum summarizes the types of pollutant point sources that discharge to the upper Milwaukee River watershed, the lower Root River watershed, and the portions of the Lake Michigan direct drainage area north of Wind Point for years 2002-2003 conditions which were to be used for the base year 2000 conditions. A June 28, 2005, SEWRPC technical memorandum summarizes the methodology to be used for characterizing the point sources outside the MMSD planning area under 2020 conditions. The point sources considered include municipal sewage treatment plants, local community sanitary sewer bypasses, industrial discharges, private sewage treatment plants, and other point sources (as identified).

CONSIDERATION OF CITY OF CHICAGO COMBINED SEWER OVERFLOW CONCENTRATION DATA PROVIDED BY MARQUETTE UNIVERSITY

As noted above, a December 2004 technical memorandum prepared by the MMSD 2020 Facilities Planning Team identified the sources of data, assumptions, protocols, and methodologies used to calculate the point source pollutant loadings. In his role as a member of the SEWRPC regional water quality management plan update (RWQMPU) Advisory Committee and Modeling Subcommittee, on April 26, 2005, Dr. Steve Melching of Marquette University provided combined sewer overflow (CSO) event mean concentration data for biochemical oxygen demand (BOD), total suspended solids (TSS), total phosphorus, organic nitrogen, ammonia, nitrate/nitrite, and dissolved oxygen. Those data were based on

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[1] *Mary Recketenwalt, Jeremy Nitka, Tom Sear, and Laura Gerold,* Point Source Loadings Calculations for Purposes of Water Quality Modeling: MMSD Planning Area, *Draft Technical Memorandum, Triad Engineering, December 13, 2004.*

sampling at Chicago, Illinois CSO pumping stations. We have developed the following recommendations regarding use of the data for the RWQMPU water quality modeling .

BOD, TSS, and Total Phosphorus Concentrations Comparisons

Comparisons between the Chicago CSO and recommended mean concentrations for BOD, TSS, and total phosphorus recommended for modeling shows that the Chicago data are more consistent with the "most polluted" Menomonee River CT 5/6 outfall location as shown in Table 1. Hence, the Chicago CSO concentrations from the three outfall locations, as shown in Exhibit A, are not considered to be representative of the majority of MMSD CSO concentrations for which data are available. We do not recommend using the Chicago CSO data to characterize MMSD CSO concentrations for modeling of these three constituents.

Nitrogen Species Concentrations Comparisons

Comparisons between the Chicago CSO data and the recommended mean concentrations for organic nitrogen, ammonia, and nitrate/nitrite recommended for modeling show that the Chicago data are consistent with the "most polluted" conditions at the Menomonee River CT 5/6 outfall location as shown in Table 2, except for nitrate/nitrite. Hence, the Chicago CSO concentrations from the three outfall locations, as shown in Exhibit A, are not likely to be representative of the majority of the MMSD CSO concentrations of organic nitrogen or ammonia. The mean nitrate/nitrite concentrations of the Chicago CSO and Ohio River Valley Sanitation Commission (ORVWSC) CSO data are nearly the same concentration, so no change in the concentration used for the modeling is necessary. We do not recommend using the Chicago CSO data to change the recommended MMSD CSO modeling concentrations for organic nitrogen or ammonia.

Further, we do not recommend using linear relationships between BOD versus organic nitrogen or ammonia concentrations based on the Chicago CSO data to estimate average conditions for modeling MMSD CSO organic nitrogen or ammonia concentrations for the following reasons:

- BOD concentrations within the Chicago CSO are much higher compared to most MMSD CSO concentrations;
- Chicago CSO concentrations are based on a limited number of overflow events; and
- BOD, organic nitrogen, and ammonia concentrations within the Chicago CSO are much more limited in concentration ranges compared to the data used for generation of the recommended concentrations for modeling, as shown in Table 2, either using data directly from MMSD or data from the ORVWSC.

Dissolved Oxygen Concentrations

Chicago CSO dissolved oxygen (DO) concentrations indicate that DO does not decrease to negligible concentrations or to zero, despite corresponding relatively high BOD concentrations (Exhibit A). Therefore, we recommend that the modelers use an average DO geometric mean concentration of 3.4 milligrams per liter based on the Chicago CSO data, which are the only real data of which we are aware that contain actual measurements of DO concentrations.

NITROGEN CONCENTRATIONS

Total nitrogen is a composite of several different compounds, including ammonia, nitrate, nitrite, and organic nitrogen. This section of the point source memo addendum describes the representation of the concentrations of nitrogen components in noncontact cooling water point source discharges and other industrial point source discharges that are included in the water quality model.

Table 1[2]

RECOMMENDED CSO GEOMETRIC MEAN CONCENTRATIONS FOR MODELING[3]
(Directly From MMSD Sampling Data), (Directly From Chicago CSO Sampling Data)

Parameter	BOD_5 (mg/L)	Total Suspended Solids (mg/L)	Fecal Coliform (#/100 mL)[1]	E-coli Coliform (#/100 mL)[1,2]	Total Phosphorus (mg/L)	Copper (mg/L)	Zinc (mg/L)
Source	MMSD sampling	MMSD sampling	MMSD sampling	MMSD Sampling	MMSD sampling	MMSD sampling	MMSD sampling
Menomonee River (all but CT 5/6)	9 (14)	56(88)	160,000 (650,000)	96,000 (130,000)	0.64(0.83)	0.02 (0.02)	0.09 (0.10)
Menomonee River (only CT 5/6)	54(134)	116(172)	160,000 (650,000)	96,000 (130,000)	1.07(1.46)	0.02 (0.02)	0.12 (0.17)
Kinnickinnic River	9(14)	56(88)	160,000 (650,000)	96,000 (130,000)	0.64(0.80)	0.02 (0.02)	0.09 (0.10)
Milwaukee River	9(14)	56(88)	160,000 (650,000)	96,000 (130,000)	0.48(0.58)	0.02 (0.02)	0.09 (0.10)
Number of Values Analyzed [4]	332	331	78	28	304	136	136
Range (Min-Max) [5]	0.1-1,200	4-680	400-24,000,000	18,000- 370,000	0.02-8.4	0.0059- 0.17	0.029-0.7
Error of Mean [6]	0.8 (59)	5 (36)	340,000	17,800	0.04-0.09 (0.4)	0.0012	0.005 (0.068)
Chicago CSO (measured data)	42.94	118.48	- -	- -	1.10	- -	- -
Number of Samples	24	20	- -	- -	10	- -	- -
Range (Min-Max)	10.79-186.11	26.16-1,405.47	- -	- -	0.46-2.70	- -	- -
Error of Mean	8.50	75.13	- -	- -	0.22	- -	- -

1) Bacteria concentrations were rounded to two significant figures. 2) There were an insufficient number of samples to create an e-coli mean for each watershed. 3) Arithmetic means are presented in parentheses 4) Number of values analyzed is the number of CSO sample results from all watersheds (including CSOs to Lake Michigan). 5) Range is the min-max of all CSO sample results. 6) Standard error of arithmetic mean. Error of mean of BOD, TSS and zinc for CT 5/6 in parentheses. Error of mean for phosphorus varies by watershed (because mean varies by watershed) but it ranges from 0.04 (Milwaukee River) to 0.4 (Menomonee @ CT 5/6).

[2] *Same as Table 5 from December 13, 2004, draft memorandum* Point Source Loadings Calculations for Purposes of Watercourse Modeling; MMSD Planning Area *but updated to include Chicago CSO data.*

Table 2[3]

RECOMMENDED CSO GEOMETRIC CONCENTRATIONS FOR MODELING- NITROGEN SPECIES[4]
(Derived Values), (Directly From Chicago CSO Sampling Data)

Parameter	Organic Nitrogen as N (mg/L)	Ammonia (mg/L) as N	Nitrate/ Nitrite (mg/L) as N
Source	ORVWSC Sampling [1]	ORVWSC Sampling [1]	ORVWSC Sampling [2]
Menomonee River (all but CT 5/6)	1.3 (1.7)	0.7 (0.8)	1
Menomonee River (only CT 5/6)	5.4 (12.8)	1.9 (4.0)	1
Kinnickinnic River	1.3 (1.7)	0.7 (0.8)	1
Milwaukee River	1.3 (1.7)	0.7 (0.8)	1
Number of Values Analyzed [3]	332	332	162
Range (Min-Max) [5]	0.44-111	0.48-32	0-7
Error of Mean [6]	NA	NA	0.09
Chicago CSO (measured data)	4.79	1.46	0.91
Number of Samples	10	15	11
Range (Min-Max)	2.45-14.16	0.32-5.81	0.36-1.93
Error of Mean	1.05	0.36	.018

1) These values were calculated based on a BOD/Organic Nitrogen regression analysis performed on CSO data from the Ohio River Valley Water Sanitation Commission (ORVWSC). 2) There is no statistically significant linear relationship between BOD and nitrate/nitrite, therefore we recommend using the means directly from the ORVWSC study {0.9 rounded to 1}. Details of this analysis are presented in Appendix A. 3) Number of values for organic nitrogen and ammonia are the number of MMSD sample results (BOD concentrations) applied to the regression analysis. The number of nitrate/nitrate values is the number of nitrate/nitrate sample results provided by the ORVWSC. 4) Arithmetic means in parentheses. 5) Range is the min/max of calculated values from regression analysis. 6) Standard error of the arithmetic mean for nitrate/nitrite calculated directly from ORVWSC data. It is inappropriate to calculate arithmetic standard error of mean on the regressed data.

Ammonia concentrations in permitted point source discharges are monitored under the conditions of the Wisconsin Pollutant Discharge Elimination System permits. Thus, those monitored concentrations were used in the model.

Much of the noncontact cooling water in the study area comes municipal water systems draining water from Lake Michigan. Since there are no known additives to the cooling water that would change the nitrate and nitrite concentrations from those for municipal water supplies, it is reasonable to use the nitrate and nitrite concentrations characteristic of treated water from those supplies. The 2004 Annual Water Quality Report for the Milwaukee Water Works, which is the primary source of industria noncontact cooling water in the study area, lists maximum, minimum, and median concentrations of nitrate, as nitrogen, of 0.420 mg/l, 0.190 mg/l, and 0.290 mg/l, respectively. That report also lists maximum, minimum, and median concentrations of nitrite, as nitrogen, of 0.005 mg/l, <0.005 mg/l, and

[3] *Same as Table 6 from December 13, 2004, draft memorandum* Point Source Loadings Calculations for Purposes of Watercourse Modeling; MMSD Planning Area *but updated to include Chicago CSO data.*

<0.005 mg/l, respectively. A nitrate concentration of 0.3 mg/l which is consistent with the median drinking water concentration of 0.290 mg/l was selected for use in the model. Based on the low median nitrite concentration, the nitrite concentration was considered to be negligible and was taken as 0 mg/l in the model. Organic nitrogen concentrations were also considered to be negligible and taken to be 0 mg/l.

Based on the experience of the modelers, industrial point source discharges other than noncontact cooling water were assumed to have a nitrate concentration of 3.0 mg/l, an organic nitrogen concentration of 1.0 mg/l, and a nitrite concentration of 0 mg/l.

LESAFFRE YEAST CORPORATION

The Lesaffre Yeast Corporation plant in the Menomonee River watershed will be closed as of the end of 2005. Thus, point source loads from that plant will be excluded from all model representations based on year 2020 land use conditions.

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