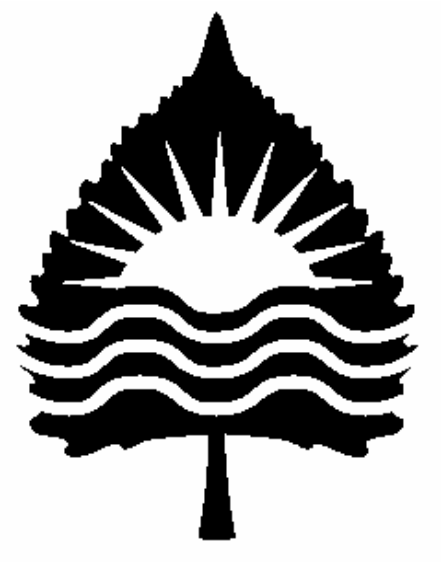


Total Maximum Daily Loads for the Papillion Creek Watershed

(Segments MT1-10100, MT1-10110, MT1-10111, MT1-10111.1, MT1-10120 and MT1-10200)

Parameter of Concern: *E. coli* Bacteria

Nebraska Department of Environmental Quality
Planning Unit, Water Quality Division

October 2009

Table of Contents

List of Figures and Tables

Executive Summary

Six segments in the Missouri Tributaries/Papillion Creek Watershed were included in the 2008 Nebraska Water Quality Integrated Report (NDEQ 2008) in Category 5 as impaired by excessive *E.* coli. As such, total maximum daily loads must be developed in accordance with the Clean Water Act.

Based on the strategy of a basin wide approach as well as the hydrologic connections, TMDLs have been developed and included for all six waterbodies. In 2002, the Department opted to convert from fecal coliform to *E.* coli bacteria as the indicator for primary contact recreation assessment. This document presents TMDLs for *E. coli* that are designed to allow the Papillion Creek Watershed segments to fully support the primary contact recreation beneficial use. The information contained herein should be considered six TMDLs

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.
Missouri Tributaries Basin: MT1-10100, MT1-10110, MT1-10111, MT1-10111.1, MT1-10120 and MT1-10200

2. Identification of the pollutant and applicable water quality standard
The pollutant causing the impairment(s) of the water quality standard and designated beneficial use is *E. coli* bacteria. Designated uses assigned to the above-identified segments include: primary contact recreation, aquatic life Warmwater class A and Warmwater Class B, agriculture water supply class A and aesthetics (NDEQ 2006). Excessive *E. coli* has been determined to be impairing the primary contact recreation beneficial uses. The applicable water quality criteria are a recreation season (May 1-September 30) geometric mean of 126/100 ml for *E. coli.*

3. Quantification of the pollutant load that may be present in the waterbody and still allows attainment and maintenance of the water quality standards.
The allowable pollutant load is based upon the available stream flow volume. That is, loading capacities are developed for each flow by multiplying the water quality standard (WQS) by the selected stream flow and a conversion factor (C) with the equation being:

Loading capacity = WQS * Flow * C

4. Quantification of the amount or degree by which the current pollutant load in the waterbody, including upstream sources that are being accounted for as background loading deviates from the pollutant load needed to attain and maintain water quality standards.

Segment	# *E. coli* colonies <126/100 ml
MT1-10100	1582
MT1-10110	1579
MT1-10111	2162
MT1-10111.1	3978
MT1-10120	1477
MT1-10200	722

5. Identification of the pollutant source categories.
Both point and nonpoint sources (including natural sources) have been identified to be contributing to the pollutant loads being delivered to the Papillion Creek Watershed segments.

6. Wasteload allocations for pollutants from point sources.

The wasteload allocations for point source discharges will be equivalent to the water quality criteria associated with the primary contact recreation beneficial use. Therefore, the WLA is a monthly geometric mean of 126/100 ml. The daily load would be the effluent flow multiplied by 126 and by a constant/conversion factor.

7. Load allocations for pollutants from nonpoint sources.

The load allocations assigned to these TMDLs will be based upon the stream flow volume and will be defined as:

$$LA_i = Q_i * 126/100 \text{ ml} * C$$

Where:
LA_i = load allocations at the i^{th} flow
Q_i = stream flow at the i^{th} flow
126/100 ml = applicable/target water quality criteria for *E. coli* from Title 117
C = conversion factor

8 A margin of safety.

These TMDLs contain an implicit and explicit margin of safety. Specifically, decay/die-off from the potential source to the recreational segment was not included in the pollutant source evaluation; all point sources were assumed to be discharging the expected concentration. As well, the targeted reduction will focus on achieving 90% of the water quality target (≤113/100 ml).

9. Consideration for seasonal variation.

The water quality criteria are only applicable during the Title 117 defined recreation season that starts May 1 and ends September 30. Because of this, the water quality and stream volume data was limited to this time period.

10. Allowances for reasonably foreseeable increases in pollutant loads.

There was no allowance for future growth included in these TMDLs.

11. Implementation Plan

Implementation of the reductions for *E. coli* will be carried out through a combination of regulatory and non-regulatory activities. Point sources will be regulated under the auspice of the National Pollutant Discharge Elimination System and the Rules and Regulations Pertaining to Livestock Waste Control. Nonpoint source pollution will be addressed using available programs, technical advice, information and educations and financial incentives such as cost share.

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 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 TMDLs has been or is 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 capacity, load allocations, etc.) and if revisions are appropriate.

1.0 Introduction

Thirteen stream segments within the Missouri Tributaries River basin were listed in Category 5 of the 2008 Nebraska Surface Water Quality Integrated Report (Integrated Report) (NDEQ 2008). Category 5 waterbodies are deemed impaired and in need of a TMDL. Data collected in 2005 indicate the primary contact recreation beneficial use is impaired in six of these segments with the pollutant of concern being *E. coli* bacteria. Along with the primary recreation use, the aquatic life beneficial use is impaired on several segments with the pollutants of concern being low dissolved oxygen, PCBs and Dieldrin and impaired biological communities due to unknown pollutants.

Table 1 below provides information of the 2008 Nebraska Water Quality Integrated Report assessments for all the segments in the Missouri Tributaries River basin for Category 5 waterbodies and those needing TMDLs, including the additional streams designated with the primary contact recreation beneficial use.

Table 1. 2008 Integrated Report Status for Waters in Missouri Tributaries River Basin

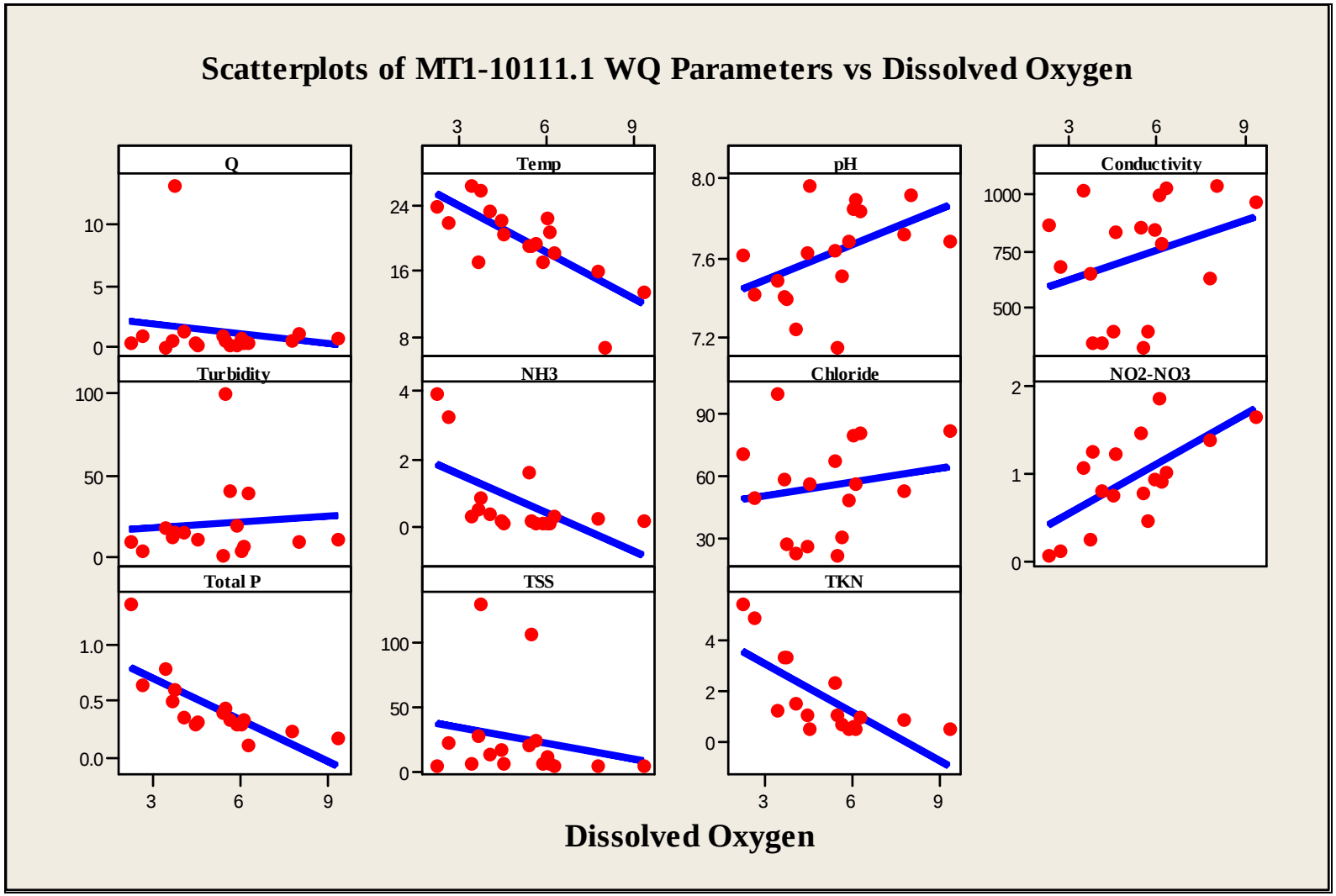
Segment	Waterbody Name	Parameters of Concern
MT1-10000	Missouri River	PCBs and Dieldrin
MT1-10100	Papillion Creek	*E. coli*, Selenium, PCBs and Dieldrin
MT1-10110	Big Papillion Creek	*E. coli*
MT1-10111	Little Papillion Creek	*E. coli*
MT1-10111.1	Cole Creek	*E. coli* and Dissolved Oxygen
MT1-10120	Big Papillion Creek	*E. coli*
MT1-10200	Papillion Creek	*E. coli*
MT1-10210	Walnut Creek	Unknown[1]
MT1-10240	South Papillion Creek	Unknown[1]
MT1-10250	West Papillion Creek	PCBs and Dieldrin
MT1-12100	Omaha Creek	PCBs and Dieldrin
MT2-10300	Elk Creek	Unknown[1]
MT2-11000	Lime Creek	Uknown[1]

[1] Aquatic life was deemed impaired based on biological community assessments.

Segment MT1-10111.1: Cole Creek was identified as impaired due to low dissolved oxygen. Data collected in 2005 also included flow, temperature, turbidity, pH, conductivity, ammonia, nitrate-nitrite, total kjeldahl nitrogen, total suspended solids, chloride and total phosphorus. Each parameter was plotted against the corresponding dissolved oxygen measurement (Figure 1.0). Relationships of dissolved oxygen and ammonia, total kjeldahl and total phosphorus do indicate decreasing dissolved oxygen with increasing concentrations of each. However, the data shows a relationship of increasing dissolved oxygen with increasing concentrations of nitrate-nitrite.

Many of the water quality models that address dissolved oxygen in streams require biochemical oxygen demand as an input and this data is lacking for Cole Creek. As well, Cole Creek lies within a portion of the City of Omaha with a combined storm and sanitary sewer system and overflows can occur as a result of precipitation events. The City of Omaha has committed in the long-term control plan to address the discharges in the Cole Creek drainage.

Figure 1. MT1-10111.1 2005 Water Quality Data



There is insufficient data to determine the extent of water quality impact on Cole Creek from the combined sewer overflows (CSO). It is likely that implementation of the CSO long term control plan will result in an improvement to the water quality of Cole Creek (MT1-10111.1). Preparation of a TMDL at this time is not achievable due to a lack of sufficient water quality data and information – namely biochemical oxygen demand (BOD). Development of the TMDL will be delayed in order to allow the NDEQ time to collect the necessary data and information to completely assess water quality. During this time, implementation of the long term control plan will be ongoing.

Development of metrics to assess biological metrics has recently been completed and refinement continues. In the future the process should be sufficient to assist in determining a pollutant or other cause of impairment. Based on this the TMDLs for biological impairments will be delayed.

Finally, the Department has been investigating options for addressing the Dieldrin and PCB impairments that include bypassing TMDL development.

Therefore, from the above discussion, six TMDLs will be prepared and submitted herein. The TMDLs will be for *E. coli* for segments MT1-10100, MT1-10110, MT1-10111, MT1-10111.1, MT1-10120 and MT1-10200.

Because all of the waterbodies are located in the Papillion Creek watershed, the narrative portion and discussions will be limited to this area.

1.1 Background Information

Papillion Creek located is located in eastern Nebraska and the southern portion of the Missouri River Tributaries basin (Figure 1.1). The watershed covers approximately 402 square miles and encompasses more than one third of Nebraska's population. Due to the large population and associated land use, flows in the basin are heavily a function of precipitation events and surface run-off. Several municipalities lie in the basin.

1.1.1 Waterbody Description

1.1.1.1 Waterbody Names and Stream Identification Numbers: The waterbodies for which TMDLs are being prepared are: Papillion Creek – MT1-10100, Big Papillion Creek – MT1-10110, Little Papillion Creek – MT1-10111, Cole Creek – MT1-10111.1, Big Papillion Creek – MT1-10120 and Papillion Creek MT1-10200

1.1.1.2 Major River Basin: Missouri

1.1.1.3 Minor River Basin: Missouri Tributaries

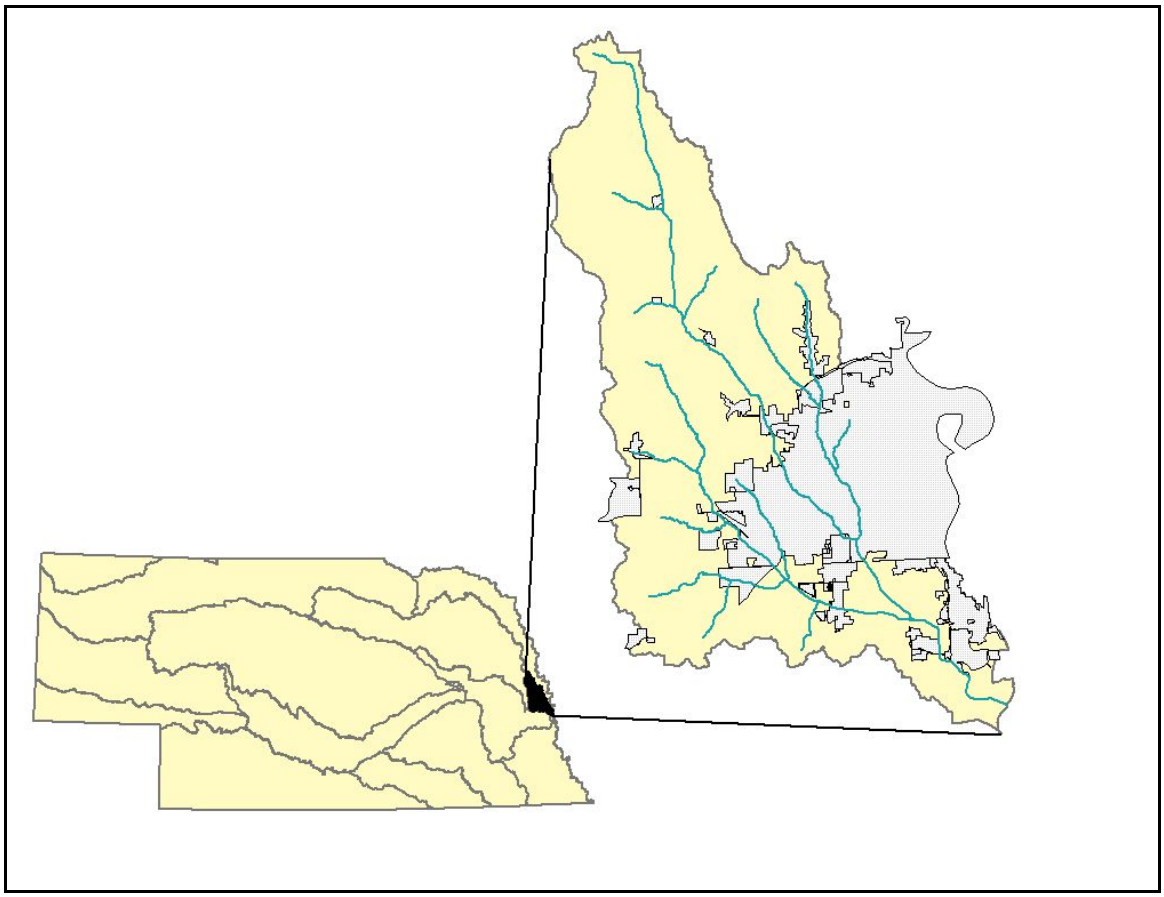
1.1.1.4 Hydrologic Unit Code: 10230006

1.1.1.5 Assigned Beneficial Uses: Source Title 117 Nebraska Surface Water Quality Standards (Title 117)

Segment	Primary Contact Recreation	Aquatic Life Use	Water Supply	Aesthetics	Key Aquatic Species
MT1-10100	Yes	Warmwater A	Agriculture A	Yes	Channel Catfish
MT1-10110	Yes	Warmwater A	Agriculture A	Yes	None
MT1-10111	Yes	Warmwater B	Agriculture A	Yes	None
MT1-10111.1	Yes	Warmwater B	Agriculture A	Yes	None
MT1-10120	Yes	Warmwater A	Agriculture A	Yes	None
MT1-10200	Yes	Warmwater A	Agriculture A	Yes	None

1.1.1.6 Major Tributaries: Little Papillion Creek, Thomas Creek, Cole Creek, Butter Flat Creek

Figure 1.1 Location of the Papillion Creek Watershed in the Missouri Tributaries Basin



1.1.2 Watershed Characterization

1.1.2.1 Physical Features: The Papillion Creek watershed encompasses approximately 402 mi^2 in the eastern of the state and the southern most portions of the Missouri River Tributaries. The watershed lies in three counties, Douglas, Sarpy and Washington with the water being conveyed to the Missouri River. The watershed lays the Western Corn Belt Plains Level III ecoregion (Chapman, et. al. 2001). Drainage in the basin is generally east and southeast. The majority of the basin is urbanized with the far reaches remaining as agricultural land. The anticipated build out date for the watershed is 2040 with about 3-4 square miles of land consumption per year.

1.1.2.2 Climate: Precipitation within the watershed averages approximately 30 inches. Typically, a majority of the precipitation occurs during the spring and early summer. Temperatures in the basin range from an average high in the upper 80's during the summer to average lows in the 10's during the winter (High Plains Regional Climate Center Database).

Table 1.1 Physical Description of the Papillion Creek Watershed

Parameter	Papillion Creek Basin
State	Nebraska
Counties (whole or in part)	Douglas, Sarpy and Washington
Watershed Area	402 mi^2
Sub-basins	0
Designated Stream Segments	22
Stream Miles (designated)	140 miles

1.1.2.3 Demographics: Ten municipal communities reside in the Papillion Creek Watershed boundaries and range from a metropolitan class city to villages. Some of the larger communities include: Omaha – population 392,127, Bellevue – population 45,955, Papillion – population 17,738, LaVista – population 11,699, Ralston population – 6,314, Gretna – population 2,355 and Bennington – population 1,006. Along with the municipal governments, several clustered residential dwellings lie in the basin with or without formal governing bodies.

1.1.2.4 Land Use: The majority of the basin is urbanized with the far reaches remaining as agricultural land. The anticipated build out date for the watershed is 2040 with about 3-4 square miles of land consumption per year. Urbanization includes areas that are developed as clustered residential areas.

2.0 *E. coli* TMDL

2.1 Problem Identification

Segments MT1-10100, MT1-10110 MT1-10111, MT1-10111.1 MT1-10120 and MT1-10200 were included in Category 5 of the 2008 Nebraska Water Quality Integrated Report as having an impaired primary contact recreation beneficial use with the parameter of concern being *E. coli* bacteria. This section deals with the extent and nature of the water quality impairments caused by excessive *E. coli* bacteria in the Papillion Creek Watershed.

2.1.1 Water Quality Criteria Violated and/or Beneficial Uses Impaired

The Primary Contact Recreation beneficial use has been deemed impaired on the above-identified segments. The Primary Contact Recreation beneficial use applies to surface waters which are used or have the potential to be used for primary contact recreation that includes activities where the body may come into prolonged or intimate contact with the water such that water may be accidentally ingested or sensitive body organs (e.g. eyes, ears, nose) may be exposed (NDEQ 2006). Stream segments assign the primary contact recreation use for which these TMDLs are being developed are found in figure 2.1.1.

2.1.2 Data Sources

The Nebraska Department of Environmental Quality (NDEQ) monitors surface waters based upon a rotating basin scheme, whereby monitoring is limited to two or three river basins each year with all 13 basins being (partially) examined in a five year period. Under the auspice of the rotating basin plan, data was collected from the Missouri Tributaries/Papillion Creek Watershed in 2005. The City of Omaha also collected data from the Papillion Creek Watershed in 2005 that was used in the TMDLs.

Stream flow data and information used in the TMDLs were obtained from the United States Geological Survey (USGS) and United States Army Corps of Engineers (USACE) who operates the monitoring gages. Where long-term data was lacking, field measurements and extrapolations were used to develop hydrographs.

During the triennial review of Title 117 – Nebraska Surface Water Quality Standards (Title 117), conducted in 2005, removed fecal coliform as a Title 117 parameter for assessing the primary contact recreation in the future.

E. coli will be the sole parameter for assessing the recreation use and due to the advances of analytical techniques; fecal coliform data was not obtained during 2005. Because fecal coliform will be removed as criteria in the future, these TMDLs will focus on the attainment of the primary contact recreation beneficial use, using only *E. coli*.

2.1.3 Water Quality Assessment

Water quality data assessments were based upon the beneficial use assessment procedures used to identify Category 5/impaired waters for the 2008 Integrated Report. For *E. coli*, Title 117 includes criteria for both a recreation season geometric mean and a single season maximum. The November 16, 2004 Federal Register (Volume 69, No. 220) contained information regarding the final rule for "Water Quality Standards for Costal and Great Lakes Recreational Waters". This rule includes a discussion on the use of the single season maximum (SSM). Specifically:

"EPA expects that the single season maximum values would be used for making beach notification and closure decisions. EPA recognizes however that States and Territories also use criteria in their water quality standards for other purposes under the Clean Water Act in order to protect and improve water quality. Other than in the beach notification and closure decision context, the geometric mean is the more relevant value for ensuring that appropriate actions are taken to protect and improve water quality because it is a more reliable measure, being less subject to random variation and more directly linked to the underlying studies on which the 1986 criteria were based."

In accordance with the recommendation, impairments decisions are based on the recreation season geometric mean. The details of the assessment process to determine the use support of the Primary Contact Recreation beneficial use can be found in table 2.1.3

Table 2.1.3 Assessment of the Primary Contact Recreation Beneficial Use Using *E. coli* Bacteria Data

Parameter	Season Geometric Mean	Supported	Impaired
E. coli	≤126/100 ml	Season geometric mean ≤126/100 ml	Season geometric mean >126/100 ml

2.1.4 Water Quality Conditions

E. coli data collected during the 2005 recreation season (May 1 through September 30) was assessed to determine the beneficial use support for primary contact recreation. Table 2.1.4 presents this information.

Figure 2.1.1 Papillion Creek Watershed TMDL Streams Assigned the Primary Contact Recreation Beneficial Use

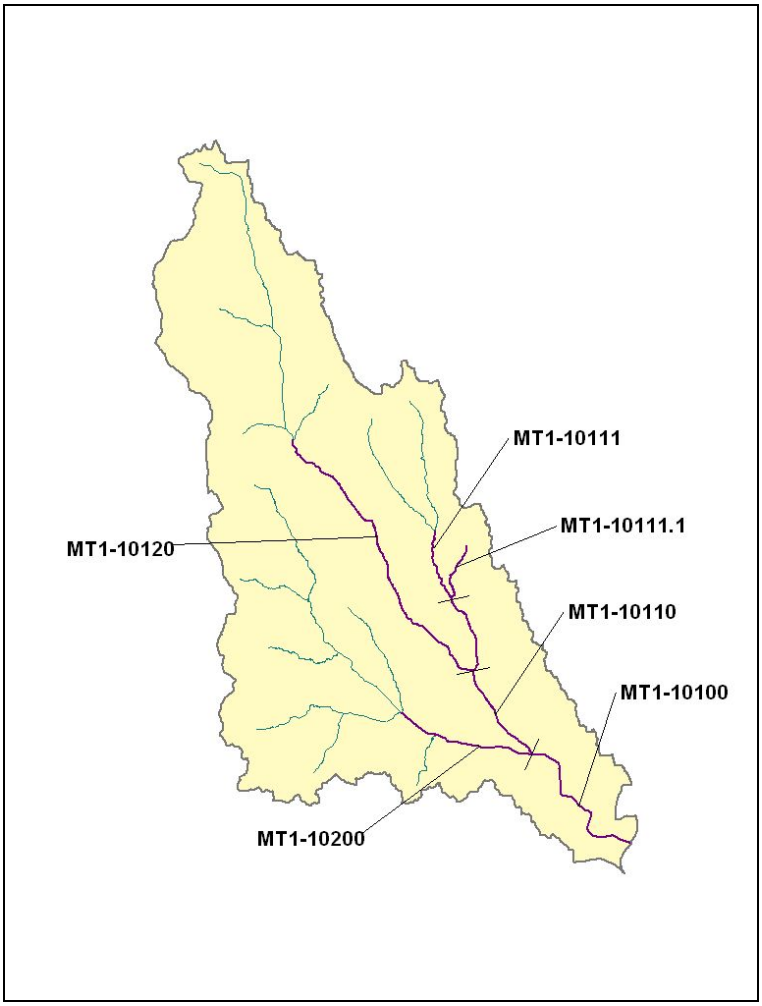


Table 2.1.4 Papillion Creek Watershed – 2005 *E. coli* Data and Assessments – Category 5 Waterbodies

Segment	Site Location	USGS/DNR Gage Associated with Site	Number of Samples	Season Geometric Mean (#/100 ml)
MT1-10100	Papillion Creek @ Fort Crook Road	06610795	21	1708
MT1-10110	Big Papillion Creek @ Bellevue	None	21	1705
MT1-10111	Little Papillion Creek @ Omaha	None	21	2288
MT1-10111.1	Cole Creek @ Omaha	None	21	4104
MT1-10120	Big Papillion Creek @ Omaha	None	21	1605
MT1-10200	West Papillion Creek	None	22	848

2.1.5 Potential Pollutant Sources

2.1.5.1 Point Sources: Point sources discharge or have the potential to discharge to waters in the Papillion Creek Watershed. Facility types include: municipal wastewater treatment facilities. The facilities that have been issued a National Pollutant Discharge Elimination System Permit (according to EPA's Permit Compliance System) in the Papillion Creek Watershed that are potential sources are shown in Figure 2.1.5.1a.

Municipalities and other entities have been issued stormwater permits and are considered point sources and regulated under the NPDES program.

Illicit connections and discharges, combined sewer overflows; sanitary sewer overflows, straight pipes from septic tanks or other on-site wastewater systems can also be sources of *E. coli* bacteria. While these are potential sources, there have not been investigations to determine the nature and extent of these sources contributions.

Animal feeding operations that have been issued State of Nebraska permits required for construction and operation of livestock waste control facilities (LWCF) if the operation has discharged, or has the potential to discharge, livestock waste to waters of the State are also considered potential sources. Figure 2.1.5.1b shows the facilities within the Papillion Creek Watershed that have been issued or requested a permit. These facilities are designed to contain any run-off that is generated by storm events that are less in intensity than the 25-year, 24-hour rainfall.

2.1.5.2 Nonpoint Sources: Several nonpoint sources of *E. coli* exist in the Papillion Creek Watershed. These sources include: failing septic tanks or other on-site wastewater systems, run-off from livestock pastures, improper or over-application of biosolids (wastewater treatment facility sludge, septage or manure) and urban stormwater runoff not regulated by an NPDES permit.

2.1.5.3 Natural Sources: The primary natural source of *E. coli* is wildlife. A variety of wildlife is native to or have adapted to the diverse habitat of the Papillion Creek Watershed. Big game, upland game, furbearers, waterfowl and non-game species have been documented to reside within the basin.

2.2 TMDL Endpoint

The endpoint for these TMDLs will be based on the numeric criteria associated with the Primary Contact Recreation beneficial use.

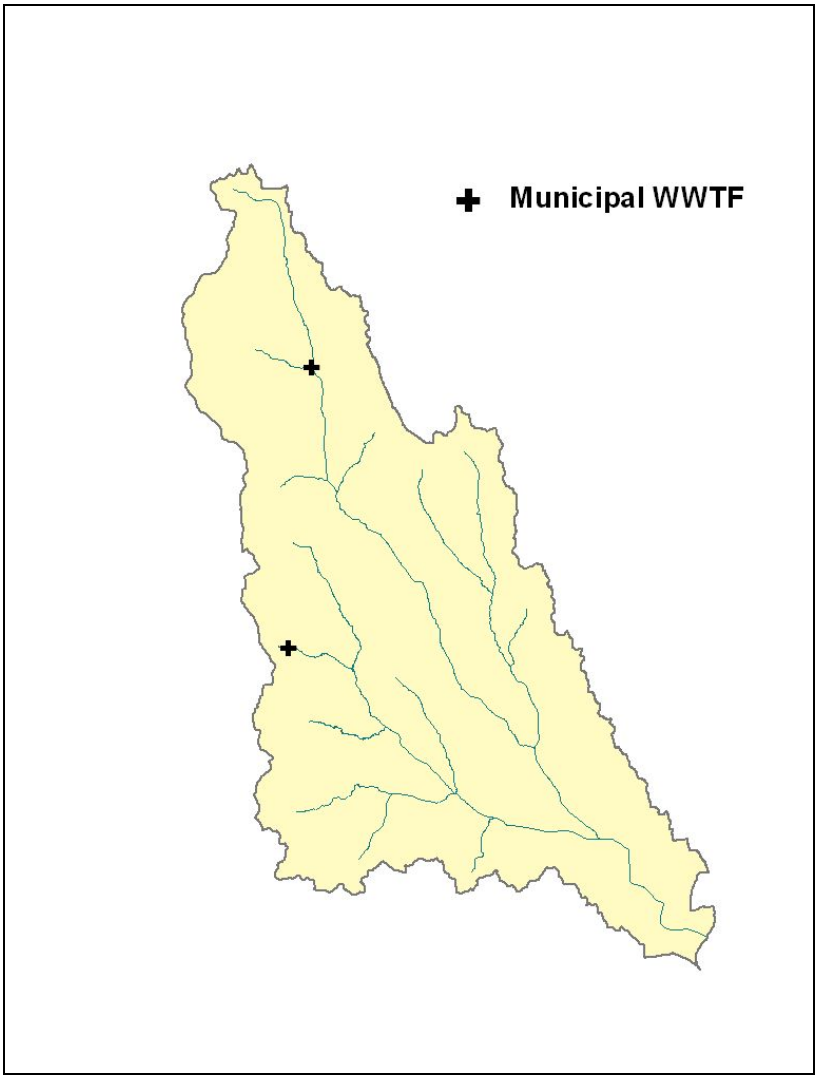
2.2.1 Numeric Water Quality Criteria

Water quality criteria established for the protection of the Primary Contact Recreation beneficial use can be found in Title 117, Chapter 4 and are as follows:

E. coli
E. coli bacteria shall not exceed a geometric mean of 126/100 ml. For increased confidence of the criteria, the geometric mean should be based on a minimum of five samples taken within a 30-day period. This does not preclude fecal coliform limitations based on effluent guidelines. The following single sample maxima shall be used solely for issuing periodic public advisories regarding use of waterbodies for Primary Contact Recreation.

235/100 ml at designated bathing beaches
298/100 ml at moderately used recreational waters
406/100 ml at lightly used recreation al waters
576/100 ml at infrequently used recreational waters

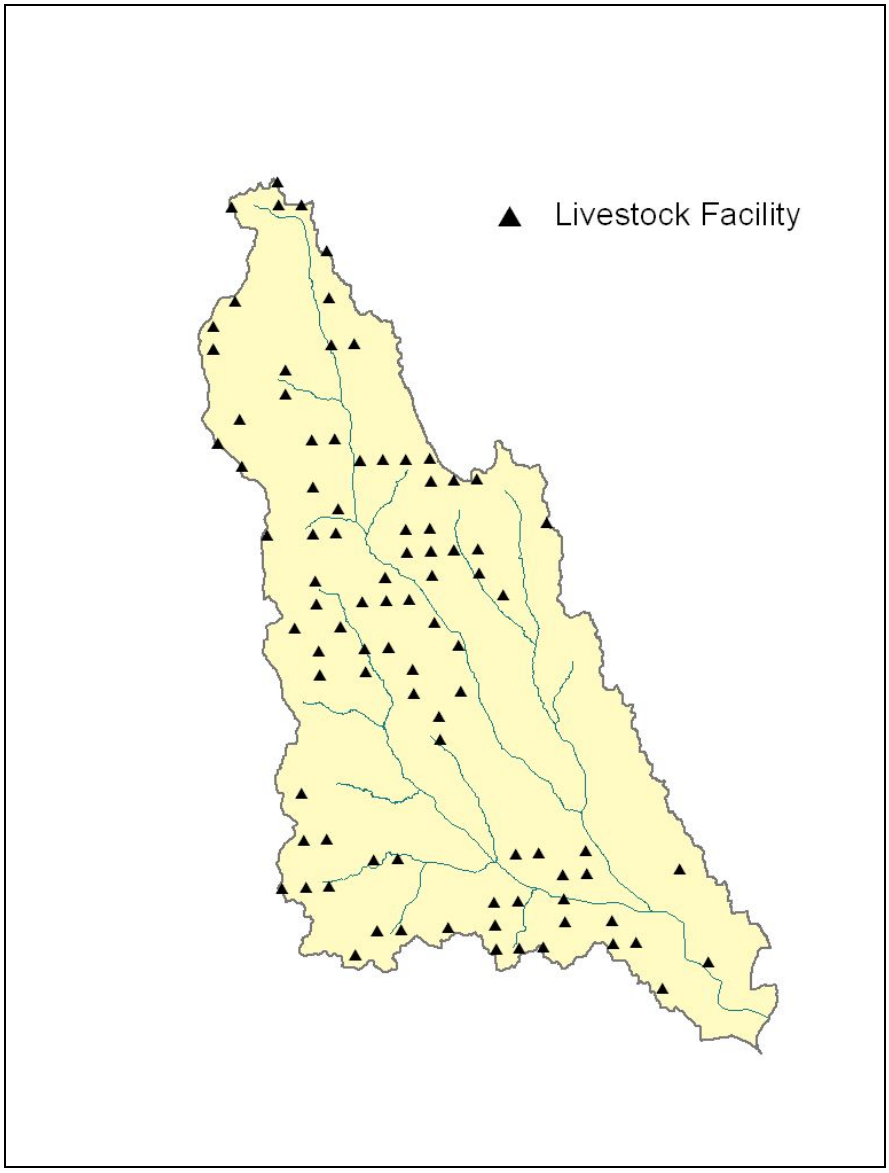
Figure 2.1.5.1a NPDES Permitted Facilities in the Papillion Creek Watershed



The November 16, 2004 Federal Register (Volume 69, No. 220) contained information regarding the final rule for "Water Quality Standards for Costal and Great Lakes Recreational Waters". This rule includes a discussion on the use of the single season maximum (SSM). Specifically:

"EPA expects that the single season maximum values would be used for making beach notification and closure decisions. EPA recognizes however that States and Territories also use criteria in their water quality standards for other purposes under the Clean Water Act in order to protect and improve water quality. Other than in the beach notification and closure decision context, the geometric mean is the more relevant value for ensuring that appropriate actions are taken to protect and improve water quality because it is a more reliable measure, being less subject to random variation and more directly linked to the underlying studies on which the 1986 criteria were based.

Figure 2.1.5.1b Animal Feeding Operations in the Papillion Creek Watershed Issued or Requesting a State Construction or Operating Permit or Requesting an Inspection



Given this discussion and recommendation regarding the use of single season maximum in TMDLs and waterbody assessments, these TMDLs will focus on meeting the *E. coli* recreation season geometric mean of 126/100 ml.

2.2.2 Selection of Critical Environmental Conditions

The water quality criteria associated with the Primary Contact Recreation beneficial use only applies from May 1 through September 30. Therefore, the critical conditions for these TMDLs will be those occurring from May 1 through September 30.

2.2.3 Waterbody Pollutant Loading Capacity

Defining waterbody pollutant loading capacity implies a steady state. These TMDLs recognize loadings are dynamic and can vary with stream flow. As well, the above section indicates a wide range of environmental conditions that must be accounted for.

The method chosen to account for the variation in flow is based upon a load duration (TMDL) curve. Data assessment curves are initiated by the development a stream's hydrograph using the long-term gage information. The flow information (curve) is then translated into a load curve by multiplying the flow values by the water quality standard (WQS) and a conversion factor (C). The acceptable "load" is then plotted graphically.

Therefore, the loading capacity for each of the segments will be defined by:

Loading capacity = WQS * Flow * C

2.3 Pollutant Source Assessment

For these TMDLs the source loading is based upon the position of the monitoring data points in relation to the boundary established on the TMDL curve between point source and nonpoint source influences. This process for selecting the load point is described in the document entitled Nebraska's Approach for Developing TMDLs for Streams Using the Load Duration Curve Methodology (NDEQ 2002d). In the situation where a boundary has not been included on a TMDL curve, the information indicates no point source facilities discharge to the contributing watershed. For these waterbodies, the pollutant will be considered derived from nonpoint and natural sources.

2.3.1 Existing Pollutant Conditions

The existing pollutant conditions are shown in the data assessment curves (Figure 2.3.1a through 2.3.1f) provided for each of the segments where a TMDL is being developed. The points plotted above the acceptable loading indicate a deviance from the water quality criteria. It is recognized that with *E.* coli bacteria a load cannot be calculated. The purpose for inclusion of the data assessment curves for these waterbodies is to present a comparison of the water quality data to the stream flow and attempt to explain the conditions under which the data was collected. The y axis is unitless.

2.3.2 Deviation from Acceptable Pollutant Loading Capacity

Table 2.3.2 describes the deviation from the acceptable water quality standards based upon the 2005 *E. coli* monitoring information.

Table 2.3.2 Deviation From the Applicable Water Quality Criteria

Segment	Observed Season Geometric Mean (#/100 ml)	#/100 ml Above WQS
MT1-10100	1708	1582
MT1-10110	1705	1579
MT1-10111	2288	2162
MT1-10111.1	4104	3978
MT1-10120	1605	1477
MT1-10200	848	722

Figure 2.3.1a. Data Assessment Curve for MT1-10100

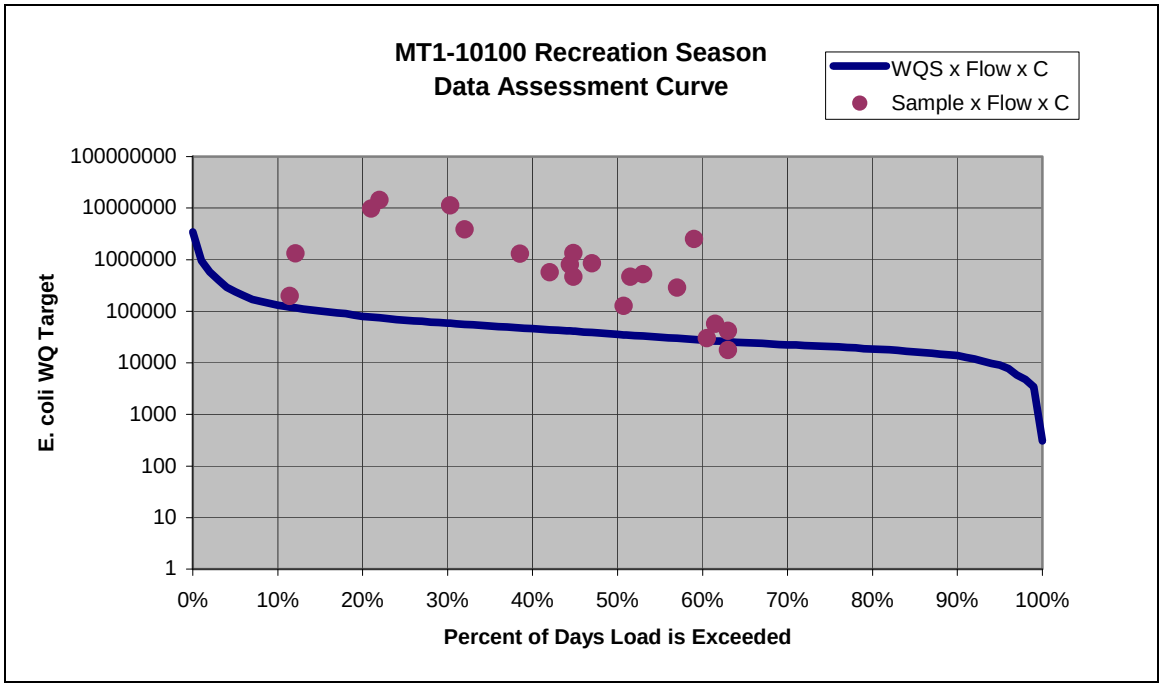


Figure 2.3.1b. Data Assessment Curve for MT1-10110

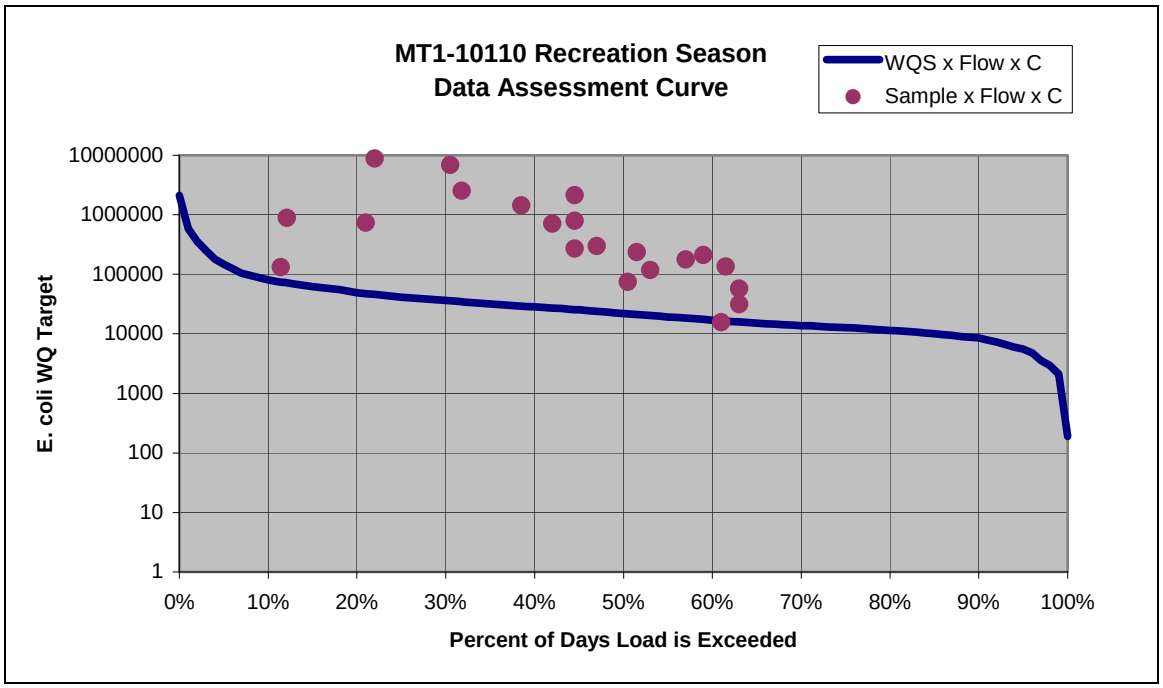


Figure 2.3.1c. Data Assessment Curve for MT1-10111

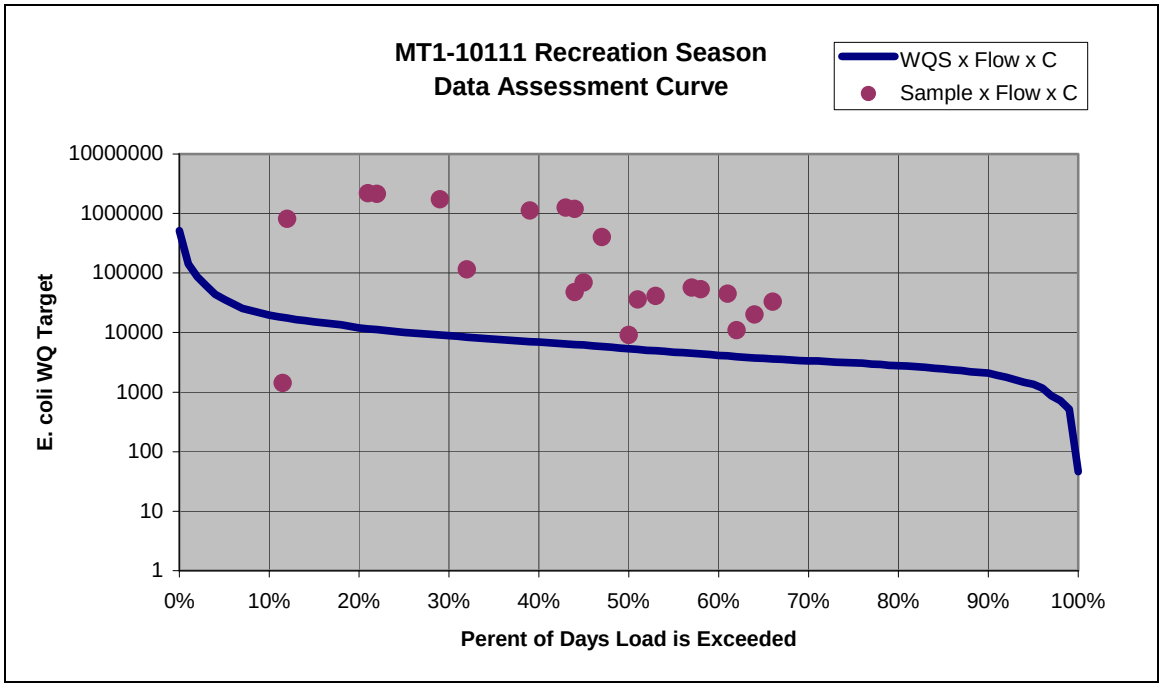


Figure 2.3.1d. Data Assessment Curve for MT1-10111.1

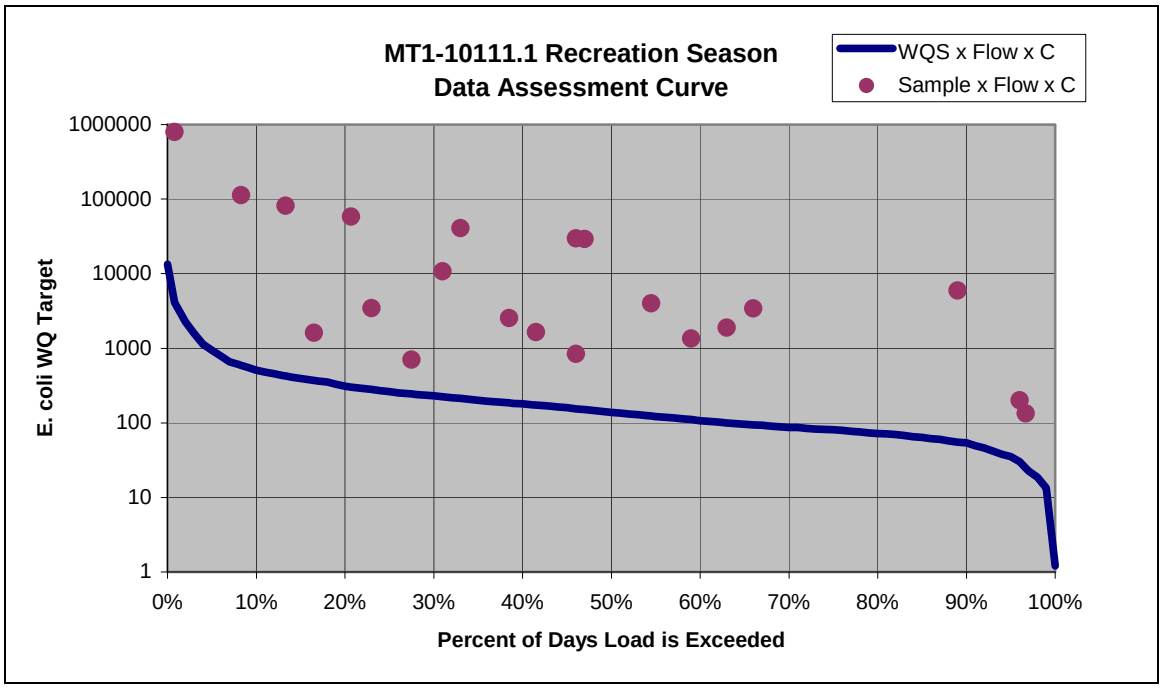


Figure 2.3.1e. Data Assessment Curve for MT1-10120

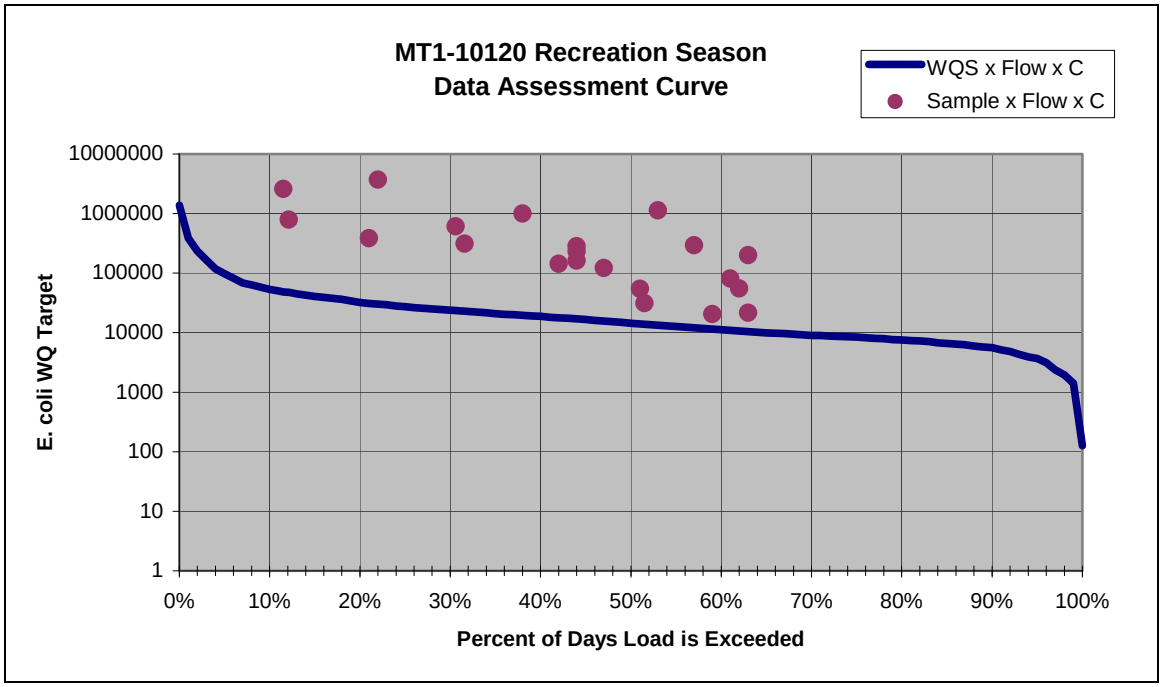
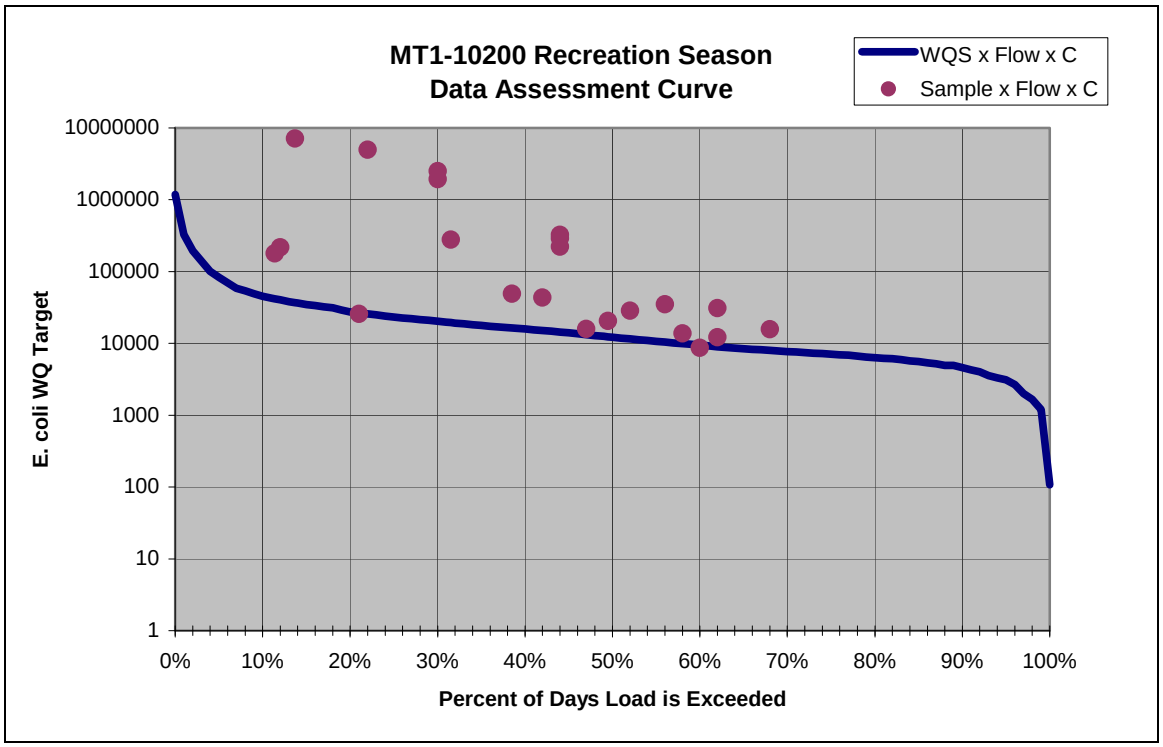


Figure 2.3.1f. Data Assessment Curve for MT1-10200



2.3.3 Identification of Pollutant Sources

Both point and nonpoint sources are known to exist along the segment and within the contributing watersheds. Due to the size of the watersheds, the somewhat limited data, the delivery methods and the location of the potential sources in relation to the impaired waterbody; it is difficult to definitively identify specific sources. It is important to note that all potential sources may not contribute to the water quality impairments and some sources may contribute at a greater degree than others.

The method utilized to determine the contributions of the sources will be based upon a demarcation where known and permitted point source discharges are not expected to further impact the waterbody. That is, based on the concept of a continuous and relatively constant effluent volume, a dilution or flow value can be determined where point sources are no longer expected to contribute to water quality excursions. The process is explained in the document entitled Nebraska's Approach for Developing TMDLs for Streams Using the Load Duration Curve Methodology.

E. coli concentrations in wastewater can vary greatly, depending upon treatment technology, wastewater strength, industrial contributions, treatment efficiency and season. The selection of an all-encompassing effluent density value must then account for these and other variables. To that end, the NDEQ has collected effluent *E. coli* information from several facilities not providing disinfection of the wastewater discharge. The data was obtained from 24 facilities that include both mechanical and lagoon facilities and as seen in Figure 2.3.3a, exhibits a normal distribution. The median value was selected as the input for the "expected pollutant concentration". The equation to determine the point source/nonpoint source boundary then becomes:

$$Q_s = (8{,}400/100 \text{ ml} * \Sigma Q_e)/126/100 \text{ ml}$$

Where:

Q_s	= stream flow volume necessary to meet water quality standards
8,400/100 ml	= expected *E. coli* coliform density from point sources
ΣQ_e	= sum of **all** design flows from point sources discharging to the segment (direct or via tributaries)
126/100 ml	= water quality standard

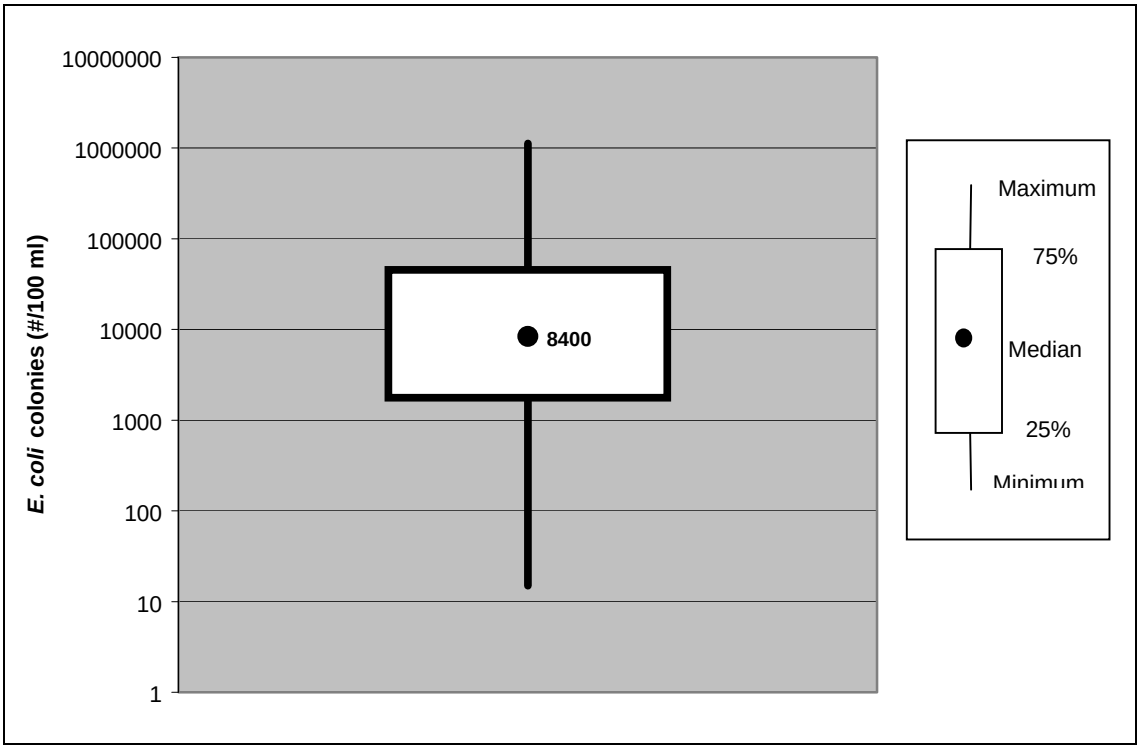
The values for ΣQ_e can be found in Table 2.3.3b as can the boundary flows. As shown in figure 2.1.5.1a only two point sources that potentially contribute E. coli to the watershed were identified. This is largely due to the City of Omaha providing wastewater collection and treatment services to much of the area.

Table 2.3.3 Sum of Wastewater Treatment Facility Design Flows in the Papillion Creek Watershed

Segment	Total Number of Facilities	Sum of Contributing Facility Design Flows	Flow Value for Point vs. Nonpoint Boundary
MT1-10120	1	0.03 cfs	8 cfs*
MT1-10200	1	1.55 cfs	103 cfs

* Recreation season 7q10 value

Figure 2.3.3a. *E. coli* Data from 24 Wastewater Treatment Facilities



The identification of pollutant sources and impacts for segment MT1-10200 is shown in figures 2.3.3b. No pollutant source assessment charge will be provided for segment MT1-10120 as all of the monitored points fall above the boundary. No pollutant source chart will be presented for segments MT1-10100, MT1-10110, MT1-10111 and MT1-10111.1, as there are no continuously discharging point source discharges to these segments.

2.3.2.1 Point Sources of *E. coli*: Based upon the data assessment curve and the position of the monitoring data points it appears continuous discharging point sources are contributing to the *E. coli* impairment within segment MT1-10200. The permitted facilities that discharge either directly to or into a tributary of the Papillion Creek River basin recreation segments and are potential sources of *E. coli* are listed in Table 2.3.3.1.

Along with the more traditional NPDES permits, a combined sewer system permit has been issued to the City of Omaha and municipal separate storm sewer system (MS4) permits have been issued to the City of Omaha and other entities in the urbanized area. The permit identification numbers can be found in table 2.3.3.2.

2.3.2.2 Nonpoint and Natural Sources of *E. coli*: Due to the diverse nature, distribution and delivery method, nonpoint and natural sources will not be separated. Therefore, the monitoring data that fall to the left of the boundary are considered to be the result of nonpoint and natural background sources.

Figure 2.3.3b. Identification of Pollutant Sources Using the Data Assessment Curve for MT1-10200

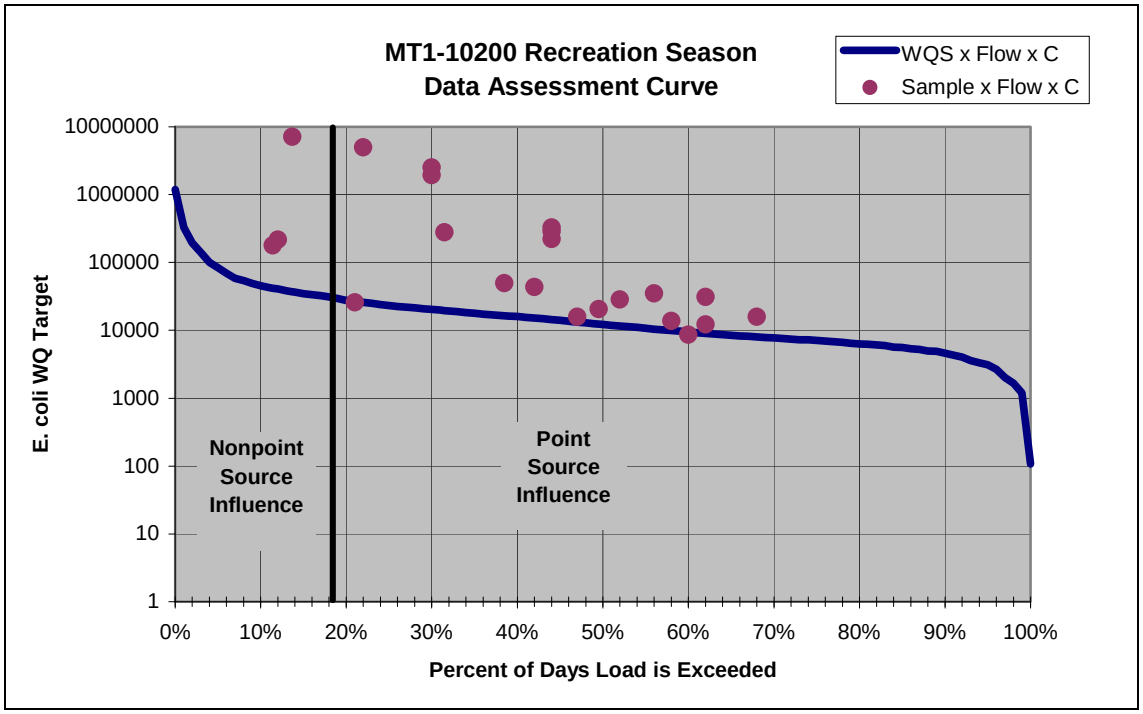


Table 2.3.3.1 NPDES Point Sources Discharging to the Papillion Creek Watershed

Recreation Segment	Receiving Water	Facility	NPDES Permit Number	Facility Design Flow (cfs)	Facility Discharge Directly to Recreation Segment?	Approximate Distance to Recreation Segment (stream miles)	*E. coli*/ Fecal coliform Limits in NPDES permit?
MT1-10120	Big Papillion Creek	Kennard WWTF	NE0122157	0.03	No	6.1	No
MT1-10200	West Papillion Creek	Elkhorn WWTF	NE0040096	1.55	No	11.4	Yes

The source identification process utilized was done so in order to get a general idea of the source category. This simplified numeric process should not be considered exclusive as an overlap of source contributions is recognized during periods where run-off is contributing to stream volume. In the future, expanded sampling may target specific source identification. Future monitoring and assessment will also take into account the controls (i.e. wastewater disinfection) that have been instituted. When considered, the demarcation may fluctuate and the source contributions re-evaluated.

2.4 Pollutant Allocation

A TMDL is defined as:

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

As stated above, the loading capacity is based upon flow position in the hydrograph and is defined by:

Load Capacity = Flow x 126/100 ml x C

Where:

Flow = Stream flow volume (cubic feet per second)
126/100 ml = applicable/target water quality criteria for *E. coli* from Title 117
C = conversion factor.

By regulation, a TMDL requires a loading capacity value for the pollutant of concern. In the case of *E. coli*, a "load" (flow rate x concentration x time) could be calculated, but the approach may not be appropriate for expressing this non-conservative parameter. Therefore, for the purposes of these TMDLs, a loading capacity will not be "calculated" but will be expressed as the water quality standard. Because the water quality is expressed as a concentration, the LC will not equal the WLA + the LA.

The flow hydrographs (0-100th Percentile) used in the *E. coli* TMDLs are provided in Table 2.4.

Table 2.3.3.2 NPDES Permits for Papillion Creek Stormwater and CSO Discharges

Facility/Entity	Permit Identification	Discharge Type
Boys and Girls Town	NER200006	MS4
City of Bellevue	NER200002	MS4
City of Elkhorn (Omaha)	NER200008	MS4
City of LaVista	NER200005	MS4
City of Omaha	NE0133698	MS4
City of Omaha	NE0133680	Combined Sewer Overflow
City of Papillion	NER200003	MS4
City of Ralston	NER200004	MS4
Douglas County	NER200001	MS4
Sarpy County	NER200007	MS4

Table 2.4 Recreation Season Hydrograph (cubic feet per second) for Papillion Creek TMDLs

Percentile	**MT1-10100**	**MT1-10110**	**MT1-10111**	**MT1-10111.1**	**MT1-10120**	**MT1-10200**
0	1	0.6	0.15	0.004	0.41	0.35
10	45	28	7	0.18	19	15
20	60	37	9	0.23	24	20
30	72	44	11	0.28	29	25
40	89	55	13	0.35	36	31
50	115	71	17	0.45	47	39
60	150	92	23	0.59	61	52
70	191	118	29	0.75	78	66
80	258	159	39	1.0	105	89
90	424	261	64	1.65	172	147
100	11067	6823	1663	43	4501	3842

To achieve the desired loading capacities requires the following allocations:

2.4.1 Wasteload Allocations

2.4.1.1 NPDES Permitted Facilities: Title 117 does not allow for the application of a mixing zone for the initial assimilation of effluents in order to meet the criteria associated with the recreation beneficial use. Because of this, the water quality criteria are applied to the "end-of-pipe" concentrations and are applicable at all stream flows >7q10. Therefore, the *E. coli* wasteload allocation established by this TMDL will be a monthly geometric mean 126/100 ml. The daily load can be calculated by multiplying the effluent flow by 126/100 ml by a conversion factor.

The wasteload allocation will initially be applied to all facilities that discharge directly to a recreational segment. Future monitoring and evaluation will be utilized to determine if *E. coli* limitations are necessary for facilities discharging to the recreation segment's tributaries.

2.1.4.2 Dry Weather Discharges: Dry weather discharges can either be from illicit sources, cross-connections or mechanical failure and often exhibit the greatest influence on the base flow conditions of the stream. Thus, it is most appropriate to group these discharges and limit similarly to the WWTFs. Specifically, the wasteload allocations assigned to these discharges shall be a seasonal geometric mean of 126/100 ml. The daily load can be calculated by multiplying the effluent flow by 126/100 ml by a conversion factor.

2.1.4.3 Non-Discharging Facilities: Several facilities including confined animal feeding operations and lagoons are designed for "zero" discharge. In the case of animal feeding operations, discharges may only occur as the result of a 25-year 24-hour storm event or a chronic wet period with an accumulative precipitation equivalent to a 25-year 24-hour storm. Based on this permitting provision, the WLA for facilities classified as non-discharging will be zero (0).

2.4.2 Load Allocations

The load allocations assigned to these TMDLs will be based upon the stream flow volume and will be defined as:

$$LA_i = Q_i * 126/100 \text{ ml} * C$$

Where:
LA_i = load allocations at the i^{th} flow
Q_i = stream flow at the i^{th} flow
126/100 ml = applicable/target water quality criteria for *E. coli* from Title 117
C = conversion factor

2.4.2.1 Load Reduction to Meet Water Quality Criteria: It is important to report the reductions necessary to meet the water quality criteria. The necessary reductions were determined based upon the 2005 data, which is considered representative information. The targeted reductions found in Table 2.4.2.1 provide water quality managers with a quantitative endpoint by which implementation planning can be carried out. The noted reductions along including the application of point source controls if achieved should result in the waterbodies fully supporting the primary contact recreation beneficial use. The reductions stated in the table also include the margin of safety described below.

2.4.3 Margin of Safety

A margin of safety (MOS) must be incorporated into TMDLs in an attempt to account for uncertainty in the data, analysis or targeted allocations. The MOS can either be explicit or implicit and for these TMDLs are as follows:

- To account for uncertainty in the nonpoint source load reduction, the targeted reductions will be set at 90% of the water quality target (126/100 ml). Specifically the reductions shall be applied to meet a seasonal geometric mean of ≤113/100 ml.
- Decay and/or die off of *E. coli* were not accounted for in either the source assessment or in establishment of the load reduction. That is, the entire concentration/load from the source was assumed to be present within the waterbody and the reductions should focus on the load.
- These TMDLs assumed the effluents discharge the *E. coli* density allowed by the WLA or 126/100 ml. WWTF disinfection systems are often designed and operated to achieve 100% reduction in the indicator bacteria or 0/100ml. Thus, the actual NPDES permitted point source contribution is likely less than expected by the TMDL.

Table 2.4.2.1 Targeted Reductions

Segment	Targeted Reduction	Expected Season Geometric Mean
MT1-10100	94%	102/100 ml
MT1-10110	94%	102/100 ml
MT1-10111	96%	92/100 ml
MT1-10111.1	98%	82/100 ml
MT1-10120	93%	112/100 ml
MT1-10200	87%	110/100 ml

2.4.3 Expression of TMDLs as Daily Loads

The April 25, 2006 decision by the U.S. District Court of Appeals for the D.C. Circuit in *"Friends of the Earth, Inc. vs. EPA et. al."* recommends that all TMDLs and associated wasteload allocations and load allocations include a daily expression. The approach for these TMDLs will based upon the conversion of the targeted concentration of E. coli to counts per day. The daily expression for each TMDL segment can be found in Appendix B.

3.0 Implementation Plan

The implementation of controls to manage *E. coli* within the Papillion Creek Watershed includes but is not limited to:

3.1 NPDES Permitted Point Sources

Facilities that discharge directly to all segments within the Papillion Creek Watershed designated with the primary contact recreation use will be required to meet the wasteload allocations – *E. coli* = 126/100 ml – at the end of the pipe. Facilities discharging to tributaries will be evaluated to determine the extent of the effluent's impact on the recreation segment. If deemed significant, a request will be made to limit the *E. coli* concentration discharged from these facilities in the NPDES permit.

In addition to the permits, in the course of compliance audits, deficiencies in the operation of the WWTF disinfection appurtenances and noncompliance with the NPDES permit limits should be noted and corrective action pursued.

Biosolids (sludge) generated by municipal and industrial facilities are regulated under 40 CFR Part 257 and 40 CFR Part 503, respectively. 40 CFR part 257 requires that facilities and practices not cause nonpoint source pollution of waters of the United States. Part 503 specifically requires that sludge applications be not less that 10 meters from waters of the United States and that the sludge not be applied to frozen, flooded or snow covered ground if the sludge can enter into waters of the United States.

Consistent with Section 3.5 below, a recommendation will be made that all NPDES permittees be required to adhere to Section 3.5 items #1and #2 for land application activities taking place either during or 10 days prior to the recreation season (May 1 – September 30). In those areas where land slope or drainage is such where the application has a greater potential to run-off, or where application has been observed to have run-off, the recommendation will be consistent with Section 3.5 #3

3.2 NPDES Storm Water Discharges

The WLA defined in section 2.4.1.1 will be applicable to all NPDES discharges including discharge from regulated stormwater outfall. The NDEQ is responsible for determining the applicability of NPDES stormwater permits for urbanized areas with populations >10,000 but <100,000. As well, other municipal or construction areas can be designated for coverage under an NPDES (stormwater) permit if the NDEQ determines control of the stormwater is necessary.

Facilities discharging stormwater under the authority of a NPDES permit are required to implement minimum control measures (i.e. six minimum control measures), thus all permits will be consistent with applicable regulations.

Rather than apply numeric limitations on individual stormwater outfalls, the strategy will be to initially allow the municipalities and other facilities regulated by and permit, sufficient opportunity to comply with the NPDES requirements; either voluntarily or under the authority of an NPDES permit. In the future, should additional monitoring data indicate the minimum control measures are inadequate or have not been incorporated; consideration will be given to application of wasteload allocations for the outfalls in the area of concern.

In situations where MS4 or other NPDES permits have been issued, during review and re-issuance of these permit, the NDEQ must incorporate the WLAs established in the TMDL. Incorporation of the WLAs in to the TMDL will be consistent with EPA guidance, specifically; the November 22, 2002 memorandum from Robert Wayland and James Hanlon (http://www.epa.gov/owow/tmdl/policy.html).

3.3 Combined Sewer Overflows

There are currently eleven combined sewer overflow (CSO) points discharging directly to or to a tributary of Papillion Creek. In October 2002 the City of Omaha was issued an NPDES permit and outlined specific nine minimum controls and long-term control plan (LTCP) requirements (City of Omaha 2007). A substantively complete LTCP was received by NDEQ in October 2007 with a final plan being due October 2009. The plan focuses on the control of *E. coli* contributions to Papillion Creek from CSO events.

3.4 Dry Weather Discharges

Title 119 – Rules and Regulations Pertaining to the Issuance of Permits Under the National Pollutant Discharge Elimination System, Chapter 2 states:

> "All persons discharging pollutants from a point source into any waters of the State are required to apply for and have a permit to discharge."

Discharges not permitted should be required to obtain the proper authorization to discharge. All discharges are then subject to the appropriate limitations consistent with the WLAs established by this TMDL. Elimination of the discharge should be undertaken in the event permitting and control is not feasible.

3.5 Animal Feeding Operations

Title 130 – Rules and Regulations Pertaining to Livestock Waste Control states:

> 001 A livestock waste control facility shall be required for an existing or proposed livestock operation of three hundred animal units or larger, when livestock wastes:
>
> > 001.01 Violate or threaten to violate Title 117 (Neb. Administrative Code (NAC)), Nebraska Surface Water Quality Standards;
> > 001.02 Violate or threaten to violate Title 118 (NAC), Ground Water Quality Standards and Use Classification;
> > 001.03 Discharge into waters of the State; or
> > 001.04 Violate The Nebraska Environmental Protection Act.
>
> 002 Any livestock operation less than three hundred animal units is exempt from the permitting process, including the requirement to request an inspection, unless there has been a confirmed discharge into waters of the State, or the Department has determined that because of conditions at the livestock operation there is a high potential for discharge into waters of the State in which case the Department shall notify the owner of the livestock operation by certified mail that the owner is subject to the Livestock Waste Management Act.

When a livestock waste control facility is required the owner/operator must also be issued a construction and/or a state-operating permit. State operating permits require facilities be properly operated and maintained to prevent water pollution and to protect the environment of the State.

Livestock waste control facilities for open lots, by regulation must be designed and constructed to contain all waste generated under conditions less than a 25 year 24 hour precipitation event. Confined animal feeding operations are required to maintain 180 days of storage or a lagoon to treat the waste products. Meeting these permit requirements should equate to "zero" discharge during conditions less than a 25 year 24 hour precipitation event, or a chronic wet period.

Wastewater and biosolids (manure) produced by the animal feeding operations are most often land applied for beneficial reuse. Permitted facilities are required to follow best management practices (BMPs) for the land application as defined in Title 130, Chapter 11. Those BMPs include:

1. Utilize application areas which are under proper conservation treatment to prevent run-off into waters of the State
2. Not apply waste within 30 feet of any stream, lake or impounded waters identified in Chapter 6 and Chapter 7 of Title 117, unless in accordance with an approved comprehensive nutrient management plan
3. When waste is applied within 100 feet of any streams, lakes an impounded waters identified in Chapter 6 and 7 of Title 117, the Department may also require additional buffer and/or vegetative buffers, and that the livestock waste be applied in a manner which reduces potential for run-off of nutrients or pathogens by incorporation, injection of waste or other approved practices.

Based upon the above, it shall be recommended that the NDEQ's Agriculture Section stipulate in the state operating or other permits, for facilities located in the Papillion Creek Watershed, that the application of livestock waste occurring during or 10 days prior to the Recreation Season (May 1 – September 30) be consistent with the above #1 and #2 and the application setback be the minimum of 30 feet regardless of the status of the comprehensive nutrient management plan. In those areas where land slope or drainage is such where the application has a greater potential to run-off, or where application has been observed to have run-off, the recommendation will be consistent with the requirements of #3 with the minimum setback being 100 feet.

3.5 Exempt Facilities/Other Agricultural Sources

Animal feeding operations are exempt from regulations set forth in Title 130 if:

- The operation is less than 300 animal units
- There has not been a confirmed discharge to waters of the State, or
- The Department has determined that because of conditions at the livestock operation there is **not** a high potential for discharge to waters of the state.

Periodically, the NDEQ will receive a complaint on or a request for an inspection from a facility operating with <300 animal units. Should deficiencies be noted during the on-site visit, the owners/operator will often be given an opportunity to make corrections prior to enforcement or permit action being taken. In the event the efforts at voluntary compliance fail, civil enforcement or the issuance of a permit will be pursued to bring about the necessary corrective measures.

Because these facilities are "non-regulated", it is difficult to assess the impacts to the environment. As well, pastures or other temporary feeding practices may contribute to the *E. coli* impairments if conditions are such that run-off from the site occurs. In lieu of regulatory requirements, the NDEQ will first look to the USDA-Natural Resource Conservation Service for assistance utilizing programs under the control of the Service such as Conservation Reserve Program, Environmental Quality Incentives Program, Conservation Farm Option, Conservation of Private Grazing Land Initiative, the Wetlands Reserve Program and others that aid in the maintenance and improvement of water quality.

3.6 Section 319 – Nonpoint Source Management Program

The United States Environmental Protection Agency supplies grant funds to states to aid in managing nonpoint source pollution. When grant applications are submitted for review, an effort should be made to include the control of *E. coli* and surface run-off for the proposed projects in the Papillion Creek Watershed. As well, an effort will be made to redirect applicants to develop proposals consistent with the goals of this TMDL. Preference may be given to those projects that will have a direct reduction in the *E. coli* contributions of nonpoint source discharges.

3.7 Non-Government Organizations

Several non-governmental organizations with an emphasis on agriculture disseminate information to their members on a regular basis. As well, some of the organizations have established environmental education programs to assist in the understanding of environmental regulations and topics. The NDEQ will communicate with these entities in an attempt to utilize the membership distribution process as a means of providing information on the water quality impairments, the TMDL and suggestions to assist in solving the identified problems.

3.8 Reasonable Assurances

The NDEQ is responsible for the issuance of NPDES or state operating permits for industrial and municipal wastewater discharges, regulated stormwater discharges and livestock operations (open lot or confined). Issued permits must be consistent with or more stringent then the wasteload allocations set forth by this TMDL. Compliance with the permit may require construction or modification of a facility and the issued permits may account for this through the inclusion of a compliance schedule or administrative order.

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. While a few of the organizations have been previously identified, Appendix A is a more complete compilation of 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 *E. coli* contributions to the Papillion Creek. Participation will depend on the agency/organization's program capabilities.

4.0 Future Monitoring

Future monitoring will generally be consistent with the rotating basin monitoring scheme. That is, annually, two or three river basins in the same geographic location are the focus of the monitoring effort. The Papillion Creek Watershed was monitored in 2005 and will again be targeted in 2010. An effort will be made to expand the monitoring to isolate areas of concern and to focus resources to address identified problems.

Periodically, compliance monitoring will be conducted at NPDES permitted facilities to verify permit limitations are being adhered to. Facilities are selected either randomly or in response to inspection or reported information.

As well, the NPDES permits require self-monitoring of the effluent by the permittee with the frequency of the monitoring being based on the discharge characteristics. The data is then reported to NDEQ quarterly, semiannually or annually and entered into the EPA's Permitting Compliance System. The compliance monitoring and self-monitoring information will be used in assessing the success of the TMDL.

Recently, analytical techniques have been introduced that may provide a greater level of confidence in the identification of pollutant sources. These techniques include microbial source tracking and specialized sampling the targets human wastewater. As the science progresses the application of these analytical techniques may become a valuable tool for source identification and pollutant reduction.

5.0 Public Participation

The availability of the TMDLs in draft form was published on the Department Internet site with the public comment period running from approximately January 22, 2009 to March 1, 2009. Interested stakeholders were informed via email of the availability of the draft TMDLs.

In response to the public noticed TMDL the City of Omaha submitted several comments. A copy of the comments and the Department's response are included as an attachment to the TMDL submittal package. Minor language changes were made to the TMDL as a result of these comments.

6.0 References

Chapman, Shannen, S. Omernik, J.M., Freeouf, J.A., Huggins, D.G., McCauley, J.R., Freeman, C.C., Steiner, G.A., Robert, T., Schlepp, R.L., 2001. Ecoregions of Nebraska and Kansas (color poster with map, descriptive text, summary tables and photographs): Reston, Virginia, U.S. Geological Survey

Omaha CSO Control Program, 2007. Substantively Complete Long Term Control Plan. City of Omaha CSO Program Management Team. Omaha, Nebraska.

6.0 References (continued)

NDEQ 2002. Nebraska's Approach for Developing TMDLs for Streams Using the Load Duration Curve Methodology. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2005a. Title 130 – Rules and Regulations Pertaining to Livestock Waste Control. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2005. Title 119 – Rules and Regulations Pertaining to the Issuance of Permits Under the National Pollutant Discharge Elimination System. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2006. Title 117 – Nebraska Surface Water Quality Standards. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2008a. Methodologies for Waterbody Assessments and Development the 2008 Integrated Report for Nebraska. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2008b. 2008 Water Quality Integrated Report. Nebraska Department of Environmental Quality. Lincoln, NE.

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 – Daily Load Expression for Papillion Creek Basin TMDLs

Loading capacities and wasteload allocations will be expressed as daily counts using the following equation:

$$Q*35683.2 \text{ cfu/ft}^3*86400 \text{ seconds/day}$$

Daily expression of the margin of safety will be 10% of the loading capacity. The load allocation will be the remaining load available after accounting for the wasteload allocation and the margin of safety.

The tables and charts below are the daily expressions for the TMDLs contained in this document.

Table B1 Daily TMDL Expression for MT1-10100

Percent of Flows Exceed	20 Year Flow Percentile	Segment Flow (cfs)	Loading Capacity	Wasteload Allocation	Margin of Safety	Load Allocation
100%	0	1.0	3.083E+09	0	3.08E+08	2.77E+09
90%	0.1	45	1.385E+11	0	1.39E+10	1.25E+11
80%	0.2	60	1.85E+11	0	1.85E+10	1.66E+11
70%	0.3	72	2.22E+11	0	2.22E+10	2E+11
60%	0.4	89	2.748E+11	0	2.75E+10	2.47E+11
50%	0.5	115	3.545E+11	0	3.55E+10	3.19E+11
40%	0.6	150	4.625E+11	0	4.62E+10	4.16E+11
30%	0.7	191	5.896E+11	0	5.9E+10	5.31E+11
20%	0.8	258	7.939E+11	0	7.94E+10	7.15E+11
10%	0.9	424	1.306E+12	0	1.31E+11	1.18E+12
0%	1	11067	3.412E+13	0	3.41E+12	3.07E+13

Figure B1 MT1-10100 Daily Load Expression Chart

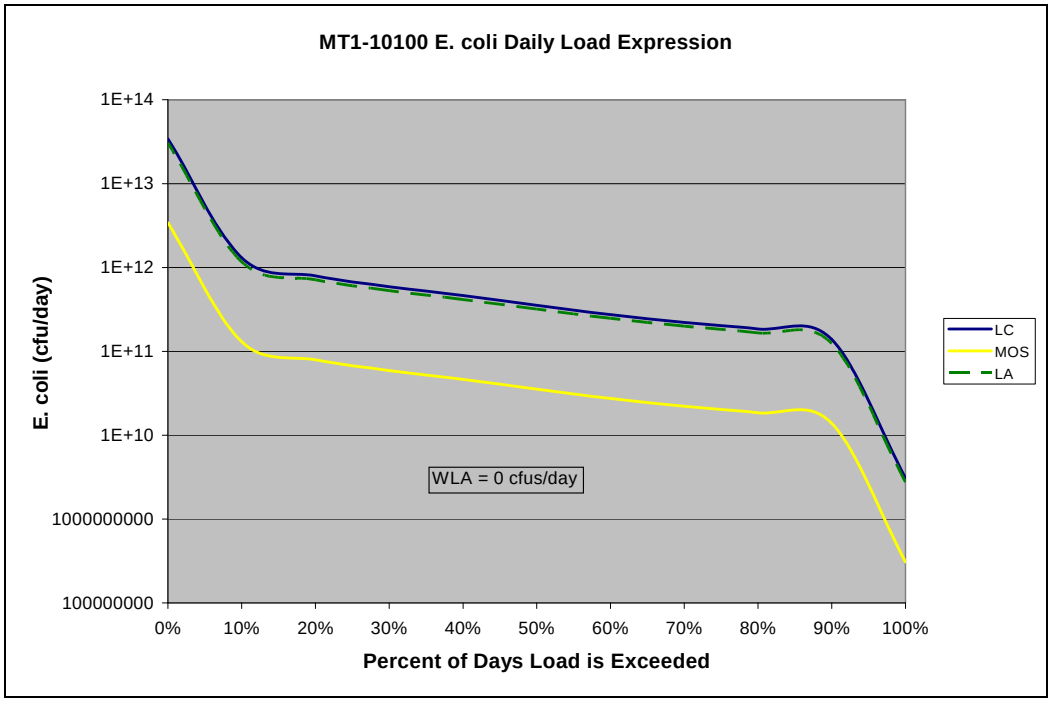


Table B2 Daily TMDL Expression for MT1-10110

Percent of Flows Exceed	20 Year Flow Percentile	Segment Flow (cfs)	Loading Capacity	Wasteload Allocation	Margin of Safety	Load Allocation
100%	0	0.6	1.9E+09	0	1.9E+08	1.71E+09
90%	0.1	28	8.54E+10	0	8.54E+09	7.69E+10
80%	0.2	37	1.14E+11	0	1.14E+10	1.03E+11
70%	0.3	44	1.37E+11	0	1.37E+10	1.23E+11
60%	0.4	55	1.69E+11	0	1.69E+10	1.52E+11
50%	0.5	71	2.19E+11	0	2.19E+10	1.97E+11
40%	0.6	92	2.85E+11	0	2.85E+10	2.57E+11
30%	0.7	118	3.64E+11	0	3.64E+10	3.27E+11
20%	0.8	159	4.9E+11	0	4.9E+10	4.41E+11
10%	0.9	261	8.05E+11	0	8.05E+10	7.25E+11
0%	1	6823	2.1E+13	0	2.1E+12	1.89E+13

Figure B2 MT1-10110 Daily Load Expression Chart

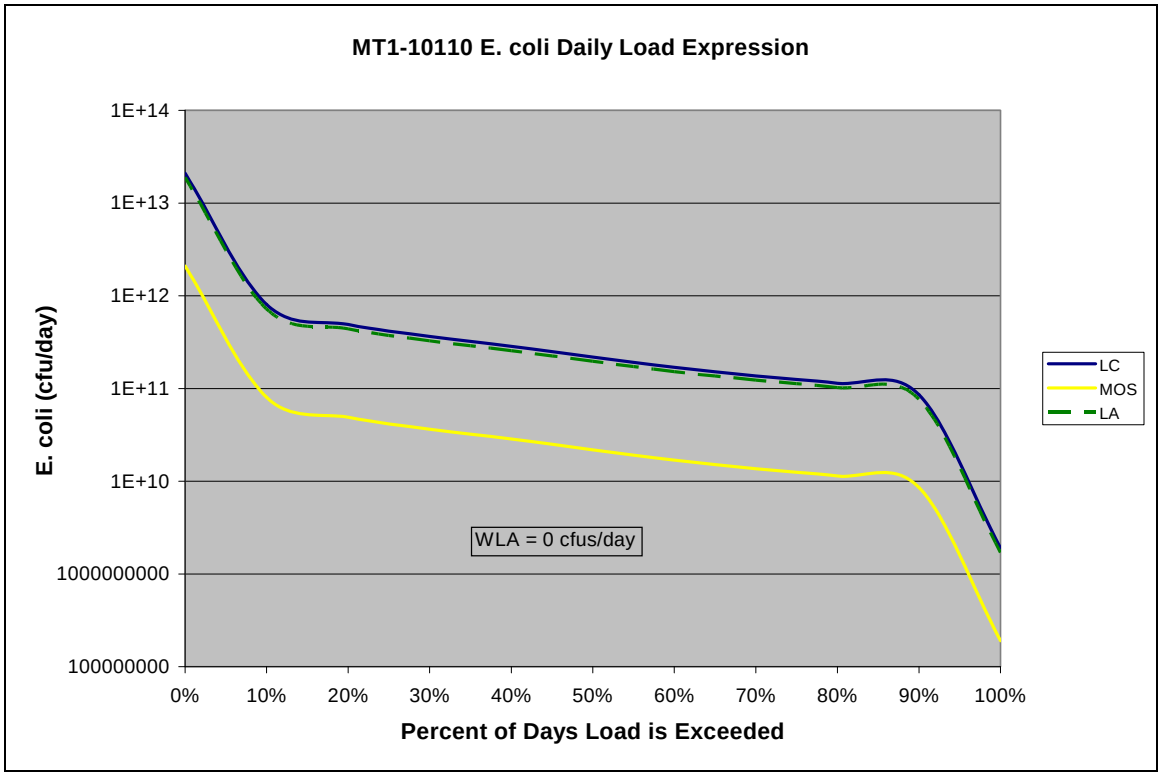


Table B3 Daily TMDL Expression for MT1-10111

Percent of Flows Exceed	20 Year Flow Percentile	Segment Flow (cfs)	Loading Capacity	Wasteload Allocation	Margin of Safety	Load Allocation
100%	0	0.15	4.63E+08	0	46325298	4.17E+08
90%	0.1	7	2.08E+10	0	2.08E+09	1.87E+10
80%	0.2	9	2.78E+10	0	2.78E+09	2.5E+10
70%	0.3	11	3.34E+10	0	3.34E+09	3E+10
60%	0.4	13	4.13E+10	0	4.13E+09	3.72E+10
50%	0.5	17	5.33E+10	0	5.33E+09	4.79E+10
40%	0.6	23	6.95E+10	0	6.95E+09	6.25E+10
30%	0.7	29	8.86E+10	0	8.86E+09	7.97E+10
20%	0.8	39	1.19E+11	0	1.19E+10	1.07E+11
10%	0.9	64	1.96E+11	0	1.96E+10	1.77E+11
0%	1	1663	5.13E+12	0	5.13E+11	4.61E+12

Figure B3 MT1-10111 Daily Load Expression Chart

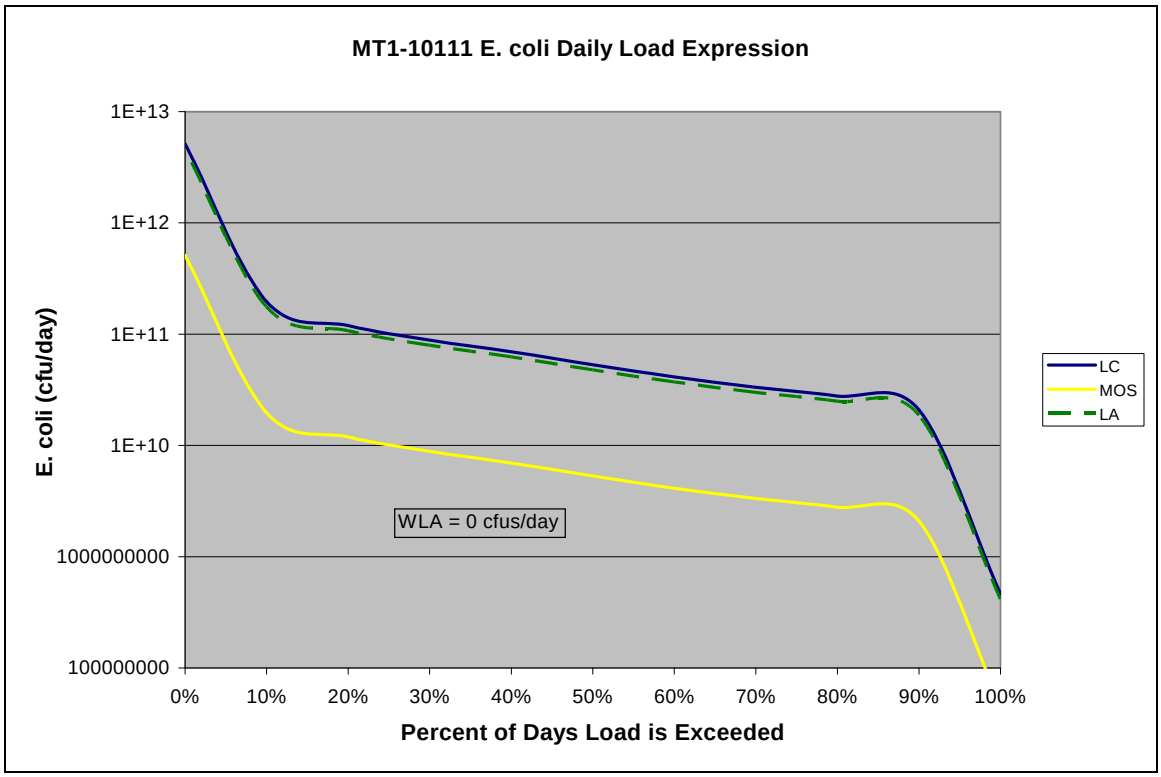


Table B4 Daily TMDL Expression for MT1-10111.1

Percent of Flows Exceed	20 Year Flow Percentile	Segment Flow (cfs)	Loading Capacity	Wasteload Allocation	Margin of Safety	Load Allocation
100%	0	0.004	12023811	0	1202381	10821430
90%	0.1	0.18	5.4E+08	0	54021983	4.86E+08
80%	0.2	0.23	7.21E+08	0	72142866	6.49E+08
70%	0.3	0.28	8.66E+08	0	86571440	7.79E+08
60%	0.4	0.35	1.07E+09	0	1.07E+08	9.64E+08
50%	0.5	0.45	1.38E+09	0	1.38E+08	1.24E+09
40%	0.6	0.59	1.8E+09	0	1.8E+08	1.62E+09
30%	0.7	0.75	2.3E+09	0	2.3E+08	2.07E+09
20%	0.8	1.00	3.1E+09	0	3.1E+08	2.79E+09
10%	0.9	1.65	5.09E+09	0	5.09E+08	4.58E+09
0%	1	43	1.33E+11	0	1.33E+10	1.2E+11

Figure B4 MT1-10111.1 Daily Load Expression Chart

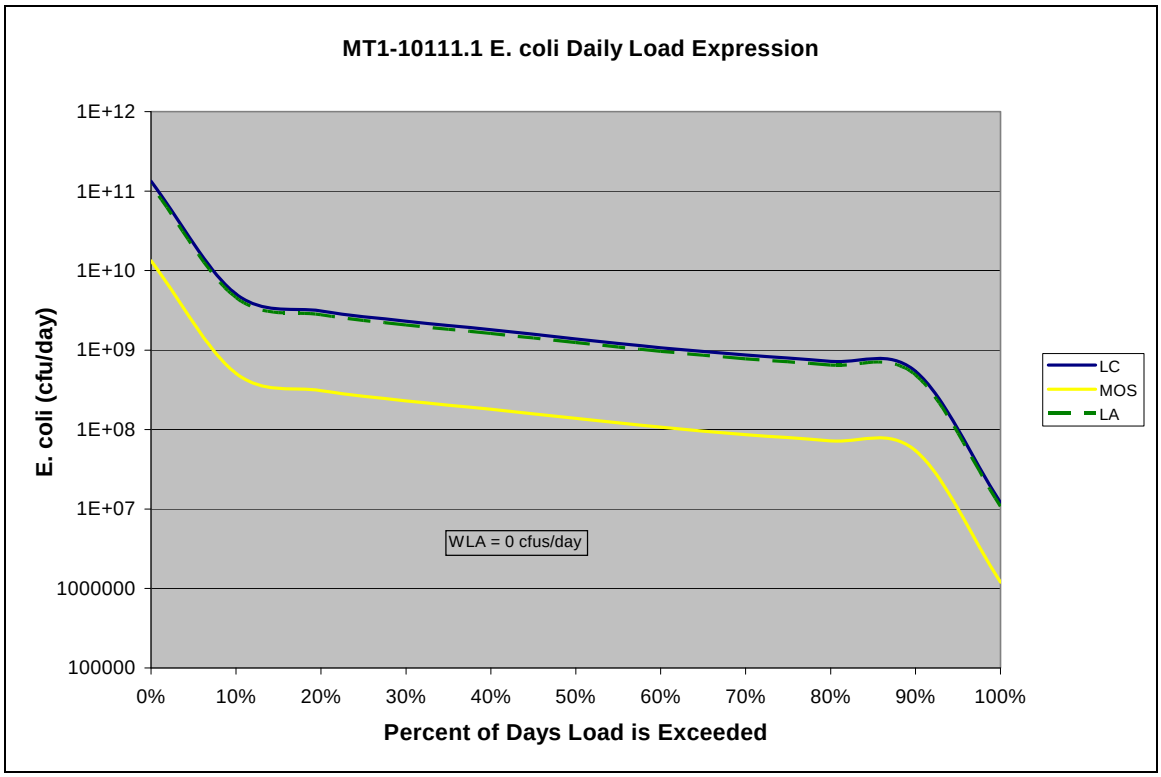


Table B5 Daily TMDL Expression for MT1-10120

Percent of Flows Exceed	20 Year Flow Percentile	Segment Flow (cfs)	Loading Capacity	Wasteload Allocation	Margin of Safety	Load Allocation
100%	0	0.4	1.25E+09	92490854	1.25E+08	1.04E+09
90%	0.1	18	5.63E+10	92490854	5.63E+09	5.06E+10
80%	0.2	24	7.52E+10	92490854	7.52E+09	6.76E+10
70%	0.3	29	9.03E+10	92490854	9.03E+09	8.12E+10
60%	0.4	36	1.12E+11	92490854	1.12E+10	1E+11
50%	0.5	47	1.44E+11	92490854	1.44E+10	1.3E+11
40%	0.6	61	1.88E+11	92490854	1.88E+10	1.69E+11
30%	0.7	78	2.4E+11	92490854	2.4E+10	2.16E+11
20%	0.8	105	3.23E+11	92490854	3.23E+10	2.91E+11
10%	0.9	172	5.31E+11	92490854	5.31E+10	4.78E+11
0%	1	4501	1.39E+13	92490854	1.39E+12	1.25E+13

Figure B5 MT1-10120 Daily Load Expression Chart

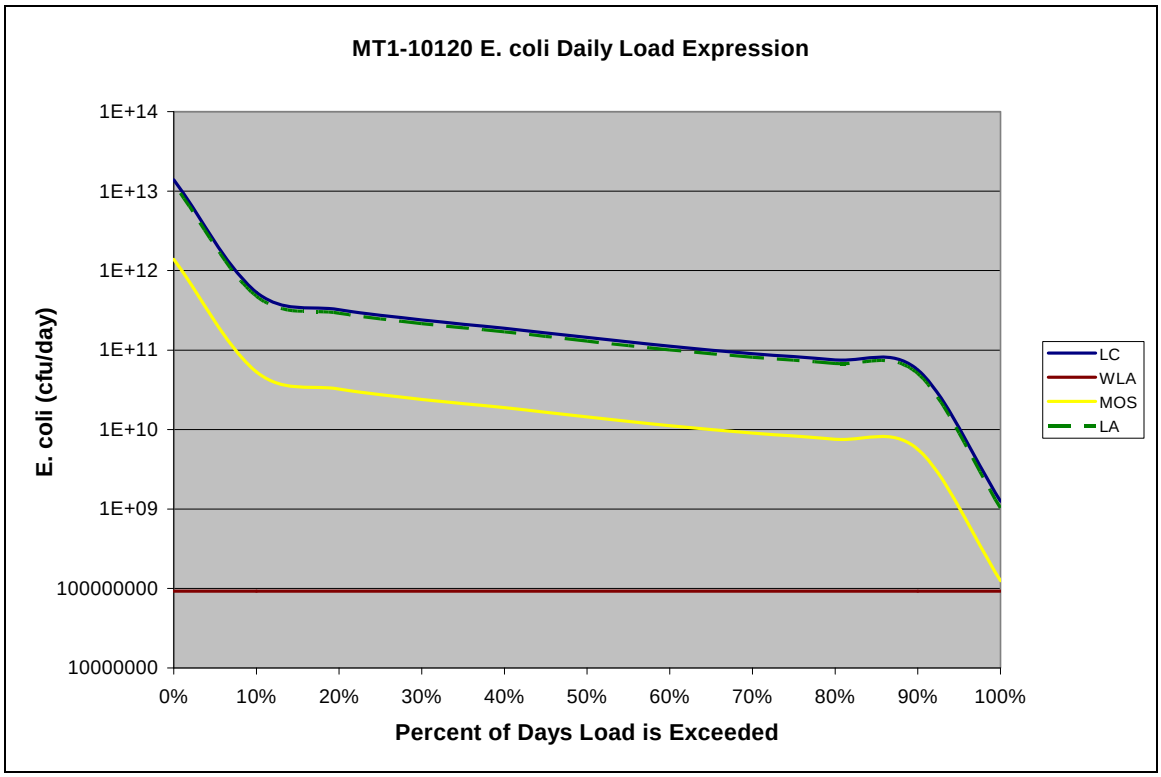
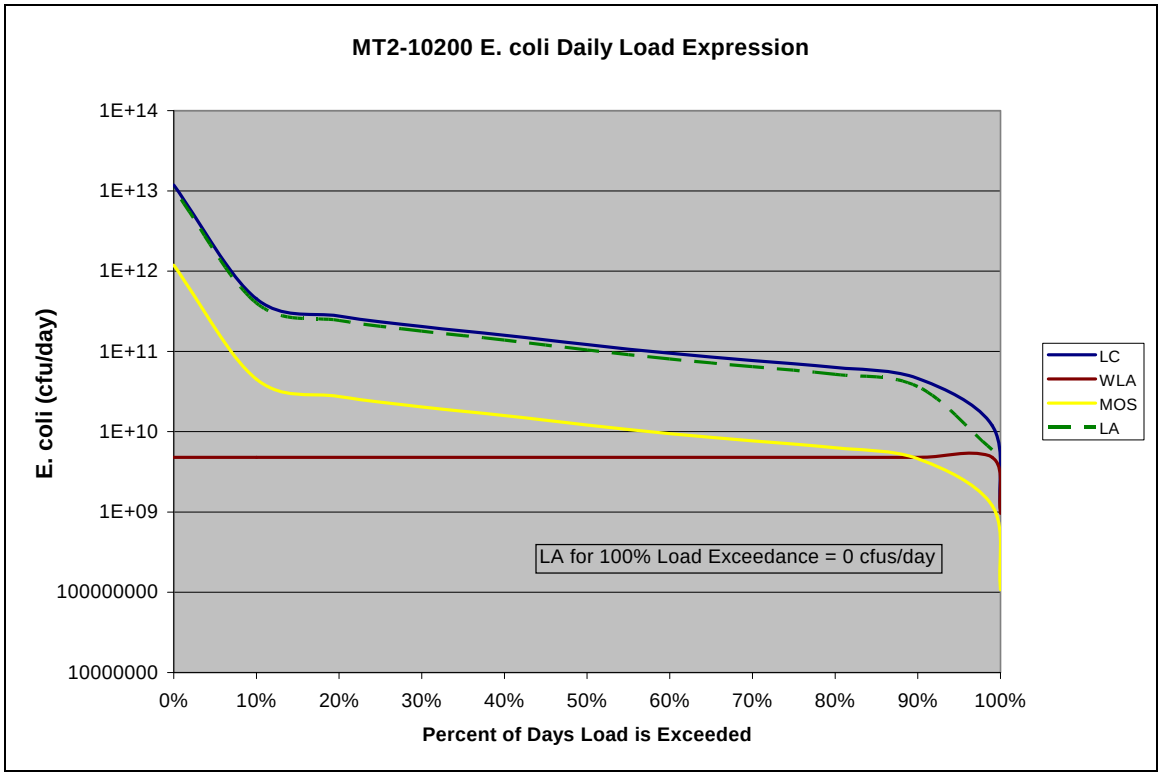


Table B6 Daily TMDL Expression for MT1-10200

Percent of Flows Exceed	20 Year Flow Percentile	Segment Flow (cfs)	Loading Capacity	Wasteload Allocation	Margin of Safety	Load Allocation
100%	0	0.3	1.07E+09	9.63E+08	1.07E+08	0
99%	0.01	4	1.19E+10	4.78E+09	1.19E+09	5.963E+09
90%	0.1	15	4.61E+10	4.78E+09	4.61E+09	3.669E+10
80%	0.2	20	6.31E+10	4.78E+09	6.31E+09	5.205E+10
70%	0.3	25	7.71E+10	4.78E+09	7.71E+09	6.458E+10
60%	0.4	31	9.49E+10	4.78E+09	9.49E+09	8.062E+10
50%	0.5	39	1.22E+11	4.78E+09	1.22E+10	1.046E+11
40%	0.6	52	1.59E+11	4.78E+09	1.59E+10	1.386E+11
30%	0.7	66	2.04E+11	4.78E+09	2.04E+10	1.791E+11
20%	0.8	89	2.75E+11	4.78E+09	2.75E+10	2.43E+11
10%	0.9	147	4.52E+11	4.78E+09	4.52E+10	4.023E+11
0%	1	3842	1.18E+13	4.78E+09	1.18E+12	1.066E+13

Figure B6 MT1-10200 Daily Load Expression Chart



Appendix C – 2005 Weekly *E. coli* Data.

Week Beginning	MT1-10100	MT1-10110	MT1-10111	MT1-10111.1	MT1-10120	MT1-10200
5/2/05	16070	1968	>24196	548	1553	123
5/9/05	> 24196	<24196	<24196	<24196	3255	15531
5/16/05	3448	6131	19863	365	6488	380
5/23/05	2755	1576	8664	687	980	151
5/31/05	1631	3282	>24190	1733	1008	361
6/6/05	8664	9208	1733	24192	1733	1810
6/13/05	1414	1553	5794	1557	2098	670
6/20/05	208	223	10	6090	6670	541
6/27/05	1414	1334	1414	>24192	2098	1931
7/5/05	4106	3873	980	>24192	1722	2510
7/11/05	1986	727	1046	1553	10462	316
7/18/05	>24190	>24190	>24190	24192	15530	24196
7/25/05	11199	1515	1553	727	228	176
8/1/05	1203	1203	1553	1203	3076	421
8/8/05	140	119	344	816	921	114
8/16/05	461	435	866	4106	488	211
8/22/05	2419	10462	>24192	>24192	1203	2831
8/29/05	7701	5794	1120	2419	261	12033
9/6/05	88	461	1414	4611	649	172
9/13/05	270	1046	219	>24192	286	248
9/20/05	1733	1414	687	13530	2419	24196
9/26/05	206	250	>24196	2419	1553	436