Total Maximum Daily Load
For
Pawnee Reservoir - Lancaster County, Nebraska

Parameter Of Concern: Sediment (Siltation)

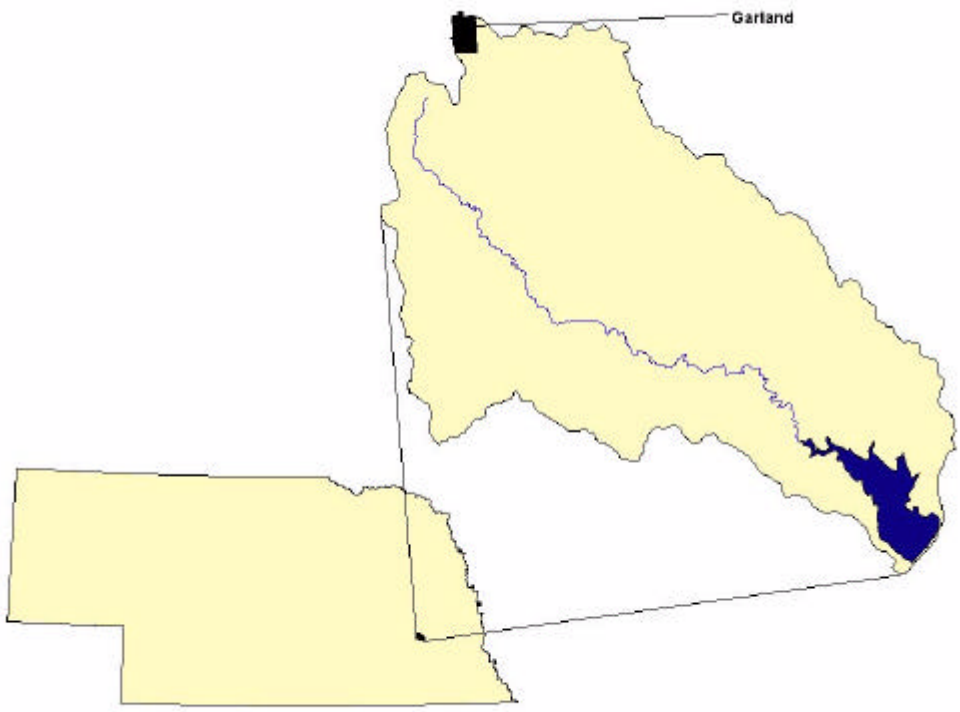
(Modified 2/28/01)

INTRODUCTION AND PROBLEM IDENTIFICATION

Pawnee Lake, located on Middle Creek in southeastern Nebraska (Figure 1) was constructed by the U.S. Army Corps of Engineers (COE) primarily as a flood control reservoir with recreation as a secondary use. The reservoir is one of several impoundments constructed in the Salt Creek watershed collectively known as the Salt Valley Lakes.

The beneficial uses of primary contact recreation, aquatic life, aesthetics, and agricultural water supplies have been assigned to Pawnee Lake in Title 117 - Nebraska Surface Water Quality Standards (Title 117)[4]. The support level of the assigned uses are determined from procedures outlined in NDEQ Standard Operating Procedure for Determining Beneficial Use Support For Lakes And Reservoirs (NDEQ 1999)[3].

Figure 1. Location Of Pawnee Reservoir



Pawnee Reservoir was determined to be partially supporting the aquatic life beneficial use due to sedimentation. Sediment sources were determined to be nonpoint source in nature. There are no point source discharges contributing to this problem. Background information on Pawnee Reservoir is provided in Table 1.

Table 1. Background Information For Pawnee Reservoir

Year Constructed	1964
State	Nebraska
County	Lancaster
Nearest Municipality	Lincoln
Hydrologic Unit Code (HUC)	10200203
Legal	SE 1/4, Sect. 8, T10N, R5E
EPA Region	VII
Major Basin	Missouri
Minor Basin	Lower Platte
NDEQ Watershed Code	LP2-L0160
Major Tributary	Middle Creek (northern branch)
Ownership	USACE
Surface Area (conservation pool)	728 acres
Shoreline Length	66,618 feet
Maximum Depth	38.3 feet
Mean Depth	11.69 feet
Storage Capacity (conservation pool)	7,813 acre feet
Retention Time	1.40 years
Designated Uses	Aq. Life, Primary Contact Recreation, Ag. Water Supply, Aesthetics
Water Quality Standards Designation	Warmwater A
Watershed Area	22,976 acres

Use Impairment: The biological integrity of the aquatic life are impaired from excessive sedimentation. While the aquatic life use is protected through narrative criteria in Title 117, reservoir sedimentation rates are used as a numeric quantification of narrative standard.

Water Quality Standard: Title 117, Ch. 4, paragraph 003.01G. Biological Criteria. Any human activity causing water pollution that would significantly degrade the biological integrity of a body of water or significantly impact or displace an identified "key species" shall not be allowed except as specified in chapter 2.

Criteria Used To Determine Impairment: Reservoir sedimentation assessment criteria.

CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use in 1998 305(b): Partial Support - Pawnee was placed on the 1998 Section 303(d) list.

Lake Monitoring Sites: S14-01, S14-02, S14-03, S14-07, S14-08, S14-09, S14-10, S14-11, S14-12, S14-13, S14-14, S14-15, S14-16, S14-17, S14-18, S14-19, LLAPAW01

Period of Record Used: 1966-1993; Sedimentation surveys were conducted five times since 1966 (1966, 1972, 1981, 1990, 1993).

Current Conditions:

The uncontrolled drainage area of Pawnee Reservoir is 20,976 acres. A majority of the watershed is utilized for crop production or pastureland. Approximately eight percent of the watershed is enrolled in the Conservation Reserve Program (CRP). Residential acreages and a portion of the small town of Garland comprise approximately one percent of the total watershed area. In regards to acreages, portions of the watershed are shifting from the traditional agriculture uses to family residential dwellings. The topography of the watershed is gently rolling hills. Streams are deeply incised and susceptible to streambank erosion. Watershed soils are highly vulnerable to erosion and rich in nutrients.

Sedimentation information dating back to 1966 was assessed to determine long-term average annual volume losses within the reservoir. Based on this assessment, Pawnee Reservoir was estimated as having an average annual volume loss to the conservation pool of 0.75 percent that is equal to the Section 303(d) listing criteria.

Volume loss estimates (acre feet) were converted to a sediment load (tons) using a sediment density factor of 1,400 tons/acre foot, which is based on the soils in this region. Loading calculations were conducted to determine the amount of sediment deposited in the flood storage zone and conservation zone of the reservoir as well as the amount transported downstream through the outlet works (Table 2). The average annual sediment load to Pawnee Reservoir is estimated to be 90,513 tons, of which, 82,320 tons (91%) are deposited in the conservation zone.

Table 2. Average Annual Sediment Budget For Pawnee Reservoir

Total Load (tons)	Flood Zone Deposition (tons)	Conservation Zone Deposition (tons)	Outlet Losses (tons)
90,513	4,573	82,320	3,620

Desired Endpoint:

In 1998 the NDEQ adopted methods to evaluate the severity of sedimentation in reservoirs. The methodology, which is similar to a methodology used by the State of Illinois to determine a level of impairment, utilizes the percent of reservoir volume loss, on an average annual basis, to the conservation pool. Four categories were defined for assessment purposes that are:

Substantial	>0.75 percent
Moderate	0.50-0.75 percent
Minimal	0.25-0.50 percent
Slight	< 0.25 percent

These criteria are also used as the basis for placing reservoirs on the Section 303(d) list for sedimentation. Any reservoir with average annual volume loss greater than or equal to 0.75 percent falls into the "substantial" category and is placed on the Section 303(d) list.

The desired endpoint for this TMDL was based on the maximum volume loss allowed before a Section 303(d) listing would occur, which is 0.749 percent. In order to help direct implementation efforts, a corresponding sediment load was calculated for the TMDL endpoint. The targeted sedimentation load or loading capacity that corresponds to a 0.749 percent average annual volume loss is 90,224 tons per year. Ten percent has been subtracted from the loading capacity to account for a ten percent margin of safety, which makes the target load 81,202 tons per year.

SOURCE INVENTORY AND ASSESSMENT

Sediment sources to Pawnee Reservoir stem entirely from nonpoint sources. There are no point source contributions of sediment to the reservoir. The primary source of sediment entering Pawnee Reservoir is overland sheet and rill erosion (LPSNRD, 1992)[1]. Approximately 2,520 acres (12 percent of the watershed) have been identified as having a gross erosion rate more than five tons per acre per year.

Gully erosion also contributes sediment to the reservoir. Watershed topography, land use, and soil type are factors promoting the formation and growth of gullies. Due to the widespread nature of overland gullies and the lack of access on private lands, the quantification of gully erosion in the watershed was impossible.

Streambank erosion is a widespread problem in this drainage as well as in other drainages in this area of the state. Vertical banks as high as 15 feet or more are common in the watershed.

Shoreline erosion has also been identified as a problem in some areas of the reservoir. Approximately 7,500 linear feet of shoreline have shown signs of erosion. Shoreline erosion is caused by wave action created by wind and power boating.

Since sediment loadings to reservoirs are directly related to rainfall amounts and intensity, seasonal and annual variation can be significant. Because of this variation, NDEQ utilizes long-term average annual loadings to assess problems. As the period of record used in the assessments increases, the influence of season and annual variation decreases. Since data for Pawnee Reservoir dates back to the 1960's, seasonal and annual variation is not a factor.

LOAD ALLOCATION/WASTELOAD ALLOCATION

The entire sediment load to Pawnee Reservoir stems from nonpoint sources; therefore, the Waste Load Allocation (WLA) will be "zero". A load of 81,202 tons per year will be allocated to nonpoint sources.

In order to achieve sedimentation rates below the 303(d) assessment criteria and a full support status for aquatic life, only a minor reduction in sedimentation is needed. A sufficient amount of sediment reduction may be achieved through ongoing critical area treatment on agricultural lands and the reservoir shoreline.

MARGIN OF SAFETY

An explicit margin of safety (MOS) of 10 percent will be utilized for this TMDL. Therefore, the allocated margin of safety becomes 9,022 tons of sediment per year.

IMPLEMENTATION

The implementation plan developed for Pawnee Reservoir is based entirely on nonpoint source controls. Implementation of the proposed activities listed below will conducted voluntarily. When possible, low impact and low cost alternatives such bio-remediation will be used.

Desired Implementation Activities

1. Overland and Gully Erosion: Desired implementation activities will be targeted at the areas identified as being the largest contributors of sediment to the lake. These areas typically correspond to cropped areas on steeper slopes that do not have best management practices in place.

- Implement management practices that will increase crop residue such as no-till farming,
- Construct terraces and grassed waterways.
- Install buffer strips along stream corridors.
- Construct grade stabilization structures to reduce head cutting and gully expansion.

2. Streambank Erosion: Desired implementation activities will be targeted at the areas identified as being that largest contributor of sediment from eroding stream banks. It would not be feasible to treat the entire stream network.

- Install check dams on smaller tributaries to reduce peak flows during runoff events.

- Install streambank protection using vegetation and graded rock.

3. Shoreline Erosion: Desired implementation activities will be targeted at the areas identified as being that largest contributor of sediment from eroding shorelines.

- Reshape shorelines to a 3:1 slope and install protection with vegetation or graded rock.

Reasonable Assurances

Effective management of nonpoint source pollution in Nebraska necessarily requires a cooperative and coordinated effort by many agencies and organizations, both public and private. Each organization is uniquely equipped to deliver specific services and assistance to the citizens of Nebraska to help reduce the effects of nonpoint source pollution on the State's water resources. Appendix A lists those entities that may be included in the implementation process. These agencies have been identified as being responsible for program oversight or fund allocation that may be useful in addressing and reducing sedimentation to Pawnee Reservoir. Participation will depend on the agency/organization's program capabilities.

MONITORING

The USACE plans to continue their sedimentation surveys at Pawnee Reservoir approximately every five years. Once new information is available, conditions will be re-assessed and compared back to the statewide sedimentation goal.

FEEDBACK

In 1990 the Lower Platte South Natural Resources District and the Nebraska Department of Environmental Quality established Technical and Citizens Advisory Committees to assist in the assessment of water quality and development of recommendations for addressing water quality problems in Pawnee Reservoir. The advisory committees held several joint meetings during 1990, 1991, and 1992. Two public meetings were held in 1992 in Lincoln and Malcolm, Nebraska. The meetings were held to obtain and respond to public comments and concerns regarding the water quality findings. Most of the questions and comments were related to the methods for determining critical areas, recommended pollution control measures, and potential cost of implementation to landowners.

Public Participation

This TMDL was made available to the public on the Department's Internet site and the availability of the draft TMDL was announced through three newspapers; namely Lincoln Journal Star, York News-Times and the Hastings Tribune. The public notice/comment period was from June 17 through October 17, 2000. Additionally a copy of the draft TMDL were mailed to potential stakeholders. The Department also attended and made presentations at a combined Lancaster County, Seward County and Saline County Farm Bureaus meeting.

Comments received on the draft TMDLs and the Department's responses have been prepared.

References

1. LPSNRD, 1992. Clean Lakes Phase I Diagnostic/Feasibility Study On Pawnee Reservoir. Lower Platte South Natural Resources District. Lincoln, Nebraska.

2. NDEQ, 1998. 1998 Nebraska Water Quality Report, Nebraska Department of Environmental Quality-Water Quality Division. Lincoln, Nebraska.

3. NDEQ, 1999. Standard Operating Procedure For Assessing Beneficial Use Support On Lakes And Reservoirs. Nebraska Department of Environmental Quality-Water Quality Division. Lincoln, Nebraska.

4. NDEQ, 2000. Title 117. Nebraska Surface Water Quality Standards, Nebraska Department of Environmental Quality. Lincoln, Nebraska.

Appendix A – Federal, State Agency and Private Organizations Included in TMDL Implementation.

FEDERAL

- Bureau of Reclamation
- Environmental Protection Agency
- Fish and Wildlife Service
- Geological Survey
- Department of Agriculture - Farm Services Agency
- Department of Agriculture - Natural Resources Conservation Service

STATE

- Association of Resources Districts
- Department of Agriculture
- Department of Environmental Quality
- Department of Roads
- Department of Water Resources
- Department of Health and Human Services
- Environmental Trust
- Game and Parks Commission
- Natural Resources Commission
- University of Nebraska Institute of Agriculture and Natural Resources (IANR)
- UN-IANR: Agricultural Research Division
- UN-IANR: Cooperative Extension Division
- UN-IANR: Conservation and Survey Division
- UN-IANR: Nebraska Forest Service
- UN-IANR: Water Center and Environmental Programs

LOCAL

- Natural Resources Districts
- County Governments (Zoning Board)
- City/Village Governments

NON-GOVERNMENTAL ORGANIZATIONS

- Nebraska Wildlife Federation
- Pheasants Forever
- Nebraska Water Environment Association
- Nebraska Corn Growers Association, Wheat Growers, etc.
- Nebraska Cattlemen's Association, Pork Producers, etc
- Other specialty interest groups
- Local Associations (i.e. homeowners associations)