Total Maximum Daily Loads
for
Iron Horse Trail Lake
Pawnee County, Nebraska

Parameters of Concern: Nutrients and Sediment

Pollutant Addressed: Phosphorus and Sediment

Nebraska Department of Environmental Quality
Planning Unit, Water Quality Division

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Table of Contents

Table of Contents – Continued

List of Figures and Tables

Executive Summary

Iron Horse Trail Lake was included as a Category 5 waterbody on the 2004 Nebraska Surface Water Quality Integrated Report (NDEQ 2004) due to impairment by mercury, nutrients and excessive sediment. As such, total maximum daily loads must be developed in accordance with the Clean Water Act. This document presents TMDLs, for phosphorus and sediment to address these impairments. The information contained herein should be considered 2 TMDLs.

The impairment for mercury was based on the analysis of fish tissue and the issuance of a fish consumption advisory. While important, the Nebraska Department of Environmental Quality has not established procedures for addressing impairments associated with fish tissue. Rather than delay the TMDLs for nutrients and sediment, the TMDL for mercury will be postponed until technically feasible.

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 TMDL is being developed.

Iron Horse Trail Lake, Section 17, T 1 North, R 12 East, Pawnee County, Nebraska. Lat. 40° 02' 30", Long. 95° 56' 30"

2. Identification of the pollutant and applicable water quality standard

The pollutant causing the impairment(s) of the water quality targets, designated beneficial uses and for which these TMDLs are being developed are nutrients (phosphorus) and sediment. Designated uses assigned to Iron Horse Trail Lake include: primary contact recreation, aquatic life Warmwater Class A, agriculture water supply class A and aesthetics (NDEQ 2002). Excessive 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.

Empirical data and the EUTROMOD water quality model were employed to determine the current and maximum nutrient load that if achieved should result in beneficial use attainment. This value is 2,379 lbs/year (1,079 kg/year) for phosphorus.

Empirical data obtained from design plans and bathymetric surveys were employed to determine the current average annual sediment load and the stakeholder derived water quality target that if achieved will result in beneficial use attainment. This value is 9,200 tons/year.

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 total phosphorus load delivered to Iron Horse Trail Lake is estimated to be 9,827 lbs/year (4,458 kg/year). To meet the water quality goals, the average annual loading capacity is 2,379 lbs/year and approximately a 76% reduction is needed.

The average annual sediment load delivered to Iron Horse Trail Lake has been determined to be 24,966 tons/year. To meet the water quality goals, the average annual loading capacity is 9,200 tons/year and approximately a 63% reduction is needed.

5. Identification of the pollution source categories.

Nonpoint and natural sources of nutrients have been identified as the cause of impairment to Iron Horse Trail Lake.

6. Wasteload allocations for pollutants from point sources.
No point sources discharge in the watershed and therefore the wasteload allocations for both phosphorus and sediment will be set at zero (0).

7. Load allocations for pollutants from nonpoint sources.
For this TMDL the phosphorus and sediment load allocation were set at 2,352 lbs/year and 9,200 tons/year, respectively. These allocations were developed using models and empirical data. Based upon water quality modeling, a background loading of 27 lbs/year was set as the (natural) allocation for nutrients. No specific sediment load allocations were made for natural sources as allowed by 40 CFR Part 130.7.

8 A margin of safety.
This TMDL contain an implicit margin of safety. Pollutants are discharged from the system via the reservoir's outlet. The TMDL will assume all pollutants delivered to the waterbody remain, again 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. However, in-lake and watershed model inputs require that seasonal changes (e.g. vegetative cover, precipitation) be accounted for. Because nonpoint sources have been identified as the largest contributor, management practices and implementation will be targeted at those times when the nonpoint 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, potential for future dissolved oxygen impairments and sediment reducing the volume of the lake.

10. Allowances for reasonably foreseeable increases in pollutant loads.
There was no allowance for future growth included in these TMDLs.

11. Implementation Plan

An implementation plan has been developed as part of the community based planning process. Desired and implemented control measures will be a function of available funding and other factors. Targeted or potential implementation activities include but are not limited to: in-lake sediment basin, limited dredging, upgrade of septic systems, decommissioning of abandoned or other wells, land treatment within the watershed and information and education. When complete, a copy of the implementation plan will be included as an addendum to these TMDLs.

The TMDL(s) 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 4.0) 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

Iron Horse Trail Lake was included on Category 5 of the 2004 Nebraska Surface Water Quality Integrated Report. Category 5 represents those waterbodies that have been identified as not supporting one or more beneficial uses and needing one or more Total Maximum Daily Loads (TMDL). For Iron Horse Trail Lake, the pollutants of concern are nutrients, sediment and mercury. The identified mercury impairment is the result of fish tissue analysis and the issuance of a consumption advisory. While the presence of a fish consumption advisory is a concern, the suspected sources are either natural or the result of air deposition and because of the complexity of the process, the Nebraska Department of Environmental Quality (NDEQ) is not prepared to establish TMDLs for mercury. Rather than delay the TMDLs for sediment and nutrients, development of the mercury TMDL will be postponed until technically feasible.

During the summers of 2004 and 2005 and following concerns raised by recreational users of Nebraska waters, the Department and other entities began weekly sampling and analysis for microcystin. Microcystin is a toxin produced by some types of cyanobacteria also referred to as blue green algae. To toxin can produce rashes, lesions and blisters on humans, pets and livestock from external contact and may be fatal if ingested. Currently, there are no water quality criteria for the assessment of microcystin data. The Department in conjunction with the Nebraska Department of Health and Human Services, the Nebraska Game and Parks Commission and the University of Nebraska has developed a process for issuing a "Health Alert" based on frequent monitoring to warn users of the potential dangers associated with primary contact recreation in the affected waterbodies. Iron Horse Trail Lake was one of the waterbodies where primary contact has been affected.

The warning levels used to issue health alerts was established based on literature review and other available information. As stated above, Title 117 – Nebraska Surface Water Quality Standards does not currently include water quality criteria for microcystin for the protection of the primary contact recreation beneficial use. Although blue-green algae have been an issue for some time in Nebraska waters, the concerns were mainly focused on aesthetics rather than primary contact recreation. The Department is in the process of collecting and reviewing additional information from Nebraska waterbodies as well as tracking the problem and solutions in other areas. During the 2008 triennial review of Title 117, the parameters will be examined for potential inclusion with two of the options being a numeric value(s) or narrative statements.

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 nutrients and sediment have been developed and contained herein to address the identified impairments. While no TMDL will be developed to address the microcystin issue, the linkage to nutrients is clear and the nutrient TMDL that has been developed should have a positive influence on the problem.

1.1 Background Information

Iron Horse Trail Lake is located in Pawnee County, Nebraska (Figure 1) and was constructed under P.L. 566 as part of the South Fork Watershed flood control project with facility completion occurring in 1985 (NNRD 2004). The lake and associated area are owned and operated by the Nemaha Natural Resource District (NNRD). Iron Horse Trail Lake was designed as a multi-purpose flow retarding and recreation structure (NNRD 1994). A description of the physical information is provided in Table 1.1. The Nebraska Game and Parks Commission (NGPC) manage the fishery and the NNRD manages the immediate surrounding 275 acres as a recreation facility. No towns exist within the watershed boundary however, Du Bois (population 166) lies approximately 2.5 miles to the southeast.

1.1.1 Waterbody Description

1.1.1.1 Waterbody Name: Iron Horse Trail Lake

Lake Identification Number: NE2-L0090 (Tile 117 – Nebraska Surface Water Quality Standards)

1.1.1.2 Major River Basin: Missouri River

1.1.1.3 Minor River Basin: Nemaha

1.1.1.4 Hydrologic Unit Code: 10240008

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) (NDEQ 2002).

1.1.1.6 Major Tributary: Lores Branch - NE-12110

1.1.2 Watershed Characterization

1.1.2.1 Physical Features: Iron Horse Trail Lake has a watershed of approximately 4,732 acres and is located in the Western Corn Belt Plains (Level III) ecoregion as defined by Chapman, et al. (2001). The recreation area was completed in 1985 by the NNRD who retains ownership however; the lake's fishery is managed by the NGPC. The watershed is rural with general agriculture (e.g. row crops, pasture) dominating the land use with lesser amounts of homesteads and wooded areas.

Figure 1.1 Locations of Iron Horse Trail Lake and Watershed in Pawnee County, Nebraska

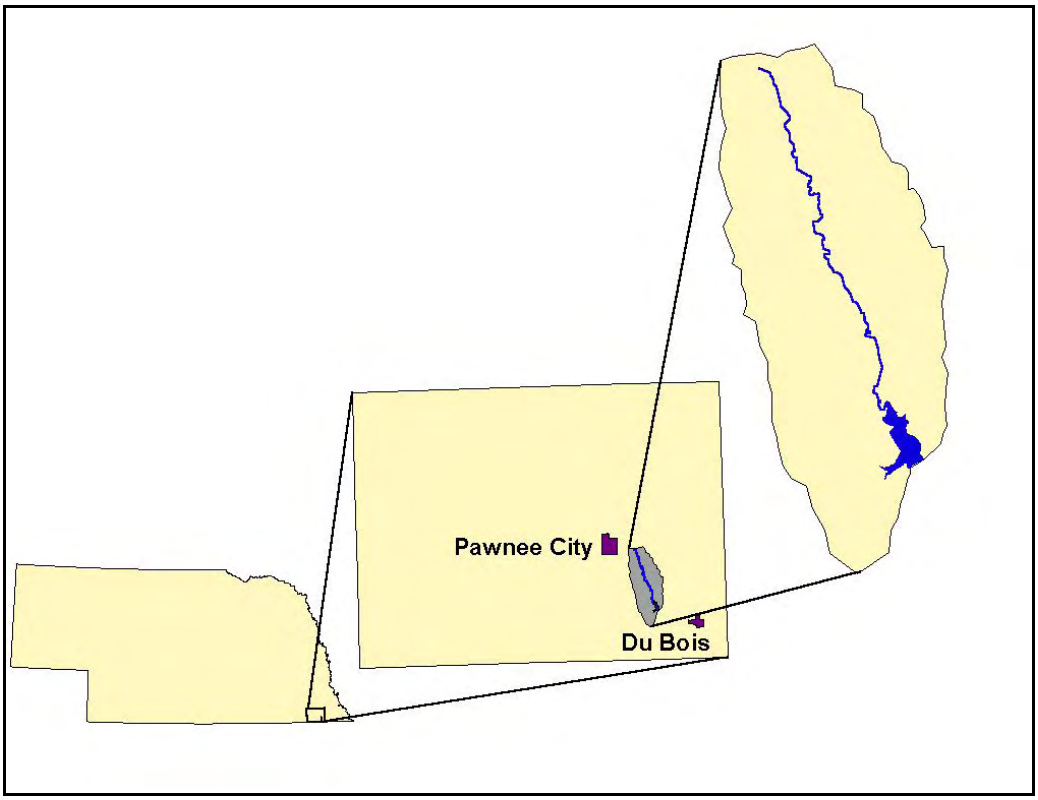


Table 1.1 Physical Description of Iron Horse Trail Lake

Parameter	Iron Horse Trail Lake
State	Nebraska
County	Pawnee
Latitude (center of dam)	40° 02’ 30”
Longitude (center of dam)	96° 05’ 30”
Section, Township, Range (dam)	Section 17, T 1 North, R 12 East
Surface Area – 1985	85 acres
Surface Area – 2001	74 acres
Shoreline length (approximate)	2.7 miles
Mean Depth – 1986	10.45 feet (3.18 meters)
Mean Depth – 2001	7.5 feet (2.3 meters)
Conservation Pool Volume – 1986	878 acre-feet
Conservation Pool Volume – 2001	557 acre-feet
Number of Major Inlets	1
Watershed Area	4,732 acres
Lake to Watershed Area Ratio	1:56

Lores Creek – NE2-12110 is the only tributary and enters the lake from the north/northwest. The land surface in watershed consists of rolling hills that descend to flat valleys. Drainage in the valleys is poor in some areas but well defined with rapid surface runoff in the remainder of the watershed (NNRC 1976). Soil associations in the watershed include the Kennebec-Judson-Wabash, Wymore and Pawnee-Mayberry-Burchard. Soils of the Kennebec-Judson-Wabash association are deep, nearly level to gently sloping, well-drained silty soils and poor drained clayey soils and are considered bottomland soils. The soils of the Wymore association are deep; nearly level to strongly sloping moderately well drained that have a silty surface layer and a clayey subsoil. The soils of the Pawnee-Mayberry-Burchard association are deep nearly level to moderately steep loamy and clayey subsoil on glacial uplands. The latter two associations are considered upland soils (Sautter 1976).

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 33 inches (DNR Data bank). The majority of the precipitation occurs during the growing season.

1.1.2.3 Demographics: While no municipality lies in the watershed, the Village of Du Bois – population 166 and the City of Pawnee City – population 1,033 – lie approximately 2.5 miles to the southeast and 7 miles to the northwest, respectfully. Du Bois has seen an approximate 43% population increase from 1990 to 2000 while Pawnee City seen a 3 percent increase during the same period.

1.1.2.4 Land Uses: Agriculture dominates the land use in the watershed with the 1992 estimates being 43% being devoted to cropland, 18% pasture and grass, 28% enrolled in the Conservation Reserve Program and the remaining 11% being homesteads, water and wooded areas (NNRD 1994). An aerial photograph of the watershed is provided in Figure 1.1.2

2.0 Phosphorus TMDL to Address Nutrient Impairment

2.1 Problem Identification

Iron Horse Trail Lake was included as a Category 5 waterbody on the 2004 Nebraska Surface Water Quality Integrated Report (Integrated Report), 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. Iron Horse Trail Lake watershed modeling and 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 Iron Horse Trail Lake.

2.1.1 Water Quality Impairments

Iron Horse Trail Lake assigned beneficial uses for Warmwater A (WWA) Aquatic Life and Aesthetics were identified as impaired due to excessive nutrients – specifically, phosphorus.

2.1.2 Data Sources

The NNRD and NDEQ have collected various water quality data and information on a semi-regular basis mainly from 1995 through 2004. The two entities will continue to collect such information in accordance with basin rotation pre- and post-project monitoring 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.

2.1.3 Water Quality Data Assessment

Iron Horse Trail Lake was first identified as impaired by excessive nutrients on the 1998 Section 303(d) list. Prior to 2004, the impairment by nutrients was determined using a waterbodies trophic state index or (TSI) (Carlson 1977; Carlson and Simpson 1996). 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).

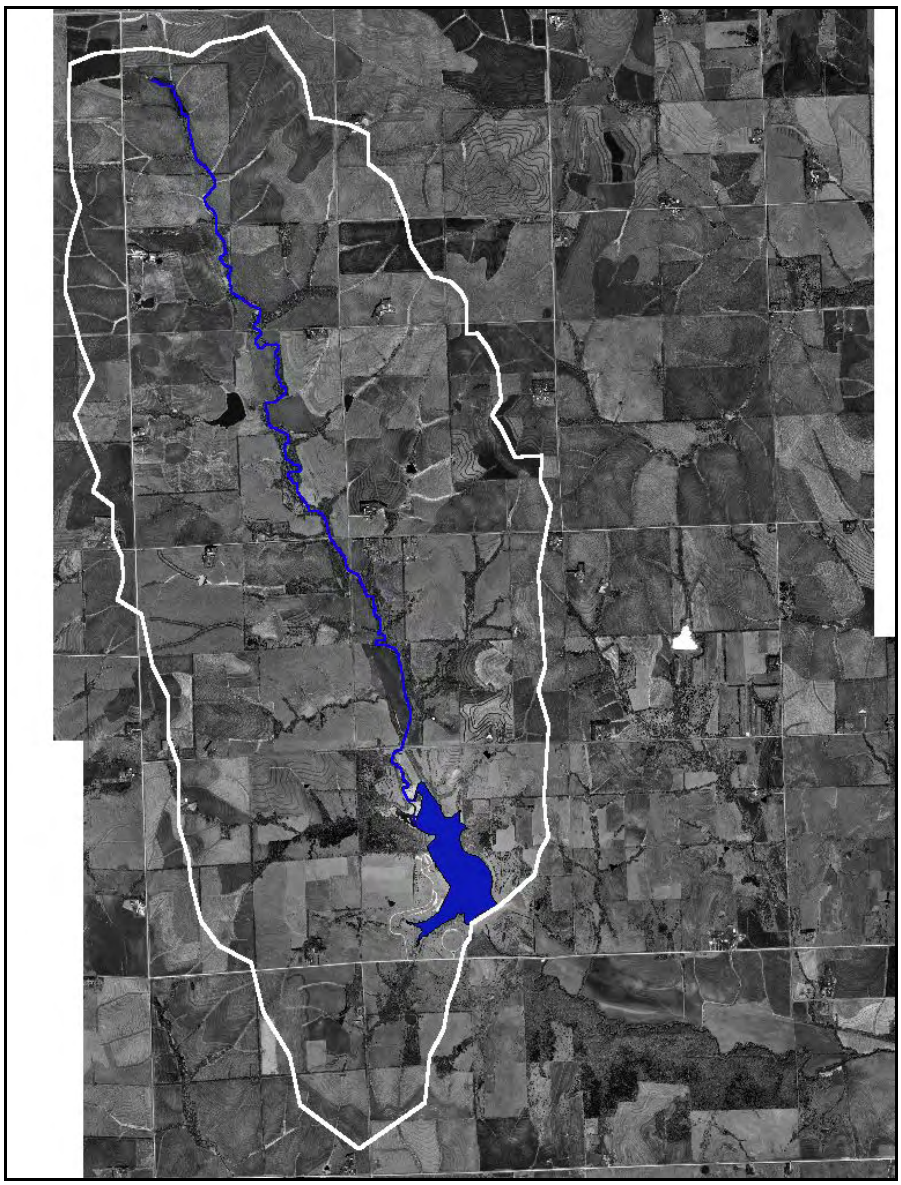
For the past several years, the University of Nebraska has been collecting data from reservoirs throughout the state for the purpose of developing a classification scheme. Included within this scheme is the establishment of region nutrient (nitrogen, phosphorus and chlorophyll *a*) water quality targets. The selection of these water quality targets as TMDL goals/endpoints is consistent with EPA recommendations set forth in the document *Protocol for Developing Nutrient TMDLs* 1999. As well, derivation of the water quality targets was done in conjunction with the convening of a regional technical advisory group (RTAG). Finally, it is the Department's intent to add these targets as the applicable water quality criteria during the 2005 triennial review of Title 117 for the lakes/reservoirs within the identified regions. The water quality targets for Iron Horse Trail Lake are 15 mg/l total nitrogen, 143 μg/l total phosphorus and 16 mg/m^3 chlorophyll *a*. The application of the water quality targets will be as a growing season average.

2.1.3.1 Water Quality Conditions: For the assessment period 2002-2004, 14 total phosphorus samples were obtained during the growing season. One of three annual average values exceeded the water quality target (143 µg/l), as did the long-term average (169 µg/l). The data is illustrated in Figure 2.1.3.1. From this data and information and using the average annual total phosphorus concentration of 169 µg/l and the average annual load determined using the EUTROMOD (Reckhow 1992) water quality model is 9,827 lbs (4,458 kg) as shown in Table 2.1.3.1.

2.1.4 Potential Pollutant Sources

2.1.4.1 Point Source: No point sources, permitted under the National Pollutant Discharge Elimination System (NPDES) program has been identified in the Iron Horse Trail Lake watershed. There are four facilities that have been issued or have requested a state construction or operating permit or have requested an inspection. If issued, these operating permits are "no discharge" permits.

Figure 1.1.2.4 Aerial Photograph of Iron Horse Trail Lake and Watershed



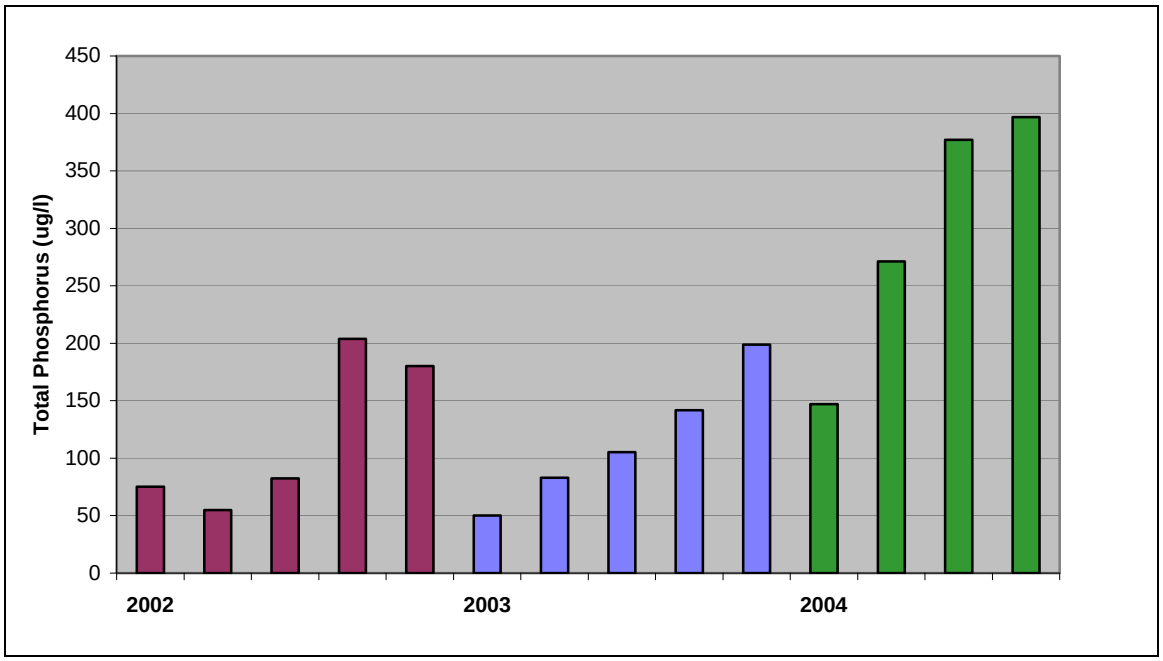
2.1.4.2 Nonpoint Sources: Multiple nonpoint phosphorus sources have been identified in the Iron Horse Trail Lake watershed that includes: stream bank and gully erosion, agricultural, and other land uses (i.e., grasslands, wooded, etc.).

2.1.4.3 Natural Sources: Natural background/source determination was based upon the contribution of phosphorus as estimated by EUTROMOD modeling techniques.

2.2 TMDL Endpoint

The endpoint for the nutrient TMDL is based upon narrative criteria, numeric water quality targets and stakeholder defined water quality goals. As described below, phosphorus loading targets in comparison with current load estimates allowed for the determination of an acceptable load (desired endpoint) and the needed reduction necessary to attain full support designation and the stakeholder-defined goals.

Figure 2.1.3.1 Iron Horse Trail Total In-Lake Phosphorus 2002-2004



2.2.1 Criteria for Assessing Water Quality Attainment

2.2.1.1 Numeric Water Quality Target: Phosphorus was selected as the nutrient/parameter of concern because past monitoring has indicated eastern Nebraska lakes to be phosphorus limited. Chlorophyll *a* is a measure of lake productivity. The water quality endpoints for this TMDL will be total phosphorus and chlorophyll *a* with the regionally based water quality targets for Iron Horse Trail Lake being 0.143 mg/l and 16mg/m^3, respectively.

Table 2.1.3.1 Iron Horse Trail Lake Total Phosphorus Data

Sample Date	Total Phosphorus (µg/l)	Average Annual Concentration	EUTROMOD Predicted Average Annual Load (lbs)
5/20/02	75		
6/12/02	55		
7/10/02	82		
8/14/02	204		
9/3/02	180	119	3,375
5/5/03	50		
6/4/03	83		
7/2/03	105		
8/6/03	142		
9/4/03	199	116	3,125
6/3/04	147		
8/12/04	271		
9/15/04	377		
10/14/04	397	298	123,000
Long Term Average	**169**		**9,827**

2.2.1.2 Local Stakeholder Defined Goals: Through stakeholder meetings held in the Iron Horse Trail Lake watershed, in-lake water quality goals were established. A summary of the desired conditions are based on Carlson's Trophic State Index (Carlson 1996) and are presented in Table 2.2.1.2 with the complete listing of goals being included as Appendix B.

Table 2.2.1.2 Iron Horse Trail Lake Stakeholder Defined Water Quality Goals

Parameter	Desired In-Lake Condition (growing season)
Transparency (Secchi depth)	>30 inches (0.7 meters)
Chlorophyll *a*	30 mg/m^3
Total phosphorus	184 µg/l

For this TMDL, the water quality targets (draft water quality criteria) are more stringent than the stakeholder selected goals. Also, the loading reductions necessary to meet the chlorophyll *a* target is greater than that needed to meet the total phosphorus target. Therefore, the endpoint for this TMDL will be the load and reductions necessary to meet the chlorophyll *a* water quality target.

2.2.1 Selection of Critical Environmental Conditions

The "critical condition" for which this nutrient TMDL applies is the entire year. Although the April-October growing season data is utilized, the loading to meet the conditions calculated by EUTROMOD is an annual load. This approach 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 non-point source controls will target those times or conditions when a large percentage of the loading is occurring.

2.2.2 Waterbody Pollutant Loading Capacity

The loading capacity for this nutrient TMDL is defined as the amount of phosphorus Iron Horse Trail Lake can receive on an average annual basis and still meet the applicable in-lake water quality targets. Utilizing the EUTROMOD model, to meet the chlorophyll *a* water quality target for the waterbody, the phosphorus average annual loading capacity for Iron Horse Trail Lake is 2,379 lbs (1,079 kg)

2.3 Pollutant Assessment

For this TMDL, the pollutant assessment is based upon the water quality information collected from Iron Horse Trail Lake.

2.3.1 Existing Pollutant Concentration and Load

As stated in section 2.1.3.1 the existing long-term average in-lake phosphorus concentration is 169 μg/l (0.169 mg/l). The calculated average annual phosphorus load delivered to Iron Horse Trail Lake is 9,827 lbs/year (4,458 kg/year) as predicted by EUTROMOD (Appendix C). This loading has led to 1 of 3 average annual concentrations exceeding the 0.143 mg/l water quality target.

2.3.2 Deviance From Desired In-lake Pollutant Concentration and Loading Capacity

In order to meet the chlorophyll *a* water quality target, the average annual total phosphorus concentration must be reduced from 168 μg/l to 103 μg/l. To accomplish this the existing load must be reduced by approximately 76%. The loading reduction model output is located in Appendix D.

2.3.3 Identification of Pollutant Sources

Because no point sources have been identified in the Iron Horse Trail Lake watershed, the pollutant load is believed to originate from nonpoint and natural sources. In the future, should the requested animal feeding operations be issued state operating permits, said permits will prohibit the discharge of pollutant to waters of the state and require facilities to contain all pollutants and nutrient management plans for the beneficial reuse of manure. For the purposes of this phosphorus TMDL, these will not be considered point sources, subject to WLA calculation and restriction.

Typically, areas with high sediment yields also produce significant phosphorus loads. The 1992-93 land uses indicate approximately 61% of the watershed is devoted to agriculture purposes (crop or pasture). As well, stream bank, gully and shoreline erosion should be considered phosphorus sources.

2.3.4 Linkage of Sources to Endpoints

The average annual load of 9,827 lbs/year is the sum of the nonpoint source (watershed) load of 9,800 lbs/year and the natural background (precipitation) load of 27 lbs/year.

2.4 Pollutant Allocation

A TMDL is defined as:

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

As stated above, the phosphorus loading capacity for Iron Horse Trail Lake is 2,379 lbs/year (1,079 kg/year). To achieve the defined phosphorus loading capacity the required allocations are contained in the following sections.

2.4.1 Wasteload Allocation

The four livestock production facilities located in the Iron Horse Trail Watershed can be considered point sources. The facilities are permitted and designed for zero discharge. The wasteload allocation for these point sources will be "zero" – 0 lbs/year (0 kg/year).

2.4.2 Load Allocation

The phosphorus load allocation distributed among the nonpoint sources within the watershed will be 2,352 lbs/year (1067 kg/year).

2.4.3 Natural Background

Utilizing annual precipitation, waterbody surface area and precipitation phosphorus concentration the natural background load of phosphorus was determined to be approximately 27 lbs/year (12.3 kg/year).

2.4.4 Margin of Safety

Monitoring conducted at several Salt Valley Lakes during the Clean Lakes Phase I indicated that on average 4% of pollutants entering a lake are released through the outlet. The margin of safety for the nutrient TMDL will be based on the conservative assumption that the entire phosphorus load delivered to the lake remains available for algae production.

2.4.5 Nutrient (Phosphorus) TMDL Summary

TMDL/Waterbody Loading Capacity = 0 lbs/year (WLA) + 2,352 lbs/year (LA) + 27 lbs/year (Natural Background) + Implicit Margin of Safety

3.0 Sediment TMDL

3.1 Problem Identification

This section details the extent and nature of the water quality impairments caused by excessive sedimentation (siltation) in Iron Horse Trail Lake.

3.1.1 Water Quality Criteria Violated and/or Beneficial Uses Impaired

The *Aquatic Life* – Warmwater Class A and *Aesthetics* beneficial uses assigned to Iron Horse Trail Lake are not being met (impaired) due to excessive sedimentation.

3.1.2 Data Sources

Sediment loading and volume loss estimates for Iron Horse Trail Lake were determined from GPS based storage volume (bathymetric) surveys conducted by the EA Engineering under contract with NDEQ. The latest bathymetric survey was conduct in June 2001.

3.1.3 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 identify a waterbody as impaired (Section 303(d) listed when a 25% volume loss has been reached or when the annual sedimentation rate exceeds 0.75%. For Iron Horse Trail Lake the 2001 volume loss was estimated to be approximately 37%.

The Nebraska Game and Parks Commission is responsible for the management of Iron Horse Trial Lake and has identified the fishery as one of high quality. Excessive sedimentation and eutrophication have raised concerns over degradation of the fishery and the need to maintain the recreational opportunities. Therefore, the NNRD has deemed the waterbody a priority and did so following public meetings and the receipt of public comments. A watershed management plan will be developed that includes shoreline stabilization and protection, an enhancement of aquatic habitat and reduction in the overall sediment and nutrient loading.

The 2004 Nebraska Surface Water Quality Integrated Report identified Iron Horse Trail Lake as a high priority and the NDEQ has opted to complete the sediment and nutrient TMDL as an accompaniment to the watershed management plan. Both the NNRD action and the NDEQ action should result in a maintained or 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. Within the community based watershed management plan stakeholders have defined water quality goals and targets and prioritize implementation activities.

3.1.3.1 Water Quality Conditions: Based on the bathymetric survey data, Iron Horse Trail Lake's 1983 multi-purpose pool (sediment and conservation) was reported to be ≅878 acre/feet. The 2001 bathymetric evaluation determine the volume to be ≅557 acre/feet for a realize volume loss of 321 acre/feet or 37% loss of the multi-purpose pool. This equates to an average annual volume loss of 2.05%.

3.1.3.2 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, Iron Horse Trail Lake falls within the "substantial/severe" category/range.

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 within the Surface Water Quality Integrated Report as described in the *Methodologies for Waterbody Assessment and Developing the 2004 Integrated Report for Nebraska* (NDEQ 2003).

3.1.4 Potential Pollutant Sources

3.1.4.1 Point Sources: No point sources of sediment exist in the Iron Horse Trail Lake watershed.

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

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

3.2 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; in the planning process the stakeholder goal setting 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.

3.2.1 Criteria for Assessing Water Quality Attainment

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

3.2.1.2 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 2002).

3.2.1.3 Local Stakeholder Defined Goals: Local stakeholders established a goal of reducing the sediment loading to Iron Horse Trail Lake by 63.1%. Using the current average annual load of 24,966 tons/year, a 63.1% reduction of the long-term average annual load would produce a target load of 9,200 tons per year. If the target load were to be achieved, the average annual volume loss would be reduced from 2.05%/year to <0.75%/year.

3.2.2 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

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3.2.3 Waterbody Loading Capacity

The loading capacity for this TMDL is defined as the amount of sediment Iron Horse Trail 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 63% reduction from the current load and an average annual volume loss of <0.75%/year the sediment loading capacity for Iron Horse Trail Lake is 9,200 tons/year.

3.3 Pollution Source Assessment

For this TMDL, sediment loading estimates for Iron Horse Trail Lake were determined NDEQ bathymetric survey conducted by EA Engineering in 2001.

3.3.1 Existing Sediment Load

Using the bathymetric survey data, the average annual pollutant load being delivered to Iron Horse Trail Lake is estimated to be 24,966 tons/year.

3.3.2 Deviance From Loading Capacity

The stakeholder-defined sediment loading capacity is being exceeded by approximately 15,766 tons/year. To achieve the targeted annual sediment load, the current average annual sediment load must be reduced by 63%.

3.3.3 Identification of Pollutant Sources

As stated, no point sources of sediment have been identified in the watershed therefore the pollutant originates from nonpoint sources and natural conditions. (For this TMDL natural background will not be separated from the load allocations.)

3.3.3.1 Nonpoint Sources of Sediment: The land uses within the watershed includes: corn, soybeans, hay, pasture, CRP, trees (wooded), alfalfa and water.

3.3.4 Linkage of Sources to Endpoint

The average annual sediment load of 24,966 tons/year delivered to Iron Horse Trail Lake has been determined to originate entirely from nonpoint sources. To meet this TMDL's (stakeholder defined) desired endpoint, the annual nonpoint source sediment contribution of 24,966 tons must be reduced by 15,766 tons/year.

3.4 Pollutant Allocation

A TMDL is defined as:

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

As stated above, the sediment loading capacity for Iron Horse Trail Lake is 9,200 tons/year and to achieve the defined sediment loading capacity the required allocations are as follows:

3.4.1 Wasteload Allocation

No point sources of sediment exist in the watershed therefore the wasteload allocation (WLA) will be "zero" (0 tons/year).

3.4.2 Load Allocation

The sediment load allocation distributed among nonpoint sources will be 9,200 tons/year. Base flows carry indiscernible amounts of sediment and thus natural background will not be separated from the load allocation.

3.4.3 Margin of Safety

The margin of safety (MOS) associated with this sediment TMDL will be: the effects of sedimentation are most greatly realized when deposition occurs in the multi-purpose pool. Monitoring conducted at the Salt Valley Lakes during Clean Lakes Phase I indicated that on average 4% of pollutants entering a lake are released through the outlet. 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.

Although the stakeholder target is just below the threshold for impairment, commitments made by landowners during the development of the watershed management plan have been positive. Similar to the Kirkman's Cove watershed management plan, when these commitments are followed through the sediment reduction should exceed the targeted 63% reduction.

3.4.4 Sediment TMDL Summary

TMDL/Waterbody Loading Capacity = 0 tons/year (WLA) + 9,200 tons/year (LA & Natural Background) + Implicit Margin of Safety

4.0 Implementation Plan

The development of an implementation plan is an integral part of the overall watershed management planning process and one of the key pieces of information necessary for the process is the level of reduction needed for beneficial use and stakeholder goal attainment. Within the community based planning process currently underway, the reductions identified by these TMDLs will be utilized to draft and finalize an implementation plan that is scheduled for Fall 2004. Once completed, application for funding will be made. Speculated activities include: in-lake sediment basin, limited dredging, upgrade of septic systems, decommissioning of abandoned or other wells, land treatment within the watershed and information and education activities. A copy of the stakeholder developed implementation plan will be included as an addendum to these TMDLs.

4.1 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 and nutrient delivery to Iron Horse Trail Lake. Participation will depend on the agency/organization's program capabilities.

5.0 Future Monitoring

Monitoring of Iron Horse Trail 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). Evaluation of the BMPs will be combination of empirical data and modeling. The NDEQ will work cooperatively with the NNRD whereby the NNRD will conduct monthly monitoring throughout the growing season and forward the results to NDEQ for assessment. NDEQ will also periodically evaluate the impacts of sedimentation (bathymetry).

6.0 Public Participation

The availability of the TMDLs in draft form was published in Humboldt Standard and the Falls City Journal with the public comment period running from approximately October 10, 2005 to December 1, 2005. These TMDLs were also made available to the public on the NDEQ's Internet site and interested stakeholders were informed via email of the availability of the draft TMDLs. Two comments were received from EPA Region 7 regarding two minor errors. The errors have been addressed in the final TMDL.

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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

- Nebraska 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 – Goal and Objectives of the Community Based Watershed Management Plan

Goal 1. Improve water quality, maintain a balanced and healthy fishery, and maintain the life expectancy of the reservoir.

Aquatic Life Use

Objective 1. Maintain water column average dissolved oxygen concentrations at the deepwater site above 5.0mg/l.

Objective 2. Reduce summer total phosphorus concentrations at the deepwater site below 0.184 mg/l.

Objective 3. Maintain levels of pesticides and heavy metals at the deepwater site below chronic standards concentrations.

Recreation Use

Objective 4. Maintain concentrations of fecal coliform bacteria at the deepwater site below water quality standards concentrations.

Aesthetics

Objective 5. Reduce summer chlorophyll concentrations at the deepwater site from 41.00 mg/l to 30.00 mg/l or less.

Objective 6. Maintain average summer water transparency measurements at the deepwater site above 30 inches.

Objective 7. Reduce average annual sediment loads delivered to the reservoir from 24,966 tons per year to 9,200 tons per year.

Agricultural Water Supplies

Objective 8. Maintain concentrations of nitrate nitrogen, selenium, and conductivity below chronic water quality standards.

Goal 2. Educate landowners, agricultural producers, recreational users, and others on the importance of watershed stewardship and good water quality.

Objective 9. Inform 100% of the landowners and producers in the watershed about available opportunities to improve their operation and downstream water quality through one on one contact.

Objective 10. Initiate demonstration projects for major treatment practices.

Objective 11. Inform recreational users of the reservoir about opportunities to have a positive impact on water quality.

Objective 12. Increase youth awareness of water quality.

Objective 13. Promote the lake as a fishery through youth fishing contests.

Goal 3. Improve economic incentives that are available to watershed landowners and operators.

Objective 14. Establish the Iron Horse Lake watershed as a high priority for government programs.

Objective 15. Develop new opportunities that are innovative and economically and technically sound that can be used to address water quality issues.

Goal 4. Maintain the existing quality of groundwater in the watershed.

Objective 16. Establish a groundwater quality monitoring and evaluation program.

Objective 17. Reduce surface contributions of nitrogen to groundwater.

Objective 18. Reduce surface contributions of bacteria to groundwater.

Objective 19. Reduce surface contributions of pesticides to groundwater.

Objective 20. Provide information and educational activities related to groundwater quality.

Appendix C. EUTROMOD Modeled Average Annual Phosphorus Load

Iron Horse Trail - 2001	Input data in green cells		Phosphorus (mg/l)	Chlorophyll a	Secchi Depth	Secchi Depth (inches)
Surface Acres (acres)	74	Monitored In-lake Value	0.1690		0	
Lake Volume (ac-ft)	557	Predicted	0.1690	20.57	0.242	9.5
Inflow (ac-ft/year)		% Similar	1.00	0.00	0.00	
Inflow (cfs)	3.86					
Annual Precipitation	32.4		TSI - phosphorus	TSI - chlorophyll *a*	TSI - secchi	MEAN TSI
Watershed P Loading (lbs)	9800	Monitored In-lake Value	78.1	#NUM!	#NUM!	#NUM!
Detention Time (years)	*0.20*	Predicted	78.1	60.3	80.4	72.9
Lake Volume (10^6 m^3)	*0.687*	% Similar	1.00	#NUM!	#NUM!	#NUM!
Volumetric Water Load (10^6 m^3/yr)	*3.447*					
Mean Depth (ft)	*7.53*		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)	*2.294*		9800			
Watershed P Loading (kg)	4445		Load Summary			
Precip P Load (kg)	*12.3*		Minimum	9800		
Septic P Load (kg)			Mean	9800		
WWTF P Load (kg)			Median	9800		
Total P Loading (kg)	*4458*		Maximum	9800		
Total P Loading (lbs)	***9827.2***					
Expected Total P-in	*1.293*					

Appendix D – Watershed Phosphorus Reduction to Meet Water Quality Targets

	Input data in green cells		Phosphorus (mg/l)	Chlorophyll a	Secchi Depth	Secchi Depth (inches)
Reduction %	76	Predicted	0.1030	15.98	0.335	13.2
Lake Volume (ac-ft)	557	Water Quality Goals	0.1430	16.00	0	
Surface Acres (acres)	74	% Similar	0.72	1.00	0.00	
Detention Time (years)	0.20					
Watershed P Loading (lbs)	9800		TSI - phosphorus	TSI - chlorophyll *a*	TSI - secchi	MEAN TSI
Reduced Watershed Load (lbs)	*2352*	Predicted	71.0	57.8	75.8	68.2
Volumetric Water Load (10^6 m^3/yr)	*3.447*	Water Quality Goals	75.7	57.8	#NUM!	#NUM!
Lake Volume (10^6 m^3)	*0.687*	% Similar	0.94	1.00	#NUM!	#NUM!
Mean Depth (ft)	*7.53*					
Mean Depth (m)	*2.294*		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)	1066.86					
Precip P Load (kg)	*12.3*		Reduction Summary			
Septic P Load (kg)	*0.0*		Minimum	0		
WWTF P Load (kg)	*0.0*		Mean	#DIV/0!		
Total Reduced P Loading (kg)	*1079.2*		Median	#NUM!		
Total Reduced P Loading (lbs)	*2379.2*		Maximum	0		
Expected Total P-in	*0.313*					