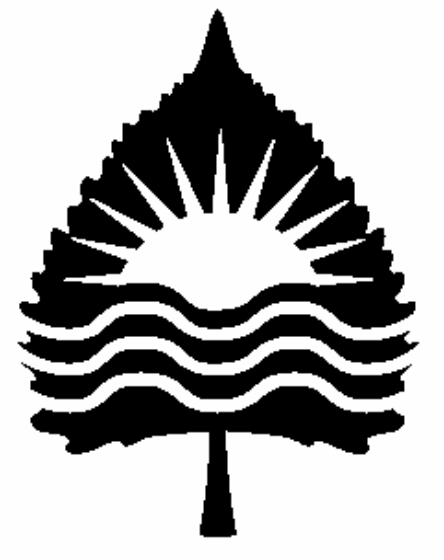

Total Maximum Daily Loads
for
Holmes Lake – Lancaster County, Nebraska

Parameters of Concern: Siltation/Sedimentation and Nutrients

Pollutants Addressed: Sediment and Phosphorus

Nebraska Department of Environmental Quality
Planning Unit, Water Quality Division

June 2003

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Executive Summary

Holmes Lake was included on the 2002 Nebraska Section 303(d) List of Impaired Waters (NDEQ 2002) due to impairment of the aesthetic and aquatic life beneficial uses due to excess sedimentation (siltation) and nutrients. As such, a total maximum daily load must be developed for each impaired parameter in accordance with the Clean Water Act. As well, Holmes Lake was included on Part 5 - Water Quality Concerns, of the Section 303(d) list with the parameter of concern being dissolved oxygen. (Part 5 is not considered a portion of the Section 303(d) list subject to EPA approval/disapproval but is prepared as a means of providing a comprehensive report of the beneficial use status. Waters on Part 5 lack sufficient information to determine whether a waterbody is "impaired" or not. Part 5 waterbodies are considered high priorities for additional monitoring.)

This document presents TMDLs for sediment and nutrients (i.e., phosphorus), designed to allow Holmes Lake to fully support its designated uses in addition to water quality goals established through the Community Based Watershed Planning Process. The information contained herein should be considered 2 TMDLs that target 2 pollutants. Specifically, sediment has been targeted to address the siltation/sedimentation impairment and phosphorus is the pollutant targeted to address the nutrient impairment. While a TMDL will not be developed specifically for dissolved oxygen, nutrient and sediment control strategies should also be sufficient to address the dissolved oxygen concerns.

These TMDLs have been prepared to comply with the current (1992) regulations found at 40 CFR Part 130.7.

1. **Name and geographic location of the impaired waterbody for which the TMDLs are being developed.**
Holmes Lake, Section 4, Township 9 North, Range 7 East, Lancaster County, Nebraska, Lat. 40° 46' 57", Long. 96° 38' 10"

2. **Identification of the pollutant and applicable water quality standard**
The pollutants causing the impairment(s) of the water quality standard and designated beneficial uses are sediment and nutrients (phosphorus). Designated uses assigned to Holmes Lake include: primary contact recreation, aquatic life warmwater class A, agriculture water supply class A and aesthetics (NDEQ 2000). Excessive sediment and nutrient inputs have been determined to be impairing the aesthetic and aquatic life beneficial uses.

3. **Quantification of the pollutant load that may be present in the waterbody and still allows attainment and maintenance of the water quality standards.**
Bathymetric survey data and the EUTROMOD water quality model were employed to determine the current sediment and nutrient loads. The loading capacities, that if achieved and will result in beneficial use attainment were based upon local stakeholder derived water quality goals. These values are 5,000 tons/year and 260 lbs/year (118 kg/year) for sediment and phosphorus, respectively.

4. **Quantification of the amount or degree by which the current pollutant load in the waterbody, including upstream sources that is being accounted for as background loading deviates from the pollutant load needed to attain and maintain water quality standards.**
The average annual sediment load is exceeding the water quality goal by 5,574 tons/year. Empirical data indicates approximately 10,574 tons/year of sediment is delivered to Holmes Lake. To achieve the sedimentation goal, a 53% reduction from the current average annual load is needed.

The total phosphorus load delivered to Holmes Lake is estimated to be 8,070 lbs/year. To meet the water quality goals, the average annual loading capacity is 260 lbs/year. To achieve the loading capacity a 97.25% reduction is needed.

5. Identification of the pollutant source categories.

Both point and nonpoint sources of sediment have been identified as the cause of the siltation/sedimentation impairment to Holmes Lake. Point nonpoint and natural sources have been identified as the cause of the nutrient impairment to Holmes Lake. The identified point sources include stormwater discharges from construction sites and the City of Lincoln storm sewer(s). Nonpoint sources include, stormwater discharges from sites not covered by NPDES permits and other agriculture, urban and rural run-off.

6. Wasteload allocations for pollutants from point sources.

The watershed contributing to Holmes Lake is in a state of transition from rural to urban and because of this, the established WLA is dynamic in an attempt to account for all sources. The wasteload allocation (WLA) for the sediment TMDL is:

$$\text{WLA (ton/year)} = (5{,}000 \text{ tons/yr} \div 3{,}456 \text{ acres}) * \text{NPDES permitted acres}$$

Where:
5,000 tons/yr = stakeholder defined water quality goal
3,456 acres = watershed size
NPDES permitted acres = acres covered by the City of Lincoln MS4 or general NPDES permit

The WLA for the nutrient (phosphorus) TMDL is:

$$\text{WLA (lbs/year)} = (\{260 \text{ lbs/yr} - 37.5 \text{ lbs/yr}\} \div 3{,}456 \text{ acres}) * \text{NPDES permitted acres}$$

Where:
260 lbs/yr = waterbody loading capacity to meet the stakeholder defined water quality goals
37.5 lbs/yr = natural background phosphorus load
3,456 acres = watershed size
NPDES permitted acres = acres covered by the City of Lincoln MS4 or general NPDES permit

7. Load allocations for pollutants from nonpoint sources.

Because the WLAs are dynamic, the load allocations (LA) must be dynamic and a function of the committed load that includes both the WLA and the natural background. No specific sediment allocations were made for natural sources as allowed by 40 CFR Part 130.7. Based upon water quality modeling, a background loading of 37.5lbs/year was set as the (natural) allocation for nutrients. Therefore, the LA for sediment is:

$$\text{LA} = 5{,}000 \text{ tons/year} - \text{WLA (tons/year)}$$

The LA for nutrient is:

$$\text{LA} = 260 \text{ lbs/year} - (\text{WLA} + 37.5 \text{ lbs/yr})$$

8 A margin of safety.

These TMDLs contain an implicit margin of safety. For the sediment TMDLs, the water quality goals/reductions have been set at a level 2 times greater than necessary to attain full support status. As well, sediment and nutrients are discharged from the system via the reservoir's outlet. These TMDLs will assume the sediments and nutrients delivered to the waterbody remain, reflecting a worst-case condition.

9. Consideration for seasonal variation.

The pollutants of concern are delivered on a year round basis and the assessment of the data considers annual average conditions. Because nonpoint sources and stormwater discharges (nonpoint source like sources) have been identified as a significant contributor, management practices and implementation will be targeted at those times when the source influence is the greatest. This usually revolves around the precipitation events of mid to late spring when there is a high potential for run-off of sediment, phosphorus (attached to sediment), and nitrogen. The effects of the excess pollutant loadings are: large quantities of algae growth occurring during the growing season, dissolved oxygen impairments and sediment reducing the volume of the lake.

10. Allowances for reasonably foreseeable increases in pollutant loads.

The issue of future growth is addressed in the dynamic wasteload allocation and load allocation determination. That is, as urbanization continues in the watershed, the wasteload allocations and load allocations have been established to account for the state of flux by "self-adjusting" by employing the coverage of issued NPDES stormwater permits.

11. Implementation Plan

Implementation of the reductions for the 2 pollutants is currently underway for Holmes Lake and is comprised of 2 phases: 1) watershed management planning and 2) lake restoration and watershed treatment. Along with the watershed management planning, the City of Lincoln has began developing and implementing an information/education program aimed at the ongoing preservation of the lake. Public awareness and involvement has been generated through a series of public meetings.

The WLAs will be implemented through the NDPES program and as recommended by EPA, will attempt to utilize "non-numeric" water quality based effluent limits in the form of best management practices (BMPs)

The TMDLs included in the following text can be considered "phased TMDLs" and as such are an iterative approach to managing water quality based on the feedback mechanism of implementing a required monitoring plan that will determine the adequacy of load reductions to meet water quality standards and revision of the TMDL in the future if necessary. A description of the future monitoring (Section 5.0) that is planned has been included. .

Monitoring is essential to all TMDLs in order to:

- Assess the future beneficial use status;
- Determine if the water quality is improving, degrading or remaining status quo;
- Evaluate the effectiveness of implemented best management practices.

The additional data collected should be used to determine if the implemented TMDL and watershed management plan have been or are effective in addressing the identified water quality impairments. As well the data and information can be used to determine if the TMDLs have accurately identified the required components (i.e. loading/assimilative capacity, load allocations, in lake response to pollutant loads, etc.) and if revisions are appropriate.

1.0 Introduction

Holmes Lake was listed on the 2002 Nebraska Section 303(d) list of impaired waters (NDEQ 2002) as not supporting the assigned beneficial uses with the pollutants of concern being nutrients and sedimentation. As well, Part 5 – of the Section 303(d) list, identifies waters where data indicates a concern but is insufficient to warrant "listing". (Part 5 waters are not considered a portion of the 303(d) list and therefore no TMDL is required for this parameter. However, additional data will be obtained from waterbodies listed on Part 5 in an effort to increase confidence in the assessment.) Holmes Lake was included on Part 5 with the parameter of concern being dissolved oxygen. Dissolved oxygen problems can occur in response to excessive algae production and eventual die-off/decomposition.

In 2001, the City of Lincoln – Parks and Recreation Department initiated a project aimed at development of a watershed management plan to compliment the needed restoration of Holmes Lake. The scope of the project will be to address in-lake problems through the implementation of structural controls (i.e. basin, wetlands) to minimize the impacts of future pollutant loadings. While in the short term these controls may be effective, long-term control of sediment and nutrients from the watershed is desired to ensure the lake continually supports beneficial uses. As well, based upon the delivery mechanisms, sediment and nutrient TMDLs often compliment each other that is, reductions and best management practices often target both pollutants simultaneously.

Therefore, based on the above and as required by Section 303(d) of the Clean Water Act and 40 CFR Part 130.7, TMDLs for sediment and nutrients have been developed and contained herein to address the impairments. While no TMDL is being developed to specifically address dissolved oxygen, control of the nutrient inputs should be considered a factor in addressing future dissolved oxygen concerns.

1.1 Background Information

Holmes is located in Lancaster County, Nebraska (Figure 1.1), and was constructed by the United States Army Corps of Engineers (USACE) primarily as a flood control structure with completion and the initial fill occurring in 1962 (USACE 1995). The waterbody also supports recreation (primary contact, fishing, etc.) as a secondary use. A description of the physical information is provided in Table 1.1. The Nebraska Game and Parks Commission (NGPC) manage the fishery with the immediate surrounding 555 acres being managed as a city park that includes a golf course, softball fields and other appurtenances. Holmes Lake, and the majority of the watershed lie within the Lincoln city limits and because of this, the area is used extensively by the public for many various recreational activities.

1.1.1 Waterbody Description

1.1.1.1 Waterbody Name: Holmes Lake

Lake Identification Number: LP2-L0040 (Tile 117 – Nebraska Surface Water Quality Standards)

1.1.1.2 Major River Basin: Missouri River

1.1.1.3 Minor River Basin: Lower Platte

1.1.1.4 Hydrologic Unit Code 10200203

1.1.1.5 Assigned Beneficial Uses: Primary contact recreation, Aquatic Life Warmwater Class A, Agricultural Water Supply Class A and Aesthetics (Title 117 – Nebraska Surface Water Quality Standards)

1.1.1.6 Major Tributary: Antelope Creek: Segment identification LP2-20900

Figure 1.1 Location of Holmes Lake and Watershed in Lancaster County, Nebraska

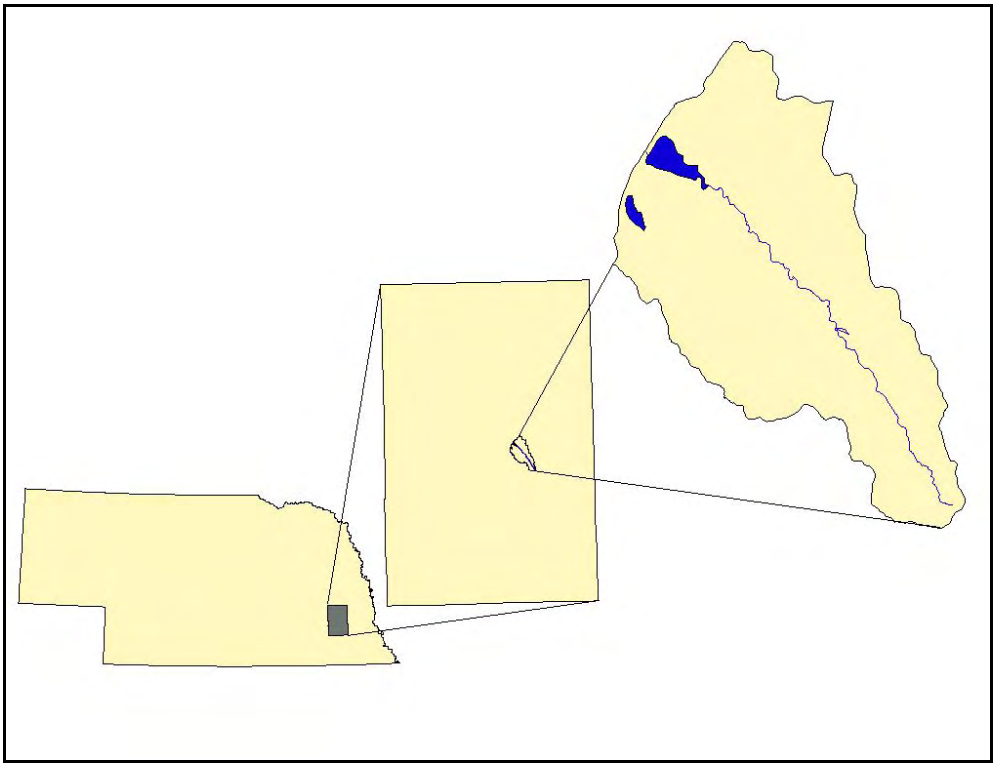


Table 1.1 Physical Description of Holmes Lake

Parameter	Holmes Lake
State	Nebraska
County	Lancaster
Latitude (center of dam)	40° 46’ 57”
Longitude (center of dam)	96° 38’ 10”
Legal Locations (dam)	Section 4, Township 9 North, Range 7 East
Surface Area – 1962	123 acres
Surface Area – 2001	110 acres
Shoreline Length (pre-renovation)	4 miles (approximately)
Mean Depth – 1962	8.6 feet (2.6 meters)
Mean Depth – 2001	7.0 feet (2.1 meters)
Volume – 1962	1059 acre/feet
Volume – 2001	772 acre/feet
Number of inlets	2
Watershed Area	3,456 acres
Lake to Watershed Ratio	1:27

1.1.2 Watershed Characterization

1.1.2.1 Physical Features: Holmes Lake has a contributing watershed of approximately 3,456 acres and is located in the Western Corn Belt Plains (Level III) ecoregion as defined by Chapman, et al. (2001). The reservoir was completed in 1962 by the USACE who retains ownership however, the lake's fishery is managed by the NGPC in cooperation with the City of Lincoln and the surrounding area is solely manage by the City of Lincoln as an urban park. In 1992, approximately 56% of the watershed was considered urban (LPSNRD 1992) and over the past 10 years, the watershed has seen a steady transition from agriculture to urban, residential acreages and commercial. The watershed is expected to achieve a complete build out in the near future.

Holmes Lake is fed by Antelope Creek, which enters the lake from the south/southeast. The surface drainage is rapid on the hills and the drainage ways are well defined (NNRC 1974). The aspect is mostly northward through the City of Lincoln proper and towards Salt Creek (LP2-20000). Three major soils associations are present in the watershed: the Pawnee-Burchard Wymore-Pawnee and the Sharpsburg-Judson Associations. Soils of the Pawnee-Burchard Association are deep, gently sloping to steep, moderately well drained and well-drained, loamy and clayey soils that formed in glacial till. The soils of the Sharpsburg-Judson association are deep, nearly level to moderately steep, moderately and well-drained silty soils that formed in loess and colluvium. The Wymore-Pawnee Association are deep, nearly level to strongly sloping, moderately well drained, silty soils that formed in loess and loamy soils that formed in glacial till. All associations are considered upland soils. As well, water erosion is considered a main hazard for these soils (Brown et al., 1980).

1.1.2.2 Climate: Winters in the watershed are cold with precipitation mainly occurring as snowfall. Summers can be hot but with occasional cool spells. Annual precipitation in the area is approximately 32 inches (DNR Data bank). Rainfall can be periodically heavy during the summer months.

1.1.2.3 Demographics: Holmes Lake lies within the Lincoln city limits (population 215,928), as does a large percentage of the contributing watershed. The municipality is part of Lancaster County, which has shown an approximate 12% growth in the last 10 years.

1.1.2.4 Land Uses: Due to the lake and the watershed's location, much of the land use is urban housing, residential acreages and commercial property. In 1992, 56% of the watershed was considered urban (LPSNRD 1992) and the transition for rural/agriculture to urban has remained steady with the current estimate being 80-90%. Complete "build-out" of the watershed is expected to occur in 15-25 years. An aerial photograph of the 1999 watershed is provided in figure 1.1.2.4.

2.0 Sediment TMDL

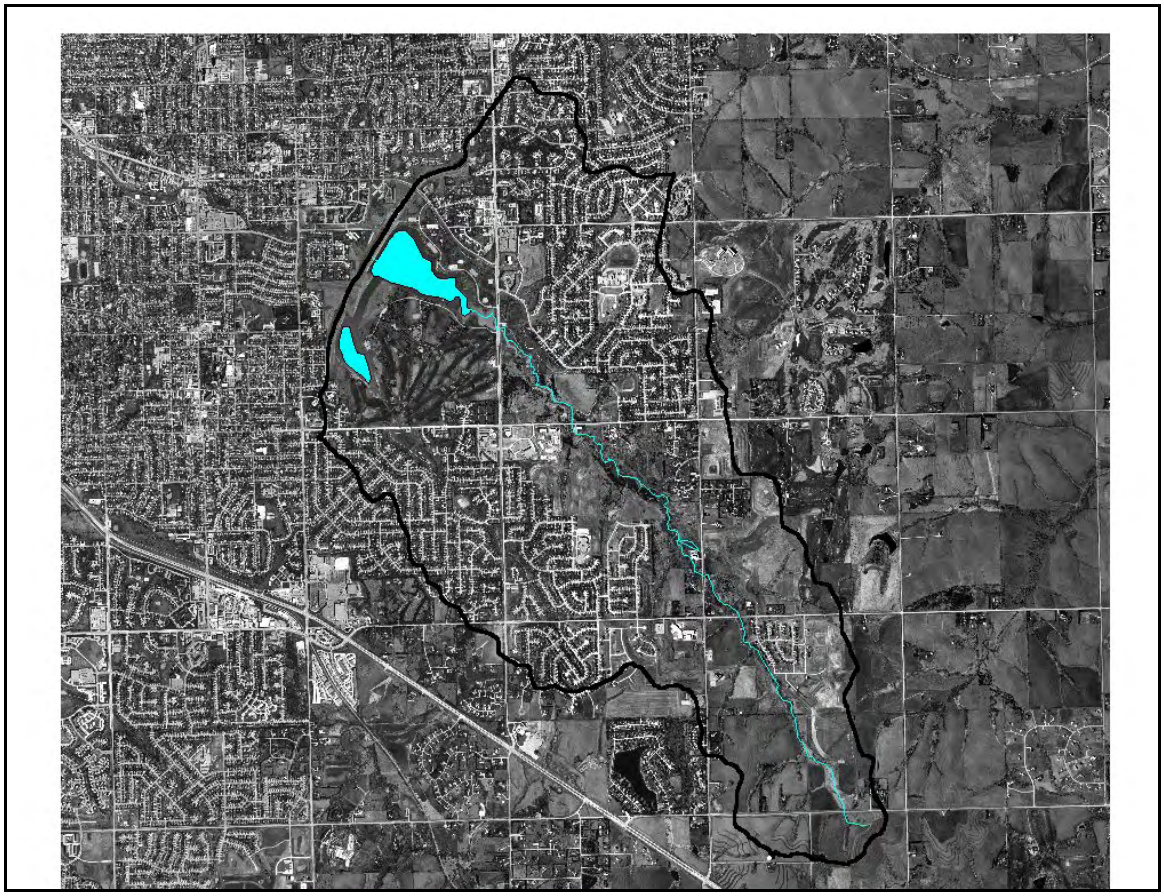
2.1 Problem Identification

This section details the extent and nature of the water quality impairments caused by excessive sedimentation in Holmes Lake.

2.1.1 Water Quality Criteria Violated and/or Beneficial Uses Impaired: The *Aquatic Life* – Warmwater Class A and *Aesthetics* beneficial uses assigned to Holmes Lake are not being met (impaired) due to excessive sedimentation.

2.1.2 Data Sources: Sediment loading and volume loss estimates for Holmes Lake were determined from area-capacity studies conducted by the USACE and the NDEQ. Reservoir capacity studies were conducted on Holmes Lake in 1963, 1977 1984, 1993 and 2001.

Figure 1.1.2.4 Aerial Photograph of Holmes Lake and Watershed



2.1.3 Water Quality Assessment: Nebraska does not have numeric water quality criteria for sediment or total suspended solids but the NDEQ has adopted methods to evaluate the severity of sedimentation in reservoirs. A consideration of the assessment is the overall volume lost of the reservoir multi-purpose pool (conservation pool and sediment pool combined). The NDEQ will include a waterbody on the Section 303(d) list when a 25% volume loss has been reached. For Holmes Lake the 2001 volume loss was estimated to be approximately 27.1%. This also equates to a calculated annual sedimentation rate of 0.71%/year, which falls into the "moderate" category, which will be described in section 2.1.3.2.

The Nebraska Game and Parks Commission (NGPC) manages the state's fisheries and will expend resources to rehabilitate waterbodies when interested parties or the general public express concerns over degrading recreational opportunities and when the aquatic communities exhibit a shift from the original management scheme (i.e. bass/bluegill to carp/bullhead). Therefore, the public ultimately decides if a waterbody is aesthetically acceptable or un-acceptable. In regards to Holmes Lake the NGPC has deemed the waterbody a priority for renovation and did so following public meetings and the receipt of public comments. The main focus of the renovation will be an enhancement of aquatic habitat and reduction in the overall sediment and nutrient loading.

The City of Lincoln has also committed resources to assist in the rehabilitation of the waterbody based upon concerns over the degrading recreational opportunities. Recognizing the physical renovation may will only treat the problems occurring in the waterbody rather than the sources, the City of Lincoln has initiated a community based planning process whereby stakeholders define water quality goals and targets and assist in prioritizing implementation activities

The 2002 Nebraska Section 303(d) List identified Holmes Lake as a high priority and the NDEQ has opted to complete the sediment and nutrient TMDL as an accompaniment to the renovation project. Both the City of Lincoln and the NDEQ action should result in an enhanced fishery and increase public acceptance and use. As well, the NDEQ has identified the waterbody as a high priority for the development and implementation of nonpoint source pollution management actions.

2.1.3.1 Water Quality Conditions: Based on USACE and NDEQ data, Holmes Lake's 1962 multi-purpose pool (sediment and conservation) was reported to be ≅1,059 acre/feet. The 2001 bathymetric evaluation determine the volume to be ≅772 acre/feet for a realize volume loss of 287 acre/feet or 27.1% loss of the original multi-purpose pool. This equates to an average annual volume loss of 0.71%.

2.1.3.2 Severity of Water Quality Problems: As stated, Nebraska has not formally adopted (in Title 117) criteria for sediment, sedimentation or total suspended solids. To evaluate the severity of the sedimentation problem four categories of average annual volume loss/sedimentation rate have been utilized:

Substantial/Severe = ≥ 0.75%/year
Moderate = ≥0.5% but <0.75%
Slight = ≥0.25% to <0.5%
Minimal = <0.25%

Based on the USACE sedimentation survey, Holmes Lake falls within the "moderated" category/range.

Although the period of record (1963-2001) sedimentation rate falls into the moderate category, the assessment of the data collected in 1984 and 1993 indicates the short-term sedimentation rates to be 1.47% and 1.31%, respectively.

Along with sedimentation rate, overall lake volume loss is considered when evaluating beneficial use attainment. Review of past NGPC actions indicates the NGPC will generally initiate reservoir rehabilitation (dredging, sediment removal and habitat restoration) when 20-25% of the lake's volume has been lost. This trend, while undocumented serves as the guide for the NDEQ in listing waters as impaired on Section 303(d) list as described in the *Methodology for Waterbody Assessment and Developing the 2002 Section 303(d) List of Impaired Waterbodies for Nebraska* (NDEQ 2001).

2.1.4 Potential Pollutant Sources

2.1.4.1 Point Sources: The point sources of sediment or total suspended solids that exist in the Holmes Lake watershed are construction sites covered under NPDES permits and the City of Lincoln stormwater discharges covered under the issued MS4 NPDES permit.

2.1.4.2 Nonpoint Source: Multiple nonpoint sources of sediment have been identified in the Holmes watershed. Sources include: sheet and rill erosion, overland run-off from agriculture and urban lands; gully and stream bank erosion.

2.1.4.3 Natural Background Sources: Although natural sources of sediment and total suspended solids exist, background conditions were not separated form the total nonpoint source load.

2.2 TMDL Endpoint

The end point with the sedimentation TMDL is based water quality targets and goals established during the community based watershed management planning process. It should be noted; during the watershed planning the stakeholder goal setting process uses the NDEQ's water quality standard(s) and assessment criteria as the starting point. As described below, annual volume loss and sedimentation targets in comparison with current sediment load estimates allowed for the determination of the allowable load (desired endpoint) as the associated degree of sediment load reduction needed to attain assigned beneficial uses and the stakeholder's expectations.

2.2.1 Criteria for Assessing Water Quality Attainment

2.2.1.1 Numeric Water Quality Standards/Criteria: As previously stated, Nebraska does not have numeric water quality criteria for sediment or total suspended solids.

2.2.1.2 Quantification of Narrative Water Quality Standards/Criteria: The Warmwater Class A *Aquatic Life* beneficial use is protected through the overall reservoir volume loss and the annual reservoir sedimentation rate utilized by NDEQ during waterbody assessments. In support of the sedimentation assessment criteria, the narrative criteria for the *Aesthetics* beneficial use found in Title 117 state in part "To be aesthetically acceptable, waters shall be free from human induced pollution which causes floating, suspended, colloidal or settleable materials that produce objectionable films, colors, turbidity or deposits" (NDEQ 2000).

2.2.1.3 Local Stakeholder Defined Goals: Local stakeholders established the goal of limiting the average annual sediment lad to 5,000 tons/year or less. Using the current average annual load of 10,574 tons/year, a 53% reduction of the long-term average annual load would produce the target load of 5,000 tons per year. If the target load were to be achieved, the average annual volume loss would be reduced from 0.71%/year to 0.34%/year increasing the life span of the waterbody from 141 to 294 years.

2.2.2 Selection of Environmental Conditions

There are no "specific environmental or critical conditions" associated with this sediment TMDL because once the pollutant settles in a reservoir, it is assumed the have an infinite residence time and is present on a year round basis.

2.2.3 Waterbody Loading Capacity

The loading capacity for this TMDL is defined as the amount of sediment Holmes Lake can receive on an annual basis and still meet the assigned beneficial use criteria and the in-lake, stakeholder defined water quality targets. In achieving the stakeholder-defined goals, the criteria associated with the assigned beneficial uses will also be met. To achieve a 53% reduction from the current load and an average annual volume loss of 0.34%/year the sediment loading capacity for Holmes Lake is 5,000 tons/year. It should be noted, the loading capacity for the sediment TMDL has been defined by the stakeholders and will remain the same throughout the expected urbanization of the watershed.

2.3 Pollution Source Assessment

For this TMDL, historic and current sediment loading estimates for Holmes Lake were determined from the USACE's (USACE 1997) and NDEQ's bathymetric surveys.

2.3.1 Existing Sediment Load

Using the USACE and NDEQ sedimentation survey data, the pollutant load being delivered to Holmes Lake is estimated to be 10,574 tons/year.

2.3.2 Deviance From Loading Capacity

The stakeholder-defined sediment loading capacity is being exceeded by approximately 5,574 tons/year. To achieve the targeted sedimentation rate and an annual volume loss of the average annual sediment load must be reduced by 53%.

2.3.3 Identification of Pollutant Sources

One wastewater treatment facility (WWTF) historically discharged to the Holmes Lake watershed. The WWTF has since been decommissioned with the City of Lincoln utilities providing the treatment needs. Construction sites regulated under the NPDES program, other nonpoint sources and natural conditions have been identified as the sources of the sediment being delivered to Holmes Lake.

2.3.4 Linkage of Sources to Endpoint

The average annual sediment load of 10,547 tons/year delivered to Holmes Lake has been determined to originate from activities associated with the urbanization of the watershed and other nonpoint sources. To meet this TMDL's (stakeholder defined) desired endpoint, the annual nonpoint source (including construction site activities) sediment contribution of 10,574 tons per year must be reduced by 5,574 tons/year.

2.4 Pollutant Allocation

A TMDL is defined as:

$$\text{TMDL} = \text{Loading Capacity} = \text{WLA} + \text{LA} + \text{Background} + \text{MOS}$$

Although identified as point sources, NPDES regulated stormwater discharges in the past were included in the load allocation portion of the TMDL. However, a November 22, 2002 memorandum authored by Bob Wayland and James Hanlon, EPA explains that NPDES stormwater discharges must be addressed by the wasteload allocation component of the TMDL. Therefore, the below allocations/allocation process have been established to meet the stakeholder defined water quality goal of 5,000 tons/year.

2.4.1 Wasteload Allocation

Sources identified as contributors of sediment include areas being transitioned from rural/agriculture to urban, in other words, areas under construction. These areas are subject to coverage under a general NPDES permit and as such a WLA must be developed. The difficulty in establishing the WLA is the dynamic nature of these areas. That is, the number of acres in transition is changing as the urbanization is completed and the next project is initiated. Along with this, the City of Lincoln has been issued an MS4 NPDES stormwater permit that requires the City to have a construction site stormwater program as well as other control measures.

To account for this, the TMDL must also be dynamic and contain the flexibility to account for the changes while progressing towards meeting the water quality goals. Therefore, the WLA will be based upon the acreages under construction and/or covered under the City of Lincoln MS4 permit, the allowable per/acre contribution and the water quality goal for the lake. The formula to calculate the WLA is as follows:

$$\text{WLA (ton/year)} = (5000 \text{ tons/yr} \div 3{,}456 \text{ acres}) * \text{NPDES permitted acres}$$

Where:
5,000 tons/yr = stakeholder defined water quality goal
3,456 acres = watershed size
NPDES permitted acres = acres covered by the City of Lincoln MS4 or general NPDES permit

2.4.2 Load Allocation

Based upon the dynamic nature of the above wasteload allocations, the load allocations must be a function of the remaining loading capacity. Therefore the LA for this TMDL will be established by the following formula:

LA = 5,000 tons/year – WLA (tons/year)

Base flows carry indiscernible amounts of sediment and thus natural background will not be separated from the load allocation.

2.4.3 Margin of Safety

The margin of safety (MOS) associated with this sediment TMDL will be:

1. The assessment of reservoir sedimentation is based upon both overall volume loss and annual sedimentation rate. Upon meeting the stakeholder defined loading capacity of 0.34%/year the sedimentation rate will be well below the 0.75%/year sedimentation rate that triggers water quality concerns as identified in the *Methodology for Waterbody Assessment and Developing the 2002 Section 303(d) List of Impaired Waterbodies for Nebraska* (NDEQ 2001). The reductions targeted are approximately 2 times greater than required to be assessed as fully supporting the beneficial uses.
2. The effects of sedimentation are most greatly realized when deposition occurs in the multi-purpose pool. Losses through the outlet and deposition in the flood storage zone will not be separated out. This assumes then that all the sediment delivered is deposited in the multi-purpose pool.

2.4.4 TMDL Summary/Example

Table 2.4.4 provides examples of the dynamic wasteload allocations and load allocations that coincide with the changing variable being the acres of land covered under NPDES permits.

Table 2.4.4 Example of TMDL Equations for Sediment

Total Number of Acres covered by NPDES permits	Loading Capacity (tons/year)	Allowable tons/acre/year	Wasteload allocation (tons/year)	Load allocation (tons/year)
2500	5000	1.447	3616.9	1383.1
2750*	5000	1.447	3978.6	1021.4
3000	5000	1.447	4340.3	659.7
3250	5000	1.447	4702.0	298.0

*Represents (approximate) current conditions.

3. Nutrient TMDL

3.1 Problem Identification

Holmes Lake was included on the 2002 Section 303(d) list as being impaired by excessive nutrients. In-lake conditions indicate accelerated eutrophication caused by excessive nutrient loading. The linkage between accelerated eutrophication and water quality impairments has been repeatedly documented (USEPA 1999). Eastern Nebraska reservoirs classified as being eutrophic or hypereutrophic are generally high in phosphorus, particularly in agricultural watersheds that produce high sediment yields. Holmes Lake in-lake conditions have resulted in phosphorus being the targeted parameter of concern. The following sections detail the extent and nature of the water quality impairments related to accelerated eutrophication in Holmes Lake.

3.1.1 Water Quality Impairments

Holmes Lake was included on the 2002 Section 303(d) list as being impaired by excessive nutrients. Excessive nutrients can lead to accelerated algae growth (algal blooms) that degrade a waterbodies aesthetic quality and may cause dissolved oxygen problems. Phosphorus was selected as the nutrient/parameter of concern because past monitoring has indicated eastern Nebraska lakes to be phosphorus limited.

3.1.2 Data Sources

The NDEQ and USACE have collected various water quality data and information on a semi-regular basis from 1974 through 1994. NDEQ continued to collect such information through 2001 in accordance with basin rotation and other priorities. The existing data includes, water transparency, dissolved oxygen, temperature, conductivity, pH, pesticides, chlorophyll *a*, nitrogen series, dissolved and total phosphorus and total suspended solids.

3.1.3 Water Quality Data Assessments

Nebraska currently does not have numeric water quality criteria for nutrients however; a biomass trophic state index (TSI) (Carlson 1977; Carlson and Simpson 1996) is used as the metric for evaluating this source/stressor. TSI's calculated from transparency (secchi depth), chlorophyll *a*, and total phosphorus concentration data, were utilized to infer whether algal growth was nutrient or light limited (if the three indices are approximately equal, it can be inferred that algal growth is phosphorus limited (USEPA 1999)). Also, the average of the three TSI scores is used as a single measure of lake conditions (e.g., oligotrophic, mesotrpophic, eutrophic or hypereutrophic) as described in Carlson and Simpson (1996). The following classification is used to interpret the TSI:

Trophic State Index Score	Trophic Status	Assessment Criteria	NDEQ Beneficial Use Attainment Status
<40	Oligotrophic	2 of 3 parameters	Full Support
>35 but <45	Mesotrophic	2 of 3 parameters	Full Support
>45	Eutrophic	2 of 3 parameters	Full Support
>60	Hypereutrophic	2 of 3 parameters	Partial Support

3.1.3.1 Water Quality Conditions

Trophic State Indices scores for Holmes Lake using average growing season in-lake data collected from 1997-2001 include:

Parameter	TSI Score
Secchi depth (meters)	74.9
Chlorophyll *a* (mg/m^3)	68.8
Total Phosphorus (μg/l)	75.1
Mean TSI	**72.9**

3.1.4 Potential Pollutant Sources

3.1.4.1 Point Sources: The point sources of nutrients/phosphorus that exist in the Holmes Lake watershed are construction sites covered under NPDES permits and the City of Lincoln stormwater discharges covered under the issued MS4 NPDES permit.

3.1.4.2 Nonpoint Source: Multiple nonpoint sources of nutrients/phosphorus have been identified in the Holmes watershed. Sources include: sheet and rill erosion, overland run-off from agriculture and urban lands; gully and stream bank erosion.

3.1.4.3 Natural Background Sources: Natural sources of nutrients/phosphorus will be determined based upon modeled estimations that take into account precipitation and lake surface acres.

3.2 TMDL Endpoint

The endpoint for the nutrient TMDL is based on the assessment criteria associated with beneficial use attainment. As described below, the targeted in-lake water quality conditions will result in the lake being deemed fully supporting the aesthetic beneficial use.

3.2.1 Criteria for Assessing Water Quality Standards Attainment

3.2.1.1 Numeric Water Quality Standards: No numeric water quality standard exists for phosphorus or nitrogen. Although not identified as an impairment, excessive nutrients can lead to dissolved oxygen problems and the TMDL endpoint will be a preventative measure for the protection of the applicable dissolved oxygen criteria.

3.2.1.2 Quantification of Narrative Water Quality Criteria: As previously outlined in Section 3.1.3, Nebraska does not have numeric water quality standards for nutrients. However, Nebraska's water quality standards for "Aesthetics" states in part, "To be aesthetically acceptable, waters shall be free from human-induced pollution which causes floating, suspended, colloidal, or settleable materials that produce objectionable films, colors, turbidity, or deposits (NDEQ 2000).

The application of the "Aesthetics" beneficial use is through the assessment of a lake's trophic status using Carlson's trophic state index (TSI) as described in Section 3.1.3. In order for a water body to achieve a "full support status", 2 of 3 TSI parameters must be less than 60. Table 3.2.1.2 presents the conditions necessary and the associated TSI score for the waterbody fully support the beneficial use.

Table 3.2.1.2 Holmes Lake Growing Season Water Quality Goals

TSI Parameter	Desired In-Lake Condition (growing season)	TSI Score	Mean TSI Value
Transparency (Secchi depth)	1.0 m	60	****
Chlorophyll *a*	20 mg/m^3	60	****
Total phosphorus	48 µg/l	60	****
			60

Ultimately, the public will decide if a waterbody is aesthetically acceptable or un-acceptable. Therefore, the goals/endpoints used for the nutrient TMDL (nutrients and dissolved oxygen) has been established by the Holmes Lake Water Quality Advisory Council.

3.2.1.3 Local Stakeholder Defined Goals: Through stakeholder meetings held in the Holmes Lake watershed, in-lake water quality goals were established and are presented in Table 3.2.1.3. The goals portion of the water quality management plan can be found in Appendix D.

Table 3.2.1.3a Holmes Lake Stakeholder Defined Water Quality Goals

TSI Parameter	Desired In-Lake Condition (growing season)	TSI Score	Mean TSI Score
Transparency (Secchi depth)	30 inches (0.76 meters)	64	****
Chlorophyll *a*	15 mg/m^3	57.2	****
Total phosphorus	90 µg/l	69	****
			63.4

As shown in the above table, the water quality goals do not meet the NDEQ assessment criteria to deem the water full support. However, in order to meet the transparency goal both the total phosphorus and chlorophyll must be reduced from the selected goals, which if met, will result in the water being deemed full support. Table 3.2.1.3b illustrates the phosphorus, chlorophyll *a* values that have been modeled to occur as a result of attaining the transparency goal.

Table 3.2.1.3b Resulting Total P and Chlorophyll *a* From Attaining the Transparency Goal

TSI Parameter	Desired In-Lake Condition (growing season)	TSI Score	Mean TSI Score
Transparency (Secchi depth)	30 inches (0.76 meters)	63.9	****
Chlorophyll *a*	11.2 mg/m^3	54.3	****
Total phosphorus	36.6 µg/l	54.8	****
			57.7

3.2.2 Selection of Critical Environmental Conditions

The "critical condition" for which this nutrient TMDL applies is the entire year. An annual loading period was utilized in modeling Holmes Lake's assimilative capacity and for estimating loading reductions necessary to meet in-lake water quality targets. This approach also takes into consideration that nutrients being lost from the water column and trapped in the bottom sediments have the potential to re-enter the water column at a later time. However, implementation of controls will target those times when a large percent of the loading is occurring.

3.2.3 Waterbody Pollutant Loading Capacity

The loading capacity for this nutrient TMDL is defined as the amount of phosphorus Homes Lake can receive on an annual basis and still meet the applicable water quality criteria, assigned beneficial use criteria and established in-lake water quality targets. Utilizing the EUTROMOD (Reckhow 1992) model, the meet the secchi, chlorophyll *a* and phosphorus goals, the loading capacity for phosphorus, for Holmes Lake is 260 lbs/year (118 kg/year). It should be noted, the loading capacity for the phosphorus TMDL has been defined in order to meet the stakeholder goals and will remain the same throughout the expected urbanization of the watershed.

3.3 Pollutant Source Assessment

For this nutrient TMDL, the phosphorus loading was estimated using a combination of models and chemical data. The model utilized was EUTROMOD.

3.3.1 Existing Pollutant Load

The average annual phosphorus load is estimated to be 8,070 lbs/year (3,660 kg/year). This value was estimated using the EUTROMOD models and calibrated to in-lake conditions (Appendix B).

3.3.2 Deviance From Loading Capacity

The targeted waterbody loading capacity for phosphorus, to meet the in-lake goals is 260 lbs/year and the modeled average annual load is 8,070 lbs/year. The loading capacity is being exceeded by 7,810 lbs/year and to achieve the loading capacity, a 97.25% reduction from the current annual phosphorus load is needed (Appendix C).

**It should be noted; the modeling to determine the current average annual load was based upon the existing bathymetric/lake volume information with the comparison to monitored in-lake conditions. The modeling to determine the loading capacity and watershed reductions necessary was based upon the lake volume following restoration. The Holmes Lake restoration plan will be describe in greater detail in Section 4.0.

3.3.3 Identification of Pollutant Sources

One wastewater treatment facility (WWTF) historically discharged to the Holmes Lake watershed. The WWTF has since been decommissioned with the City of Lincoln utilities providing the treatment needs. Construction sites regulated under the NPDES program, urban run-off, agriculture nonpoint sources and natural conditions have been identified as the sources of phosphorus being delivered to Holmes Lake.

3.3.4 Linkage of Sources to Endpoint

The average annual phosphorus load of 8,070 lbs/year delivered to Holmes Lake has been determined to originate from activities associated with the urbanization of the watershed and other nonpoint sources that primarily result from precipitation events. To meet this TMDL's (stakeholder defined) desired endpoint, the annual nonpoint source (including construction site activities) phosphorus contribution of 8,070 pounds per year must be reduced by 7,810 lbs/year.

3.4 Pollutant Allocation

A TMDL is defined as:

TMDL = Loading Capacity = WLA + LA + Background + MOS

Although identified as point sources, NPDES regulated stormwater discharges in the past were included in the load allocation portion of the TMDL. However, a November 22, 2002 memorandum authored by Bob Wayland and James Hanlon, EPA explains that NPDES stormwater discharges must be addressed by the wasteload allocation component of the TMDL. Therefore, the below allocations/allocation process have been established to meet the stakeholder defined water quality goal of 260 lbs/year.

3.4.1 Wasteload Allocation

Sources identified as contributors of nutrients include areas being transitioned from rural/agriculture to urban, in other words, areas under construction. These areas are subject to coverage under a general NPDES permit and as such a WLA must be developed. The difficulty in establishing the WLA is the dynamic nature of these areas. That is, the number of acres in transition is changing as the urbanization is completed and the next project is initiated. Along with this, the City of Lincoln has been issued an MS4 NPDES stormwater permit that requires the City to have a construction site stormwater program as well as other control measures.

To account for this, the TMDL must to be dynamic and contain the flexibility to account for the changes while progressing towards meeting the water quality goals. Therefore, the WLA will be based upon the acreages under construction, the allowable per/acre contribution and the water quality goal for the lake. The formula to calculate the WLA is as follows:

WLA (lbs/year) = ({260lbs/yr – 37.5 lbs/yr} ÷ 3,456 acres) * NPDES permitted acres

Where:
260 lbs/yr = waterbody loading capacity to meet the stakeholder defined water quality goals
37.5 lbs/yr = natural background phosphorus load
3,456 acres = watershed size
NPDES permitted acres = acres covered by the City of Lincoln MS4 or general NPDES permit

3.4.2 Load Allocation

Based upon the dynamic nature of the above wasteload allocations, the load allocations must be a function of the remaining loading capacity. Therefore the LA for this TMDL will be established by following formula:

LA = 260 lbs/year – (WLA (lbs/year)+ Background)

Base flows carry indiscernible amounts of sediment and thus natural background will not be separated from the load allocation.

3.4.3 Natural Background

Utilizing annual precipitation, waterbody surface area and precipitation concentration the natural background load of phosphorus was determined by the EUTROMOD model to be approximately 37.5 lbs/year (17 kg/year).

3.4.4 Margin of Safety

The margin of safety for the nutrient TMDL will be: phosphorus can be discharged from the Holmes Lake/Reservoir outlet without being utilized. While this reduction is realized in the system, the TMDL will not account for this and assume the phosphorus load delivered to the lake remains available for algae production.

3.4.5 TMDL Summary/Example

Table 3.4.5 provides examples of the dynamic wasteload allocations and load allocations that coincide with the changing variable being the acres of land covered under NPDES permits.

Table 3.4.5 Example of TMDL Equation for Phosphorus

Total Number of Acres covered by NPDES permits	Loading Capacity (lbs/year)	Natural Background (lbs/year)	Allowable Remaining lbs/acre/year	Wasteload allocation (lbs/year)	Load allocation (lbs/year)
2500	260	37.5	0.064	161.0	61.5
2750*	260	37.5	0.064	177.0	45.5
3000	260	37.5	0.064	193.1	29.4
3250	260	37.5	0.064	209.2	13.3

*Represents (approximate) current conditions

4.0 Implementation Plan

The implementation plan to meet the water quality goals for Holmes Lake has been segregated into two phases: 1) Watershed management planning and 2) Lake restoration/watershed treatment. The watershed management planning process is scheduled to be completed in January 2003 and will direct the final restoration process. In conjunction with the planning phase, the City of Lincoln has been developing and incorporating an information/education programs aimed at the future preservation of the waterbody.

The second phase of the project will involve a physical restoration of the waterbody and the surrounding park amenities (City of Lincoln, 2001). The preliminary restoration and construction concepts have been completed and include the excavation of approximately 400,000 cubic yards of deposited sediment resulting in an increase of waterbody mean depth from 3 to 9 feet, renovation of the fishery, shoreline stabilization and the construction of multiple jetties. Project partners include, the City of Lincoln, Nebraska Department of Environmental Quality, Nebraska Game and Parks Commission, Natural Resource Conservation Service, University of Nebraska-Lincoln, United States Army Corps of Engineers, and Lower Platte South Natural Resource District.

4.1 Reasonable Assurances

The Nebraska Department of Environmental Quality has been delegated the authority to review applications, issue permits and conduct enforcement in regards to stormwater discharges. Under the auspice of the NPDES program, a general permit has been issued to regulate construction site discharges and the City of Lincoln has been issued an MS4 stormwater permit. As recommended by EPA, the WLAs will be implemented through the NDPES program and will attempt to utilize “non-numeric” water quality based effluent limits in the form of best management practices (BMPs)

This permitting action should have a positive influence in reducing the nutrients and sediment being delivered to Holmes Lake.

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 and nutrient delivery to Holmes Lake. Participation will depend on the agency/organization's program capabilities.

5.0 Future Monitoring

Monitoring of Homes Lake will be conducted in the future to determine if the water quality is improving, degrading or remaining status quo. As well, monitoring will be conducted to evaluate the effectiveness of implemented best management practices (BMPs). The NDEQ has entered into an agreement with the USACE whereby the USACE will conduct monthly monitoring throughout the growing season and forward the results to NDEQ for assessment. Also, the USACE and or NDEQ will periodically evaluate the impacts of sedimentation (bathymetry). The lake has been drained to accommodate the rehabilitation and restoration activities and because of this, monitoring by the USACE will begin once the restoration has been completed and the lake refilled. Along with the USACE monitoring, NDEQ may periodically conduct monitoring to evaluate the effectiveness of BMPs (i.e. in-lake basins).

6.0 Public Participation

The availability of the TMDLs in draft form was published in the Omaha World Herald and the Lincoln Journal Star with the public comment period running from May 11, 2003 to June 13, 2003. These TMDLs were also made available to the public on the NDEQ's Internet site and announcement letters were mailed to interested stakeholders.

As a result of the public notice, comment letters were received from the Nebraska Pork Producers Association (NPPA) and the United States Fish and Wildlife Service (USFWS). No action or response was required as a result of the comments made by the NPPA. Comments made by USFWS pertained to future monitoring and the delisting of waterbodies as impaired by atrazine. The response to comments (included with the submittal package) explains the future monitoring objectives and expected parameters and defers the atrazine comment to the water quality standards program. No changes were made to the TMDLs as a result of the USFWS comments.

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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)

Appendix B - EUTROMOD Modeled Average Annual Phosphorus Load

Holmes Lake	Input data in green cells		Phosphorus (mg/l)	Chlorophyll a	Secchi Depth	Secchi Depth (inches)
Surface Acres (acres)	110	Monitored In-lake Value	0.1350	49.3	0.35	13.6
Lake Volume (ac-ft)	772	Predicted	0.1350	23.23	0.271	10.7
Inflow (ac-ft/year)	1567	% Similar	1.00	0.47	0.77	
Inflow (cfs)						
Annual Precipitation	30.0		TSI - phosphorus	TSI - chlorophyll *a*	TSI - secchi	MEAN TSI
Watershed P Loading (lbs)	8070	Monitored In-lake Value	74.9	68.8	75.1	72.9
Detention Time (years)	*0.49*	Predicted	74.9	61.5	78.8	71.7
Lake Volume (10^6 m^3)	*0.952*	% Similar	1.00	0.89	0.95	0.98
Volumetric Water Load (10^6 m^3/yr)	*1.933*					
Mean Depth (ft)	*7.02*		Watershed load to meet in-lake p concentration (lbs)	Watershed load to meet in-lake Chlorophyll *a* (lbs)	Watershed load to meet in-lake secchi (lbs)	
Mean Depth (m)	*2.139*		8070		2050	
Watershed P Loading (kg)	3661		Load Summary			
Precip P Load (kg)	*17.0*		Minimum	2050		
Septic P Load (kg)			Mean	5060		
WWTF P Load (kg)			Median	5060		
Total P Loading (kg)	*3677*		Maximum	8070		
Total P Loading (lbs)	*8107.4*					
Expected Total P-in	*1.902*					

Appendix C – Total Phosphorus Reduction to Meet Stakeholder Derived Secchi Depth Goal

Holmes Lake	Input data in green cells		Phosphorus (mg/l)	Chlorophyll a	Secchi Depth	Secchi Depth (inches)
Reduction %	97.25	Predicted	0.0336	11.16	0.761	30
Lake Volume (ac-ft)	1020	Water Quality Goals	0.0900	15.00	0.76	30
Surface Acres (acres)	113	% Similar	0.37	0.74	1.00	
Detention Time (years)	0.65					
Watershed P Loading (lbs)	8070		TSI - phosphorus	TSI - chlorophyll *a*	TSI - secchi	MEAN TSI
Reduced Watershed Load (lbs)	*221.9*	Predicted	54.8	54.3	63.9	57.7
Volumetric Water Load (10^6 m^3/yr)	*1.933*	Water Quality Goals	69.0	57.2	64.0	63.4
Lake Volume (10^6 m^3)	*1.258*	% Similar	0.79	0.95	1.00	0.91
Mean Depth (ft)	*9.03*					
Mean Depth (m)	*2.751*		Watershed load Reduction to meet p concentration water quality goal (lbs)	Watershed load reduction to meet Chlorophyll *a* water quality goal (lbs)	Watershed load reduction to meet secchi measurement goal (lbs)	
Reduced Watershed Load (kg)	100.65					
Precip P Load (kg)	*17.4*		Reduction Summary			
Septic P Load (kg)	*0.0*		Minimum	0		
WWTF P Load (kg)	*0.0*		Mean	#DIV/0!		
Total Reduced P Loading (kg)	*118.1*		Median	#NUM!		
Total Reduced P Loading (lbs)	*260.3*		Maximum	0		
Expected Total P-in	*0.061*					

Appendix D – Goal and Objectives of the Community Based Watershed Management Plan

GOAL I. Protect Holmes Lake from sedimentation by controlling erosion in the watershed.

Objective 1: Maintain average annual sediment loads delivered to Holmes Lake at or below 5,000 tons.

GOAL II. Promote practices through public education that reduce runoff pollution to Holmes Lake.

Objective 1: Encourage pet owners to properly dispose of all pet wastes on public and private land.

Objective 2: Reduce the amount of lawn fertilizers and pesticides used by watershed residents.

GOAL III. Provide long-term protection of water quality in Holmes Lake for wildlife and recreation.

Objective 1: Decrease average summer total phosphorus concentrations at the deepwater site by 35 percent from 0.14 mg/l to 0.09 mg/l.

Objective 2: Maintain concentrations of fecal coliform bacteria at the deepwater site below water quality standards concentrations during each recreation season.

Objective 3: Reduce average summer chlorophyll concentrations at the deepwater site to 15.00 mg/m3.

Objective 4: Increase and maintain average summer water transparency measurements at the deepwater site to 30 inches.

Objective 5: Maintain levels of pesticides and heavy metals at the deepwater site below chronic water quality standards concentrations.

GOAL IV. Maintain the flood control capacity of Holmes Lake.

Objective 1: Mitigate for any in-lake structures constructed in the flood storage area during the lake restoration.

GOAL V. Restore the fisheries of Holmes Lake.

Objective 1: Increase water column average dissolved oxygen concentrations at the deepwater site above 5.0mg/l for more than 90 percent of the summer.

Objective 2: Reduce total suspended solids concentrations at the deepwater site by 64 percent from 42 mg/l to 15 mg/l.

Objective 3: Complete the in-lake restoration activities.