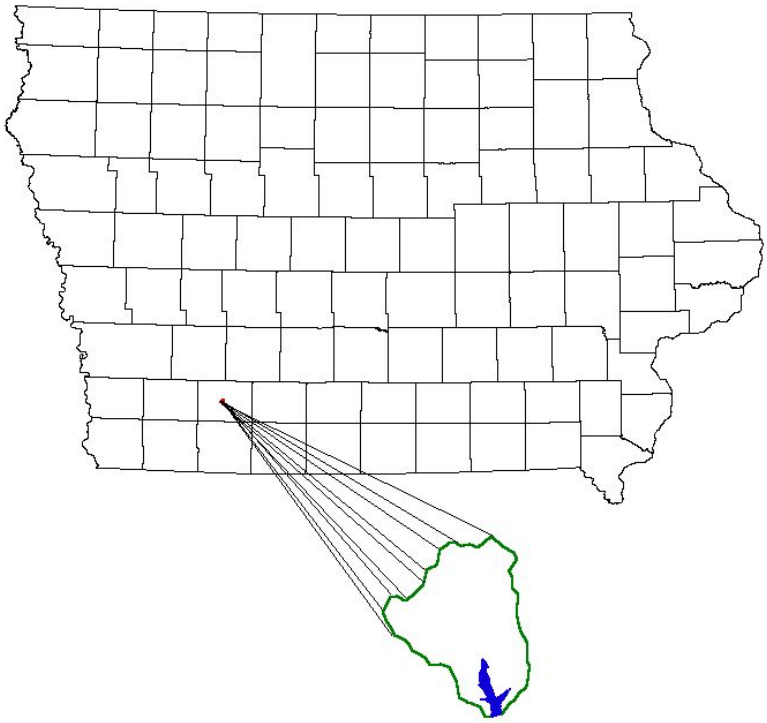
Total Maximum Daily Load
For Siltation
Binder Lake
Adams County, Iowa

July 2001

Iowa Department of Natural Resources
Water Resources Section

TMDL for Siltation
Binder Lake
Adams County, Iowa

Waterbody Name:	Binder Lake
IDNR Waterbody ID:	IA 05-NOD-00415-L
Hydrologic Unit Code:	HUC11 10240010030
Location:	Sec. 25, T72N, R34W
Latitude:	41 Deg. 00 Min. N
Longitude:	94 Deg. 42 Min W
Use Designation Class:	A (primary contact recreation) B(LW) (aquatic life) C (potable water source)
Watershed Area:	1,994 acres
Lake Area:	Approx. 80 acres
Major River Basin:	Southern Iowa River Basin
Tributaries:	Unnamed intermittent streams
Receiving Water Body:	E. Nodaway River
Pollutant:	Siltation
Pollutant Sources:	Agricultural Non-point
Impaired Use:	B (LW) (aquatic life)
1998 303d Priority:	High



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1. Description of Waterbody and Watershed

Binder Lake was built in 1942 as a potable water source for the city of Corning and is located in southwestern Iowa about 1 mile northeast of Corning, Iowa. The current surface area of the lake is approximately 80 acres (based on 2001 land use data).

Binder Lake is owned and managed by the City of Corning. The lake provides facilities for fishing, boating, swimming, camping, picnicking, hiking, and hunting. Game fish include largemouth bass, yellow bass, bluegill, crappie, catfish, and carp. Park use is approximately 34,000 visits per year.

Roughly three-fourths (73%) of the land in the Binder Lake watershed is in pasture and hay. Numerous sediment ponds and wetlands (approximately 35 acres) exist throughout the watershed.

The Binder Lake watershed has an area of approximately 1,994 acres and has a watershed-to-lake ratio of 25:1. The land uses and associated areas for the watershed are shown in the table below.

Table 1. Land use in Binder Lake watershed (2001)

Land use	Area in Acres	Percent of Total Area
Cropland	139	7
Pasture & Hayland	1459	73
Urban/residential	53	3
Timber	312	16
Other (roads, etc)	31	1
Total	1994	100

Average rainfall in the area is 33 inches/year, with the greatest monthly amount (5.5 inches) occurring in June.

2. Applicable Water Quality Standards

The State of Iowa does not have numeric water quality standards for siltation. In the 1996 Department of Natural Resources (DNR) biennial water quality 305(b) report the fishable uses (Class B) for Binder Lake were assessed as partially supported due to excessive sediment from agricultural sources, based on information from a water quality project application (Adams County – Three Lakes Project). This assessment was based on information collected during the 1994-1995 period. That assessment of partially supporting of Class B (LW) has continued to be used in subsequent biennial reports. Excess sediment impacts the Class B (LW) designated use by altering the physical and chemical characteristics of the lake so that a balanced community normally associated with lake-like conditions is not maintained (IAC 567-61.3(1)b(7)). The altering of the physical and chemical characteristics causes impairments of the following beneficial uses: 1) aquatic habitat; 2) spawning, reproduction and development; and, 3) sport fishing. In addition, siltation reduces food supplies by smothering benthic macro invertebrates.

3. Water Quality Conditions

The Iowa Water Quality Standards (IAC, 1996) list the designated uses for Binder Lake as Primary Contact Recreation (Class A), Aquatic Life (Class B (LW)), and Potable Water Source

(Class C). The application for the Adams County Three Lakes Project suggested that Binder Lake was primarily impaired due to sediment eroded from the watershed. The primary impact of sediment is interference with reproduction and growth of fish and other aquatic life. Excessive sediment deposition has lead to the lake being assessed as not meeting water quality standards.

Binder has very little Water Quality data available. The University Hygienic Laboratory (UHL) conducted winter studies to assess the presence of herbicides in water supply reservoirs in Iowa in 1993 and 1995. These studies showed low levels of Atrazine in the water at Binder Lake (0.16 & 0.19 ug/l in 1993; 0.66 and 0.82 ug/l in 1995) and no herbicides in the lake sediments. There are no known impairments to drinking water uses.

There are numerous sediment ponds and wetlands (approximately 35 acres) throughout the watershed well upland from the lake.

4. Desired Endpoint

The listing of Binder Lake is based on narrative criteria. There are no numeric criteria for siltation applicable to Binder Lake or its sources in Chapter 61 of the Iowa Water Quality Standards (IAC, 1996). Since excessive sediment deposition has impacted this water body, the endpoint needs to include both sediment loads to the lake, and measurement of the aquatic life within the lake. Therefore, this TMDL will incorporate two endpoints.

The first endpoint will deal with direct deposition of eroded sediment delivered to the lake. Endpoint number one for Binder Lake is to reduce the gross erosion rate from fields in the watershed to “T” and thereby reduce the corresponding delivery to the lake. “T” is an estimate of the maximum average annual rate of erosion by wind or water that can occur without affecting crop productivity over a sustained period” (USDA-SCS, 1990). There is an additional sediment contribution from one active gully, but there is no significant contribution from streambeds or shorelines to be considered. Reducing the erosion rate to T from fields in the Binder Lake watershed is expected to result in the protection of aquatic life by eliminating the adverse effects of excessive sediment loading to Binder Lake. This target load reduction is a reasonable initial estimate of needed reductions because it will result in an average rate of deposition in the lake low enough to minimize the impact on aquatic life.

The sediment delivery endpoints in Table 2 were calculated using the Erosion and Sediment Delivery Procedure, Section I, Erosion Protection (USDA/NRCS, 1998). Endpoint values incorporating an erosion factor T, calculated from these delivery predictions, are in tons of sediment delivered per year. “The resultant endpoint for this TMDL for Binder Lake will be 2,841 tons/year. Pertinent calculations can be found in Appendix I.

The second endpoint for this TMDL will be achieved when the fishery of Binder Lake is determined to be fully supporting the Class B aquatic life uses. This determination will be accomplished through an assessment conducted by the DNR Fisheries Bureau in either 2001 or 2002. The DNR Fisheries Bureau will conduct an assessment of West Lake - Corning in accordance with the Statewide Biological Sampling Plan protocol (Larscheid, 2001) by the end of the 2002 season to characterize the condition of aquatic life. IDNR Fisheries Bureau is using this protocol to help develop benchmarks for fishery integrity in Iowa lakes. Sampling techniques for these surveys are outlined in “Standard Gear and Techniques for Fisheries Surveys in Iowa”, 1995. This assessment will include growth, size structure, body condition, relative abundance, and species.

Binder Lake will not be considered restored until the Phase II endpoint is achieved. If the aquatic life endpoint is achieved prior to the sediment delivery endpoint, then the level of conservation practices implemented at the time of the assessment may become the baseline for the watershed. If however, after a reasonable time following the completion of the sediment delivery practices the aquatic life use has not been restored, then further study and practices may be necessary.

5. Loading Capacity

The Iowa DNR has determined that reducing the sediment delivery to T would enable the lake to meet water quality standards. “T is an estimate of the maximum average annual rate of erosion by wind or water that can occur without affecting crop productivity over a sustained period” (USDA-SCS, 1990). The erosion factor T in Binder Lake watershed is 4.39 t/a/y. Using an average delivery rate of 32% (from “Erosion and Sediment Delivery Procedure”, Section I, Erosion Protection (USDA/NRCS, 1998)) would yield 1.4 t/a/y of sediment delivered to the lake at T. This totals 2,801 tons/year for the entire watershed on an annual basis. The sediment delivery to the lake from gully erosion is 40 tons/year, making the total predicted delivery to Binder Lake at 2,841 tons/year.

6. Pollutant Sources

Water quality in Binder Lake is influenced only by non-point sources. There are no point source discharges in the watershed. Primary non-point sources in the watershed are cropland and pastureland. The Adams County Soil and Water Conservation District implemented a water quality project in 1996 to address these sources. The main focus of this water quality project has been to reduce sediment and associated contaminant delivery to the lake.

Non-point source pollution is caused by material transported to the lake by runoff from the watershed. Gully, streambank/streambed, sheet and rill, and shoreline erosion can contribute significantly to poor water quality and deterioration of the lake. There is no streambank /streambed erosion in the Binder Lake watershed. There is gully erosion in the Binder watershed, and about 900 feet of shoreline need stabilization conducted, although there is no significant contribution from this source at present. Although all land within a watershed contributes to sediment runoff, the main sources of this pollutant in the Binder Lake watershed are sheet and rill erosion from agricultural fields, and gully erosion at the northwest edge of the lake.

7. Pollutant Allocation

7.1 Point Sources

There are no point discharges within the Binder Lake watershed. Therefore, the Wasteload Allocation established under this TMDL is zero.

7.2 Non-Point Sources

Cropland accounts for 6% of the land use for the Binder Lake watershed. Timber areas account for another 15%. A culvert runs under the road at the northern edge of the lake, concentrating runoff from approximately 40 acres into a very small area. The Adams County Soil and Water Conservation District reports there is also about 900 ft of lake shoreline that needs stabilization. Calculations include only average sheet and rill erosion for the entire watershed and that contribution from the gully fed by the culvert.

Sediment delivery estimates were determined by using the Erosion and Sediment Delivery, Section I, Erosion Protection (USDA/NRCS, 1998). The following equation was used to calculate sediment delivery to Binder Lake:

Sediment Delivery (t/y) = Drainage Area x Gross Erosion Rate x SDR x Gully Factor

Where: Drainage Area is the subwatershed in acres

Gross Erosion is 4.39 Tons/acre/year (T)

SDR is the Sediment Delivery Rate = 32%

(Taken from Chart 1, "Estimated Sediment Delivery for Landform Regions" using drainage area in acres. (USDA/NRCS, 1998))

Gully Factor is determined by the activity in the watershed:

When no gullies are present this factor is 1. For active, uncontrolled gullies, these factors are:

(1) moderately active gully = 1.35

(2) active gully = 1.7

(3) Extremely active gully = 2.0.

Calculations were made for each subwatershed using this sediment delivery equation. A trap efficiency of 90% was calculated for the portions of the lake protected by the silt dams on the northwest and east arms of the lake. The total sediment deliveries for each subwatershed were added together to obtain the total delivery to Binder Lake. The Load Capacity to support the endpoint of this TMDL is 2,801 tons/year. The sediment delivery to the lake from gully erosion is 40 tons/year, making the total predicted delivery to Binder Lake at 2,841 tons/year. A reduction in total sediment delivered will improve water quality by allowing the lake to "maintain a balanced community normally associated with lake-like conditions" (IAC, 1996).

There are three subwatersheds within in the Binder Lake watershed. Appendix II shows the boundaries of each. There is an 8 acre silt pond on the northwest arm of the lake, and a 2 acre silt pond constructed on the east arm of Binder Lake.

Table 2 shows, by source, the Load Capacity representing a reduction to T and the load after reduction (assuming 90% efficiency) from the silt ponds.

Table 2. Sediment delivery to Binder Lake (T/Y).

Source	Acres	Load Capacity	Sediment Loads After Silt Ponds
I	1595	2240	224
II	239	336	336
III	160	225	23
Gully (active)	40	40	4
Total	1994	2,841	587

7.3 Load Allocation and Margin of Safety

An implicit margin of safety is recognized by virtue of the fact that the aquatic life use must be restored to Binder Lake. The use of the dual endpoints of sediment load reduction and aquatic life assessment assures that the uses will be restored regardless of the accuracy of the sediment delivery endpoint. Failure to achieve water quality standards will trigger review and probable revision of the TMDL, allocations, and/or sediment source management approaches.

8. Seasonal Variation

It is expected that the majority of all erosion in the Binder Lake watershed occurs in the spring and early summer during periods of high rainfall and when the vegetation cover may be reduced. This TMDL recognizes that sediment loading and transport varies substantially from year to year as well as seasonally. In addition, sediment impacts are felt over longer timeframes, and predictions regarding those impacts can only be assessed over multi-year periods. Therefore, the Load Allocations in this document are appropriate when expressed as an average per year.

9. Implementation

The Iowa Department of Natural Resources recognizes that an implementation plan is not a required component of a Total Maximum Daily Load. However, the IDNR offers a two-phase implementation strategy to improve water quality at Binder Lake.

There are two parts to addressing the water quality issues involved at Binder Lake. The primary impact of sediment at Binder Lake is interference with reproduction and growth of fish and other aquatic life. Habitat degradation as a result of excess sediment contributes to the lake being assessed as not meeting water quality standards. Phase I of this TMDL reduces the sediment delivery to the lake. This would stop the continuing negative impact to the lake. Phase II includes the restoration of the fishery to a level that fully supports the Class B aquatic life uses.

Phase I: Field investigations to determine landuses, cropping patterns, fertilizer use, conservation practices, livestock operations, and gully erosion were made in early 2001 by the local Soil and Water Conservation District (SWCD) office. Estimates used “Predicting Rainfall Erosion Losses, The Revised Universal Soil Loss Equation (RUSLE)” Section I, Erosion Prediction (USDA/NRCS 2000) for sheet and rill erosion; and “Erosion and Sediment Delivery Procedure”, Section I, Erosion Protection (USDA/NRCS 1998) for the sediment delivery factors. Pertinent calculations can be found in Appendix I. These two calculations are generally accepted in the agricultural community as simple and straightforward methods for determining gross erosion and its resultant delivery to a body of water. Using landuse and practices supplied by the Adams County Soil and Water Conservation District (Waters, 2001), it is estimated that the current (2001) sediment load to the lake is 958 tons/year. With the additional reductions from the silt ponds in place, the adjusted load to the lake is 587 t/y. A reduction in the contribution from gully erosion is necessary to extend the life expectancy of the silt dam on the northwest arm, but is not required to meet the TMDL endpoint allotted. The Adams County Soil and Water Conservation District will be conducting shoreline stabilization along the 900 feet of shoreline of concern, before a problem develops. They are also developing a plan to address the gully erosion.

The Three Lakes Water Quality Project has been implementing upland conservation measures in the Lake Icaria, Binder Lake, and West Lake - Corning watersheds since 1996. Best management practices installed in the watersheds include terraces, grade stabilization structures, and planned grazing systems. In addition to continued work on private lands, areas on public lands have been identified that would benefit from the construction of grade stabilization structures or wetlands. In further support of Phase I, the Adams County Soil and Water Conservation District has applied for a grant from Clean Water Act Section 319 to implement a second phase of the Three Lakes Project. Section 319 grants are subject to the provisions of the Endangered Species Act. Any projects within the watershed that utilize federal funds will consider any endangered species.

Phase II: The DNR Fisheries Bureau will conduct an assessment of Binder Lake in accordance with the Statewide Biological Sampling Plan protocol (Larscheid, 2001) by the end of the 2002 season to characterize the condition of aquatic life. Sampling techniques for these surveys are outlined in "Standard Gear and Techniques for Fisheries Surveys in Iowa", 1995. This assessment will include growth, size structure, body condition, relative abundance, and species.

10. Public Participation

Public informational meetings for the Binder Lake TMDL development were held on January 17, 2001, in Des Moines, Iowa; and on February 5, 2001 in Corning, Iowa. Another meeting was held in Corning June 11, 2001 to discuss the draft document. Comments received have been incorporated into the final document, where appropriate.

11. References

IAC, 1996. Iowa Administrative Code 567, Chapter 61, Iowa Water Quality Standards.

Kennedy, J.O. and J.G. Miller. 1987. 1986 Iowa lakes study. Report 87-3. University Hygienic Laboratory, University of Iowa, Iowa City, Iowa. 363 p.

Kennedy, J.O. and J.G. Miller. 1993. Herbicides in Water and Sediment from 15 Iowa Water Supply Reservoirs, January-March, 1993. Report 93-3. University Hygienic Laboratory, University of Iowa, Iowa City, Iowa. 60 p.

Kennedy, J.O. and J.G. Miller. 1995. Study of Herbicides in Water and Sediment from 19 Iowa Water Supply Reservoirs, January-February, 1995. Report 95-1. University Hygienic Laboratory, University of Iowa, Iowa City, Iowa. 60 p.

Larscheid, Joe. Statewide Biological Sampling Plan, July 2001.

USDA / Natural Resources Conservation Service. 1998. Field Office Technical Guide Notice No. IA-198. "Erosion and Sediment Delivery Procedure", Section I, Erosion Protection.

USDA-SCS. 1990. United States Department of Agriculture, Soil Conservation Service. March, 1990. Soil Survey of Adams County, Iowa.

Waters, Bob. Environmental Specialist. Adams County Soil and Water Conservation District. Personal Communication, May 2000.

12. Appendix I

Table 3. Erosion Estimates at T

Source	Acres	Gross Erosion Rate (t/a/y)	Del %	Sediment Delivered
Sheet and Rill	1994	4.39	32%	2801
Gully Erosion	40	4.39 X (Gully Factor = 1.7)	32%	96
Total			32%	2897

Table 4. 2000 Erosion Estimates

Source	Acres	Gross Erosion Rate (t/a/y)	Del %	Sediment Delivered
Sheet and Rill	1994	1.4	32%	893
Gully Erosion	40	1.4 X (Gully Factor = 1.7)	32%	30
Total			32%	923

RUSLE

PREDICTING RAINFALL EROSION LOSSES THE REVISED UNIVERSAL SOIL LOSS EQUATION (RUSLE)

The equation is expressed as follows: A = RKLSCP where:
A = average annual soil loss from inter-rill (sheet) and rill erosion caused by rainfall and its associated overland flow expressed in tons/ac/yr,

R = the factor for climatic erodibility,
K = the factor for soil erodibility measured under a standard condition,
L = the factor for slope length,
S = the factor for slope steepness,
C = the factor for cover-management, and
P = the factor for support practices.

Example calculation from Binder / West Lake - Corning Watershed:

A= ?
R= 170 rainfall factor
K= 0.26 erodibility factor (by soil type)
LS= 3.6 length / slope
C= 0.39 cropping factor
P= 1.00 practice factor (ex: 0% reduction, therefore 100% of load)

A= (170) (0.26) (3.6) (0.39) (1.0)
= 62.0568 t/a/y
= 62.0 t/a/y

13. Appendix II

Figure 1
Binder Subwatersheds

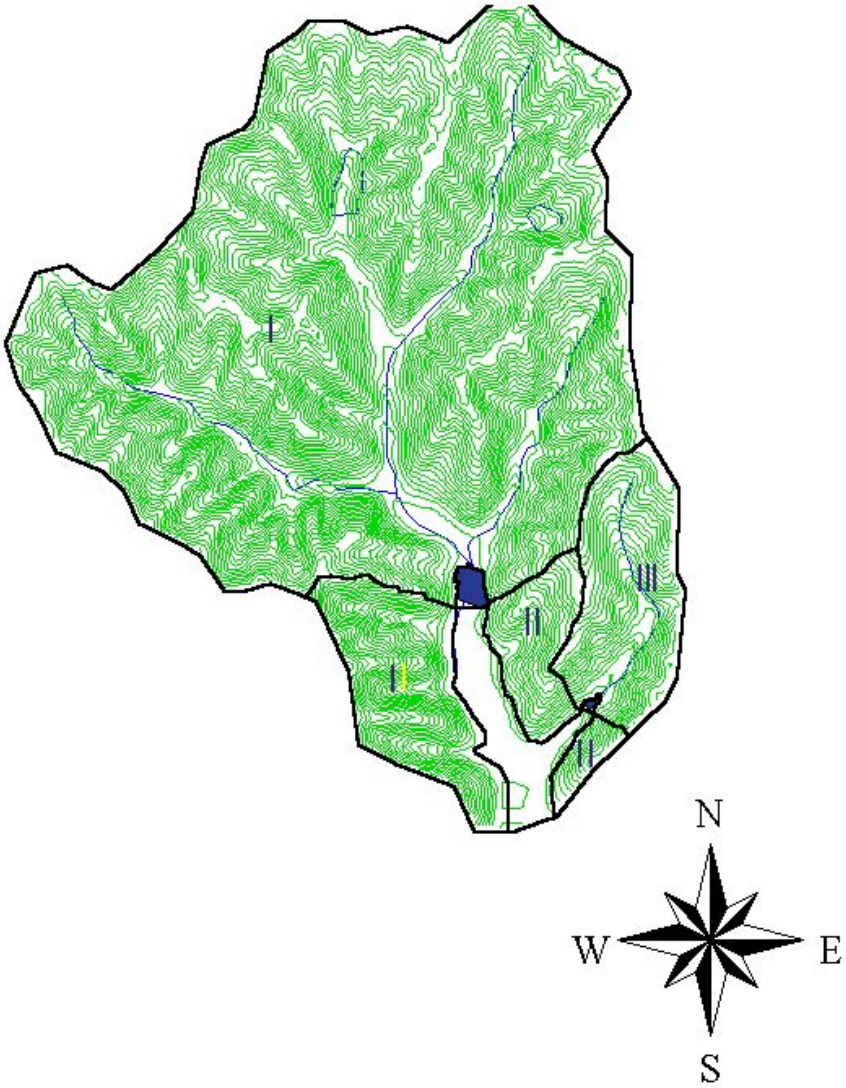

Figure 2
Binder Watershed