Okabena-Ocheda-Bella Clean Water Partnership Diagnostic Study

The Okabena-Ocheda-Bella Clean Water Partnership project was sponsored by the City of Worthington and the Okabena-Ocheda Watershed District. The project was accomplished in two parts. A diagnostic study was conducted between October 1989 and September 1991. After analysis of the data collected during the diagnostic study, a plan was developed.

The diagnostic study included lake and stream monitoring, analysis of existing and historical water quality data, evaluation of land uses in the watershed, and the preparation of a water quality model for Lake Okabena and its watershed. The table below provides a water quality summary and compares lake specific water quality data with ecoregion means and values for lakes and streams in the Western Corn Belt Plains (WCBP) and the North Glaciated Plains (NGP) Ecoregions.

GROWING SEASON AVERAGE SURFACE WATER QUALITY SUMMARY

	1990	**1991**
Lake Okabena		
TP (ug/l)	220	195
SRP (ug/l	136	102
TSS (mg/l)	15	16
Chlorophyll-a (ug/l)	3.4	25.5
Secchi Disk (m)	0.6	0.45
Average TSI	64	71
Lake Ocheda		
TP (ug/l)		230
SRP (ug/l		15
TSS (mg/l)		70
Chlorophyll-a (ug/l)		105
Secchi Disk (m)		0.22
Average TSI		80
Bella Lake		
TP (ug/l)	260	244
SRP (ug/l	82	23
TSS (mg/l)	26	26
Chlorophyll-a (ug/l)	80	89
Secchi Disk (m)	0.4	0.4
Average TSI	73	77

Ecoregion Mean[*] WCB NGP

Ecoregion Mean[*]	WCBP	NGP
SRP (ug/l		
TSS (mg/l)	7-18	10-30
Chlorophyll-a (ug/l)	30-80	30-55
Secchi Disk (m)	1.6-3.3	0.3-1.0

[*] **Heiskary and Wilson, 1990**

Numerous observations were made during the Diagnostic Study that were pertinent to the development of the Implementation Plan. They were summarized as follows:

! All three study lakes are relatively shallow with average depths of 4-6 feet.

! The contributing watershed areas of the lakes are relatively large with watershed to surface area ratios of 14.4, 18, and 223 for Lakes Okabena, Ocheda, and Bella, respectively.

! Agricultural land uses currently dominate land uses in the watershed. The City of Worthington, however, occupies portions of the Lake Okabena and Lake Ocheda subwatersheds.

! A number of feedlots were observed in the watershed. However, none were considered as having a high potential for creating surface water quality problems.

! Soils with the potential for significant erosion are primarily located in the central and southern portions of the watershed surrounding Lakes Ocheda and Bella.

! Significant changes have been made to drainage patterns in the watershed. Lake Okabena historically discharged north to Okabena Creek that flows to Heron Lake. With the construction of the dam and County Ditch 6, the lake now discharges south to Ocheda Lake. East Okabena Lake was drained in 1914 to make land available for the railroad. Whiskey Ditch was constructed to drain the northern portions of Okabena Creek to Lake Okabena. Sunset Bay on the southwest corner of Lake Okabena was modified in 1969 to serve as a desilting basin for an unnamed stream draining into Lake Okabena. Most recently, County Ditch 4, constructed in 1983, diverted runoff from the Herlein Boote wildlife slough to Okabena Creek. The net result of all these changes was an increase in the size of the watershed to Lake Okabena by approximately 9,000 acres.

! Lakes Okabena, Ocheda, and Bella are important recreational as well as water supply resources for the region.

! Monitoring data showed that all three study lakes are nutrient enriched and in the eutrophic-hypereutrophic category.

- The primary water quality problem affecting the three lakes is water clarity. The average water clarity on all three lakes was 0.5 meters or less.

  Water clarity in Lake Okabena is primarily affected by total suspended solids (TSS) concentrations. However, nuisance algal blooms did occur in 1991.

- Water clarity in Lakes Ocheda and Bella is controlled by both TSS and algal productivity.

- Algal productivity in Lake Okabena is lower than in Lakes Ocheda and Bella. Algal productivity in Lake Okabena appears to be controlled by an element or condition other than the availability of total phosphorus (TP). Possible controlling factors include nonalgal turbidity and micronutrients. This controlling factor appears to be influenced by runoff. Reductions in algal productivity will come from reducing runoff. However, TP should also be reduced since increasing water clarity by reducing nonalgal turbidity may allow more nuisance algal blooms.

- Algal productivity in Lake Bella is generally controlled by the availability of TP.

- Lake Ocheda had the poorest water quality of all three study lakes.

- Previous studies have shown that submergent vegetation has disappeared from Lake Ocheda. The likely mechanism for this change is poor water clarity.

- The major sources of TP to Lake Okabena are Whiskey Ditch and internal loading which account for 38.5% and 33% of the TP load, respectively.

- The major source of suspended inorganic solids loading to Lake Okabena is Whiskey Ditch, accounting for 79% of the total external load.

- Based on both inorganic and organic sediment loads, Lake Okabena will lose about 1 foot of depth every 50 years.

Okabena-Ocheda-Bella Project Implementation Plan

Based on data from the Diagnostic Study, input from several public meetings and a series of smaller committee meetings with project sponsors and contributing co-sponsors, project goals were set. The implementation plan goals were stated in both narrative and specific numerical formats. The narrative goals are broader statements of future conditions to work toward. Specific goals were also listed to provide a set of numerical criteria based on physical, chemical, and biological parameters that can be used for progress evaluation over time.

The narrative goals are grouped into five categories which are: lakes, uplands, humans, groundwater, and tributary streams. These goals are listed below.

Lakes

Goal #1. Improvement of lake water quality so that the partial support of swimming as a recreational activity is restored.

Goal #2. A reduction in the frequency and severity of nuisance algal blooms.

Goal #3. Affect changes in lake water quality so that a trend is established which shifts the lakes from hypereutrophic to eutrophic conditions.

Goal #4. Through efforts to improve water quality, we will affect changes in the fish, wildlife, and aquatic plant communities to increase diversity and sustainabilty. This effort is linked to providing recreational opportunities for residents and visitors of the watershed.

Uplands

Rationale: The external loading of nutrients and sediment to the lakes is a function of the management of upland areas. The implementation and maintenance of upland BMPs is critical for the long-term success of our efforts.

Goal #1. Implement upland BMPs that will maximize water quality benefits while improving long-term soil conditions. A second part of this goal is to maintain critical BMPs for the long-term.

Humans

Rationale: The success of watershed management in the Okabena-Ocheda watershed depends on the awareness people have and commitment people are willing to make to change conditions toward more ecological stability.

Goal #1. Provide current and pertinent information to all watershed residents concerning the status of their water and how they can improve it.

Goal #2. Increase the knowledge and awareness of watershed residents of all ages concerning the links between land use, land management and water quality/quantity.

Goal #3. To coordinate a project of this type, a qualified person is required to work with landowners, local governments, students, and funding agencies. Our goal is to support such as staff person, both financially and institutionally. This position will coordinate all aspects of the project.

Groundwater

Rationale: Surface and groundwaters are interconnected, and knowledge and understanding of both must occur for appropriate management of the watershed's resources.

Goal #1. Develop an educational process where management decisions by rural and urban residents involve the consideration of both surface and groundwaters, and processes that interconnect the two.

Goal #2. Protect the Bella wellfield through the reduction of surface water contaminant transport and the application of appropriate BMPs in upgradient zones.

Tributary Streams

Rationale: Tributary streams and ditches deliver water and pollutants to our lakes. Reductions in water flow and improvements in water quality must occur if lake water quality is to improve in the long term.

Goal #1. Continue selective monitoring of key tributary inflow sites so that information on runoff and trends are available for decision making.

Goal #2. Develop a trend of reducing peak flow volumes, especially during critical periods of spring and early summer.

Goal #3. Reduce pollutant loads transported by the tributaries.

The setting of specific, numerical goals for the lakes focused on Lake Okabena, since the Diagnostic Study monitoring activities were most intensive there. Ranges were used to reflect changes anticipated due to natural variability and differential loading due to rainfall and climatic patterns. The degree of specificity in the goals for Lakes Ocheda and Bella depended on available data. The goals are based on summer means.

Lake Okabena Goals

Physical Goals - Lake Okabena:
Inorganic Suspended Solids Concentrations: 5-8 mg/l (reduction from an observed range of 12-15 mg/l)

Water transparency: Secchi transparency: 0.7-0.9 meters. (improvement from 0.5 - 0.6 meters)

Chemical Goals - Lake Okabena:
Total Phosphorus: 120 - 160 ug/l.

Soluble Reactive Phosphorus: Reduction to less than 40% of the total phosphorus

Biological Goals - Lake Okabena:
Chlorophyl: 15-20 ug/l (algal biomass estimator)

Aquatic plants: begin reestablishment at appropriate sites on the lake.

Fish: Walleye: 10 fish/gill net at 2 lbs. each.

Black and White Crappie: maintain secondary populations.

Monitor abundance of walleye, crappie, channel catfish, and bullhead species.

Lake Ocheda Goals

Physical Goals - Lake Ocheda
Water Transparency - Secchi transparency 0.3 to 0.5 meters (from O.2 meters monitored in 1991).

Shoreline stabilization: Seek shoreline stabilization methods that are ecologically sound and sustainable.

Chemical Goals - Lake Ocheda
Total Phosphorus - Develop a downward trend for inlake total phosphorus, with a goal range of 160-195 ug/l.

Biological Goals - Lake Ocheda
Aquatic vegetation. Establish vegetative coverage at 25% of the lake surface area (about 480 acres) for shoreline and sediment stabilization, nutrient reduction and wildlife habitat benefits.

Lake Bella Goals

Physical Goals - Lake Bella

Dissolved oxygen. Maintenance of dissolved oxygen levels at 5ppm or greater.

Chemical Goals - Lake Bella

Total Phosphorus: 130 - 170 ug/l.

Biological Goals - Lake Bella.

Chlorophyll. 56-70 ug/l.

Tributary Reduction Goals:

Data analysis and modeling for the Lake Okabena watershed showed that pollutant load reductions in the range of 45-66% are necessary to meet the lower number for the inlake water quality goal ranges presented above. These are significant reductions that are provided as our best estimate at this time. A long-term approach will be taken to first begin a downward trend of pollutant transport and delivery to the lakes. A 15 to 25 percent reductions within seven years is established as an interim goal. These high percentage reductions may be adjusted based on a review of additional monitoring data and an analysis of watershed BMP effectiveness.

Okabena-Ocheda-Bella Project Implementation Plan Objectives

In the feasibility study, a number of alternatives were evaluated to reach the pollutant loading reduction and other goals established in the diagnostic study. These alternatives ranged from administrative alternatives such as City ordinances to structural alternatives such as sediment basins. Each alternative was evaluated for its water quality benefit, hydrologic, benefit, initial and long-term (operation and maintenance) costs, and technical feasibility. The most technically sound and cost-effective options were incorporated into the Implementation Plans for improving the lakes.

Special consideration was given to alternatives that address problems and reduce pollutant loadings at their source, and to alternatives that have the potential to reduce runoff, as well as pollutants. The study also identified a number of existing water quality initiatives by local agencies. The implementation plans were designed to complement these existing initiatives. To facilitate phasing the implementation project, separate implementation plans were developed for each lake. The final plans are described briefly below.

Lake Okabena

The Lake Okabena Implementation Plan is divided into nine project elements. These are:

* A public information/education program that will focus on informing, enlisting support, and improving nonpoint source pollution prevention practices by local landowners.

* Promotion of no-till farming through an incentive program.

* Restoration of two wetlands in the Whiskey Ditch sub-watershed to remove inorganic suspended solids and phosphorus, and to provide additional hydrologic storage.

* Continued monitoring to document and adjust the program if necessary.

* Construction of a sediment basin along Okabena Creek to remove inorganic suspended solids and phosphorus prior to discharging into the lake.

* Development of a construction erosion control ordinance to reduce sediment loss from construction sites.

* Aeration to reduce internal phosphorus loading.

* Completion of bench-scale tests to determine the primary limiting nutrient for algal growth.

Estimated cost of implementing the plan over the six-year project duration is $857,490. With a 50% grant and local in-kind labor, the necessary local cash contribution is $306,340.

Lake Ocheda

The Lake Ocheda Implementation Plan is divided into seven project elements. These are:

* A public information/education program that will focus on informing, enlisting support, and improving nonpoint source pollution prevention practices by local landowners.
* An incentive program to encourage farmers to use independent crop consultants for developing fertilizer management plans.

* Promotion of no-till farming through an incentive program.

* Restoration of two wetlands in the Lake Ocheda direct drainage area to remove inorganic suspended solids and phosphorus, and to provide additional hydrologic storage.

* A water level drawdown to encourage reestablishment of emergent and submergent plant growth.

* Continued monitoring to document and adjust the program if necessary.

Estimated cost of implementing the plan for three-year project is $238,440. With a 50% grant and local in-kind labor, the necessary local cash contribution is $52,020. To obtain the maximum benefits of the Lake Ocheda plan, upstream water quality improvements (i.e., the Lake Okabena plan) should be completed first or concurrently.

Lake Bella

The Lake Bella improvement plan is divided into four project elements. These are:

* A public information/education program that will focus on informing, enlisting support, and improving nonpoint source pollution prevention practices by local landowners.

* An incentive program to encourage farmers to use independent crop consultants for developing fertilizer management plans.

* An incentive program to encourage farmers to use independent crop consultants for integrated pest management and for developing fertilizer management plans.

* Continued monitoring to document and adjust the program if necessary.

Estimated cost of implementing the plan for a three-year project is $66,250. With a 50% grant and local in-kind labor, the necessary local cash contribution is $24,005. To obtain the maximum benefits of the Lake Bella plan, upstream water quality improvements (i.e., the Lake Okabena and Lake Ocheda plans) should be completed first or concurrently.

The full Okabena-Ocheda-Bella Clean Water Partnership diagnostic study and feasibility plan is available for review at the SWCD office and the Worthington City Hall.

Okabena-Ocheda-Bella Clean Water Partnership Joint Powers Board

The City of Worthington and Okabena-Ocheda Watershed District submitted grant applications to MPCA in 1994 and 1995 to accomplish the goals of the implementation plan. When it became apparent that state grant money was not available, the City and watershed district formed the Okabena-Ocheda-Bella Clean Water Partnership Joint Powers Board (CWP JPB) to accomplish some of the implementation plan goals. Local money from the City of Worthington, Okabena-Ocheda Watershed District and grants from the Olson Trust and Wal-Mart was is being used to monitor lake and stream conditions, install conservation practices on farmland and provide public education materials. Below is a list of recent and current activities sponsored by the CWP JPB and other organizations to benefit Lake Okabena.

Filter Strips

The CWP diagnostic study showed that Whiskey Ditch is the main contributor of sediment and phosphorus pollution to Lake Okabena. For this reason, the CWP JPB started a grass filterstrip incentive program in 1998 in the Whiskey Ditch subwatershed. The program offered landowners $100.00 per acre per year for land along streams placed into a 10 year Conservation Reserve Program filterstrip contract. Eighty-four acres in the subwatershed were enrolled into contracts, including all the fields most likely to contribute pollution to the lake.

The Okabena-Ocheda Watershed District offers the same incentive payment throughout the district and has another 40 acres in the Lake Ocheda and Lake Bella subwatersheds.

W-9 Water Quality Basin
During 2002 CWP-JPB will construct a detention basin on Okabena Creek to intercept sediment and phosphorus before it enters Lake Okabena. The basin is designed to remove approximately 33 percent or 380 pounds of total phosphorus per year and settle out 66 percent or 335,000 lbs per year of inorganic suspended sediment.

The project site is on Okabena Creek in the NW ¼, section 9, Worthington Township. The project will include construction of an earthen dam in the flood plain of Okabena Creek to create a stilling pool. Clay for the dam will be excavated from the surrounding agricultural land. Two smaller pools will be excavated upstream for sediment removal. The detention basin will be cleaned out on a periodic basis and the sediment spread on surrounding agricultural land.

Building basin will periodically flood 4.85 acres of existing wetland requiring construction of a replacement wetland. A drained wetland approximately of 11 acres will be restored in section 32 of Elk Township to satisfy the replacement requirements.

The cost of water quality basin and replacement wetland is expected to be about $300,000.00.

Flow Monitoring
The CWP JPB installed area –velocity meters to monitor the volume of water flowing into Lake Okabena from Whiskey Ditch and the Sunset Bay inlet in 1998. Since then, data has been collected by the flow sensors and Isco meters hourly during the water year. Several problems have been encountered using the meters. The equipment is most accurate when water is covering the sensor and flowing rapidly. Since water levels vary greatly at the inlets and the water sometimes stands still, erroneous data has been collected. In addition, when water is flowing in the Sunset Bay inlet, sediment often buries the sensor making flow measurement impossible. Battery life for the units has been unpredictable. Staff will continue to maintain the units weekly to collect the best flow data possible.

Lake Okabena Water Quality Monitoring
Water Quality monitoring began in 1998 to assess the condition water in Lake Okabena and measure progress toward the CWP goals. Samples are taken monthly from April through October. Parameters measured are transparency, total suspended solids, nitrate-nitrite, ammonia, total Kjeldahl nitrogen, total phosphorus, suspended volatile solids and chlorophyll-a. Staff will continue to collect water quality data into the foreseeable future.

Lake Okabena Survey
The Okabena-Ocheda Watershed District, Nobles County Environmental Services and Southwest Minnesota Fishing Club combined efforts in 1999 to survey the bottom of Lake Okabena. The survey was done because many local residents believed the lake was filling with silt. The survey was designed to replicate a survey completed in 1963. Approximately 100 points were measured in approximately the same locations as the earlier study.

It was not possible to measure sedimentation rates based on the two surveys because dredging occurred annually from 1963 until the early 1980's. A comparison of cross sections from the surveys showed no measurable difference in lake depth between 1963 and 1999 in most locations. Holes dredged earlier were filling with silt.

The results of the survey were reported in the Daily Globe and used to produce a lake depth that was distributed to Worthington residents by the fishing club and watershed district.

Sunset Bay Survey

The Okabena-Ocheda Watershed District conducted a survey of Sunset Bay in 1998 to see how effective the bay is at removing silt and estimate its life as a sediment removal basin. Houston Engineering was hired in 1999 to analyze the data. Modeling showed that the bay removes approximately 73% of the total load of suspended sediment during storm events and has a 99.9% long-term average sediment removal rate. The estimated annual sedimentation rate is 0.7 inches. If the sedimentation rate remains constant, the bay will need to be dredged in approximately 30 years to maintain a water residence time needed to remove suspended silt.

Brochures for Worthington Residents

The Okabena-Ocheda Watershed District produced brochures on actions urban residents can take to prevent non-point source water in 1998 and 1999. The brochures were distributed to Worthington residents through the mail and in the Daily Globe.

Lawn Soil Testing Program

The Okabena-Ocheda Watershed District along with students from the Worthington High School and Minnesota West Community and Technical College provided free lawn soil sampling interested residents in Worthington. Fifty-seven yards were sampled in 1999 for nitrogen, phosphorus and potassium. The tests showed that most yards could benefit from the annual application of nitrogen. No lawn tested, however, would benefit from additional phosphorus and ninety-two percent had phosphorus present at high or very high rates. The study showed that low phosphorus fertilizer could be promoted without harming lawns.