



Minnesota River, Minnesota

Rahr Malting Company Point Source-Nonpoint Source Trading

Permitting Authority:

Minnesota Pollution Control Agency (MPCA)

Trading Contact:

Bruce Henningsgaard, P.E.
Principal Engineer
Regional Division, MPCA
520 Lafayette Road North
St. Paul, MN 55155-4194
(651) 757-2427
bruce.henningsgaard@state.mn.us

Permit Writer:

Scott Knowles, P.E.
Principal Engineer
Industrial Division, MPCA
525 Lake Avenue, Suite 400
Duluth, MN 55802
(218) 723-4927
scott.knowles@state.mn.us

Pollutants of Concern in Watershed:

Low oxygen conditions (high biochemical oxygen demand)

Pollutants Addressed in Permit:

CBOD5, nitrogen (NH3-N), phosphorous, sediment
Permit Issued: January 8, 1997, reissued August 23, 2007

Permit Information:

Rahr Malting Company "Trading" Permit Summary:
www.pca.state.mn.us/water/pubs/rahrtrad.pdf
Lower Minnesota River TMDL – Low Dissolved Oxygen Web site:
<http://www.pca.state.mn.us/water/tmdl/project-lowerminnesota-oxygen.html>

(note: permits are not available online)

Overview and Highlights

The Rahr Malting Company (Rahr) in Shakopee, Minnesota (about 25 miles southwest of downtown Minneapolis), processes barley for various industries. Rahr had a National Pollutant Discharge Elimination System (NPDES) permit for non-contact cooling water and was also an indirect user, discharging its process and sanitary wastewater to the Metropolitan Council Environmental Services' (MCES) Blue Lake wastewater treatment plant (WWTP), a discharger to the Minnesota River. In 1996, Rahr decided to expand operations and build its own wastewater treatment plant in order to provide more cost-effective treatment and enable an increase in effluent flow. Rahr applied for an individual NPDES permit for this new discharge.

A Waste Load Allocation Study (WLA study) for biochemical oxygen demand (BOD) was developed in 1985 and revised in 1988 to address low dissolved oxygen conditions in the lower Minnesota River. The WLA Study did not include any allocation of BOD that would accommodate a new direct discharge from Rahr.

In 1997, Rahr received an NPDES permit that included provisions to allow water quality trading with nonpoint sources. The water quality trading approach was successful and allowed Rahr to build its wastewater treatment plant while still meeting the requirements of the 1988 WLA Study. In 2007, the Minnesota Pollution Control Agency (MPCA) reissued Rahr's NPDES permit and continued the point source-nonpoint source trading program. This case study focuses on the trading program incorporated into Rahr's permit to reduce oxygen demand in the lower Minnesota River.

Watershed: <i>Minnesota River, Minnesota</i>		
Key Water Quality Concerns: <i>CBOD and low dissolved oxygen</i>		
Stakeholder Involvement Techniques:		
<ul style="list-style-type: none"> <i>Discussions with the permittee and an environmental advocacy group</i> <i>Public participation during permit reissuance process</i> 		
Case Study Issues of Interest		
Type of Point Sources	POTW Discharges	
	Industrial Process Wastewater Discharges	✓
	Concentrated Animal Feeding Operations	
	Municipal Separate Storm Sewer System Discharges	
	Construction Site Stormwater Discharges	
	Industrial Facility Stormwater Discharges	
	Combined Sewer Overflows	
Highlighted Approach(es)	Statewide Watershed Approach	
	Implementation of Water Quality Standards	
	Implementation of Total Maximum Daily Loads or Other Watershed Pollutant Reduction Goals	✓
	Permit Coordination/Synchronization	
	Integrated Municipal Requirements	
	Point Source – Point Source Water Quality Trading	
	Point Source – Nonpoint Source Water Quality Trading	✓
Discharger Association		
Coordinated Watershed Monitoring		

Permitting Background

Rahr processes approximately 2.5 million pounds of barley per day for various industries. In 1996, Rahr applied for a permit to discharge from a new wastewater treatment plant that it wanted to build to treat its process wastewater effluent. Previously, Rahr had been discharging process wastewater to the MCES Blue Lake wastewater treatment plant. The proposed new direct discharge loading from Rahr would result in 150 pounds per day (lbs/day) of CBOD₅ (5-day carbonaceous BOD) discharged to the Minnesota River.

In 1988, the United States Environmental Protection Agency (EPA) and MPCA had established a Total Maximum Daily Load (TMDL) and WLA Study for the Minnesota River below river mile 25 (at Shakopee) for the seven-day ten year low flow (7Q10). The allowable loading was set at 53,400 lbs/day CBOD ultimate. Many factors contribute to the oxygen demand in the lower Minnesota River, including the upstream demand from the river and its tributaries and existing loads from two wastewater treatment plants discharging directly to the non-attainment reach (see sidebar for more on oxygen demand).

The 53,400 lbs/day load of CBOD in the reach was fully allocated to existing sources with no allocation available for new dischargers, such as Rahr. Although Rahr's CBOD loading from its process wastewater discharge to the MCES Blue Lake WWTP was removed, the CBOD allocation to the WWTP was not reduced and was reserved for future growth. Furthermore, Rahr could not achieve zero discharge of CBOD. To reduce the oxygen demand in the non-attainment reach of the Minnesota River and to compensate for the new CBOD loading proposed by Rahr, the permit for Rahr's new discharge included effluent limitations combined with non-point source reductions that could be gained through point source-nonpoint source water quality trading.

Permit Strategy

Rahr proposed a plan to trade the impacts of its new point source discharge to the Minnesota River with a reduction in nonpoint source pollutant loadings upstream in order to reduce costs while still complying with the requirements from the WLA Study. With input from Rahr and the Minnesota Center for Environmental Advocacy (MCEA), MPCA crafted an NPDES permit that included provisions to allow point source-nonpoint source water quality trading. MPCA issued the permit on January 8, 1997. This permit required Rahr to obtain 150 lbs/day of CBOD₅ "equivalent credits" (see discussion of trading under "Permit Components" below).

Through five projects in four locations, Rahr achieved a total of 212.8 equivalent credits during the permit term, which was 62.8 lbs/day more than required. The additional 62.8 lbs/day in trading credits generated has enabled Rahr

to increase its discharge to the Minnesota River. Rahr has expanded its current treatment from 1.5 million gallons per day (mgd), using an existing sequencing batch reactor (SBR), to a peak hourly wet weather flow of 2.41 mgd, using combined and parallel treatment trains of the existing SBR and a new membrane bioreactor system.

The first permit with point source-nonpoint source water quality trading expired in 2002; however, Rahr legally continued to operate under the requirements of the expired permit until the new permit was issued on August 23, 2007. The new permit continued the water quality trading program from the 1997 permit, updated water quality trade crediting calculations, modified permit limitations, and appended requirements concerning replacements for existing and future trades.

Oxygen Demand

Dissolved oxygen is the amount of oxygen present in the water. Oxygen is required to support fish and other aquatic life, and can be reduced by the effects of pollutants such as nutrients and sediment. Oxygen demand is measured by tests such as the 5-day biochemical oxygen demand (BOD₅) test. In the wasteload allocation study for the lower Minnesota River, Carbonaceous Biochemical Oxygen Demand (CBOD) is the parameter of concern and a 5-day CBOD test (CBOD₅) test, which inhibits nitrification, is specified in Rahr Malting's permit for measuring oxygen demand.

Permit Highlights

Point Source-Nonpoint Source Trading

Point source-nonpoint source pollutant trading refers to the substitution of nonpoint source pollutant load reductions for point source pollutant load reductions by a discharger permitted under the NPDES program. Trading for phosphorous, nitrogen, CBOD₅, and sediment was authorized in the 1997 and 2007 Rahr permits to reduce the oxygen demand in the lower Minnesota River. In order to address the relative persistence of these compounds in the river system and the spatial variability of best management practice (BMP) sites, nonpoint source load reductions are converted to pollutant trading units. The trading program is described in Attachment 2 of the permit and summarized below under "Permit Components."

Trade Funding

The 1997 permit required Rahr to spend \$250,000 dedicated to projects that encourage adoption of nonpoint source reduction practices. A nonprofit organization was established to administer the funds as part of the initial permit; however, it has been dissolved and the requirement was removed

from the 2007 permit. Rahr exceeded the full amount of the fund implementing projects to achieve the 212.8 lbs/day of CBOD₅ discharge credits. For future projects, the credit value for the project will be based on the ratio of Rahr’s financial contributions to the contributions from public sources. Rahr will only receive credits for portions financed by its contributions. Specific requirements for replacement trades are specified in the 2007 permit.

Permit Components

Surface Discharge Limits

The Limits and Monitoring Requirements section of the 2007 NPDES permit provides effluent limitations for discharges to surface water from two stations, one for Rahr’s non-contact cooling water and one for the discharge from its wastewater treatment plant. The permit also requires Rahr to monitor influent to both the SBR and the membrane bioreactor. Effluent limitations are established for CBOD₅, ammonia nitrogen (May-November), phosphorus, total suspended solids, pH, and dissolved oxygen (when the river flow at Jordan United States Geological Survey gauging station is less than 20,000 cubic feet per second). The 2007 permit contains a CBOD₅ monthly average effluent limit of 12 mg/l year-round, ammonia nitrogen limits that vary by month, and a phosphorous monthly average limit of 1.0 mg/l (a reduction from the 2.0 mg/L limit in the 1997 permit) in accordance with MPCA’s phosphorus strategy. The phosphorus strategy was published in 2000 to address the negative impacts of phosphorus on Minnesota’s lakes, rivers, and streams.

As noted above, the 1997 permit specified requirements for Rahr’s nonpoint CBOD₅ reductions and provided a schedule to achieve the initially required 150 lbs/day loading reduction. This reduction was achieved and exceeded during the permit term. The 2007 permit increased the allowable monthly average CBOD₅ mass loading limit to 212.8 lbs/day to account for the increased 62.8 lbs/day in additional trading credits achieved during the previous permit term.

Point Source-Nonpoint Source Trading Summary

The Point-Nonpoint Source Trading Summary, Attachment 2 of the permit, explains the premise for Rahr’s point-nonpoint source trading process. The summary was included in the 1997 permit and updates were added for the 2007 permit (presented in italics in the permit). The summary describes trading eligible BMPs, including soil erosion control, livestock exclusion, rotational grazing with livestock exclusion, critical areas set aside, wetland treatment systems, alternative surface tile inlets, cover cropping, and BMPs installed for reduction of CBOD₅. It also presents the concepts involved in developing the trading

program, including how the ratios were developed to assess the impact of phosphorus and nitrogen loading on oxygen demand in the river and assumptions for BMP load reduction determinations. In addition, the summary document highlights methods used to minimize the risks associated with point source-nonpoint source trading. These methods include conservative pollutant equivalency ratios, safety factors for estimating phosphorus content in loading from soil erosion, calculation of a “field loss factor” for nitrogen to account for volatilization of ammonia and the assimilation of nitrogen prior to entering a surface water, and “delivery ratios” to account for the distance a nonpoint source site is located from the stream. Finally, the summary document explains how the trading agreement and administration of the trades would occur during the permit term.

Pollutant Equivalency Credits are used to calculate the number of trading units achieved by a lb/day reduction of phosphorus, CBOD₅, or nitrogen or a ton/day reduction of sediment in each area of the River. MPCA establishes Pollutant Equivalency Credits using the standard that one lb/day of CBOD₅ in the Metro reach (the area of the river where reductions are needed) equals one trading unit. Loading reductions of the other tradable pollutants (nitrogen, phosphorus, and sediment) were converted to BMP CBOD₅ units using the pollutant-specific ratios provided in Attachment 2 of the permit. Table 1 presents the Pollutant Equivalency Credits for the tradable pollutants based on parameter and location of the reduction on the Minnesota River.

The amount of CBOD₅ discharge credits generated by a CBOD₅ load reduction depends on where the reduction is obtained. If the reduction is at Shakopee (River Mile 25), 100% of the credit is applied (e.g., a 1-pound reduction of CBOD₅ equals 1 credit). MPCA also established a “BOD trading zone” that extends upstream from Shakopee to River Mile 107. The number of credits available for each pound reduction in CBOD₅ loading in the trading zone is based on the exertion of oxygen demand downstream in the Metro reach during the 7-day, 10 year low flow (7Q10). For

Table 1. Pollutant Equivalency Credits

Trade parameter	Measured value	Metro reach BMP CBOD ₅ credit	Upstream BMP CBOD ₅ credit
CBOD ₅	1 pound	1 unit	Percent of 1 trading credit determined by distance of the location where reduction is achieved from Shakopee
Nitrogen	1 pound	4 units	1 unit
Phosphorus	1 pound	8 units	8 units
Sediment	1 ton	0.5 units	0.5 units

example, for a reduction at River Mile 107, only 11% of the pounds removed is credited. Outside of the “BOD trading zone” upstream, only 1% of the pounds removed is credited because most of the oxygen depletion will already have been exerted prior to the Metro reach.

The conversion of load reductions to trading units for other parameters also takes into account the relative persistence of the pollutant and the spatial variability of BMP sites. For example, for every pound of nitrogen reduced in the Metro reach, Rahr would receive 4 units of CBOD₅ discharge credits; however, for every pound of nitrogen reduced upstream of the Metro reach, Rahr would receive only 1 unit of CBOD₅ discharge credit.

The conversion of nonpoint source load reductions to credits is also conservative. For example, for every pound of phosphorus reduced upstream Rahr receives eight units of CBOD₅ discharge credits. This exchange rate is conservative in that one pound of phosphorus would actually generate approximately 16 equivalent CBOD₅ credits (rather than only 8) when the river is at attainment. This conservative conversion factor and others that were used in the credit calculation process produce an overall trading ratio of greater than 2:1 (i.e., it takes two units of nonpoint source reductions to equal one unit of point source reduction) in order to account for uncertainty and assure a net environmental benefit.

The nonpoint sources eligible to participate in trading must be within the watershed boundaries and upstream of the Rahr point source discharge. As noted above, MPCA identified a menu of approved BMP projects and credit calculation procedures. These provisions became a part of the 1997 NPDES permit and were updated in the 2007 permit. Table 2 provides the active sites participating in trading as detailed in Attachment 1 of the 2007 permit.

Water Quality Trade Crediting Calculations

The Rahr Malting Water Quality Trade Crediting Calculations are provided in Attachment 1 of the permit. Various trade calculations are necessary to determine loading reduction units for all point source and nonpoint source trades. For each type of BMP identified for point source-nonpoint source trading in the watershed, the document details the calculation procedures necessary to estimate pollutant reductions and requires that these calculations be used and submitted to MPCA for approval by the Commissioner. Attachment 1 also details new pollutant trading credit calculations for May through September and for October through April of each year for both point source and nonpoint source trades in the event that one of the existing BMP sites providing the 212.8 lbs/day credit becomes inactive or revoked for any reason or if Rahr requests additional credits.

Reporting Requirements

In addition to submitting monthly Discharge Monitoring Reports, Rahr is required to submit an Annual CBOD₅ Nonpoint Load Reduction Monitoring Report that verifies compliance with the effluent limitation for CBOD₅ nonpoint load reduction and certifies that the active sites that were approved for trade credits remain active. The report requires photographs of each site taken during the previous year for comparison to the initial photographs provided to MPCA or the landowner’s certification that the project is ongoing and effective.

Permit Effectiveness

Environmental Benefits

Five projects (i.e. two bank stabilization projects, two riparian vegetation restoration projects and one cattle exclusion project) were completed during the previous permit term and, as previously noted, all trading obligations were met for a total of 212.8 lbs/day loading reduction achieved. The Rahr permit required a monthly average 150 lb/day reduction, so the permit and trading program achieved 30 percent more reduction than required. In addition, the completed projects restored native vegetation to the Minnesota River riparian corridor and demonstrated the variety of plants that can be successfully used for such projects.

The impact of Rahr’s relocated discharge was not predicted to occur until the allocated MCES Blue Lake wastewater treatment plant and Seneca wastewater treatment plant capacities were reached

Table 2. Approved CBOD Trades

Site Name	Type of project	Location in Minnesota	CBOD equivalent credits (lbs/day)
Minnesota River	Riparian area natural and woody vegetation establishment	New Ulm	71.8
Fruhwrith Farm	Riparian area natural and woody vegetation establishment	New Ulm	28.9
Dean Hathaway	Livestock exclusion and bank stabilization	New Ulm	13.4
Sediment	Bluff stabilization	Henderson	98.7
			212.8 total

through replacement of additional wastewater sources. MPCA had estimated that capacity would be reached in ten years from 1997, but by the time of the 2007 permit issuance, the load from the treatment plants was still within the amount authorized by the TMDL.

Benefits to the Permittee

The Rahr permit required that trading with nonpoint sources be used to offset the loading from the plant's direct discharge to the Minnesota River. This approach enabled the permittee to discharge to the lower Minnesota River, even though it was not assigned a wasteload allocation to discharge to this receiving water. Rahr was able to minimize costs because the capital and operation costs were less for the nonpoint source projects than the fees paid to MCEC for discharge to the Blue Lake WWTP. Also, the additional credits generated by the projects enabled Rahr to increase its discharge flow.

Benefits to the Permitting Authority

The original development costs and trade site review costs were high since there were no national models to assist in implementation and the project was an archetype. MPCA has recognized that there was very little overhead associated with the existing four trade sites and that issuing the 2007 permit required much less effort than the initial permit development.

Point source-point source trades are easier to implement for quantification and calculation purposes than point source-nonpoint source trades. MPCA is developing statewide water quality trading rules pertaining to water quality trading between point sources, between point sources and nonpoint sources, and potentially between nonpoint sources. Minnesota's *Water Quality Trading Rule Development Web site* provides more information about the program.

Lessons Learned

The 1997 permit was the prototype; therefore it was difficult to balance the needs of the discharger, MCEA, and MPCA. Although all the stakeholders were in agreement about working on the project, the details of what should be included in the permit (e.g., negotiation of the details for expenditure requirements, inclusion of the specific trading eligible BMPs) were difficult to negotiate.

It also is important for the permitting agency to have a mechanism for developing trades. As noted, Minnesota is developing water quality trading rules to help facilitate future trades. Developing the actual calculations for the trades was also a challenge because there was no national model for measures or guidance for developing trades of this type. Now that other states and watersheds have implemented trades, point source-nonpoint source trade calculations can serve as models for new projects.

Resources

Henningsgaard, Bruce. Email and phone communications. December 16, 2008.

Minnesota Pollution Control Agency. National Pollutant Discharge Elimination System and State Disposal System Permit MN0031917. August 23, 2007.

Minnesota Pollution Control Agency. Fact Sheet for National Pollutant Discharge Elimination System and State Disposal System Permit MN0031917. July 17, 2007.

Minnesota Pollution Control Agency. *Rahr Malting Water Quality Trade Crediting Calculations: Attachment #1*. August 27, 2007.

Minnesota Pollution Control Agency. *Lower Minnesota River Dissolved Oxygen Total Maximum Daily Load Report*. May 2004. <www.pca.state.mn.us/publications/reports/tmdl-final-lowermn-doreport.pdf>

Minnesota Pollution Control Agency. *MPCA Phosphorus Permitting Strategy: NPDES Permits*. March 2000. <www.pca.state.mn.us/water/pubs/phos-npdes.pdf>

Minnesota Pollution Control Agency. *Point-Nonpoint Source Trading Summary: Finalized For Rahr Malting Permit on January 8, 1997, Updated On July 5, 2007, See Italics Text: Attachment #2*. August 27, 2007.

Minnesota Pollution Control Agency. National Pollutant Discharge Elimination System and State Disposal System Permit MN 0031917. January 8, 1997.

Minnesota Pollution Control Agency. *Nonpoint Source Trade Crediting Calculations: Finalized For Rahr Malting Permit on January 8, 1997*. January 8, 1997.

Minnesota Pollution Control Agency. *Point-Nonpoint Source Trading Summary: Finalized For Rahr Malting Permit on January 8, 1997*. January 8, 1997.

United States Environmental Protection Agency. Watershed-Based Permitting Case Study: Final Permit Rahr Malting Company. Accessed December 11, 2009. <www.epa.gov/npdes/pubs/wq_casestudy_factsht5.pdf>

Note: All Web references current as of December 11, 2009.