Total Maximum Daily Loads
for the
Republican River Basin

(Segments RE1-10000, RE1-20000, RE2-10000, RE3-10000 and RE3-20300)

Parameters of Concern: Fecal coliform and *E. coli* Bacteria

Nebraska Department of Environmental Quality
Planning Unit, Water Quality Division

February 2005

Table of Contents

List of Figures and Tables

Executive Summary

Six segments in the Republican River Basin were included on the 2004 Nebraska Surface Water Quality Integrated Report (NDEQ 2004) in Category 5 as impaired by excessive *E.* coli and/or fecal coliform bacteria. 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 five of the six waterbodies. In 2002, the Department opted to convert from fecal coliform to *E.* coli bacteria as the indicator for primary contact recreation assessment. Assessment of the available data for segment RE1-50000 suggests a conflict between the *E. coli* and fecal coliform data with the *E. coli* data assessment being fully supportive of the beneficial use. Due to this conflict, a TMDL will not be developed segment RE1-50000. This document presents TMDLs for *E. coli* that are designed to allow the Republican River basin segments to fully support the primary contact recreation beneficial use. The information contained herein should be considered 5 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.
Republican River Segments: RE1-10000, RE1-20000, RE2-10000, RE3-10000 and RE3-20300.

2. Identification of the pollutant and applicable water quality standard
The pollutants causing the impairment(s) of the water quality standard and designated beneficial use are fecal coliform and *E. coli* bacteria. Designated uses assigned to the above-identified segments include: primary contact recreation, aquatic life Warmwater class A, agriculture water supply class A and aesthetics (NDEQ 2002c). Excessive fecal coliform and *E. coli* have been determined to be impairing the primary contact recreation beneficial uses. The applicable water quality standards are a seasonal geometric mean of 200/100 ml with <10% of the samples being greater that 400/100ml for fecal coliform and a season 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:

$$\text{Loading capacity} = \text{WQS} * \text{Flow} * \text{C}$$

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.

Segment	Fecal coliform - # colonies >200/100 ml	Fecal coliform - % samples > 400/100 ml	*E. coli* - # colonies >126/100 ml
RE1-10000	129	41%	48
RE1-20000	665	76%	240
RE2-10000 (1)	384	40%	313
RE2-10000 (2)	0	14%	27
RE3-10000	444	52%	136
RE3-20300	673	73%	430

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 Republican River 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.

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:

$$LA_i = Q_i*126/100\ ml*C$$

Where:
LA_i = load allocations at the ith flow
Q_i = stream flow at the ith 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 applied 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

Six designated segments within the Republican River basin were listed in Category 5 of the Nebraska 2004 Surface Water Quality Integrated Report (Integrated Report)(NDEQ 2004). Category 5 waterbodies are deemed impaired and in need of a TMDL. Data collected in 2002 indicate the primary contact recreation beneficial use is impaired with the pollutants of concern being fecal coliform and *E. coli* bacteria. Table 1 below provides information of the 2002 Section 303(d) list and the 2004 Integrated Report Assessments for all of the segments in the Republican Basin designated with the primary contact recreation beneficial use.

Table 1.0 Assessment Summary for the Republican River Basin Segments in 2002 and 2004

Segment ID	2002 Section 303(d) list	2004 Integrated Report
RE1-10000	Part 1	Category 5
RE1-20000	Part 1	Category 5
RE1-30000	Part 1	Category 3[1]
RE1-40000	Not listed	Category 2
RE1-50000	Not listed	Category 5
RE2-10000	Part 5	Category 5
RE3-10000	Part 4	Category 5
RE3-10100	Not listed	Category 2
RE3-20000	Not listed	Category 3 [1]
RE3-20300	Part 4	Category 5
RE3-40000	Part 4	Category 2

[1.] No acceptable fecal coliform or *E. coli* bacteria data was available for the water quality assessments.

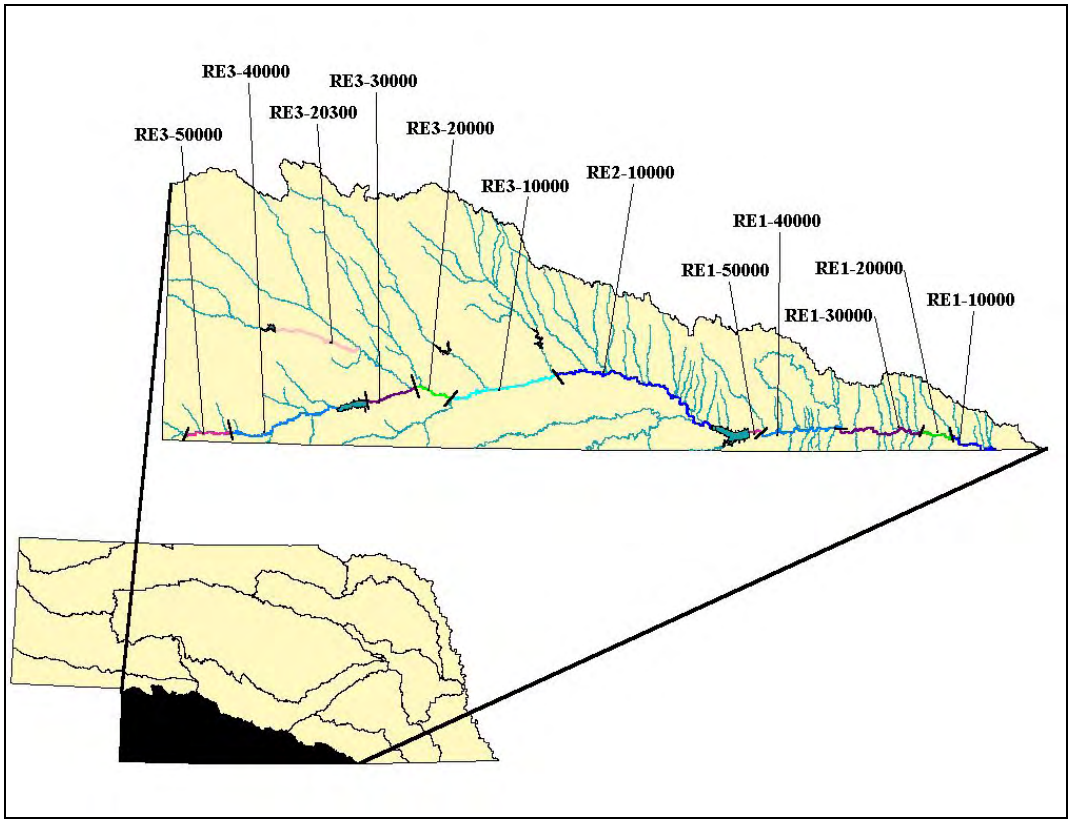
Based on the above, and as required by Section 303(d) of the Clean Water Act and 40 CFR Part 130, TMDLs have been developed for the impaired waters identified in Category 5 of the 2004 Nebraska Integrated Report. The approach for these TMDLs will be to address all of the identified waterbodies simultaneously or as a watershed. Based upon this, the information contain herein should be considered 5 TMDLs.

The data for Segment RE1-50000 will not be used in preparation of a TMDL. The reason for this is a conflict in the assessment results for the two bacteria indicators. *E. coli* data collected from the segments was assessed to be fully supporting the beneficial use while the fecal coliform data exceeded the threshold for impairment. As described below, in 2002 the NDEQ added *E. coli* to state water quality as the preferred indicated for assessment of the primary contact recreation beneficial use. In the future, fecal coliform will be removed. Given this and the conflict, a TMDL will not be prepared rather the segment will remain on Category 5 until removal of the parameter is accepted by EPA Region 7 at which time delisting proceedings will begin. Additional data will be obtained from the segment for future assessments.

1.1 Background Information

The Republican River Basin, located in southwestern Nebraska (Figure 1.1) extends from the Colorado-Nebraska border and runs across the lower portion of the state before exiting into Kansas. Approximately, 40% of the basin lies in Kansas and 10% in Colorado. Stream flow in Republican River Basin is heavily controlled by irrigation withdrawals, returns and Bureau of Reclamation reservoirs. Demands for water and a lack of precipitation have resulted in multiple Republican River segments and tributaries going dry. Several municipalities lie in the basin ranging from first class cities to villages.

Figure 1.1 Location of the Nebraska Republican River Basin



1.1.1 Waterbody Information

1.1.1.1 Waterbody Name(s): Republican River and Frenchman Creek
Stream Identification Numbers: RE1-10000, RE1-20000, RE2-10000, RE3-10000 and RE3-20300

1.1.1.2 Major River Basin: Kansas

1.1.1.3 Minor River Basin: Republican

1.1.1.4 Hydrologic Unit Codes: 10250001, 10250002, 10250003, 10250004, 10250005, 10250006, 10250007, 10250008, 10250009, 10250011, 10250014, 10250015, 10250016

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

Segment	Primary Contact Recreation	Aquatic Life Use	Agriculture	Aesthetics	Key Aquatic Species
RE1-10000	Yes	Warmwater A	Ag A	Yes	Golden Shiner, Channel Catfish, Flathead Catfish and Walleye
RE1-20000	Yes	Warmwater A	Ag A	Yes	Golden Shiner, Channel Catfish, Flathead Catfish White Bass and Walleye
RE2-10000	Yes	Warmwater A	Ag A	Yes	Channel Catfish, Flathead Catfish and White Bass
RE3-10000	Yes	Warmwater A	Ag A	Yes	Channel Catfish, Flathead Catfish and White Bass
RE3-20300	Yes	Coldwater B	Ag A	Yes	Orangethroat Darter

1.1.1.6 Major Tributaries: Elm Creek, Thompson Creek, Prairie Dog Creek, Muddy Creek, Medicine Creek, Red Willow Creek and Arikaree River.

Table 1.1 Physical Description of Republican River Basin

Parameter	Republican River Basin
State	Nebraska
Counties (whole or in part)	Chase, Dundy, Franklin, Frontier, Furnas, Gosper, Harlan, Hayes, Hitchcock, Kearney, Keith, Lincoln, Nuckolls, Perkins, Phelps, Red Willow and Webster
Watershed Area (Nebraska)	9,712 mi^2
Drainage	22,40mi^2
Sub-basins	3
Designated Stream Segments	102
Stream Miles (designated)	1,495 miles

1.1.2 Watershed Characterization

1.1.2.1 Physical Features: The Republican River watershed covers approximately 9,712mi^2 and occupies the southwest corner of the state. The basin originates in Colorado and extends generally eastward till exiting the state near Hardy, Kansas. The ecoregions of the basin include the Central Great Plains, the Western High Plains and a very small portion of the Nebraska Sandhills (Chapman, et. al. 2001). Agriculture is the major land use in the basin with approximately 45% of the basin is rangeland and pasture and 50% in cultivated cropland. Crop production varies due to soil conditions, topography and the availability of water – irrigation or natural (NDEQ 2002b). Distribution of rainfall is not always conducive to crop production.

The high plains in the western end of the Basin transcend into a narrow extension of the sandhills that in turn merges into loess plains. These loess plains are dissected by steep ravines resulting in a well-defined drainage pattern. The valley is narrow when entering the state but gradually widens toward the east or lower portion of the basin. The valleys of the tributaries are invariably quite narrow (NNRC 1976).

The streams are regulated by irrigation and flood control project maintained by the Bureau of Reclamation and Army Corps of Engineers. Some of the larger impoundments include Harlan County Reservoir, Swanson Reservoir, Hugh Butler (Red Willow) Reservoir and Harry Strunk (Medicine Creek). In addition to the alteration of natural flow by storage, diversion and return flows, an interstate compact exists and has been in effect since 1943, between the states of Colorado, Kansas and Nebraska. The compact provides an allocation of flow from the Republican and tributaries and provides beneficial consumption of 11% for Colorado, 40% for Kansas and 49% for Nebraska.

1.1.2.2 **Climate:** Precipitation ranges from an annual average of 20 inches in the western end of the basin to 27.5 inches at the eastern end. 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 (NRC Databank).

1.1.2.3 **Demographics:** Fifty-seven municipal communities reside in the Republican River basin boundaries and range from first class cities to villages. Some of the larger communities include: McCook – population 7,996, Holdrege – population 5,636, Superior – population 2,055, Imperial – population 1,982, Grant – population 1,225, Alma – population 1, 214, Red Cloud – population 1,131, Cambridge – population 1,041, Arapahoe – population 1,028, Franklin – population 1,026 and Benkelman – population 1,006.

1.1.2.4 **Land Use:** Of the nearly six million acres of agriculture land in the Republican Basin 3.3 million acres are considered arable and 2.5 million acres are classified as being suitable for irrigation. Historically, wheat, corn and sorghum are the major crops grown in the basin but also grown are alfalfa, soybeans and sugar beets. Center pivot irrigation systems have allowed for an increase in corn production.

The primary natural vegetation is Kansas mixed prairie but also present are mixed prairie, sandsage prairie, shortgrass prairie, flood plain prairie and forest and eastern deciduous forest. Eight soil associations are found in the basin with the McCook-Las being the most widespread. Soils have developed from loess, alluvium, sand, silt and sandstone parent material (NNRC 1976).

2.0 *E. coli* TMDL

2.1 Problem Identification

Segments RE1-10000, RE1-20000, RE1-50000, RE2-10000, RE3-10000 and RE3-20300 were included on in Category 5 of the 2004 Integrated Report as having an impaired primary contact recreation beneficial use with the parameters of concern being *E. coli*, fecal coliform or both. This section deals with the extent and nature of the water quality impairments caused by excessive *E. coli* and fecal coliform bacteria in the Republican River Basin. Although included as a Category 5 waterbody, the data assessment and TMDL for RE1-50000 will not be included.

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 2002c).

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 Republican River basin in 1997 and 2002. Data collected in 2002 included stream flow (volume) information and will be used for these TMDLs. Stream flow data and information were obtained from the United States Geological Survey (USGS) and Nebraska Department of Natural Resources (NDNR) who operates the monitoring gages.

During the triennial review of Title 117 – Nebraska Surface Water Quality Standards (Title 117), conducted in 2002, the Department proposed and ultimately received EPA approval to add *E. coli* as a parameter to assess primary contact recreation. The change was pursued based on EPA recommendations that states adopt the *E. coli* indicator, as the organism is more scientifically defensible than fecal coliform. It is the Department's intention to remove fecal coliform as a Title 117 parameter in the future. Based upon this, *E. coli* data was also collected in 2002, was assessed and will be reported below.

Because fecal coliform will not be a data parameter included in future monitoring and the parameters are considered statistically equivalent, the TMDLs will focus on the *E. coli* data and the reductions necessary to meet these criteria.

Water quality assessments conducted for Segment RE1-50000 indicates fecal coliform exceeds the threshold for the impairment designation while the *E. coli* assessment indicates the segment is fully supporting the beneficial use. The conversion to *E. coli* was based on EPA recommendations and guidance however, state regulations require point sources to conduct bacteria analysis using EPA approved methods found in 40 CFR Part 136. At this time, there are no approved methods for *E. coli* and fecal coliform remains in the water quality standards as a functionally equivalent parameter to demonstrate permit compliance.

The Department does not have a current National Pollutant Discharge Elimination System (NPDES) permit issued to any discharges to Segment RE1-50000. Based upon this fact and the future effort to solely utilized *E. coli* in the future, a TMDL will not be developed for segment RE1-50000 and in the future, should the data and assessment remain consistent with the 2002 information, the waterbody will be delisted.

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 2004 Integrated Report. The procedures are based on the application of the "binomial distribution" method that applies a confidence interval to the exceedance rate in an effort to determine the true exceedance of the waterbody versus the data set. A complete description of the water quality data assessment procedures can be found in the *Methodologies for Waterbody Assessments and Development the 2004 Integrated Report for Nebraska*, October 2003.

The process used in assessing data 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 Fecal Coliform and *E. coli* Bacteria Data.

Parameter	Season Geometric Mean	Single Sample Maximum	Supported	Impaired
Fecal coliform	≤200/100 ml	No more that 10% of Samples >400/100 ml	Season geometric mean ≤200/100 ml or ≤10% of samples exceed 400/100ml	Season geometric mean >200/100 ml and/or >10% of samples exceed 400/100ml
E. coli	≤126/100 ml	235-576/100 ml depending upon frequency of use	Season geometric mean ≤126/100 ml	Season geometric mean >126/100 ml

2.1.4 Water Quality Conditions

Fecal coliform and *E. coli* data collected during the 2002 recreation season (May through September) was assessed to determine the beneficial use support for primary contact recreation. Table 2.1.4a presents the fecal coliform results and table 2.1.4b presents the E coli results.

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 Republican River basin. Facility types include: municipal wastewater treatment facilities, a fish hatchery and confined animal feeding operations. The facilities that have been issued a National Pollutant Discharge Elimination System Permit (according to EPA's Permit Compliance System) in the Republican River Basin are shown in Figure 2.1.5.1a.

Illicit connections, 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.

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 Republican Basin 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.

Table 2.1.4a Republican River Basin – 2002 Fecal coliform Data and Assessments

Segment	Site Location	USGS/DNR Gage Associated with Site	Number of Samples	Season Geometric Mean (#/100 ml)	# Samples >400/100 ml	% Samples >400/100 ml
RE1-10000	Republican River near Hardy, KS	06853500	22	329	9	41%
RE1-20000	Republican River at Guide Rock	06853020	21	865	16	76%
RE1-50000	Republican River below Harlan County Reservoir	06849500	21	266	8	38%
RE2-10000 (1)	Republican River at Orleans	06844500	10	584	4	40%
RE2-10000 (2)	Republican River at Cambridge	06483500	21	118	3	14%
RE3-10000	Republican River at McCook	06837000	21	644	11	52%
RE3-20300	Frenchman Creek at Palisade	06834000	22	873	16	73%

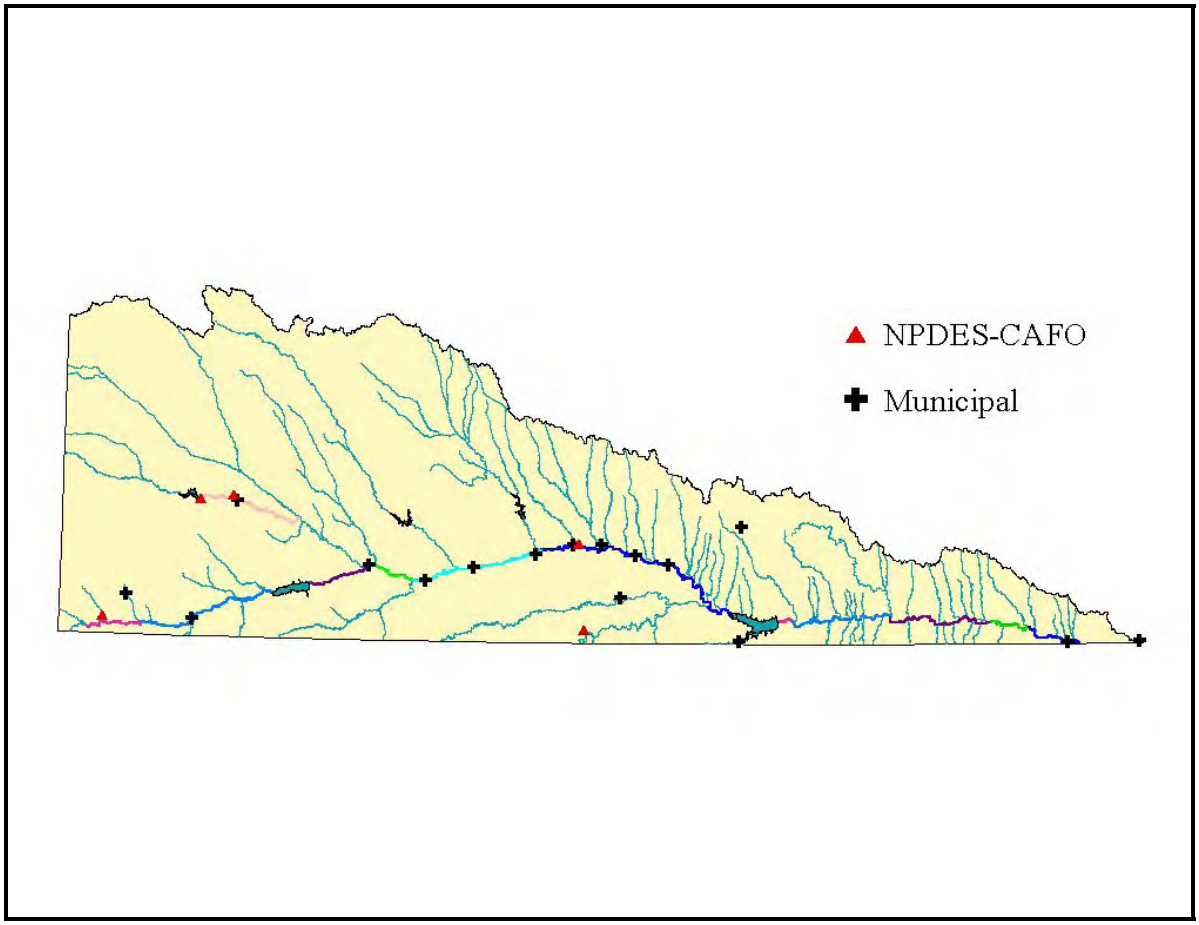
Table 2.1.4b Republican River Basin – 2002 *E. coli* Data and Assessments

Segment	Site Location	USGS/DNR Gage Associated with Site	Number of Samples	Season Geometric Mean (#/100 ml)
RE1-10000	Republican River near Hardy, KS	06853500	22	174
RE1-20000	Republican River at Guide Rock	06853020	22	366
RE1-50000	Republican River below Harlan County Reservoir	06849500	22	70
RE2-10000 (1)	Republican River at Orleans	06844500	11	439
RE2-10000 (2)	Republican River at Cambridge	06483500	21	153
RE3-10000	Republican River at McCook	06837000	21	262
RE3-20300	Frenchman Creek at Palisade	06834000	22	556

2.1.5.2 Nonpoint Sources: Several nonpoint sources of fecal coliform and *E. coli* exist in the Republican River Basin. 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 Republican River Basin. Big game, upland game, furbearers, waterfowl and non-game species have been documented to reside within the basin.

Figure 2.1.5.1a NPDES Permitted Facilities in the Republican River 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.

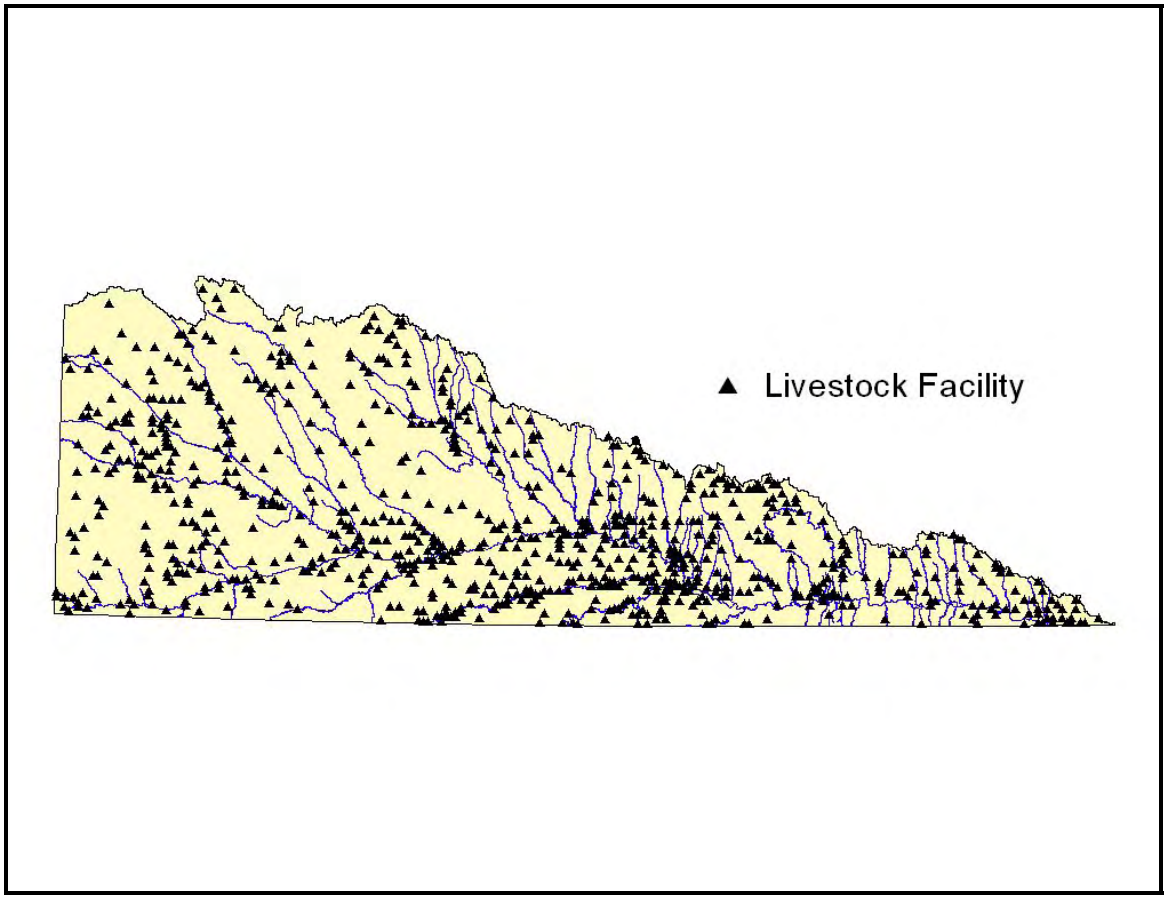
2.2.1 Numeric Water Quality Criteria

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:

Fecal Coliform
Bacteria of the Fecal coliform group shall not exceed a geometric mean of 200/100 ml, nor exceed 400/100 ml, in more than 10% of the samples. These criteria are based upon a minimum of 5 samples taken within a 30-day period. This does not preclude fecal coliform limitations based on effluent guidelines.

These criteria apply during the recreational period of May 1 through September 30.

Figure 2.1.5.1b Animal Feeding Operations in the Republican River Basin Issued or Requesting a State Construction or Operating Permit or Requesting an Inspection



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. Single sample minimum allowable densities shall not exceed the following criteria.

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

The July 9, 2004 Federal Register contained information regarding the proposed rule for "Water Quality Standards for Costal and Great Lakes Recreational Waters". This proposed rule includes a discussion on the use of the single season maximum (SSM). Specifically:

"EPA recognizes that the 1986 bacteria criteria document discusses SSMs solely in the context of beach closures. SSMs are particularly important in this context because States and Territories generally use one or two samples to make beach opening or closure decisions. EPA could thus interpret this 1986 bacteria criteria document as recommending the use of SSMs only for decisions related to public health at beaches. Under this interpretation, the SSMs would be part of the water quality criteria, but only used for making beach closure and opening decisions. States and Territories could use only the geometric mean for other CWA purposes, such as NPDES permitting, TMDLs and waterbody assessments."

Given the uncertainty over 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. The TMDL recognizes 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 curve. Load duration 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:

$$\text{Loading capacity} = \text{WQS} * \text{Flow} * \text{C}$$

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 load duration 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 load 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 load duration 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. Monitoring data was obtained from 2 locations within Segment RE2-10000 representing the upstream and downstream conditions. The sites are identified by (1) and (2) for upstream and downstream, respectively.

Figure 2.3.1a. Load Curve for RE1-10000

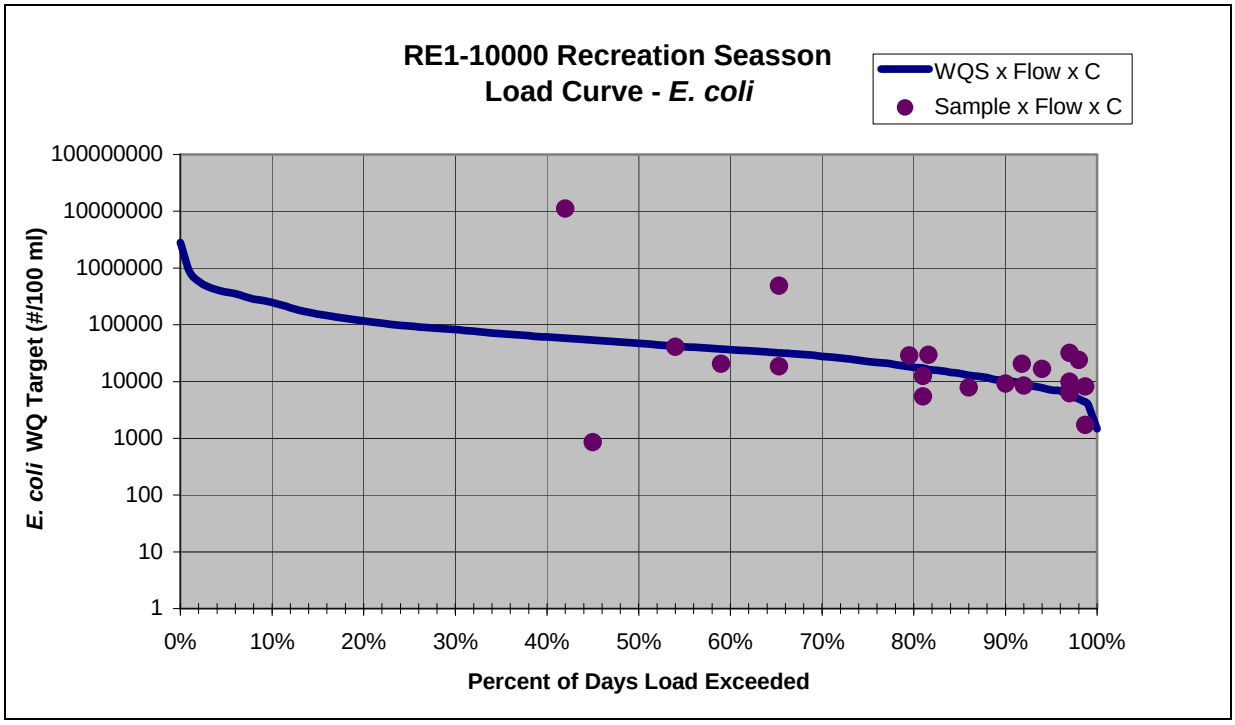


Figure 2.3.1b. Load Curve for RE1-20000

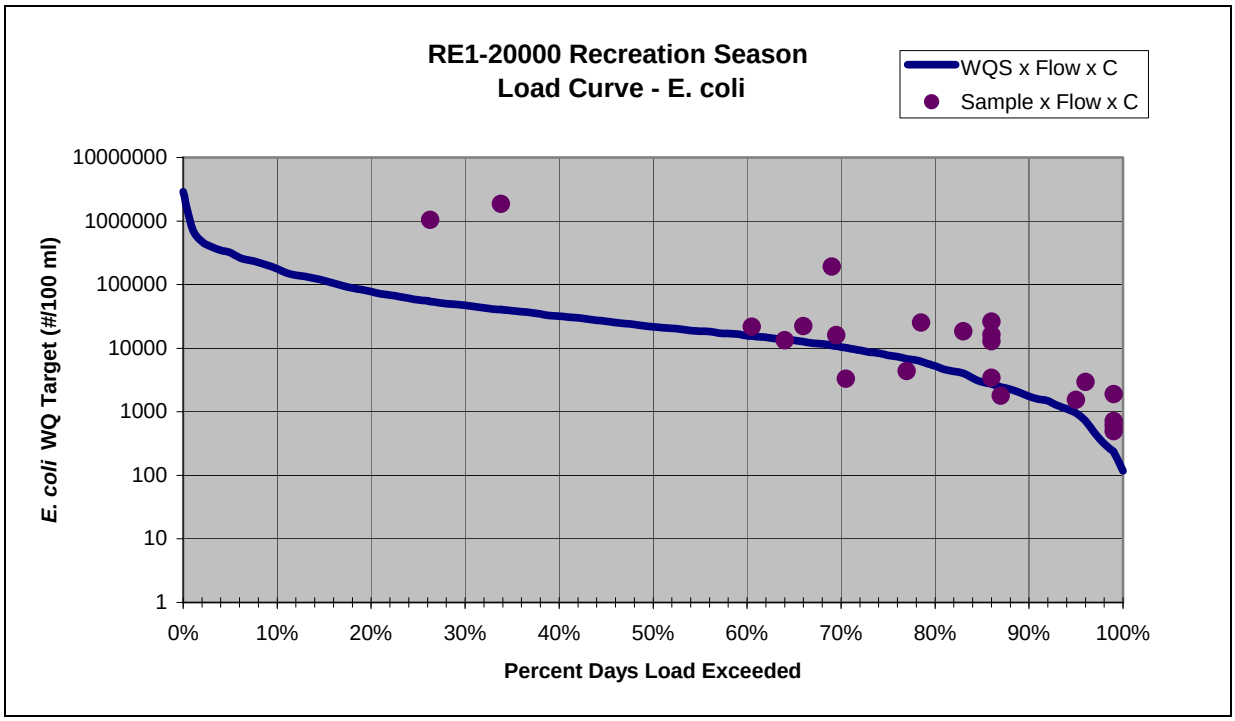


Figure 2.3.1c. Load Curve for RE2-10000 (1)

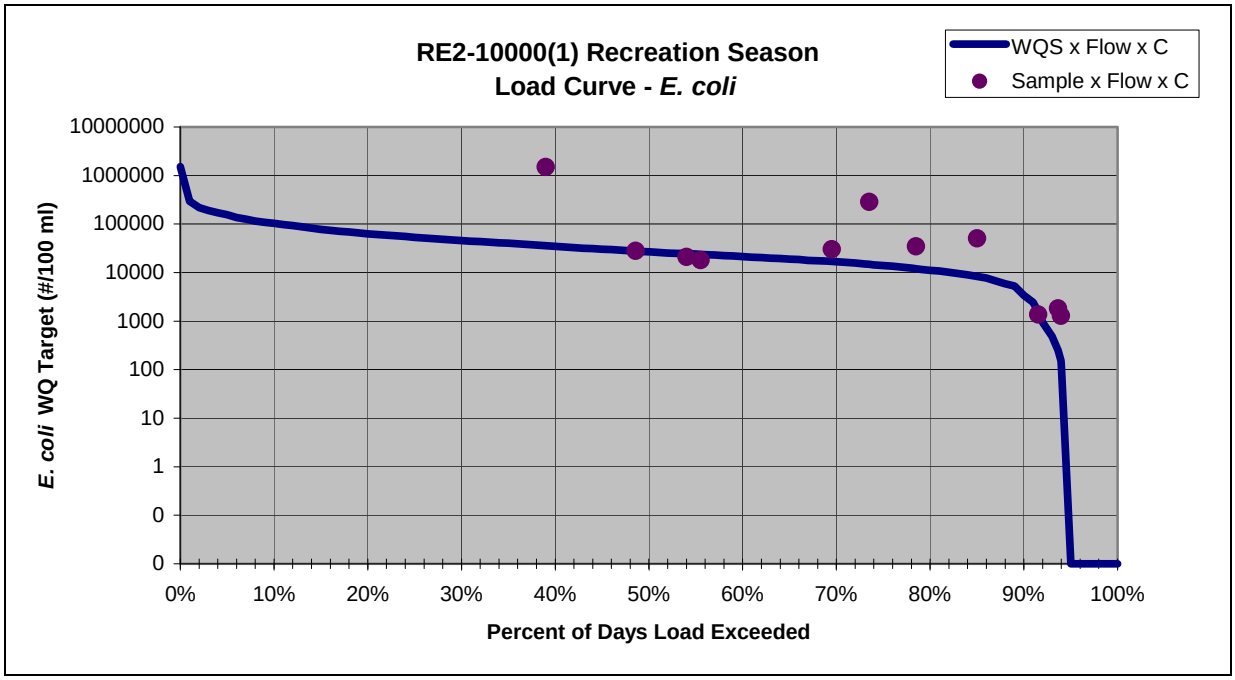


Figure 2.3.1d. Load Curve for RE2-10000 (2)

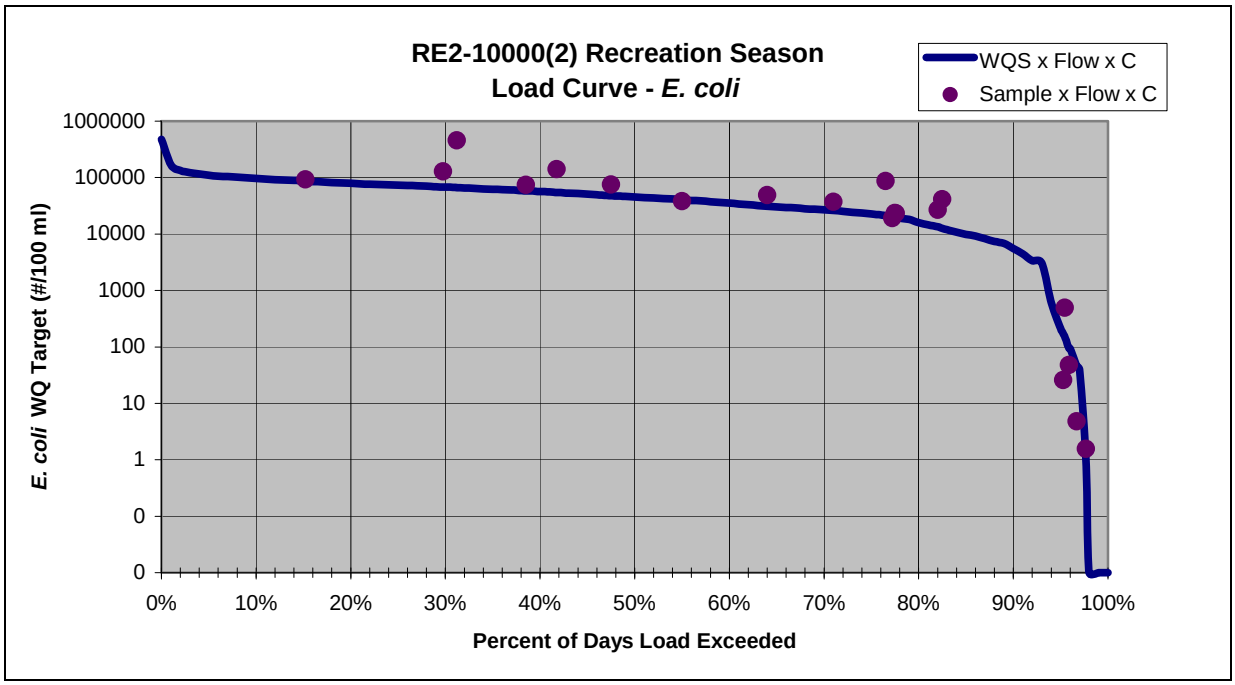


Figure 2.3.1e. Load Curve for RE3-10000

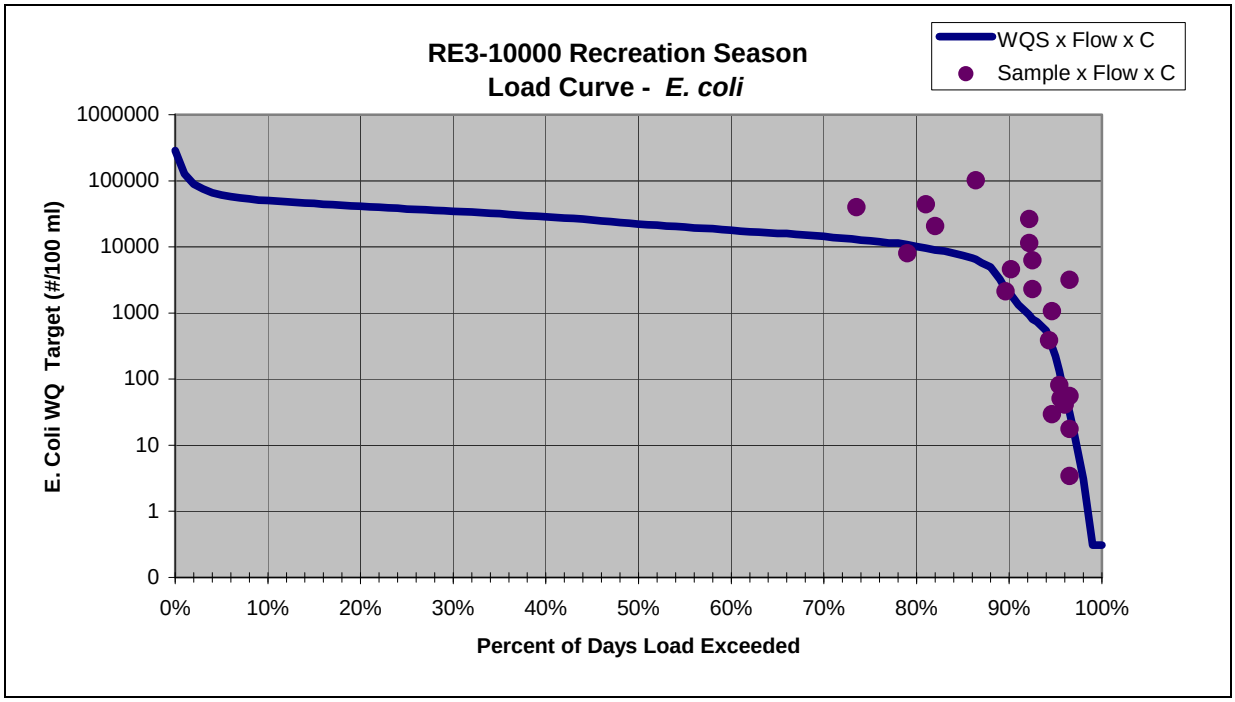
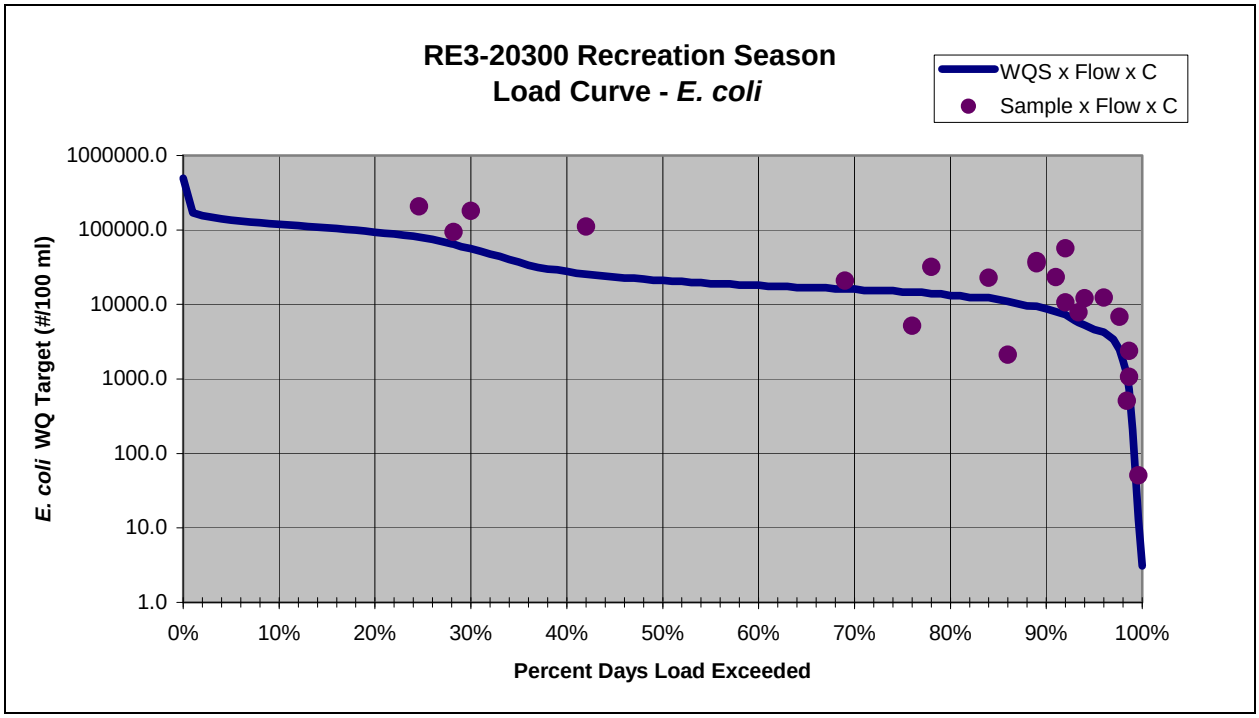


Figure 2.3.1f. Load Curve for RE3-20300



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 2002 *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
RE1-10000	174	52
RE1-20000	736	610
RE2-10000 (1)	439	313
RE2-10000 (2)	153	27
RE3-10000	262	136
RE3-20300	556	430

2.3.3 Identification of Pollutant Sources

Both point and nonpoint sources are known to exist along some of the segments 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 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 2.3.3 as can the boundary flows.

Table 2.3.3. Sum of Wastewater Treatment Facility Design Flows in the Republican River Basin

Segment	Total Number of Facilities	Sum of Contributing Facility Design Flows	Flow Value for Point vs. Nonpoint Boundary
RE1-10000	2	0.64 cfs	42.4 cfs
RE1-20000	0		
RE2-10000	5	0.92 cfs	61.5 cfs
RE3-10000	3	4.17 cfs	278 cfs
RE3-20300	1	0.13 cfs	8.5 cfs

The identification of pollutant sources and impacts are shown in figures 2.3.3b through 2.3.3.f. A pollutant source chart/curve was not provided for segment RE1-20000 based upon no point source discharging to the segment.

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

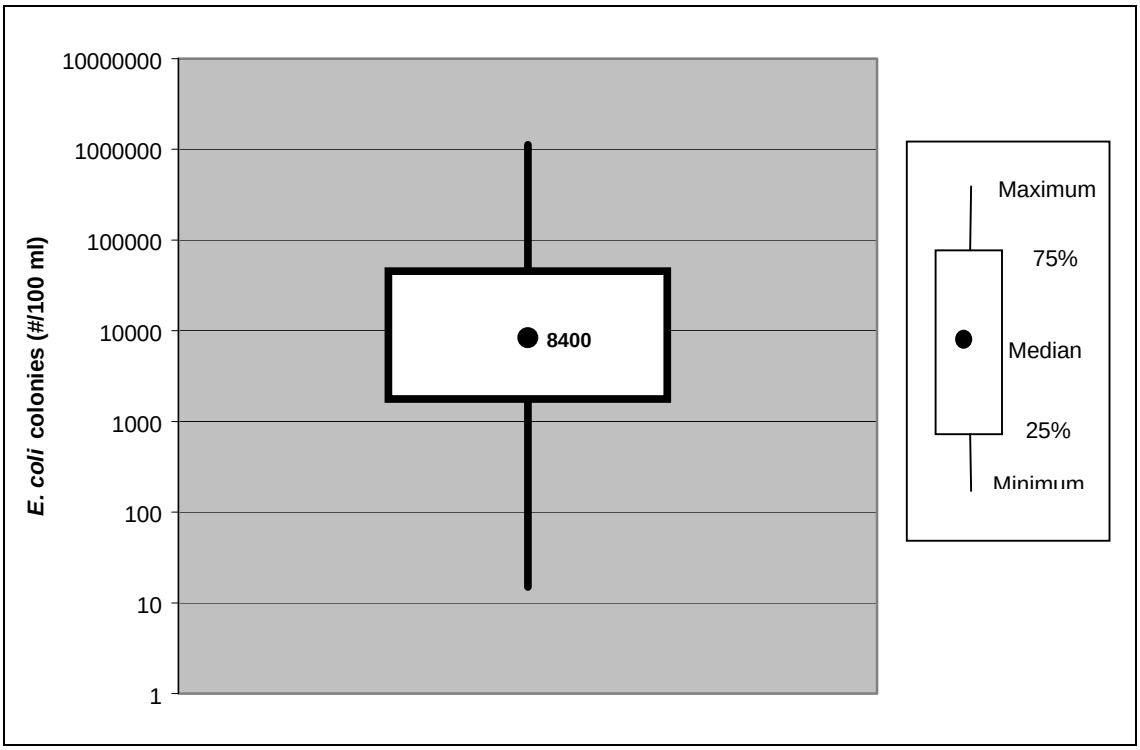


Figure 2.3.3b. Identification of Pollutant Sources Using the Load Curve for RE1-10000

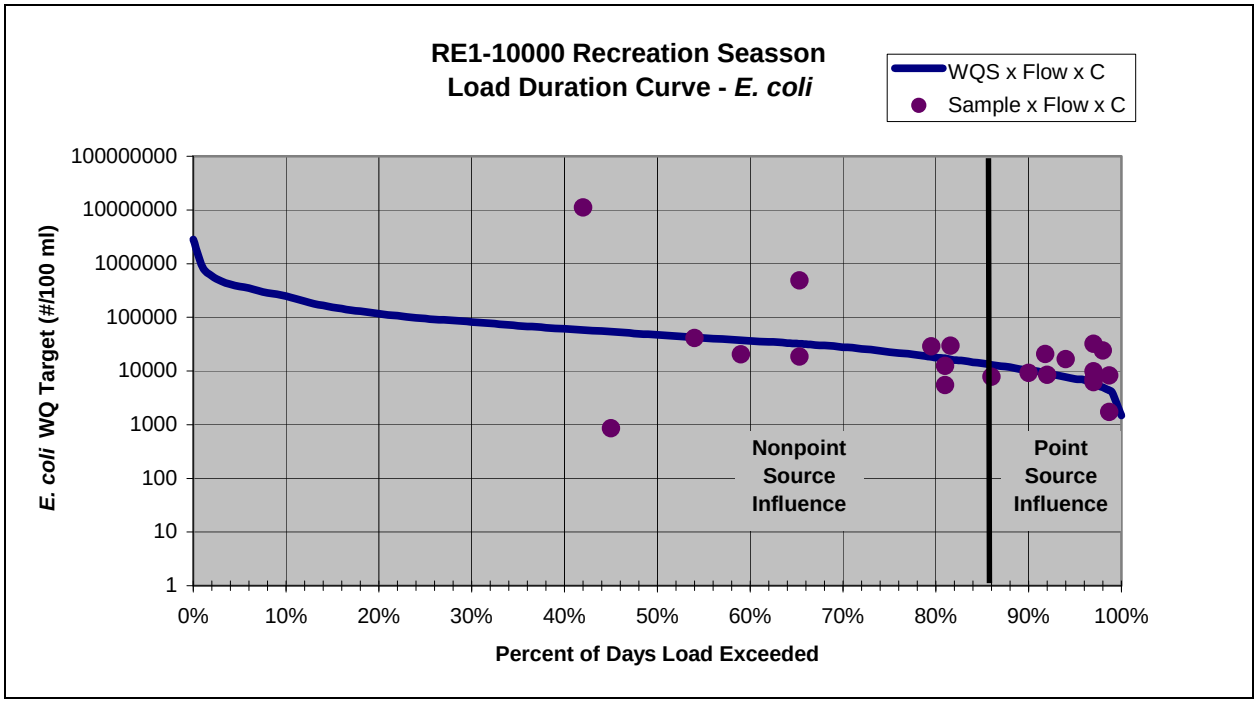


Figure 2.3.3c. Identification of Pollutant Sources Using the Load Curve for RE2-10000 (1)

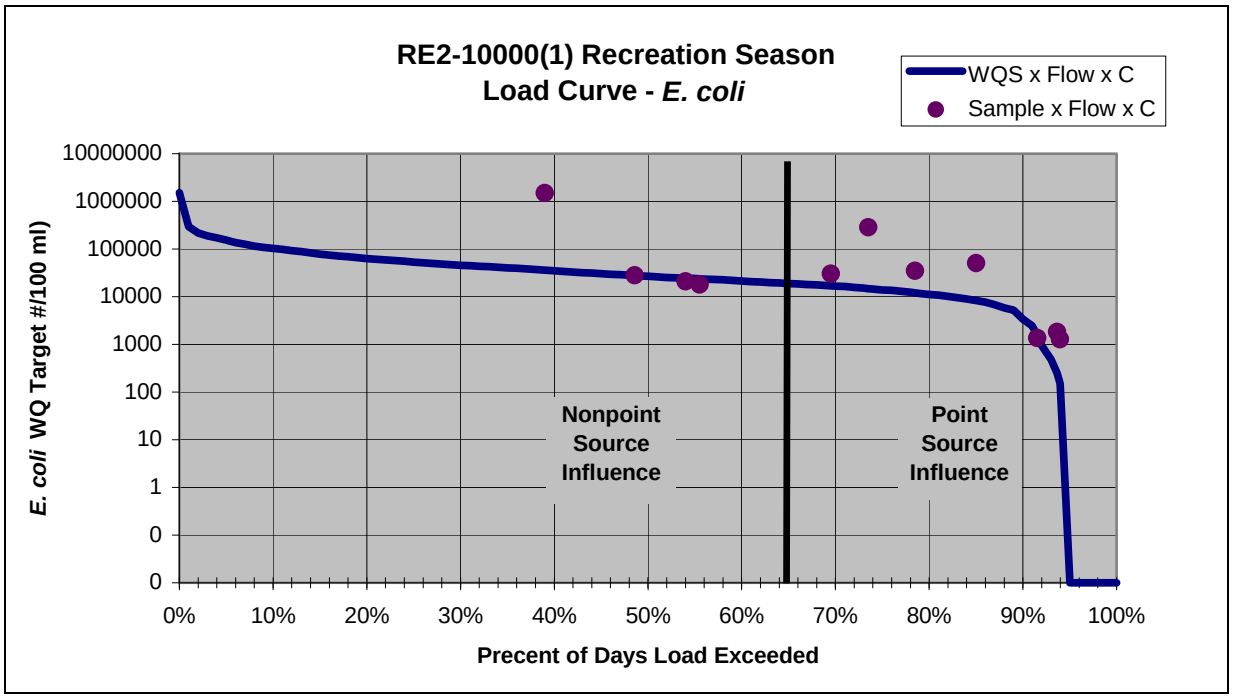


Figure 2.3.3d. Identification of Pollutant Sources Using the Load Curve for RE2-10000 (2)

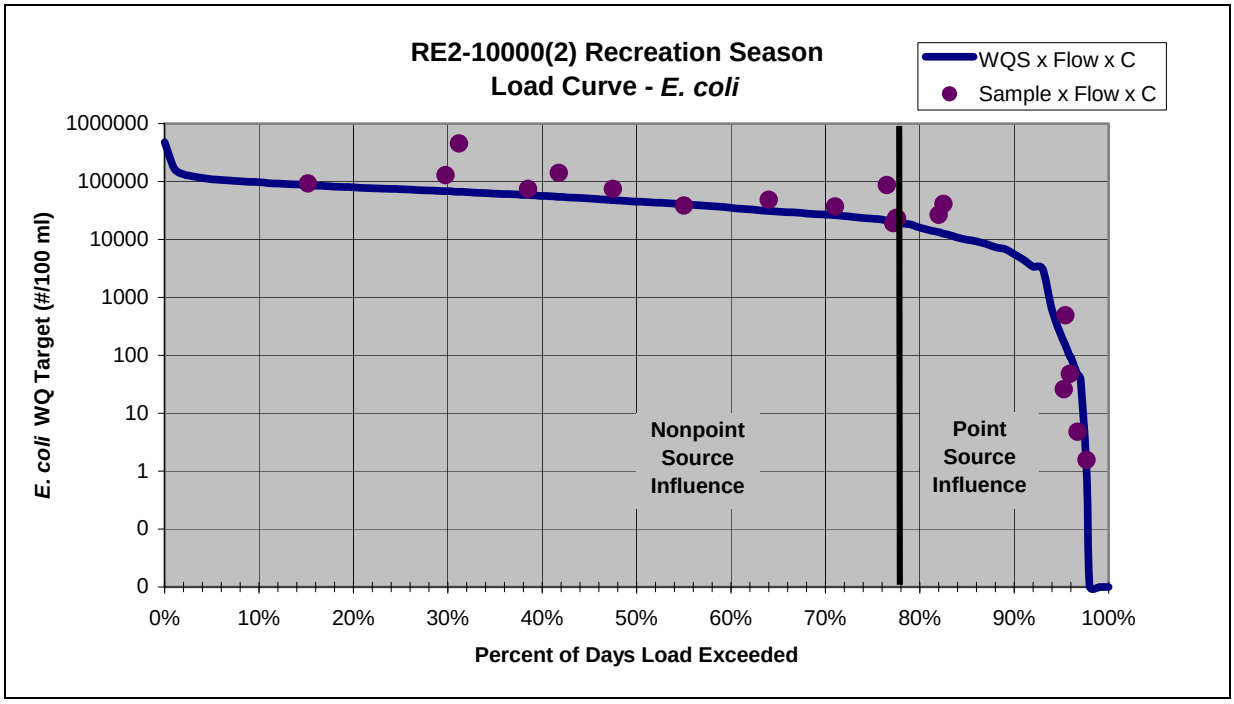


Figure 2.3.3e. Identification of Pollutant Sources Using the Load Curve for RE3-10000

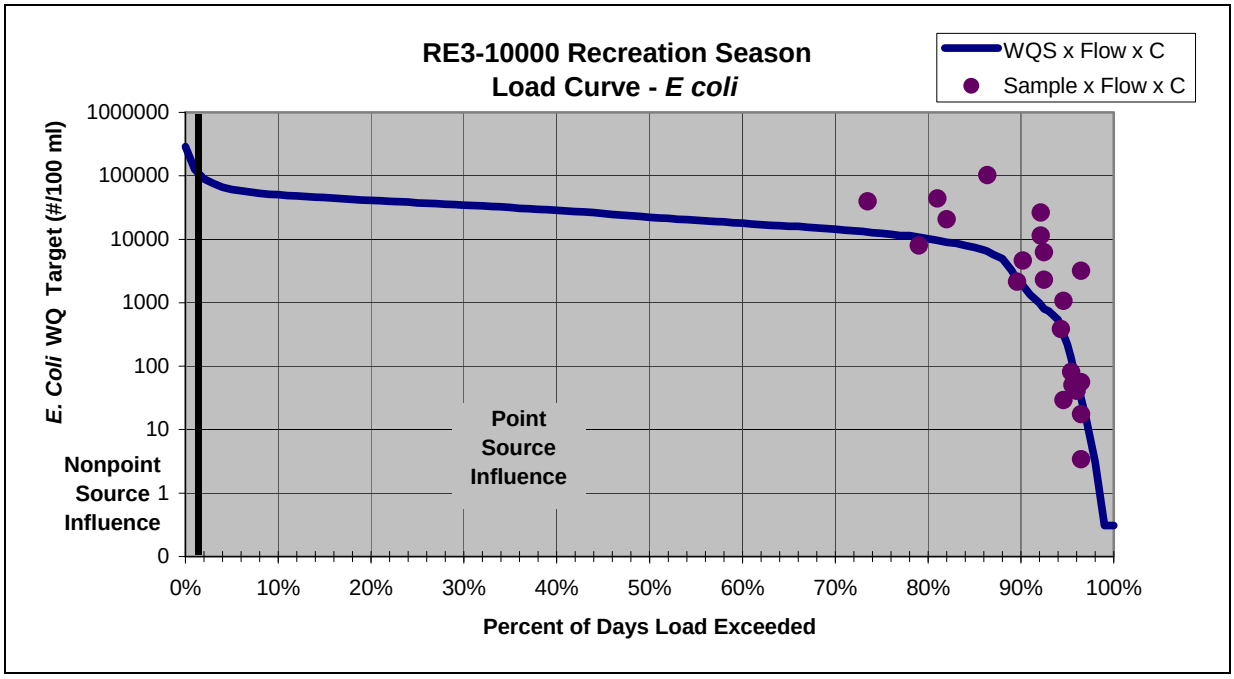
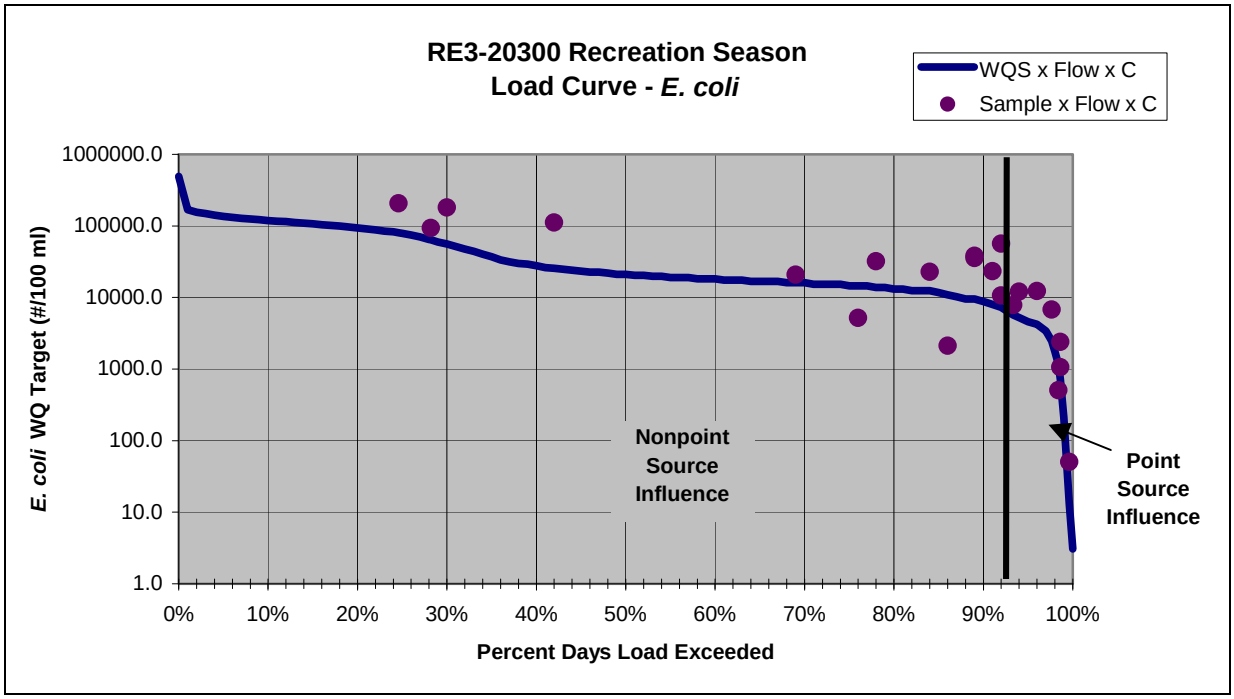


Figure 2.3.3f. Identification of Pollutant Sources Using the Load Curve for RE3-20300



2.3.3.1 Point Sources of *E. coli*: Based upon the load curves and the position of the monitoring data points and with the exception of RE1-20000, it appears point sources are contributing to the *E. coli* impairment within the remaining segments. Several facilities discharge either directly to or into a tributary of the Republican River recreation segments and are listed in Table 2.3.3.1.

Table 2.3.3.1 NPDES Permitted Discharges to Impaired Republican River Basin Segments

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)	Fecal coliform Limits in NPDES permit?
RE1-10000	UD to RE1-10000	Byron WWTF	NE0029271	0.032	No	7	No
	RE1-10000	Superior WWTF	NE0023809	0.603	**Yes**		Yes
RE2-10000	RE2-11400	Arapahoe WWTF	NE0021521	0.155	No	1.5	Yes
	RE2-10610	Beaver City WWTF	NE0026476	0.062	No	26.3	No
	RE2-10000	Edison WWTF	NE0023187	0.077	**Yes**		Yes
	RE2-10000	Holbrook WWTF	NE0023833	0.278	**Yes**		Yes
	RE2-10000	Oxford WWTF	NE0031828	0.350	**Yes**		Yes
RE3-10000	RE3-10000	Cambridge WWTF	NE0024180	0.398	**Yes**		Yes
	RE3-10000	Indianola WWTF	NE0112712	0.155	**Yes**		Yes
	RE3-10000	McCook WWTF	NE0021504	3.620	**Yes**		Yes
RE3-20300	RE3-20300	Wauneta WWTF	NE0023841	0.127	**Yes**		Yes

2.3.3.2 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.

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.

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 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.

2.4.1.2 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.

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:

$$LA_i = Q_i*126/100\ ml*C$$

Where:
LA_i = load allocations at the ith flow
Q_i = stream flow at the ith 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 2002 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.

Table 2.4.2.1 Targeted Nonpoint Source and Natural Background Reductions

Segment	Target NPS Reduction	Expected Season Geometric Mean
RE1-10000	36%	111/100 ml
RE1-20000	70%	110/100 ml
RE2-10000 (1)	75%	110/100 ml
RE2-10000 (2)	26%	113/100 ml
RE3-10000	58%	110/100 ml
RE3-20300	80%	111/100 ml

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 a 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.

3.0 Implementation Plan

The implementation of controls to manage E. coli within the Republican River Basin includes but is not limited to:

3.1 NPDES Permitted Point Sources

Limitations are established in NPDES permits in accordance with Title 121 – Effluent Guidelines and Standards (Title 121). Title 121, Chapter 8 states:

> *Chapter 8 - TEST PROCEDURES FOR ANALYSIS OF POLLUTANTS*
>
> *001 All of Title 40 Code of Federal Regulations (CFR) Part 136, July, 1990 edition, pertaining to Guidelines Establishing Test Procedures for the Analysis of Pollutants is hereby adopted and incorporated herein.*

Based upon this requirement, all samples used to demonstrate permit compliance (sampling method, transport holding, and analysis) must be in accordance with the procedures established in 40 CFR Part 136. At this time, there is no analytical procedure for *E. coli* included in Part 136. It is for this reason; fecal coliform remains in Title 117 as indicator bacteria for primary contact recreation. Although not as reliable as *E. coli*, fecal coliform should continue to be used in the NPDES permitting process. End-of-pipe limits will be set at a monthly geometric mean of 200/100 ml and a daily maximum of 400/100 ml. Compliance with these values will be considered functionally equivalent to meeting the water quality criteria for *E. coli*.

Facilities that discharge directly to all segments within the Republican River basin designated with the primary contact recreation use will be required to meet the wasteload allocations – applied as a fecal coliform limit - 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 fecal coliform 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 3.4 below, a recommendation will be made that all NPDES permittees be required to adhere to 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 #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 the following minimum control measures:

- Implement a public education and outreach program on stormwater impacts
- Comply with State and local public notice requirements when implementing a public participation program.
- Develop and enforce a program to detect and eliminate illicit discharges.
- Develop, implement and enforce a program to reduce pollutants from construction activities.
- Develop, implement and enforce a program to reduce pollutants from post construction activities in new or redevelopment projects
- Develop a pollution prevention/good housekeeping program.

Rather than apply numeric limitations on individual stormwater outfalls, the strategy will be to initially allow the municipalities 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.

At this time no MS4 permits have been issued to municipalities residing in the Republican River Basin. The issuance of future permits will likely be contingent upon the collection of additional data, the future beneficial use status of the impaired segments and the voluntary actions the candidate facilities have taken to minimize pollutants in the stormwater discharges.

3.3 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.

3.4 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 under 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 Republican Basin, 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 Republican Basin. 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 Republican River. 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 Republican River Basin was monitored in 2002 and will again be targeted in 2007. 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 in the Franklin County Chronicle, Harlan County Journal, and the Superior Express with the public comment period running from approximately December 22, 2004 to February 1, 2005. These TMDLs were also made available to the public on the NDEQ's Internet site and announcement letters were mailed to interested stakeholders. No comments were received during the public comment period.

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

NDEQ 1992. 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 1992. Title 121 – Effluent Guidelines and Standards. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2001. Title 130 – Rules and Regulations Pertaining to Livestock Waste Control. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2002a. 2002 Section 303(d) List of Impaired Waters. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2002b. 2002 Nebraska Water Quality Report. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2002c. Title 117 – Nebraska Surface Water Quality Standards. Nebraska Department of Environmental Quality. Lincoln, NE.

6.0 References (continued)

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

NDEQ 2003. Methodologies for Waterbody Assessments and Development the 2004 Integrated Report for Nebraska. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2004. 2004 Surface Water Quality Integrated Report. Nebraska Department of Environmental Quality. Lincoln, NE.

NDNR. ____. Nebraska Department of Natural Resources Databank, NDNR Internet Site, Nebraska Department of Natural Resources. Lincoln, NE.

NNRC 1976. Republican River Basin Water Quality Management Plan. Nebraska Natural Resources Commission. 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 – *E. coli* Data Collected in 2002 from Republican River Tributaries

Monitoring information collected during the recreation season in 2002 was not only obtained from sites on the segments assigned the recreation beneficial use but also from several tributaries. These sites were chosen based upon the location of a USGS or NDNR gage. The location of the sites and the area of the basin drainage evaluated by the sites are shown in Figure B1. Table B1 then provides a summary of the tributary monitoring information.

Figure B1. Tributary Monitoring Locations in the Republican River Basin

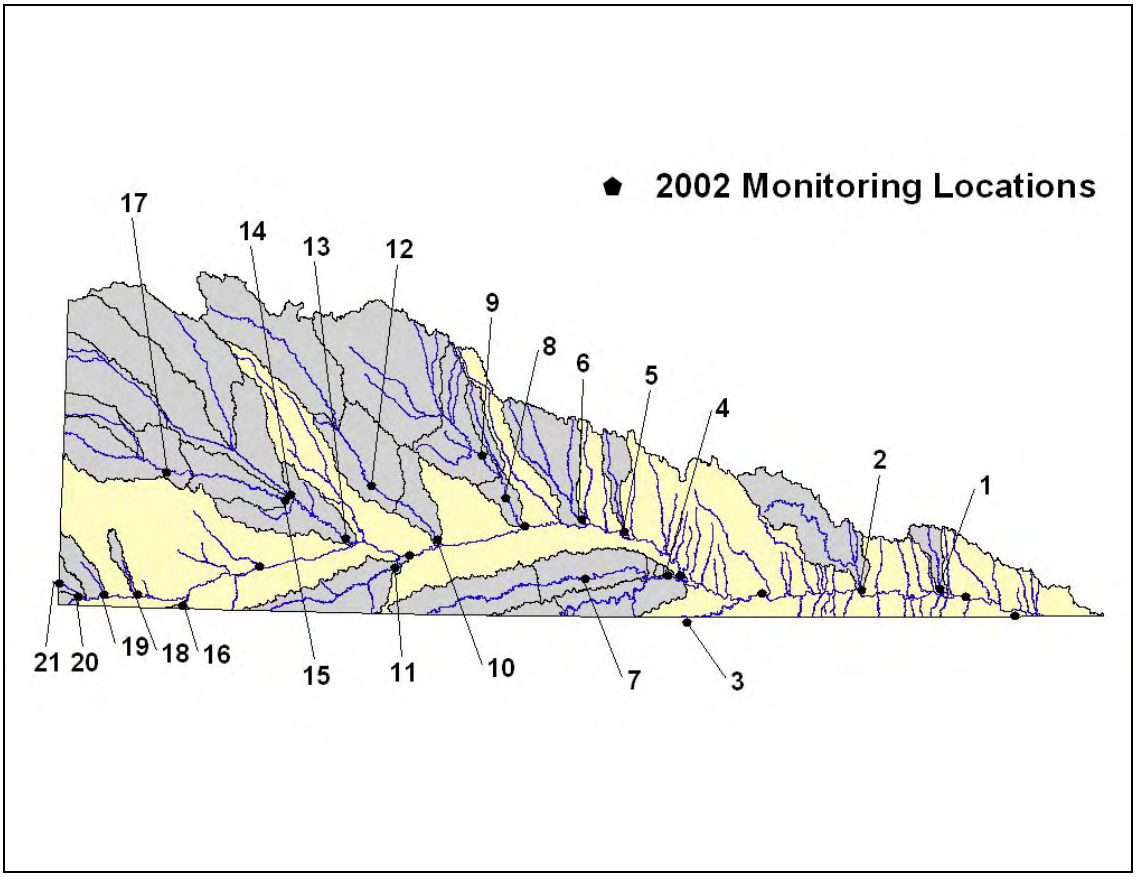


Table B1. Summary of 2002 Monitoring from Republican River Tributaries

Site Map ID	Stream	Title 117 Segment	Location	Number of Samples	Recreation Season Geometric Mean (#/100 ml)
1	Elm Creek	RE1-30100	At Amboy	22	285
2	Thompson Creek	RE1-31200	At Riverton	22	482
3	Prairie Dog Creek	RE2-10300	Near Woodruff, KS	12	469
4	Sappa Creek	RE2-10600	Near Stamford	11	664
5	Turkey Creek	RE2-11100	At Edison	22	1438
6	Muddy Creek	RE2-11400	At Arapahoe	21	814
7	Beaver Creek	RE2-10610	Near Beaver City	12	1047
8	Medicine Creek	RE3-10100	Below Harry Strunk Reservoir	21	31
9	Medicine Creek	RE3-10200	Above Harry Strunk Reservoir	21	753
10	Red Willow Creek	RE3-10500	Near Red Willow	21	1517
11	Driftwood Creek	RE3-10800	Near McCook	22	919
12	Red Willow Creek	RE3-10600	Above Hugh Butler Reservoir	22	1002
13	Frenchman Creek	RE3-20200	At Culbertson	14	498
14	Stinking Water Creek	RE3-20220	Near Palisade	22	929
15	Frenchman Creek	RE3-20300	At Palisade	22	556
16	South Fork Republican River	RE3-40500	Near Benkelman	11	593
17	Frenchman Creek	RE3-20400	Near Imperial	22	98
18	Rock Creek	RE3-40800	At Parks	22	93
19	Buffalo Creek	RE3-50100	Near Haigler	10	370
20	Arikaree River	RE3-50400	At Haigler	1	3282
21	North Fork Republican River	RE3-50300	At NE-CO Stateline	22	247