Total Maximum Daily Loads
For Pathogen Indicators
Iowa River
Johnson County, Iowa

2007

Iowa Department of Natural Resources
Watershed Improvement Section

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1. SUMMARY

Table 1. Iowa River pathogen indicator TMDL, summary.

Waterbody Name	Iowa River, Reach IA 02-IOW-0030 Segment 2
County	Johnson
Use Designation Classes	Class A1 Primary Contact Recreation Class B (WW-1) Aquatic Life Class C Drinking Water Supply
Major River Basin	Iowa River
Pollutants	Pathogen Indicator Bacteria (*E. coli*)
Pollutant Sources	Point and Nonpoint Sources
Impaired Use	Primary Contact Recreation
Watershed Area	97,747 acres
Impaired Stream Length	8.75 miles
Pathogen Indicator TMDL (*E. coli*)	
Targets	Water Quality Standard (WQS) *E. coli* pathogen indicator concentrations: • 126 organisms/100 milliliters (ml), geometric mean • 235 organisms/100 ml, single sample maximum
Load Capacity	Daily load at the WQS conc. of 126 *E. coli* org/100ml derived from the daily avg. flow, as *E. coli* org/day
Existing Load	Varies with load and conc., See Figure 16 and Table 15
Load Reduction to Achieve Target	Point source WLA's require that end of pipe discharges meet the *E. coli* WQS conc. in the Iowa R. Nonpoint source (NPS) loads must be reduced 94% from existing loads.
Load Allocation	Nonpoint source Load Allocations are in Tables 23 and 24
Wasteload Allocations (WLA)	Wastewater treatment plant (WWTP) WLA's are in Table 21. Municipal Stormwater (MS4) WLA's are in Table 22.
Margin of Safety	Implicit, conservative assumptions in analysis

One segment in the Iowa River was included in the 2004 Iowa 303(d) List as impaired by excessive indicator bacteria. As such, a total maximum daily load (TMDL) must be developed in accordance with the Clean Water Act (CWA). In 2004, the Iowa Department of Natural Resources (IDNR) opted to convert from fecal coliform to Escherichia coli (*E. coli*) bacteria as the indicator for primary contact recreation assessment. This document presents one TMDL for indicator bacteria that is designed to allow Iowa River segment IA 02-IOW-0030-Segment 2 to fully support the primary contact recreational designated use.

Required components This TMDL has been prepared in compliance with the current regulations for TMDL development that were promulgated in 1992 as 40 CFR Part 130.7 in compliance with the Clean Water Act. These regulations and consequent TMDL development are summarized below:

1. Name and geographic location of the impaired or threatened waterbody for which the TMDL is being established:

Table 2 Impaired segment description

IOWA RIVER IMPAIRED SEGMENT	SEGMENT DESCRIPTION	SEGMENT LENGTH	COUNTY
Reach IA 02-IOW-0030 segment 2	Coralville Lake dam to Burlington St. dam, Iowa City	8.75 miles	Johnson

2. Identification of the pollutant and applicable water quality standards:
The impaired segment designated uses are primary contact recreation, aquatic life protection, and drinking water supply. The primary contact recreation use (Class A1) has been assessed as "not supported" due to consistently high levels of the pathogen indicator bacteria *E. coli* and fecal coliform. The water quality standard (WQS) is for an *E. coli* geometric mean of 126 organisms/100ml and a sample maximum of 235 organisms/100ml. The aquatic life protection (Class B) and drinking water supply (Class C) uses were assessed as "fully supported/threatened."

3. Iowa River pollutant load that allows attainment and maintenance of the water quality standards:
A mass load is not applied to bacteria because they are always expressed as a density of bacterial colonies in a given volume; specifically, a count of *E. coli* organisms/100 ml. These concentrations are used to determine the total count per time unit for flow. For a TMDL the units are E. coli organisms per day. The water quality criteria, a geometric mean of 126 or a sample maximum of 235 *E. coli* organisms/100 ml, can be shown at a continuum of flow rates to generate allowable "load" curves as shown in Figure 16.

4. Departure of the current pollutant load from the maximum allowable load that meets the water quality standards.
The exceedance of existing measured bacteria concentrations from the WQS bacteria criteria of 126 *E. coli* organisms/100 ml is the pollutant reduction needed. Point source wasteload allocations must meet the criteria at the location that the effluent discharges into the impaired segment of the Iowa River. Nonpoint source (NPS) loads must be reduced 94% from existing loads.

5. Identification of pollution source categories:
Point and nonpoint sources have been identified as the pollutant sources for the impaired segment of the Iowa River.

6. Wasteload allocations for pollutants from point sources:
The water quality standards associated with the primary contact use determine the point source wasteload allocations (WLA) for discharges to the impaired Iowa River segment. The WQS for pathogen indicators are a geometric mean of 126 *E. coli*/100ml and a sample maximum of 235 *E. coli*/100 ml for facilities discharging directly to the impaired reach. The WLAs for facilities discharging to tributaries of the impaired reach are calculated based on time of travel and die off between the discharge and the Iowa River.

The WLA's for the wastewater treatment plants in the impaired segment watershed are in Table 21 and those for the Municipal Stormwater discharges are in Table 22.

7. Load allocations for pollutants from nonpoint sources:
The load allocations (LA) for this TMDL are based upon meeting the WQS for *E. coli* in the impaired Iowa River segment. The load allocations are in Tables 23 and 24.

8. A margin of safety:
This TMDL contains an implicit margin of safety based on conservative assumptions in the evaluation and modeling during the development of this TMDL document.

9. Consideration of seasonal variation:
This TMDL was developed based on the Iowa water quality standards primary contact recreation season that runs from March 15 to November 15.

10. Allowance for reasonably foreseeable increases in pollutant loads:
There was no allowance for future growth included in this TMDL because current watershed land uses are predominantly agricultural and the addition/deletion of animal feeding operations (which could increase or decrease pathogen indicator loading) cannot be predicted or quantified at this time. The watershed of this Iowa River segment is being changed from agricultural uses and is urbanizing fairly quickly. The affect of this urbanization will be to reduce bacteria loads as shown for the two land uses in the source evaluation.

11. Implementation plan:
Although not required by the current regulations, an implementation plan is outlined in Section 4 of this document. *E. coli* reduction will be accomplished through a combination of regulatory and non-regulatory activities. Point sources will be regulated through the National Pollutant Discharge Elimination System (NPDES) permitting process. Nonpoint source pollutants will be addressed using available programs, technical advice, information and education, and financial incentives.

This TMDL is phased, meaning that an iterative approach to managing water quality is being used. Monitoring feedback will determine the effectiveness of implemented management practices to meet needed bacteria reductions. Section 5, Monitoring, discusses a monitoring plan. Monitoring is important 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.

2. DESCRIPTION AND HISTORY OF THE IOWA RIVER

The Iowa River is a tributary of the Mississippi River and is about 300 miles long. Iowa City, where the impaired segment is located, is 65 miles from its mouth. The Iowa River originates from two branches (West and East) that have their headwaters in Hancock County. The Iowa River flows in a generally southeast direction to the Missisppi and it is dammed north of Iowa City to form Coralville Reservoir. The lower reaches are located in the Southern Iowa Drift Plain and the Mississippi Alluvial Plain.

2.1 The Stream and its Hydrology

The impaired segment of the Iowa River addressed by this TMDL is between two dams. The upstream dam forms Coralville Reservoir and the downstream dam is at Burlington Street in Iowa City.

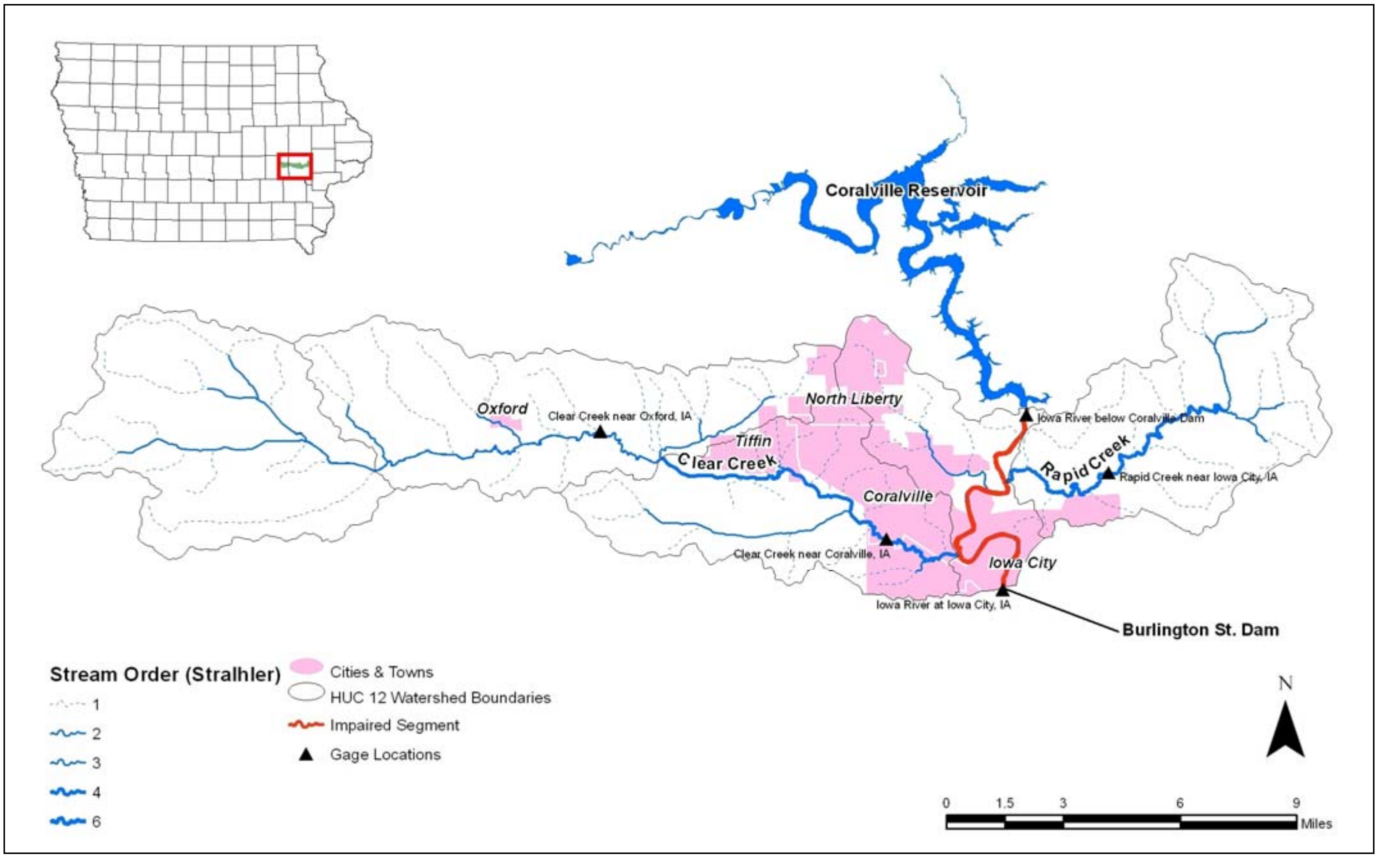

Figure 1 Impaired Segment of the Iowa River

Table 3 The Iowa River and its Basin

Waterbody Name:	Iowa River
Hydrologic Unit Code (10 digit):	0708020906
IDNR Waterbody ID:	Reach IA 02-IOW-0030 Segment 2
Location:	From Coralville dam to the Burlington Street dam
Major Tributaries:	Coralville Reservoir discharge, Clear Creek, Rapid Creek, Muddy Creek, and Sanders Creek
Receiving Waterbody:	Mississippi River
Impaired Segment Length:	8.75 miles
Direct Draining Watershed Area:	97,747 acres

For assessment purposes the Iowa River downstream of the Coralville dam to the Mississippi River has been divided into three reaches:

- Coralville dam to the English River confluence (IA 02-IOW-0030)
- English River to the Cedar River confluence (IA 02-IOW-0020)
- Cedar River to the Mississippi River confluence (IA 02-IOW-0010).

Each of these reaches has been divided into segments. The impaired segment is one of two in the Coralville dam to English River reach. The major tributaries to the impaired segment, besides the Coralville dam release, are Clear Creek with a drainage area of 98 square miles and Rapid Creek with a drainage area of 25 square miles. Much of the watershed is used for agriculture, specifically row crops, but it also takes in a large part of the Iowa City metropolitan area, including the cities of Coralville, Tiffin, and North Liberty.

Coralville Reservoir affects the hydrology of the river and has a large impact on the bacteria in the discharges to the impaired Iowa River segment. The reservoir dam is located six miles north of Iowa City and 83 miles from the river mouth. The reservoir was completed in 1958 and at normal pool has a length of 23 miles, a volume of 42,760 acre-feet, a maximum depth of 30 feet, and a surface area of 5,340 acres according to the US Army Corps of Engineers (USACOE, 2006).

The flood control pool is 475,000 acre-feet, extends the reservoir length to 41.5 miles, and drains 3,084 square miles. The USGS-measured flow below the dam averaged 2,477 cubic feet per second (cfs) for water years 1993 through 2004 and according to the Corps of Engineers the average July outflow is 1,730 cfs. The hydraulic detention time at normal pool is 12 days.

2.2 The Watershed

The area of the Iowa River watershed that drains to Coralville Reservoir is 3,084 square miles. The area of the watershed that directly drains to the impaired segment is 153 square miles. Unless otherwise specified, descriptions of the watershed in this report will relate to the watershed that directly drains to the impaired segment.

The average precipitation in the Iowa River watershed is 35 inches/year and the average snowfall is 32 inches/year. Wildlife species present in the area include whitetail deer, red fox, beavers, raccoons, ring-necked pheasants, mourning doves, and numerous other species of songbirds, waterfowl, reptiles and amphibians. Table 4 shows the distribution of generalized land uses.

Table 4. Year 2002 Landuse in Iowa River watershed

LANDUSE	AREA IN ACRES	PERCENT OF TOTAL AREA
Row Crops	41,469	42
Grass or hay	32,582	33
Forest	12,835	13
Urban/artificial	10,861	11
Total	97,747	100

Soils. The upland soils in the impaired segment watershed are mostly formed in loess over glacial till divided between areas dominated by soils formed in silty materials and those formed in sandy-loamy-silty materials. In general, the drainage of Rapid Creek on the east side of the watershed and of Clear Creek in the southwest is in the silty materials area draining to bottom lands and low stream benches formed in silty, loamy or clayey materials. The area around North Liberty in the north central part of the watershed is in the sandy-loamy-silty material that mostly drains to Muddy Creek. Figure A4 in Appendix A shows the watershed Statsgo soils map.

3. TMDL FOR PATHOGEN INDICATORS

3.1 Problem Identification

The 2004 Iowa Section 305(b) Assessment Report lists the Iowa River Reach (IA 01-IOW-0030) that includes the impaired segment as divided into 2 segments for water quality assessment purposes: IA 01-IOW-0030-1 which is 19 miles from the English River to the Burlington St. dam in Iowa City; and IA 01-IOW-0030-2 which is 8.75 miles from the Burlington St. dam to the Coralville dam.

This TMDL addresses segment IA 01-IOW-0030-2 of the Iowa River. Bacteria sources include wastewater treatment plant and urban storm sewer discharges, failed septic tank systems, wildlife, pastured livestock, runoff from fields where manure has been applied, and feedlots. Nonpoint source bacteria problems often accompany heavy rainfall events. Point sources of bacteria, such as wastewater treatment plants, usually discharge continuously.

The following paragraph is the basis for the 2004 305(b) assessment and comments for the impaired Iowa River segment; Burlington St. Dam in Iowa City (Johnson County) to Coralville Reservoir dam (Johnson County), Waterbody ID No.: IA 01-IOW-0030_2. From the 305(b) report:

> *Class A (primary contact recreation) uses are assessed (monitored) as "not supported" based on high levels of indicator bacteria at the University of Iowa/Corps of Engineers (UI/ACOE) ambient monitoring station in Iowa City. The Class B(WW) aquatic life uses are assessed (monitored) as "partially supported" based on results of a statewide survey of freshwater mussels in 1998-99. The Class C (drinking water) remain assessed (monitored) as "fully supported/threatened" based on results of ambient monitoring conducted by both IDNR/UHL and University of Iowa/Corps of Engineers. Fish consumption uses remain assessed as "fully supported" based on results of annual fish contaminant monitoring conducted by the University of Iowa/Corps of Engineers from 2000-2002. The sources of data for this assessment include (1) results of water quality monitoring conducted near the Iowa City water treatment plant by the University of Iowa (under contract with the U.S. Army Corps of Engineers) as part of the Coralville Reservoir Water Quality Study, (2) results of a statewide assessment of freshwater mussels in 1998-1999 conducted by Iowa State University (Arbuckle at al. 2000), (3) results of monitoring from the IDNR/UHL ambient city monitoring station upstream from Iowa City at the Dubuque Street bridge, and (4) results of fish tissue monitoring in 2000, 2001, and 2002 conducted for the UI/ACOE Coralville Reservoir Water Quality Study.*

Impaired Uses and Applicable Water Quality Standards

The applicable designated uses and water quality standards for pathogen indicators are found in *Iowa Administrative Code 567, Chapter 61, Water Quality Standards:*

> *61.3(3)a. Class "A" waters. Waters which are designated as Class "A1," "A2," or "A3" in subrule 61.3(5) are to be protected for primary contact, secondary contact, and children's recreational uses. The general criteria of subrule 61.3(2) and the following specific criteria apply to all Class "A" waters.*
>
> *(1) The Escherichia coli (E. coli) content shall not exceed the levels noted in the Bacteria Criteria Table when the Class "A1," "A2," or "A3" uses can reasonably be expected to occur. When a water body is designated for more than one of the recreational uses, the most stringent criteria for the appropriate season shall apply.*

Table 5 *E. coli* Bacteria Criteria Table (organisms/100 ml of water)

USE	GEOMETRIC MEAN	SAMPLE MAXIMUM
Class A1		
3/15 – 11/15	126	235
11/16 – 3/14	Does not apply	Does not apply
Class A2 (Only)		
3/15 – 11/15	630	2880
11/16 – 3/14	Does not apply	Does not apply
Class A2		
Year-Round	630	2880
Class A3		
3/15 - 11/15	126	235
11/16 - 3/14	Does not apply	Does not apply

Class A1 - Primary Contact Recreational Use, Class A2 - Secondary Contact Recreational Use, Class A3 - Children's Recreational Use. The Iowa River is Class A1.

3.2 TMDL Target

In 2004, the Iowa Department of Natural Resources converted from fecal coliform to *E. coli* bacteria as the indicator for primary contact recreation assessment. Although *E. coli* may be a better indicator of human health issues for primary contact recreation assessment, it was not always used in the development of this report since some data sets consisted only of fecal coliform data and because most of the pollutant source reference material, particularly for the Bacteria Indicator Tool (BIT) spreadsheet calculations, used fecal coliform as the pathogen indicator in research. EPA's Bacterial Indicator Tool (US EPA, 2001) was used to estimate nonpoint source loading. The BIT is a spreadsheet that estimates the bacteria contribution from multiple sources. Currently, the tool is only enabled for fecal coliform.

The fecal coliform/*E. coli* relationship used in this TMDL is based on the WQS geometric mean for fecal coliform that was used before the *E. coli* standard was adopted. The values, respectively, for these geometric means are 200 fecal coliform organisms/100 ml and 126 *E. coli* organisms/100 ml and the ratio is 1.59 - rounded to 1.6 for this document. This is also the ratio used by IDNR to put fecal coliform limits in NPDES permits. TMDL targets for fecal coliform were set to the same values as the *E. coli* standard based on this ratio. Note that *E. coli* is always a subset the fecal coliform by definition.

Data Sources

The water quality monitoring data used in the development of this TMDL project originates from three monitoring efforts. These are the Coralville Reservoir Water Monitoring Project; the IDNR ambient monitoring program that monitors upstream and downstream of Iowa City; and the IDNR Targeted Monitoring Project for the impaired segment begun in 2005 and that will continue through 2007. The locations of the different sites and their function in the watershed evaluation procedures and modeling are shown in Tables 12 and 13 and Figures 5 and 6 in the Modeling and Analytical Approach Section. The monitoring done at the site upstream of Iowa City in the IDNR City Upstream/Downstream Monitoring Project (IR1) and the monitoring done for the Coralville Reservoir Water Quality Project (IR3a) were the sources of the data used in the 305(b) water quality assessment report to establish the segment's impaired condition. The IDNR Targeted Monitoring Project includes sites on Clear Creek (CC1 and CC2) and Rapid Creek (RC1) that were used in the watershed evaluation and water quality modeling as well as those on the Iowa River. Site IR1 is seven miles upstream from the downstream site, IR3. Rapid Creek discharges to the river just upstream of site IR1 and Clear Creek discharges between sites IR1 and IR3. The site IR1 water quality data was collected from 1999 to 2004 and includes fecal coliform and *E. coli* bacteria concentrations.

Flow data was collected at five USGS gage stations. One of these gages is at the tail water of the Coralville Reservoir dam, one is on Rapid Creek before its confluence with the Iowa River, two are on Clear Creek, and the other is at the Burlington Street dam at the downstream end of the impaired segment. The USGS gage flow data used in the analysis is the daily average flow. Details of the monitoring and flow data analysis are in the Modeling and Analytical Approach Section.

3.3 Pollution Source Assessment

Point Sources

Wastewater Treatment Plants. The point sources in the Iowa River impaired segment include municipal wastewater treatment plants (wwtp) with National Pollutant Discharge Elimination System (NPDES) permits and municipal stormwater discharges with Municipal Separate Storm Sewer System (MS4) NPDES permits. The only permitted facility in the watershed with a pathogen indicator discharge limit is the North Liberty wastewater treatment plant. Although it is in the watershed, the City of Coralville's wastewater treatment plant effluent is piped below the Burlington Street dam downstream of the impaired segment and is not a part of this TMDL. Table 6 lists the cities with MS4 stormwater permits that limit bacteria indicator discharges through best management practices (BMP) and the single wastewater treatment plant with existing fecal coliform concentration limits. Table 7 lists facilities in the watershed that do not have pathogen indicator limits in their NPDES permits but are potential sources. Two facilities are controlled discharge lagoons that usually discharge twice a year when receiving stream flows are high. These are denoted with an asterisk in the facility column.

Table 6 Permitted facilities in Iowa River Watershed with fecal coliform limits

FACILITY NAME	EPA NPDES ID	RECEIVING STREAM	FACILITY	POPULATION EQUIVALENT	DESIGN ADW[1] FLOW (MGD[2])	DESIGN AWW[3] FLOW (MGD)	NPDES FECAL COLIF. LIMIT, (ORG/100ML)
City of Coralville MS4	IA0078646	Clear Creek	Storm sewers	NA	NA	NA	BMP
City of Iowa City MS4	IA 0078298	Iowa River	Storm sewers	NA	NA	NA	BMP
Univ. of Iowa MS4	IA0078182	Iowa River	Storm sewers	NA	NA	NA	BMP
City of North Liberty wwtp	IA0032905	Muddy Creek	Sequencing Batch Reactor	10353	0.884	1.16	200 geo. mean, 400 max.
City of North Liberty MS4	IA0078794	Muddy Creek	Storm sewer	NA	NA	NA	BMP

1. 30 day average dry weather flow
2. Million gallons per day
3. 30 day average wet weather flow

Table 7 Other permitted facilities in Iowa River Watershed

FACILITY NAME	EPA NPDES ID	RECEIVING STREAM	FACILITY	POPULATION EQUIVALENT	DESIGN ADW FLOW (MGD)	DESIGN AWW FLOW (MGD)
Amana-Nordstrom Inc., wwtp	IA0066265	Unnamed Tributary to Clear Creek	Aerated Lagoon	1569	0.046	0.046
Heritage Inn, Amana Colonies, wwtp	IA0074225	Unnamed Tributary to Clear Creek	Activated Sludge	359	0.029	0.029
Colony Village Restaurant, wwtp	IA0069035	Unnamed Tributary to Clear Creek	Aerated Lagoon	156	0.01	0.01
Econolodge, wwtp	IA0065838	Unnamed Tributary to Clear Creek	Aerated Lagoon	240	0.0267	0.0294
City of Oxford, wwtp	IA0032531	Hertzel Run to Clear Creek	Activated sludge, SBR	701	0.07	0.0915
Parkview Mobile Home Court, wwtp	IA0068349	Clear Creek	Facultative Lagoon *	126	NA	0.023
Sleepy Hollow Campground, wwtp	IA0069094	Unnamed trib. To Clear Creek	Facultative Lagoon *	128	NA	0.008
City of Tiffin, wwtp	IA0036617	Clear Creek	Activated Sludge	3982	0.3	0.425
Timber Trails Estates Assoc., wwtp	IA0069108	Sanders Creek to Iowa River	Aerated Lagoon	120	0.012	0.012

Livestock Feeding Operations. Livestock operations in the Iowa River watershed range in size from small farms with a few animals to large feeding operations. Open feedlots are unroofed or partially roofed animal feeding operations in which no crop, vegetation, or forage growth or residue cover is maintained during the period that animals are confined in the operation. Runoff from open feedlots can deliver substantial quantities of pathogen indicators, nutrients and oxygen demanding materials to a waterbody dependent upon factors such as proximity to a water surface, number and type of livestock and manure controls. Open feedlots with more than 1,000 animal units are required to have an NPDES permit.

Confinement animal feeding operations (CAFOs) are animal feeding operations in which animals are confined to areas that are totally roofed. CAFOs typically utilize earthen or concrete structures to contain and store manure prior to land application. Nutrients from CAFOs are delivered via runoff from land-applied manure or from leaking/failing storage structures. Currently, CAFOs with more than 500 animal units must have an approved manure management plan. Regardless of size, all CAFOs must report manure releases (IDNR AFO website, 2005).

Nonpoint Sources

As noted above, the BIT was used to estimate nonpoint source loadings for this TMDL. The BIT estimates the monthly accumulation rate of fecal coliform bacteria on four land uses (cropland, forest and ungrazed pastureland, built-up, and pastureland), as well as the asymptotic limit for the accumulation that occurs when it does not rain and there is no washoff.

The nonpoint sources of fecal coliform include contributors that do not have localized points of release into a stream. In the Iowa River watershed these sources are:

- Land application of hog and cattle manure and poultry litter
- Grazing animals
- Wildlife
- Cattle contributions directly deposited in stream
- Failing septic systems and unsewered communities
- Built-up area runoff

The contributions from each of these sources have been estimated using information from:

- IDNR and Iowa State University (ISU) wildlife biologists who provided data on watershed wildlife populations,
- IDNR staff familiar with onsite wastewater treatment and county sanitarians who provided estimates of septic tank system failure rates,
- Natural Resources Conservation Service (NRCS) and ISU researchers who provided information on manure application practices and loading rates for hog farms and cattle operations.

Livestock in the watershed. Nonpoint sources in the watershed were evaluated using two separate BIT assessments, one by EPA for the entire undifferentiated watershed, and one by IDNR that separates the load estimates by the three gage sub-watersheds described in Section 3.3 - Modeling and Analytical Approach. Both of the BIT estimates used the same assumptions for estimates of livestock and wildlife contributions:

- Dairy cattle are confined in feedlots and their waste is applied as manure.

- Access to pastureland for grazing cattle varies during the year. According to researchers at Iowa State University (Russel, 2005), cattle are
  - 80% confined from January to March.
  - During the spring and summer months (April through October) they spend 100% of their time grazing.
  - In November and December, they have slightly reduced access and spend approximately 80% of their time grazing.
- The grazing schedule for sheep is similar to cattle except that sheep are usually confined from January through March.

Livestock in the Watershed 1, EPA Total Watershed Estimate. The EPA BIT assessment of the total loads was developed using the County Agricultural Statistics for the year 2002. The county level data was reduced by calculating the percentage of the county that is part of the watershed and assuming an even distribution of livestock. The total area for each land use was determined using IDNR GIS coverages. For 2002 the animal inventory was:

Dairy cows – 548
Beef Cattle – 12,544
Hogs – 31,680
Chickens – 46,056
Sheep – 1,229
Horses – 370

Livestock in the Watershed 2, IDNR Estimate by Gage Sub-Watershed. The IDNR BIT assessment separates the loads from the three gage sub-watersheds. The results from the IDNR assessment are used in Section 3.3 - Modeling and Analytical Approach. Table 8 provides the estimated livestock numbers in each of the three gage sub-watersheds using a more refined procedure than EPA. IDNR GIS staff derived these estimates as follows:

- Cattle & Sheep: The county dairy and beef cow numbers were apportioned throughout each county based on the numbers of 30 by 30 meter rural grass cells. These cells were derived from the 2000 land cover grid and incorporated boundaries coverage, to create a dairy cow grid and a beef cow grid. Each grid was summarized by sub-watershed to estimate the number of dairy and beef cows in each.
- Swine, Chicken & Turkey: Point location data from the AFO database, manure management plans, and the permitted CAFO database was compared with 2002 aerial photography to see which of the sites had actually been built. The known built facilities data was compared with the Census of Agriculture (County Ag Stats) data to see how many animals were accounted for by the facilities. It was found that many animals were unaccounted for and a section by section confinement search was done using the aerial photography. Animal numbers were assigned by building size (i.e. approximately one hog per square meter of building) and manure storage was added when new facilities were found. The number of animals in these new facilities was combined with the number in known facilities. This total was compared with the Census of Agriculture total number and the difference in the number of animals was distributed to known

facilities. The point data was summarized to generate total animal numbers by gage sub-watershed.

Table 8 Estimated livestock numbers in the three gage sub-watersheds

GAGE SUBWATERSHED	AREA, ACRES	BEEF CATTLE	SWINE (HOGS)	DAIRY CATTLE	SHEEP
Rapid Creek	21,647	2,110	3,300	158	365
Iowa River	10,847	405	289	31	70
Clear Creek	66,131	5,945	8,350	317	721

Source Analysis for the Total Watershed (EPA Performed Assessment). The following three charts, Figures 2 through 4, show annual nonpoint source load distribution by land use and source for the entire watershed. The first chart, Figure 2, shows the relative nonpoint source bacteria loading based on land use.

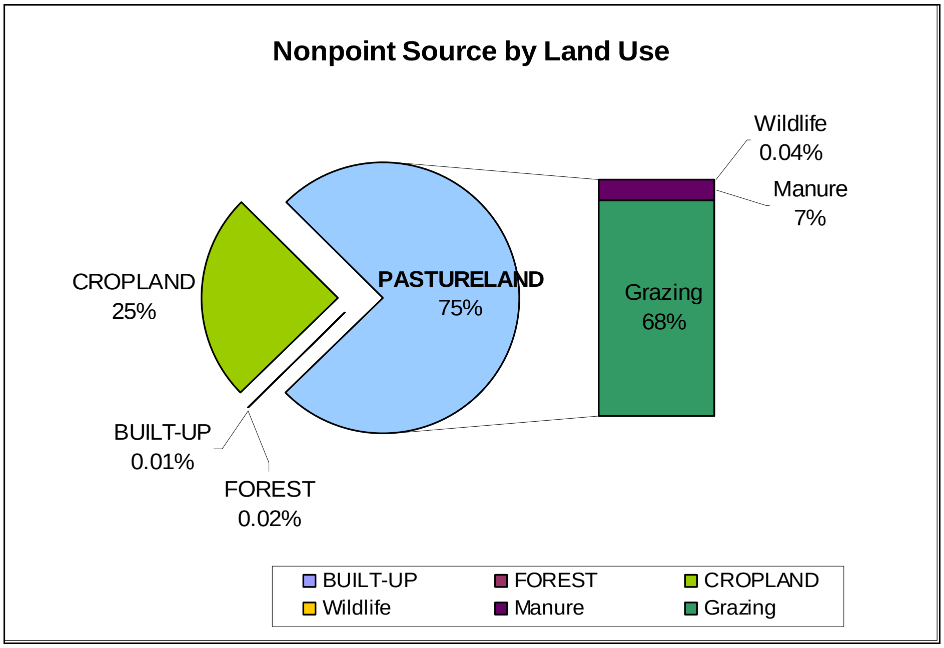

Figure 2 Nonpoint Sources of *E. coli* by Land Use

The second chart, Figure 3, shows one of the two most significant bacteria sources by landuse, cropland. Land application of manure from the Figure 3 livestock categories is a potential source of pathogens for watershed streams when transported in rainfall runoff. Manure application rates vary monthly according to management practices currently used in the area. In general, the majority of manure is applied during the months of October, November, and December in this area of Iowa (Russel, 2005). It is assumed that cattle manure is applied to cropland and pastureland and that hog manure is only applied to cropland. Figure 3 compares the fraction of bacteria from the different livestock and wildlife sources on cropland.

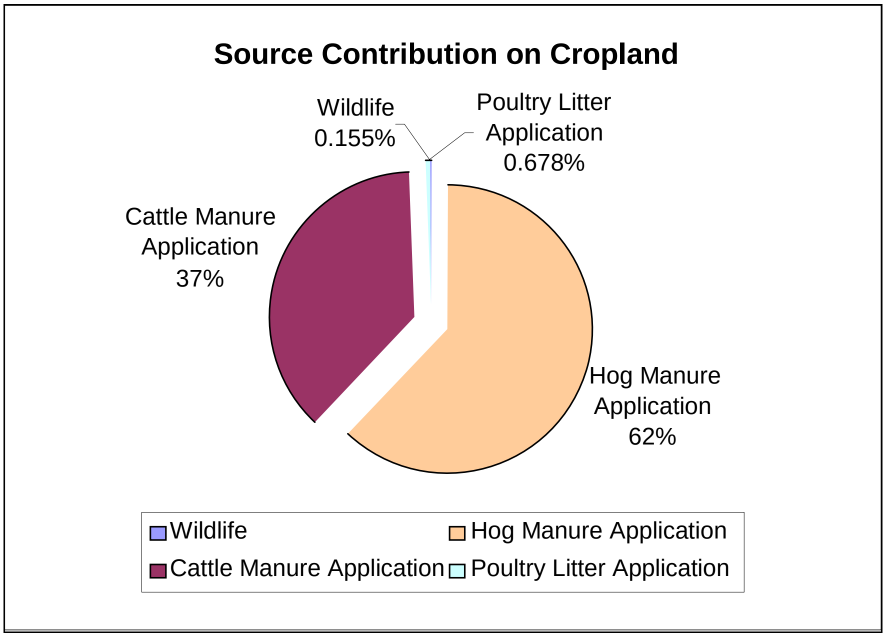

Figure 3 Cropland bacteria from land applied manure and wildlife

Cattle, horses, and sheep spend time grazing on pastureland and deposit manure onto the ground. Wildlife also deposits fecal material on the ground and during rain events part of the manure and wildlife fecal material becomes available for wash-off and delivery to receiving streams. Figure 4 shows pastureland bacteria sources by percentage of contribution.

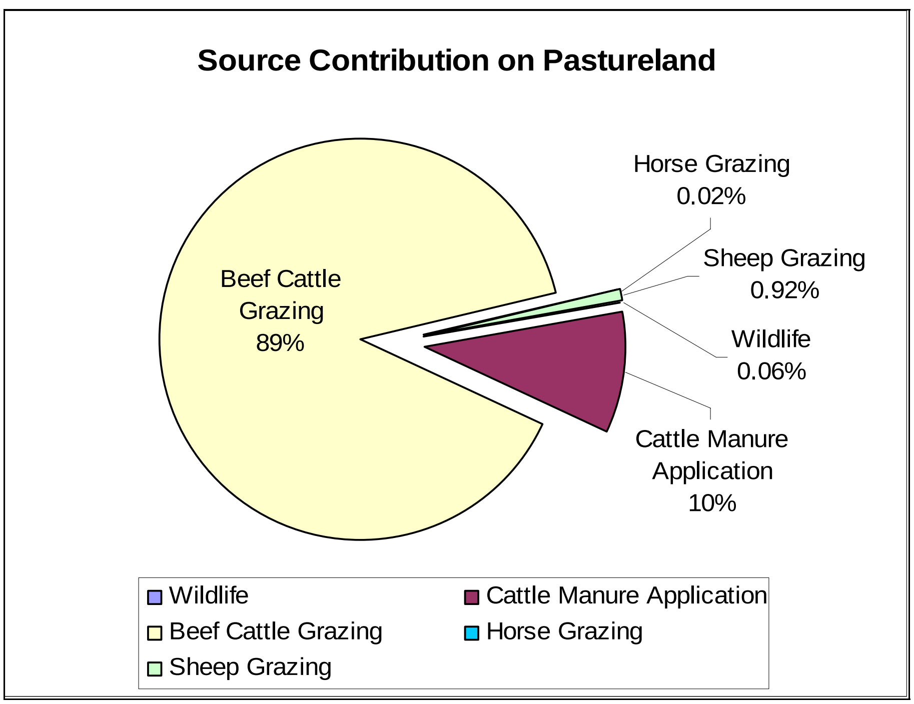

Figure 4 Pastureland bacteria from grazing, cattle manure application and wildlife

Cattle In Streams, Direct Bacteria Deposits (EPA Analysis). Cattle often have direct access to streams that run through pastureland. In Iowa approximately 90% of cattle have direct access to a stream (Russel, 2005). Pathogen indicator bacteria deposited in these streams by grazing cattle are modeled in the BIT spreadsheet as a continuous direct input of bacteria to the stream not requiring a precipitation event for transport. Iowa research indicates that cattle spend one to six percent of their time in streams from April through December (Russel, 2005).

Failing Septic Systems (EPA Analysis). Septic tank systems deliver bacteria loads to surface waters from malfunction, failure, or directly piped discharges. These on-site systems fail when the septic tank fills with solids and is not pumped, pipes are broken, or the substrate is clogged or flooded. According to IDNR staff responsible for on-site wastewater treatment systems, direct bypasses from septic tanks to ditches, tiles, or streams is fairly common in Iowa rural areas.

The number of septic systems is estimated from the watershed area normalized count of septic systems in each county. County sanitarians and IDNR staff were contacted for estimates of the on-site system failure rates. The total number of failed septic systems is 216 for both counties out of the total of 1,269 or 17 %. These rates were normalized based on the relative land area of each county in the watershed and the failure rate was then estimated to be 25% in each. Table 9 shows watershed septic systems and the failure rates. Data is from the U.S. Census Bureau (Census Bureau, 2000).

Table 9 Septic system failures by county

CATEGORY	IOWA COUNTY	JOHNSON COUNTY	TOTAL
Septic tanks or cesspools	178	1092	1269
Household size	2.44	2.58	2.56
Persons served	433	2820	3253
Failure rate	60%	10%	17%

Urban Development. Parts of Johnson and Iowa Counties are urbanizing. As a result, the fraction of the watershed that is built-up and developing will likely increase from the current 11% of the watershed area. As can be seen from the BIT analysis, livestock on agricultural land is generally a more significant contributor of pathogen indicators than built-up areas. Bacteria available for wash-off when it rains will decrease as development continues.

Pathogen loads from urban areas comes from contaminated runoff to storm sewers, illicit discharges of sanitary wastes, and contribution from improper disposal of fecal materials. The failure of sanitary sewers and septic systems and subsequent migration with stormwater runoff is also a potentially significant source. Six incorporated communities are entirely or partially in the watershed. Table 10 shows the sub-categories of the built-up land use in the watershed. There is a landuse map in Appendix A, Figure A1.

Table 10 Percent of built-up area categories by gage sub-watershed

GAGE SUB-WATERSHED	AREA, ACRES	COMMERCIAL	RESIDENTIAL	TRANS, COMM, UTIL. [1]
Rapid Creek	697	17%	27%	56%
Iowa River	2,372	32%	27%	41%
Clear Creek	4,056	27%	19%	54%

1. Transportation, communications, and utilities – mostly roads.

Natural Background Conditions – Wildlife (EPA Analysis). Wildlife deposit fecal material onto the land where it is available for wash-off when it rains. The BIT considers the contributions from deer, geese, and raccoons. Countywide deer population estimates were obtained from IDNR wildlife biologists. These estimates were used to estimate the numbers in the entire watershed based on the fraction of each county in it. The deer population is estimated to be 15 animals per square mile for this area (Suchy, 2005). The estimate of 3 geese per square mile is based on information from IDNR wildlife biologists (Zenner, 2005). Raccoon population estimates were obtained from ISU researchers (Clark, 2005). The raccoon population in this part of Iowa varies seasonally from 15 to 75 animals per square mile. A typical value of 45 per square mile was used for pastureland and forest cover. An estimate of 15 per square mile was used for cropland (Clark, 2005).

3.3 Modeling and Analytical Approach

TMDL Water Quality Criteria

The target for this TMDL is the water quality standard for Class A1, Primary Contact Recreational Use. The standard is a geometric mean of 126 *E. coli* organisms/100ml and a single sample maximum of 235 *E. coli* organisms/100ml. The "load" associated with this concentration varies with flow conditions. The criteria used to determine attainment of the water quality standards is explained in the 305(b) report assessment protocol described in the preceding S*ection 3.1, Problem Identification*.

The analytical approach used in the development of the Iowa River TMDL consists of using the EPA Bacteria Indicator Tool to evaluate nonpoint sources, septic tank systems, and direct inputs from cattle in the stream; load duration curves to evaluate the flow conditions when the bacteria impairments occur, the water quality model Qual2K (14) to evaluate the impaired flow conditions, and an analysis of the monitoring data to determine the necessary bacteria reductions needed to meet the water quality standards. All length units used for modeling layout are metric since these are the unit conventions of the Qual2K model.

Nonpoint Source Estimate, the Bacteria Indicator Tool Spreadsheet. The Bacterial Indicator Tool (BIT), a spreadsheet tool developed by EPA to assess watershed bacteria loads (20), used data collected during the pollutant source inventory to estimate nonpoint source loads. The nonpoint source load from the BIT is assumed to be a factor only during surface runoff conditions as identified by the load duration curves, otherwise it was allowed to accumulate on the land surface to a maximum of 1.8 times the daily generation.

Nonpoint source (NPS) bacteria loads present during non-runoff baseflow conditions were attributed to cattle in the streams, septic tanks, and a generalized loading that includes contribution from point sources. Pollutant accounting was done using a first order decay equation during transport and estimated time of travel done by using GIS derived hydraulic data and the Manning equation in the Qual2K model (Chapra, et al, 2006).

Spatial Model. Besides the discharge from the Coralville Reservoir dam, the impaired segment watershed, going downstream, consists of the drainage from Rapid Creek from the east, Muddy Creek from the north, and the largest sub-watershed, Clear Creek from the west. Because the QUAL2K water quality model used in the development of this TMDL uses only metric units, the stream maps are in kilometers (km). To convert from kilometers to miles, multiply by 0.622.

There are five USGS gages in the watershed of the impaired segment; one that is the furthest upstream near the Coralville discharge, one on Rapid Creek 8.8 km (5.47 miles) upstream from the Iowa River confluence, two on Clear Creek that are 5.7 (3.55 miles) and 23.9 km (14.87 miles) upstream from the Iowa River, and one at the Burlington Street dam end of the segment.

The drainage areas above the Rapid Creek and downstream Clear Creek USGS gages have been used to divide the impaired segment basin into three sub-watersheds. These three sub-basins are used in the Bacteria Indicator Tool and in calculating the flow, concentration, and load duration curves to delineate bacteria sources and loads. Table 11 shows the areas of each of these and Figure 5 shows the relationship of the three basins to the Iowa River. The Clear Creek drainage basin consists of three HUC 12 sub-watersheds and the Rapid Creek drainage basin is a single HUC 12. The center part of the segment watershed that directly drains to the Iowa River is the upstream half of a HUC 12 that is defined by the drainage upstream of the Burlington Street dam. The Muddy Creek drainage is part of the central gage watershed.

Table 11 Gage watershed areas and landuses

SUBWATERSHED	AREA, ACRES	% BUILT-UP	% CROPLAND	% PASTURELAND	% FOREST, CRP AND UNGRAZED PASTURE
Rapid Creek	21,647	3.2%	44.2%	2.8%	49.8%
Iowa River (main)	10,847	21.9%	14.9%	2.9%	60.3%
Clear Creek	66,131	6.1%	50.9%	3.3%	39.7%
Total	98,625	7.2%	45.5%	3.1%	44.2%

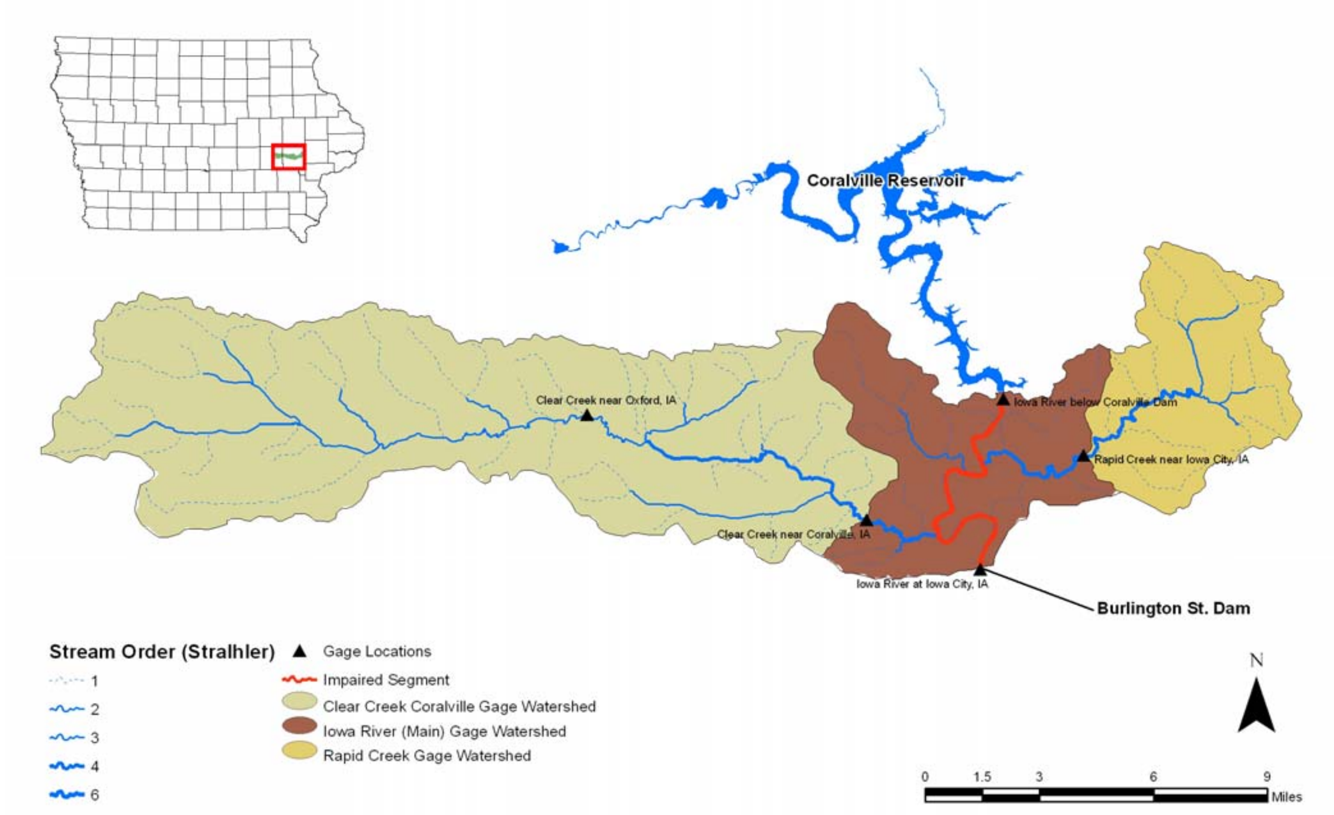

Figure 5 The sub-watersheds defined by the Rapid and Clear Creek USGS gages

Bacteria indicators were monitored at three different locations on the impaired segment of the Iowa River; two of which represent upstream conditions, i.e., the releases from Coralville Reservoir (See Table 12 and Figure 6). One of these two sites is the data from an IDNR continuing monitoring project begun in 2000 that samples upstream and downstream of Iowa City. This site is located just downstream of Rapid Creek (IR2). The other upstream site was sampled by IDNR in 2005 and is closer to the Coralville dam (IR1). The end of the impaired segment at Burlington Street dam is monitored at the nearby University of Iowa Water Plant (IR3a) for the Coralville Reservoir Water Quality Project (CRWQP). The CRWQP data set was used in the 305(b) assessment that found the segment to be impaired. IDNR also monitored near the Burlington Street dam in 2005 (IR3b). Other monitoring used for modeling and analysis was done at the Rapid and Clear Creek USGS gages.

Table 12 shows Iowa River bacteria indicator monitoring information and Table 13 shows Clear Creek and Rapid Creek bacteria monitoring information. Figure 6 shows the locations of the Iowa River and the Rapid and Clear Creek monitoring sites and also shows several sites where monthly grab samples were taken and analyzed but flow data was not collected and there were no nearby gages. This data has been used where applicable to develop the water quality model.

Table 12 Iowa River (IR) Bacteria Indicator Monitoring

ID	SITE NAME	TIME FRAME	LOCATION	ASSUMED MEANING FOR ANALYSIS
IR1	IDNR City Project, Upstream	2000 to 2006	IR Model km 10.2 (Dubuque St.)	Coralville dam release showing pathogen indicator concentration and loads
IR2	IDNR targeted monitoring, upstream IR site	2005	IR Model km 14.5 (near start of impaired segment	Coralville dam release showing pathogen indicator concentration and loads
IR3a	Coralville WQ Monitoring Project, downstream site	2000 to 2003	IR Model km 0.5 (UI Water Plant)	End of the impaired segment that includes bacteria indicator concentrations and loads from the entire watershed
IR3b	IDNR targeted monitoring, downstream IR site	2005	IR Model km 0.5 (UI Water Plant)	End of the impaired segment that includes bacteria indicator concentrations and loads from the entire watershed

Table 13 Clear Creek (CC) and Rapid Creek (RC) Bacteria Indicator Monitoring

ID	SITE NAME	TIME FRAME	LOCATION	ASSUMED MEANING FOR ANALYSIS
CC1	IDNR targeted monitoring, downstream CC site	2005	CC Model km 5.7, downstream USGS gage	End of watershed defined by the CC downstream USGS gage and the load delivered from the CC drainage.
CC2	IDNR targeted monitoring, upstream CC site	2005	CC Model km 23.9, upstream USGS gage	Mid-watershed flows, concentrations, and loads, used for CC Qual2k modeling
RC1	IDNR targeted monitoring, RC site	2005	RC Model km 8.8, USGS gage	End of watershed defined by the RC downstream USGS gage and the load delivered from the RC drainage.

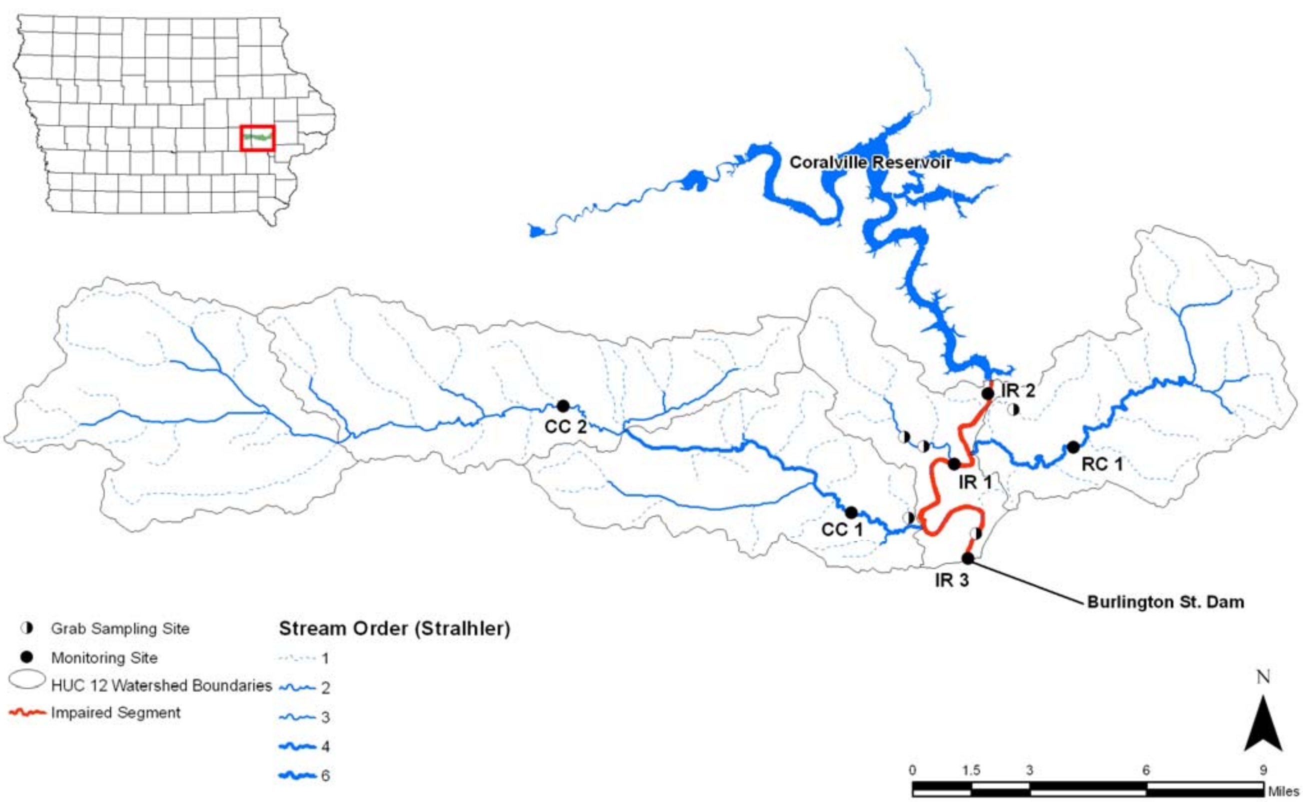

Figure 6 Monitoring Sites for the Iowa River, Clear Creek, and Rapid Creek

Conceptual Outline. Flow duration curves were developed for each of the five USGS gages in the Iowa River impaired segment watershed to describe the hydrologic conditions that exist when the bacteria impairment occurs. To do this, the monitoring data from each of the five sites and the Water Quality Standard (WQS) sample max (235 *E. coli* organisms/100 ml) were plotted on the same chart as the flow duration percentile. The charts provide information showing the flow conditions, high or low or in-between, when the criteria are exceeded. Criteria exceeded at high flow indicate that the problem occurs during run-off conditions when bacteria washing off from nonpoint sources pre-dominate. Criteria exceeded during low or base flow, when runoff is not occurring, indicate that continuous point sources such as wastewater treatment plants are the problem. Figures 7 and 8 are flow duration curves for the upstream gage near the Coralville Reservoir dam discharge. Figures 9 and 10 are for the downstream gage near the Burlington Street dam.

The Figure 7 flow duration curve plots the data used in the 305(b) assessment from the Iowa City "upstream" site data set for the IDNR Upstream/Downstream City Project. It shows that there are very few exceedances over the bacteria indicator *E. coli* WQS. The water quality assessment for the discharge data from the dam indicates that the Class A recreational use is supported.

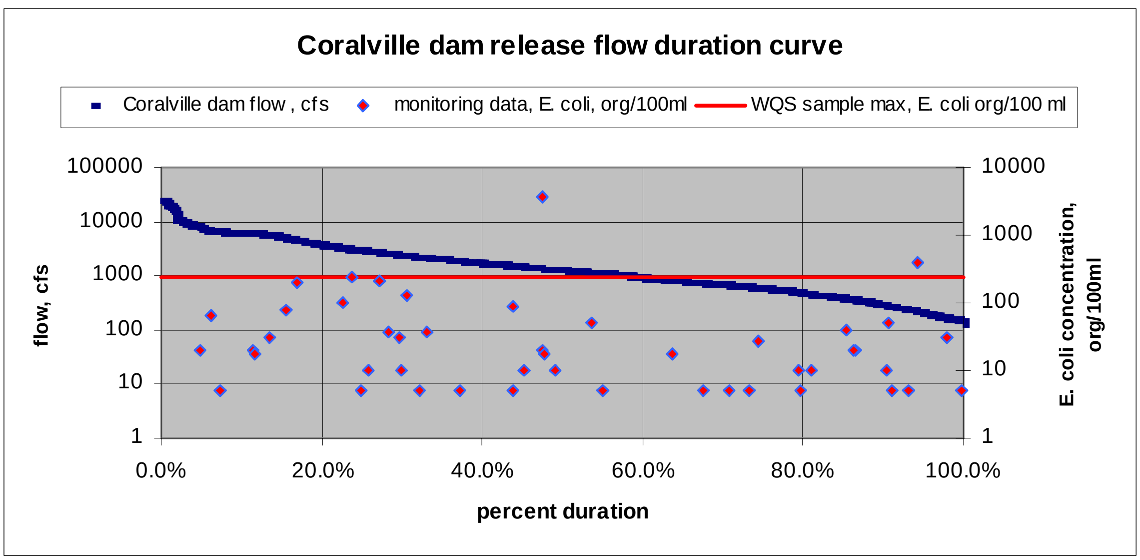

Figure 7 Monitoring data plotted with flow duration percent

Figure 8 shows the same upstream flow duration curve as in Figure 7 but with the 2005 IDNR Targeted monitoring data plotted. This data shows no *E. coli* concentration exceedances above the water quality standards for the Coralville Reservoir discharge. Based on these two data sets it is assumed that the reservoir discharge is relatively free of bacteria indicators in all flow conditions. Furthermore, since the IDNR City Upstream/Downstream Project data comes from below the Rapid Creek confluence with the Iowa River and shows no WQS exceedances, it is assumed that the Rapid Creek discharge usually does not significantly impact the *E. coli* criteria exceedances in the impaired segment.

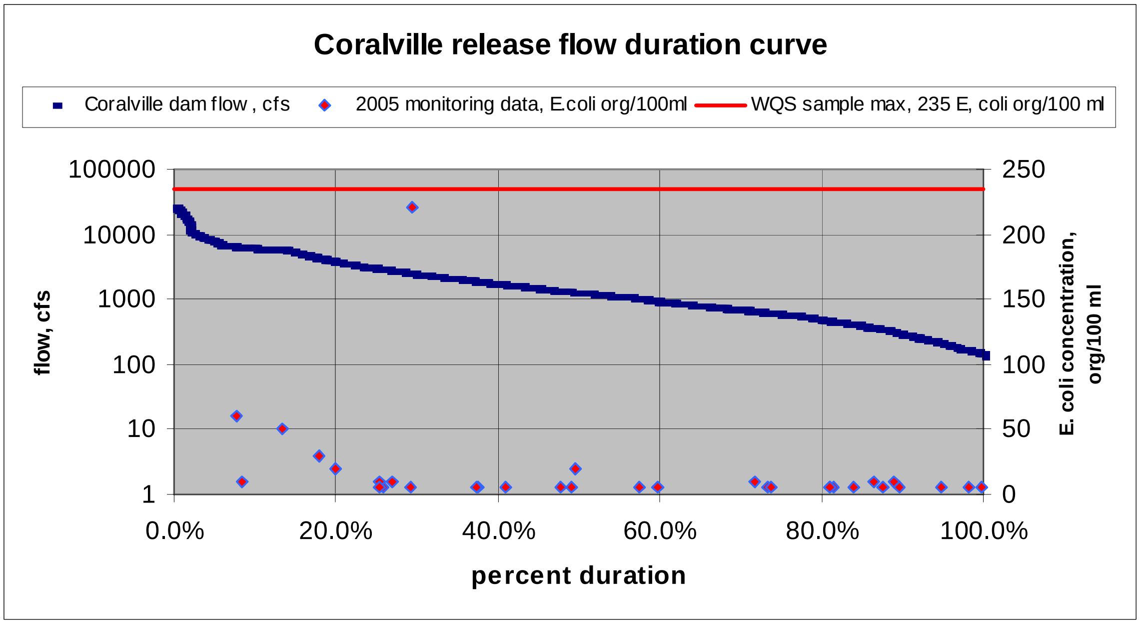

Figure 8 IDNR 2005 targeted monitoring data (upstream) plotted with the flow duration percentile

The segment's impaired condition has been assessed using the two data sets collected near the downstream end (Burlington Street dam). These data sets are plotted against the flow duration curve for the Burlington Street dam USGS gage. Figure 9 shows the Coralville WQ Monitoring Project downstream site (IR3a) bacteria data from 2000 to 2002, used in the 305(b) assessment to determine non-support of Class A uses, plotted with the downstream flow duration curve.

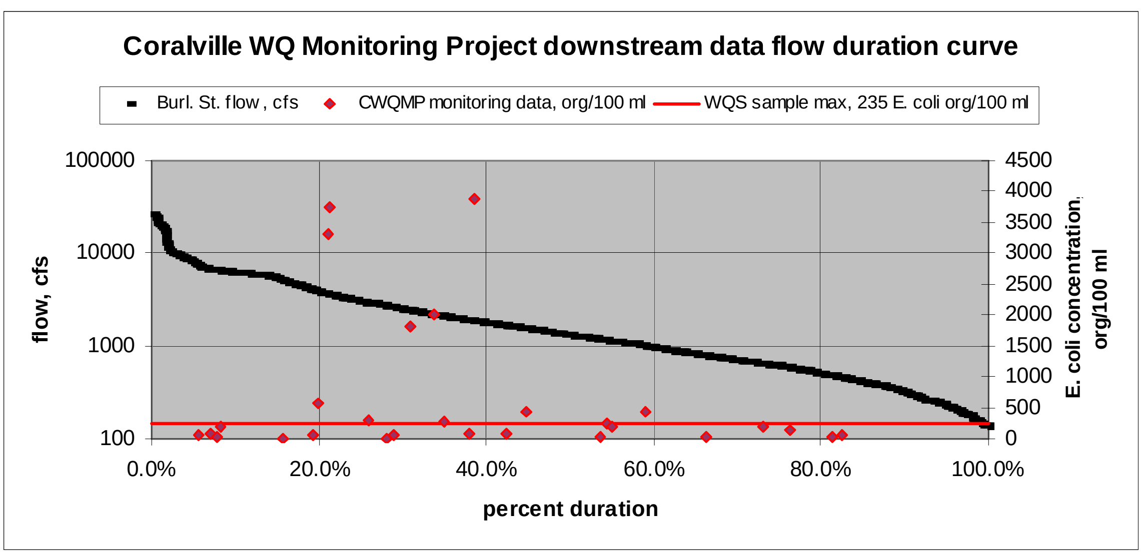

Figure 9 Downstream data plotted with downstream flow duration curve

Figure 9 shows that the exceedances from the WQ Standards occur in the 20 to 60 percent flow range. This is different from the expected impacts of NPS run-off driven problems and continuous point source problems, the former should be at their worst when flows are high, in the zero to 20 percent flow range, and the latter should be seen at low or base flow conditions, in the 80 to 100 percent flow range.

Figure 10, displaying the 2005 IDNR Targeted Monitoring bacteria data, is plotted with the same downstream flow duration curve as in Figure 9. This chart shows a similar pattern of WQS exceedances in the 20 to 60 percent flow range as Figure 9. There are also a couple of exceedances in the 80 to 100 percent low flow range in this data set.

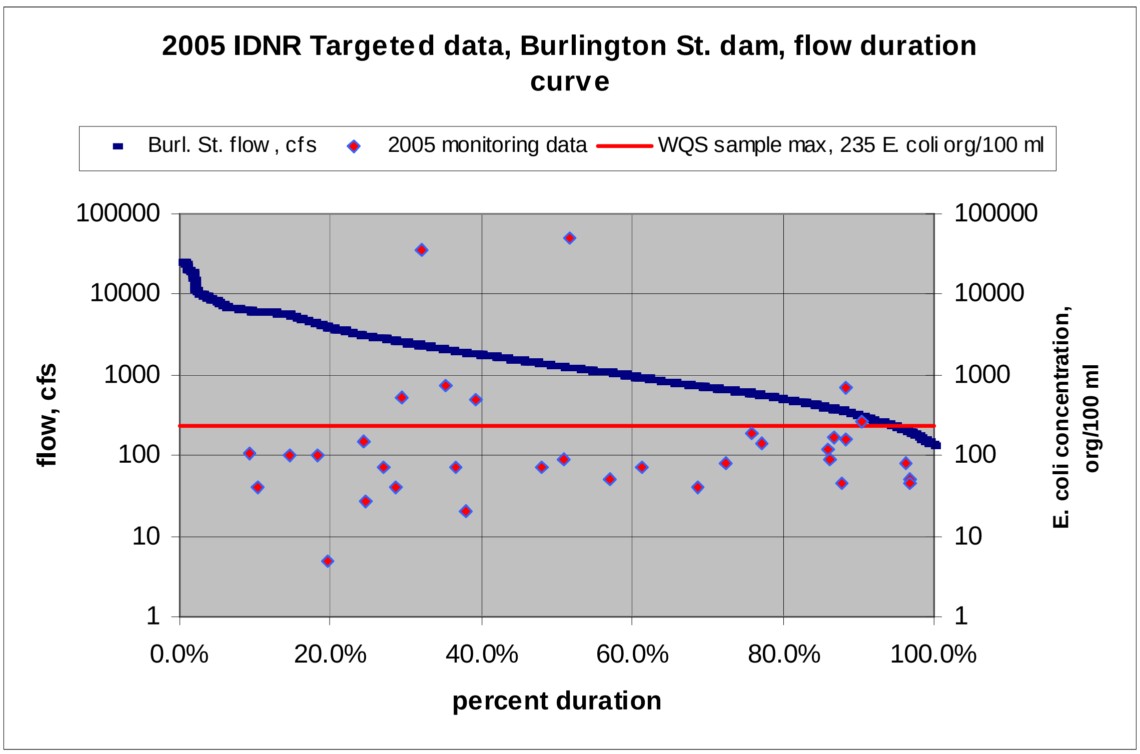

Figure 10 2005 IDNR Targeted IR data and downstream flow duration curve

Much of the drainage between the upstream and downstream data shown in Figures 7 to 10 comes from Clear Creek. It is below its confluence with the Iowa River that most of the exceedances over the bacteria criteria have been measured. Figure 11 shows the 2005 IDNR Targeted data from the Clear Creek downstream USGS gage site (CC1) plotted with the site flow duration curve. This chart shows that there are exceedances from the bacteria WQS across all flow conditions in Clear Creek. Note that there is not any data for the high flow condition (0 to 10 percent) because of the relatively short data collection time frame. In general, concentrations and loads are expected to be highest during runoff conditions when watershed bacteria available for wash-off are added to the continuous point source loads. There is a statistically significant relationship between flow and *E. coli* concentration as measured using the Kendall's tau (K-tau) robust line

(Helsel, et al, 1992) method, K-tau = 0.33 with p = 0.007. A K-tau of 0.33 compares to an R-squared of 0.50.

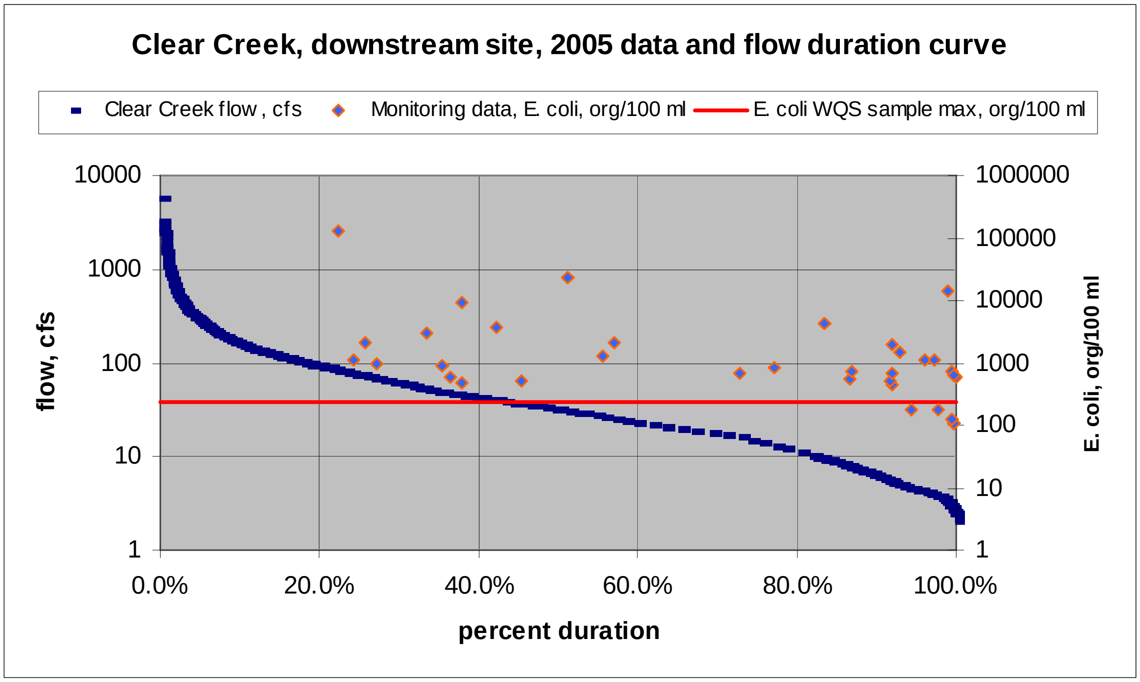

Figure 11 Clear Creek, 2005 IDNR Targeted data plotted with downstream USGS gage

The Rapid Creek flow and concentration were also evaluated using a flow duration curve based on the USGS gage data. The flow duration curve and the plotted concentration data are shown in Figure 12. The Rapid Creek flow duration curve shows that the WQ criteria are exceeded across all flow conditions where monitoring data is available. There is only one very small wastewater treatment plant in the Rapid Creek sub-watershed (Timber Trail Estates wwtp) and it is distant from the Iowa River. The IDNR Iowa City Upstream/Downstream Monitoring Project data, shown in the Figure 7 flow duration curve, was collected downstream of Rapid Creek. This data shows that loads from Rapid Creek seem to have a small impact on the Iowa River since the WQS *E. coli* criteria are rarely exceeded at this monitoring site downstream from Rapid Creek.

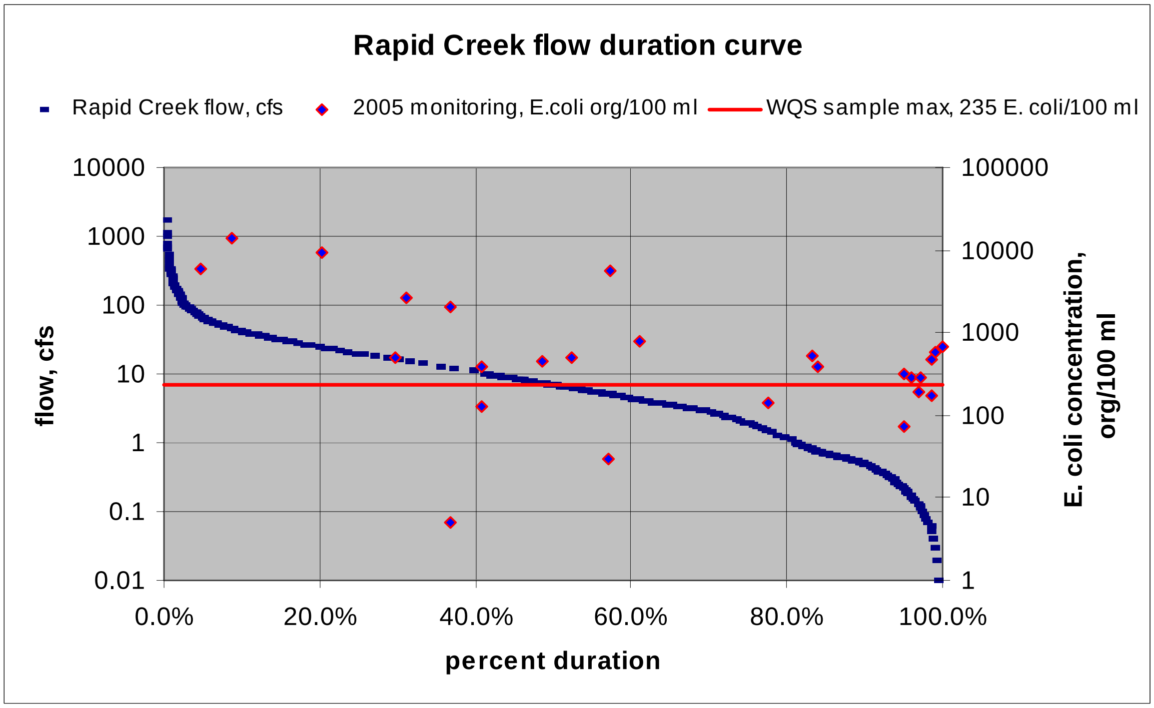

Figure 12 Rapid Creek, 2005 IDNR Targeted Monitoring data plotted with USGS gage flow duration percentile

Problem Definition. The approach that is usually used to evaluate the flow and load conditions that are causing the impairment is to determine if the WQS exceedances occur during high flow runoff conditions, i.e., nonpoint sources transported by precipitation, or low-flow conditions, i.e., continuously discharging point sources. The Iowa River bacteria data show something unusual - at the high flows there are not any WQS exceedances and they are uncommon at low flows. The criteria are exceeded mostly in the middle flow range, from 20 to 60 percent flow duration.

Examination of the upstream and downstream flow duration curves for the Iowa River and that for Clear Creek shows that bacteria in the Iowa River do not exceed the WQS until Muddy Creek, the lower part of the direct draining sub-watershed, and Clear Creek discharge into it. What is happening is that at high flows, i.e., zero to 20% duration, the volume of relatively bacteria free water discharged from Coralville Reservoir dilutes the direct draining watershed load so that bacteria indicator concentrations don't exceed the water quality criteria in the Iowa River. At low to mid-range Iowa River flows, when runoff from the watershed would be minimal, the loads from the continuous sources (wwtp's) are not usually, by themselves, sufficient to cause criteria exceedances in the Iowa River.

While this situation complicates the evaluation of the conditions causing the impairment, it is possible to use the ratio of Clear Creek to Iowa River flow to define the conditions that cause bacteria indicator concentrations to exceed the WQS. The relationship between the Clear Creek:Iowa River (CC:IR) flow ratios was analyzed using both parametric regression and non-parametric methods.

Bacteria data usually include extreme values and/or outliers that require transformations to approximate the normal probability distributions assumed for parametric analysis. The *E. coli* data were log transformed for the regression model. The natural log of *E. coli* was the response variable and the natural log of the CC:IR ratio was the explanatory variable for the regression. The regression equation produced is:

(ln *E. coli*, org/ 100 ml) = 11.3 + 1.79*(ln flow ratio, unitless)

The statistics for this regression are:

R-sq = 0.50
P-value for constant = 0.000
P-value for slope = 0.000
Press = 47

The R-squared statistic shows that the transformed regression model explains about half of the bacteria data variation. The data has also been evaluated using a non-parametric method that is less affected by outliers and non-normally distributed data. This is Kendall's tau robust line method (6). This procedure was applied to both the original *E. coli* data set and to the natural log transformed *E. coli* data set. The K-tau equation developed for the original *E. coli* data is:

(*E. coli*, org/100 ml) = 10,495 * (flow ratio, unitless) – 151

The K-tau equation developed for the log transformed *E. coli* data is:

(ln *E. coli*, org/ 100 ml) = 3.83 + 41.0*(flow ratio, unitless)

Because the Kendall's tau method is based on ranking of the data, the statistics for both K-tau equations are the same. These are:

Kendall's tau = 0.47 and p-value = 0.0005

Values for Kendall's tau use a different scale than the R-squared from regression and it runs about 20 units below R-squared. A K-tau of 0.47 is similar to an R-squared of 0.67 and in this instance is an improvement over the transformed regression (6). Figure 13 shows the three lines generated by these three equations. The values generated by the regression are the geometric mean since the applied log transform and re-exponentiation are the definition of the geometric mean. The values generated by the K-tau equations are the median since it is a procedure based on data ranking. The geometric mean and the median are generally equivalent. The WQS for bacteria are based on the geometric mean and so the values generated by these statistical methods are appropriate for evaluating bacteria impairments. The log-transformed data for both the regression and k-tau equations was un-transformed (exponentiated) to obtain the medians for the predictions.

These three equations have been applied to the Clear Creek/Iowa River flow ratio data to predict the *E. coli* concentration at the measured flow ratios. The results have been adjusted at the low bacteria concentration range for the first K-tau equation because some of the values generated by the equation are negative. Negative bacteria concentrations are physically impossible and the minimum value used was one organism/100 ml. The maximum *E. coli* concentration values for the three equations were set at 130,000 organisms/100 ml. This value was the highest measured concentration at the downstream Clear Creek gage station. These adjustments can be seen in the Figure 13 prediction lines.

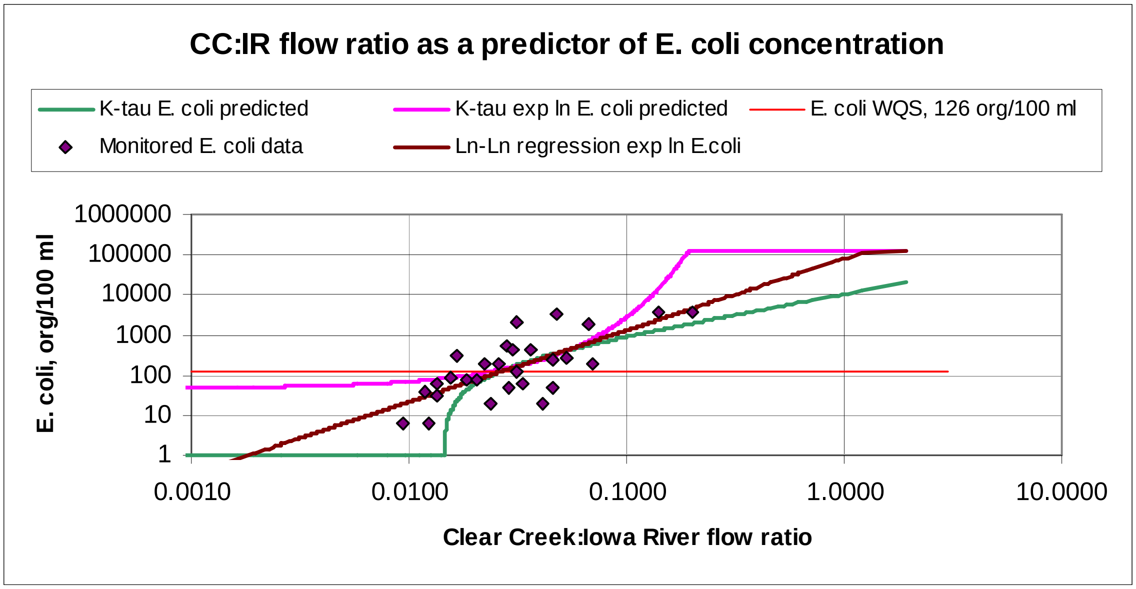

Figure 13 Applied K-tau and regression equations for flow ratio and *E. coli* median concentration

As can be seen in Figure 13, the two equations using log transformed *E. coli* data track well and the K-tau line developed using untransformed data under-predicts the median values. All three predictors converge near the geometric mean WQS of 126-organisms/100 ml, probably because this value is comfortably within the range of data used to develop these equations. An examination of the flow ratios and bacteria concentrations shows that the ratios for each equation at the WQS of 126-organisms/100 ml range from 0.0245 (K-tau ln *E. coli*) to 0.0263 (K-tau *E. coli*) to 0.0270 (regression ln *E. coli*). The lowest of these three values, 0.0245, was conservatively selected as the design value to describe the flow conditions for the two streams that define the unimpaired condition for the Iowa River segment, i.e., the TMDL. The design flow ratio and the flow duration curves can be used to develop the critical design flows for the Iowa River and Clear Creek and the loads from the gage sub-watersheds that cause the impairment.

*Design Flow and Loads, Iowa River***.** The load distribution among the sources and gage sub-watersheds are estimated in the BIT worksheet as shown in Figure 14. The nonpoint source livestock and wildlife loads transported to the Iowa River from each of the four land use categories; cropland, pastureland, forest and ungrazed pasture, and built-up; vary with the fraction of the fecal material available that is actually washed off when it rains. The other two nonpoint source categories; septic tanks and cattle in the streams, as well as the wastewater treatment plant point sources; are continuous and relatively unchanging over time. The scale used in Figure 14 is logarithmic - each increment represents an order of magnitude increase in load. The total for all three sub-watersheds is included to show that a large part of the potential load originates in the Clear Creek watershed.

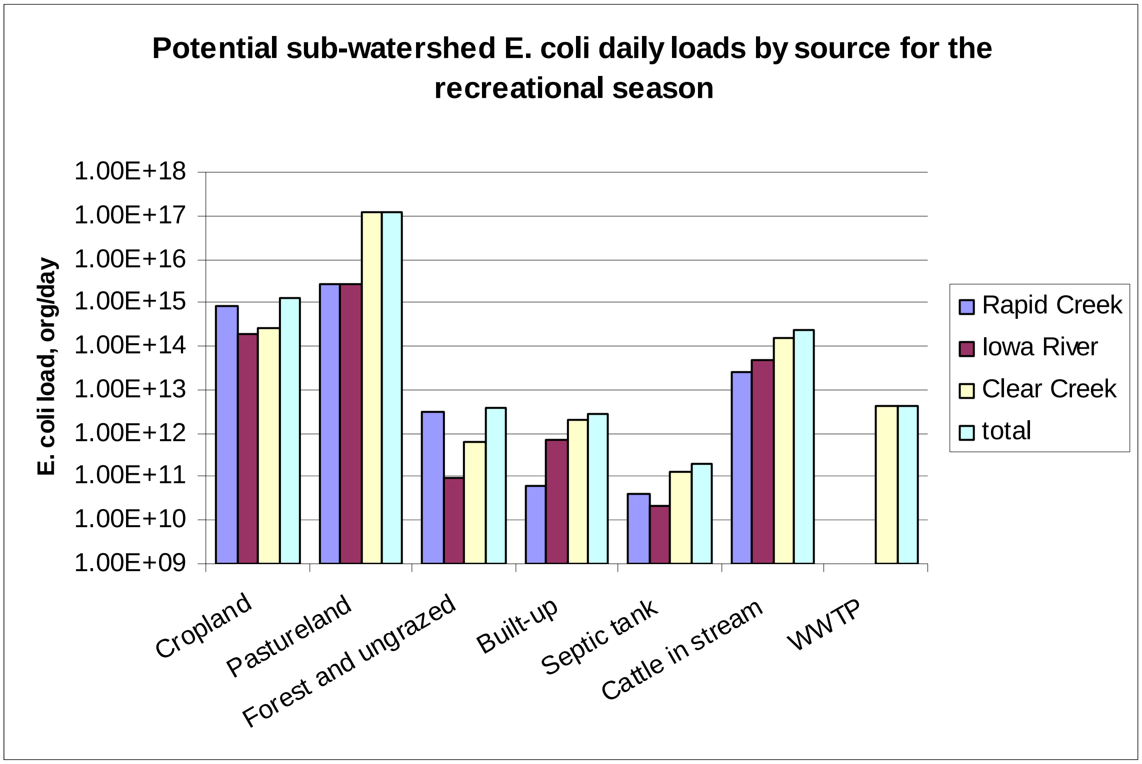

Figure 14 Potential bacteria sources by gage sub-watershed and the total of all three

Examination of the downstream flow duration curves and plotted monitoring data, Figures 9 and 10, shows that between zero and 20 percent flow duration, the *E. coli* criteria have not been exceeded. The flow at the 20th percentile is 3650 cfs. When the flows in the Iowa River exceed 3,650 cfs there are no measurements that exceed the WQS because of dilution.

The lowest Coralville Reservoir discharge for the evaluated gage data time period (1992 to 2006) was 130 cfs. This flow rate has been selected as a critical design value for the impaired Iowa River segment. This value is very conservative because it assumes that significant runoff conditions will exist in the Clear Creek watershed and the tributary flow will be high when the Iowa River flows are at their lowest. This is not likely but is not unprecedented since there can be heavy rain in the watershed at the same time that discharges from the reservoir are low.

Figure 13 shows the *E. coli* concentration maximum at 130,000 organisms/100 ml. When the CC:IR flow ratio is greater than 0.0245 exceedances over the *E. coli* WQS are likely. Examination of the Clear Creek and Iowa River flow and concentration data shows that when the Clear Creek flow is less than 3.5 cfs there is a low probability that the Iowa River will exceed the *E. coli* criteria.

The total maximum daily load that the Iowa River can take from the three gage sub-watersheds without exceeding the WQS pathogen indicator criteria can be calculated for this critical design flow. First, the load in the Coralville dam discharge must be estimated. This was done by taking the geometric mean for all of the upstream concentration monitoring data (IR1 site). This concentration is 22-organisms/100 ml. At the critical design flow of 130 cfs, the difference between the *E. coli* criteria of 126-organisms/100 ml and the load already in the river is 104-organisms/100 ml. These concentrations can be multiplied by the critical flow to get the maximum daily load that can be delivered from the sub-watersheds. Table 14 shows the loads in organisms per day for these concentrations at the critical design flow.

Table 14 Allowable maximum daily loads from the gage sub-watersheds

	CRITICAL DESIGN FLOW	***E. COLI* CONC., ORG/100 ML**	***E. COLI* LOAD, ORG/DAY**
E. coli WQS	130 cfs	126	4.01 E11
Existing load (Coralville discharge)	130 cfs	22	7.00 E10
Maximum daily load	**130 cfs**	**104**	**3.31 E11**

The maximum daily load in this table is the most stringent case of a maximum allowable load from the Clear Creek watershed including nonpoint and permitted point sources.

*Design Flows and Loads, Clear Creek***.** The allowable load from the Clear Creek watershed as shown in the preceding table is 3.31 E11 *E. coli* org/day. The Clear Creek monitoring data, plotted against the maximum allowable load in the Iowa River at its lowest flow in Figure 15, shows that the existing conditions often exceed the allowable load to the Iowa River, mostly at medium to high flows when runoff conditions exist.

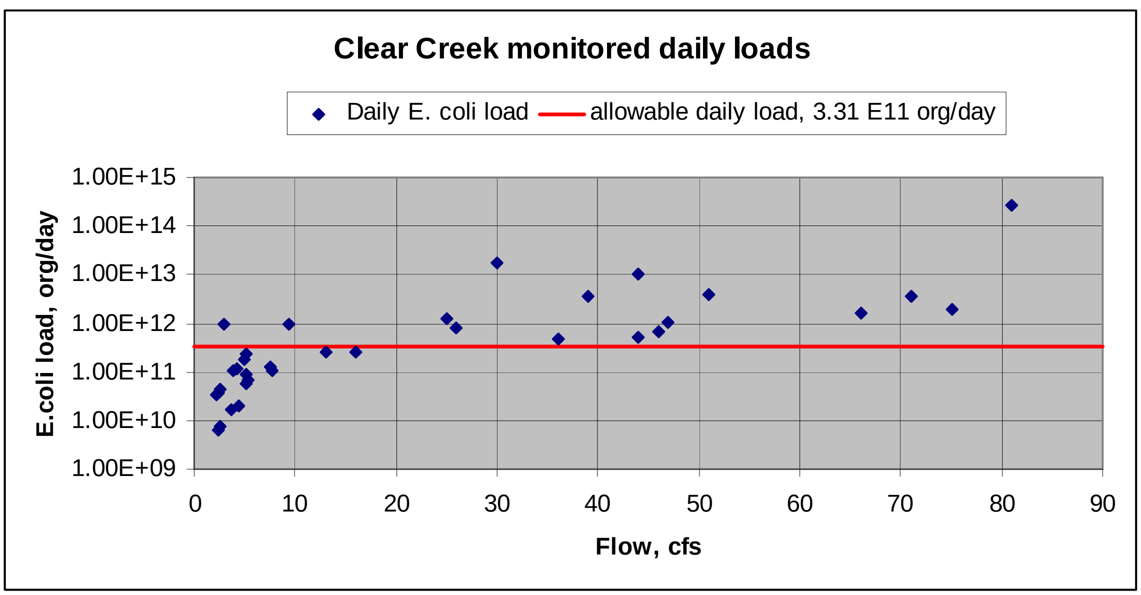

Figure 15 Measured and allowable *E. coli* loads vs. Clear Creek flow

*Waterbody Pollutant Loading Capacity***.** Bacteria waterbody loading capacity cannot be reasonably expressed as a mass per time. Because the risk and corresponding water quality criteria associated with bacteria are based on epidemiological studies relating illness rates to concentration, this TMDL is expressed as a relationship of concentration (number per volume) at a continuum of flow conditions, as shown in the preceding flow duration curves, Figures 7 through 11. Bacteria in this TMDL are also expressed as a number over time, e.g., organisms per day. The loading capacity is the number of *E. coli* organisms that are in a volume of the waterbody and does not exceed the WQS geometric mean of 126-org/100 ml.

Existing Load and Load Reductions Needed

The existing loads as measured for the Coralville Water Quality Monitoring Project (CWQMP) are shown in Figure 16 load duration curve. This curve is derived from the upstream flow duration curve and plotted monitoring concentration data in Figure 9. Multiplying the flow times the WQS *E. coli* criteria concentrations generates the curves shown. The monitored *E. coli* concentrations are multiplied by the average daily flow to get the monitored daily loads that are plotted with the load duration curves. The maximum allowable loads for a given flow equal the flow multiplied by the WQS limits for the geometric mean or single sample maximum. Monitored data that exceed the WQS criteria are above the curves.

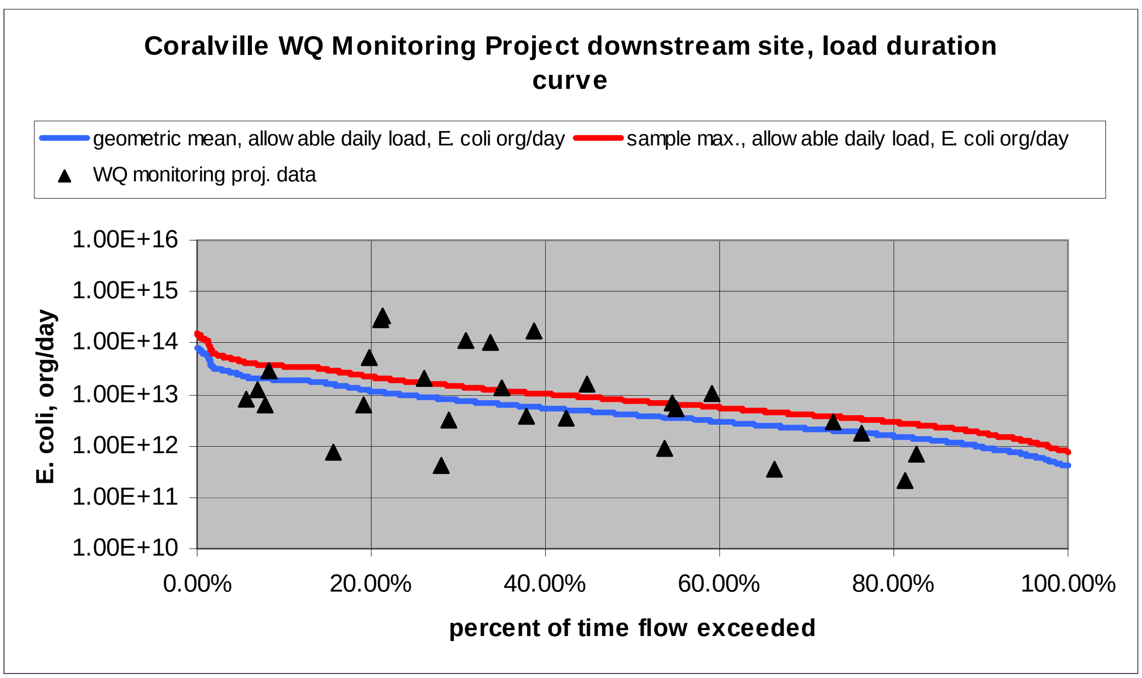

Figure 16 Load duration curve showing CWQMP existing monitored loads and WQS allowable loads.

Examination of Figure 16 shows that almost all exceedances occur in the flow range between the 20th and 60th percentile. To estimate the existing loads when the WQ criteria are exceeded, the geometric mean, the mean and the median of the CWQMP data values over 126 *E. coli* organisms/100 ml (WQS geometric mean criteria) were calculated for the 20th to 60th percentile flow duration range. The flow range was sub-divided into three sub-ranges for the estimates as shown in Table 15. The median concentration for each of the sub-ranges (20 to 30%, 30 to 40%, and 40 to 60%) corresponds to the existing load in the Iowa River for the specified flow condition. In Table 15, the needed load reduction for each flow condition was estimated by subtracting the allowable load from the existing load. The percent reduction for the 20 to 30 percent and 30 to 40 percent flow conditions were the same. Therefore, the load reduction needed is 94 percent for this data.

The WQS criteria were not exceeded in the highest flow range, zero to 20%. The calculated median load for the lowest flow range, 60 to 100%, did not exceed the allowable load at WQS concentrations.

Table 15 Iowa River existing load estimates for three flow conditions and reductions needed (CWQMP data)

PERCENT OF TIME FLOW EXCEEDED	**20 to 30%**		**30 to 40%**		**40 to 60%**	
	***E. coli*, org/100 ml**	**Flow, cfs**	***E. coli*, org/100 ml**	**Flow, cfs**	***E. coli*, org/100 ml**	**Flow, cfs**
	563	3850	1813	2420	431	1540
	3313	3610	2000	2180	250	1140
	3750	3590	269	2080	188	1120
	288	2920	3875	1850	438	987
Geomean	1191	3474	1394	2123	307	1180
Mean	1979	3493	1989	2133	327	1197
Median	1938	3600	1907	2130	341	1130
Median load/org/day	1.70712E+14	NA	9.93627E+13	NA	9.41461E+12	NA
Allowable load, org/day	1.10989E+13	NA	6.56685E+12	NA	3.48382E+12	NA
Difference	1.59613E+14	NA	9.27959E+13	NA	5.93079E+12	NA
Percent reduction needed	**93.5%**	NA	**93.4%**	NA	**63.0%**	NA

Looking again at the flow duration curve and *E. coli* data for this gage (IR3) without the a logarithmic scale for the flow, as shown in Figure 17, provides insight into what is going on hydrologically. There is a significant break in flow at the 20th percentile where the flow begins to quickly rise and dilute the loads coming in from the directly draining gage sub-watersheds during local precipitation events.

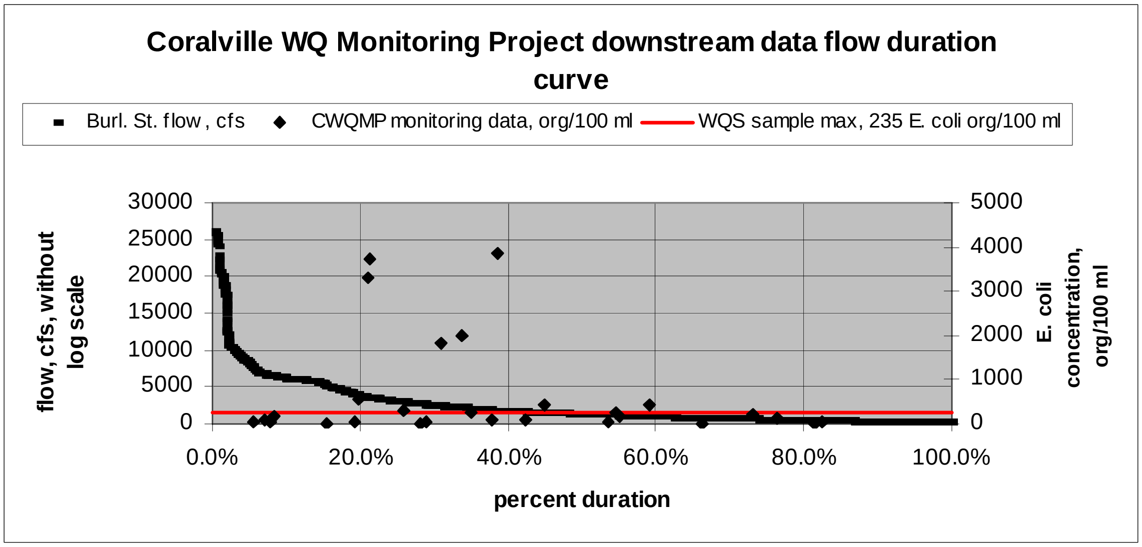

Figure 17 Downstream Iowa River flow duration without a log scale for flow

Iowa River Model The Iowa River was modeled using Qual2K (14) at a flow condition typical of the 20 to 40-percentile duration that occurred on May 12, 2005. The data for this modeling was obtained for the IDNR Targeted Monitoring Project that includes concentration data from upstream and downstream sites in the impaired Iowa River segment, Clear Creek, and Rapid Creek, as well as flow information from the five USGS gages in the watershed. The results of this modeling are shown in Figure 18.

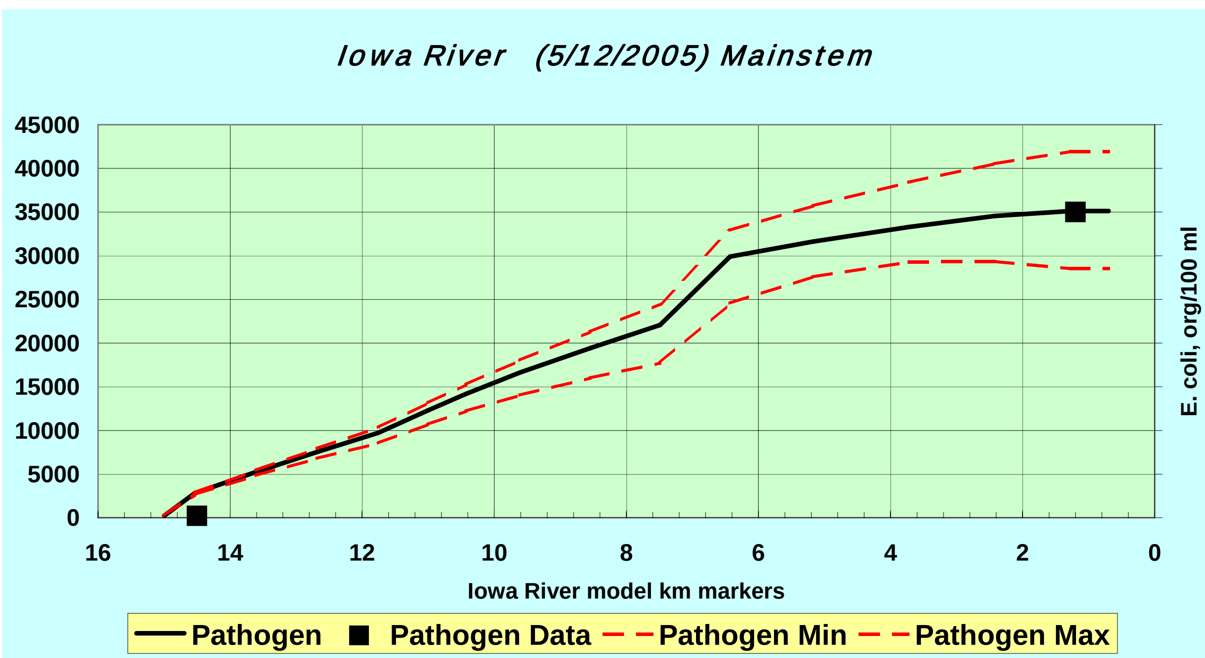

Figure 18 Modeled existing *E. coli* concentrations for the impaired Iowa River segment. The measured *E. coli* concentration at km marker 1.2 was 35,000-org/100 ml.

The x-axis in this chart shows the model km markers used for the model. Table 16 shows the important locations along the modeled segment and the associated *E. coli* load inputs.

Table 16 Longitudinal locations of important features in the Iowa River model

LOCATION NAME	MODEL KM MARKER	ESTIMATED *E. COLI* LOAD INPUT
Coralville dam discharge	15.42	1.13 E 13
Rapid Creek confluence	11.27	5.34 E 12
Iowa City Water Supply	11.00	NA
Muddy Creek confluence	9.90	4.40 E12
Clear Creek confluence	5.93	4.49 E 14
Burlington St. dam, end	0.00	NA

The bacteria inputs to the model were reduced by lowering the concentrations in the tributaries (model point sources) and for the directly draining part of the Iowa River gage sub-watershed. These reductions bring the modeled *E. coli* concentrations in the impaired segment into compliance with the WQS for pathogen indicators. Figure 19 shows the segment model maximum concentration to be 122 *E. coli* org/100 ml.

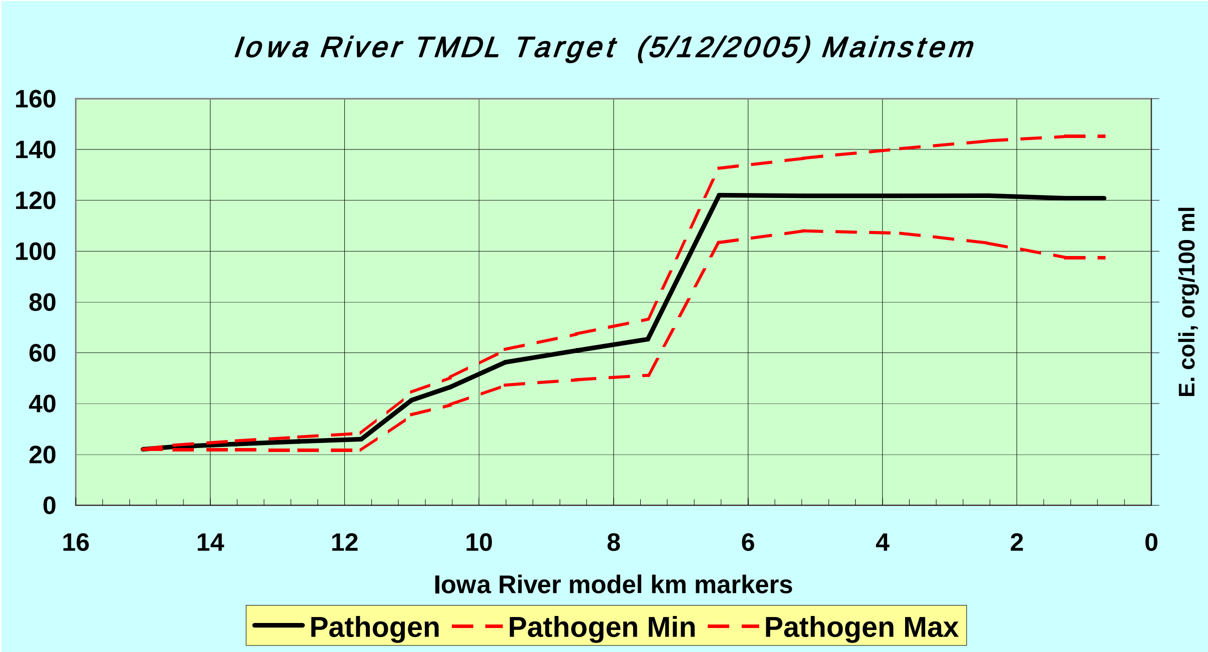

Figure 19 TMDL *E. coli* concentrations in the Iowa River

The reductions needed to achieve the WQS bacteria criteria are significant as shown in Table 17. The "diffuse flows" and the associated concentrations are for nonpoint source loads that are distributed in equal increments along the described reaches in the QUAL2K model (Chapra, 2006). The loads from the three creeks are modeled as point sources at their confluences with the Iowa River. The *E. coli* concentrations for the three creeks are those measured during the modeling period. The concentrations for the diffuse flows are estimates based on the number of organisms required to equal the measured Iowa River concentration of 35,000 organisms/100 ml at the Burlington Street dam site. The TMDL concentration targets in Table 17 are those that would not cause *E. coli* in the Iowa River to exceed the WQS criteria of 126-organisms/100 ml.

Table 17 Existing concentrations reductions needed to meet target concentrations during a precipitation event (1.5 inches)

SOURCE	EXISTING CONC., *E. COLI* ORG/100ML	TMDL CONC. TARGET, *E. COLI*/100 ML
Diffuse flow 1, Coral. dam to Rapid Creek	250,000	200
Diffuse flow 2, Rapid Creek to Muddy Creek	400,000	1000
Diffuse flow 3, Muddy Creek to Clear Creek	500,000	1000
Diffuse flow 4, Clear Creek to Burl. St. dam	500,000	1000
Rapid Creek	9100	1000
Muddy Creek	10,000	1000
Clear Creek	140,000	1200

Linkage of Sources to Target

The nonpoint sources are estimated in the Bacteria Indicator Tool worksheet. They consist of fecal material that accumulates on the ground until it rains and it is carried to streams in the runoff, and a component that continuously discharges made up of failed septic tank discharge and cattle in streams making direct deposits. The accumulation on land and the fraction that washes off and is transported to the stream has been estimated by subtracting what was measured in Clear Creek from the total BIT estimate. For Clear Creek the existing continuous nonpoint and permitted point sources are subtracted from the measured load to the Iowa River. The estimated loads are shown in Table 18.

Table 18 Clear Creek loads and wash-off delivery

Load source	Load, *E. coli* org/day
Septic tanks	1.44 E10
Cattle in stream	6.18 E12
Wastewater treatment plants	4.65 E11
Total continuous load	6.65 E12
Clear Creek monitored load	4.62 E14
BIT wash-off potential load	1.46 E16
Fraction of potential wash-off delivered to Iowa River	0.031

Clear Creek Model Clear Creek was modeled for the same period, May 12, 2005, as the Iowa River model. The flows and loads from the Clear Creek model were used as inputs into the Iowa River. The data for this modeling was obtained for the IDNR Targeted Monitoring Project that includes concentration data from two sites on Clear Creek and flow information from the USGS gages at the two sites. The results of this modeling are shown in Figure 20.

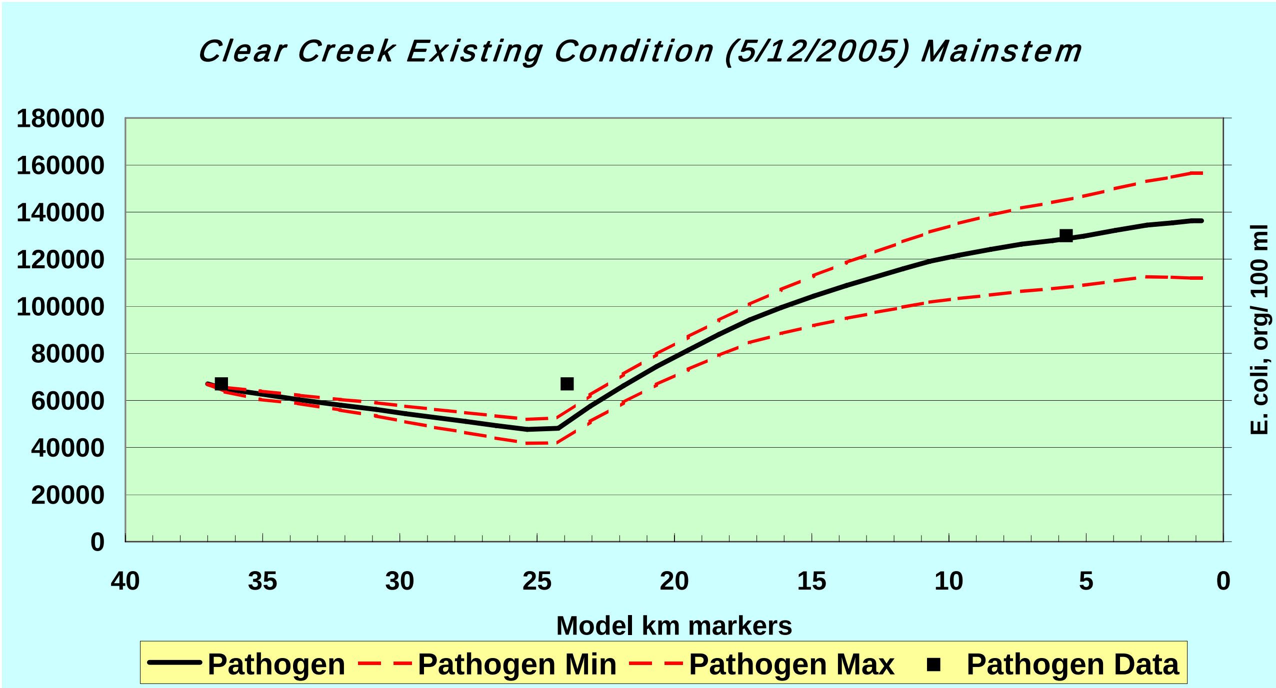

Figure 20 Clear Creek modeled existing *E. coli* concentrations. The measured *E. coli* concentration at km marker 5.7 was 130,000-org/100 ml at a flow of 114 cfs.

The x-axis in this chart shows the model km markers used for the model. Table 19 shows the important locations along the modeled segment and the associated *E. coli* load inputs.

Table 19 Longitudinal locations of important features in the Clear Creek model

LOCATION NAME	MODEL KM MARKER	ESTIMATED *E. COLI* LOAD INPUT
Headwater[1]	36.50	1.64E+14
Diffuse flow one[2]	23.90 to 5.72	4.26E+14
Diffuse flow two[3]	5.72 to 0.80	1.25E+14
Four semi-public wwtp[4]	36.50	4.65E+11
Sleepy Hollow wwtp	34.50	2.52E+10
Oxford wwtp	28.30	7.96E+11
Parkview Mobile Home wwtp	25.10	2.07E+12
Tiffin wwtp	5.85	2.04E+10

1. The headwater load is the measured flow and concentration at the upstream USGS gage and monitoring site (CC2). There are no diffused flows modeled above the upstream gage location.
2. Incremental flow distributed equally along Clear Creek between the upstream (CC2) and downstream (CC1) USGS gage sites.
3. Incremental flow distributed equally along Clear Creek between the downstream (CC1) USGS gage site and the confluence with the Iowa River.
4. The inputs for four wastewater treatment plants are assumed to be at the discharge of the westernmost HUC 12 in the Clear Creek watershed. The HUC 12 discharge is located at model km 36.5.

As shown earlier in Table 17, the target bacteria concentration for the Clear Creek discharge to the Iowa River for the modeled condition was 1,200 *E. coli* org/100 ml. The target concentration is over the WQS criteria because it is assumed that the Iowa River would dilute the load to below 126-organisms/100 ml. Lowering the concentrations of the wastewater treatment plants to the WQS reduced the bacteria inputs to the model by reducing the nonpoint source loads modeled as diffuse inputs. These reductions bring the modeled Clear Creek *E. coli* concentrations to 1200 org/100ml at the confluence with the Iowa River. Figure 21 shows the creek model with the reductions and a maximum concentration of 1200 *E. coli* org/100 ml at the confluence.

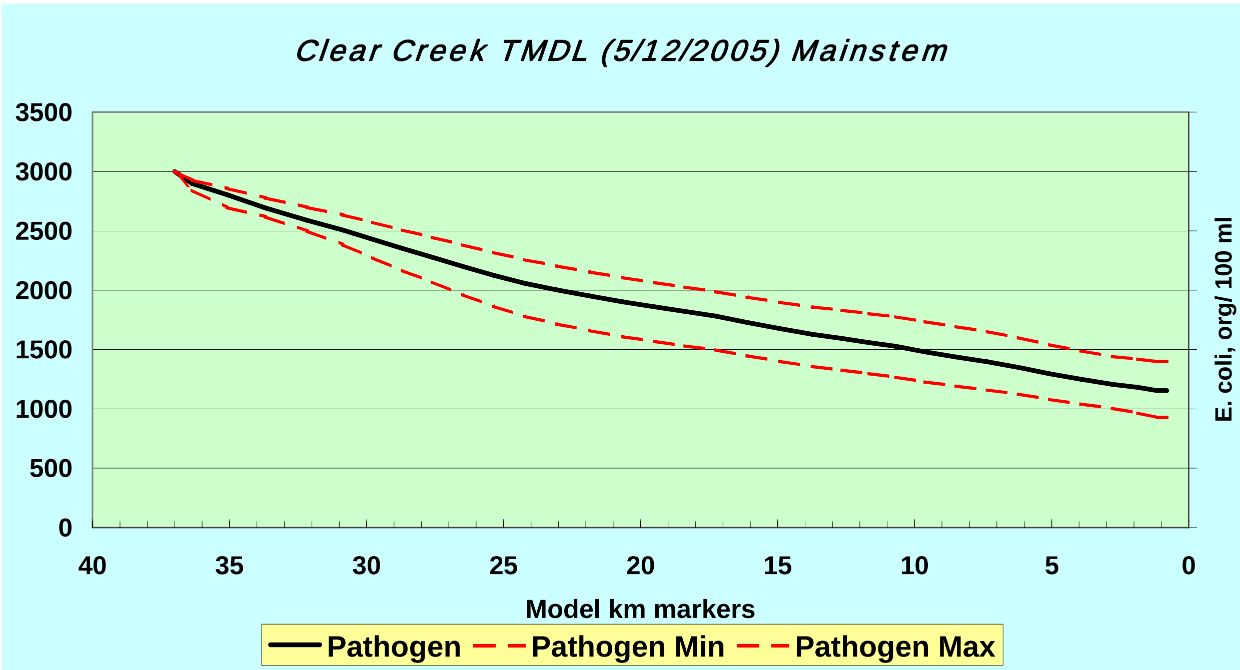

Figure 21 Clear Creek *E. coli* conc. reduced to Iowa River TMDL requirements

As with the results from the Iowa River model, the reductions needed are significant in the Clear Creek sub-watershed to achieve the target loads. The existing and TMDL target concentrations are shown in Table 20.

Table 20 Existing and target *E. coli* concentrations for the modeled precipitation event (1.5 inches)

SOURCE[1]	EXISTING CONC., *E. COLI* ORG/100ML	TMDL CONC. TARGET, *E. COLI*/100 ML
Headwater	67,000	3000
Diffuse flow 1	700,000	3000
Diffuse flow 2	700,000	1500
Colony Investment wwtp	65,000	126
Days Inn wwtp	43,000	126
Amana-Nordstrom Inc. wwtp	180,000	126
Colony Village Rest. wwtp	82,000	126
Sleepy Hollow Campground wwtp	84,000	126
Oxford wwtp	40,000	126
Parkview Mobile Home wwtp	28,000	126
Tiffin wwtp	49,000	126

1. See Table 19 footnotes on headwater and diffuse flows.

3.4 Pollutant Allocations

Wasteload Allocations

The wasteload allocations for the ten-wastewater treatment facilities discharging to the Iowa River or its tributaries are in Table 21. If a wwtp discharges directly to the Iowa River then the wasteload allocation is the same as the *E. coli* water quality standard, a geometric mean of 126-organisms/100 ml and a single sample maximum of 235-organisms/100 ml. These values present the same risk for pathogen exposure as fecal coliform values of 200-organisms/100 ml and 400-organisms/100 ml, respectively. The wasteload allocations for facilities that are a distance from the impaired segment are calculated using the standard bacteria die-off equation (See Table 21, footnote 3.). This equation incorporates the die off coefficient and velocity shown in Table 21. Currently Iowa wasteload allocations are for *E. coli* and NPDES permit bacteria limits are in fecal coliform concentrations.

Table 21 Permitted Wastewater Treatment Plant discharge Wasteload Allocations

NPDES PERMITTED MUNICIPAL/SEMI-PUBLIC TREATMENT FACILITIES			Die off Coefficient, one/day [3]		0.96	
			Stream Velocity (miles per day)		16	
City Name	**EPA NPDES ID**	**Receiving Stream**	**Miles to Impaired Reach**	**Fraction after Decay**	***E. coli* WLA[2]**	
					Geometric mean	**Sample Max.**
City of North Liberty STP[1]	IA0032905	Muddy Creek	5.3	0.73	173	323
Amana-Nordstrom Inc.	IA0066265	Unnamed Tributary to Clear Creek	25.0	0.22	565	1054
Colony Investment Services - STP	IA0074225	Unnamed Tributary to Clear Creek	25.7	0.21	589	1099
Colony Village Restaurant	IA0069035	Unnamed Tributary to Clear Creek	24.6	0.23	552	1030
Days Inn	IA0065838	Unnamed Tributary to Clear Creek	24.6	0.23	552	1030
Oxford, City of STP	IA0032531	Hertzel Run to Clear Creek	14.9	0.41	308	574
Parkview Mobile Home Court	IA0068349	Clear Creek	14.0	0.43	292	545
Sleepy Hollow Campground	IA0069094	Unnamed Tributary to Clear Creek	18.8	0.32	389	726
Tiffin, City of STP	IA0036617	Clear Creek	7.7	0.63	200	373
Timber Trails Estates Homeowner's Assoc.	IA0069108	Sanders Creek to Iowa River	3.1	0.83	152	283

1. The North Liberty wastewater treatment plants currently have wasteload allocations for *E. coli* as shown above and NPDES permit limits for fecal coliform that are the equivalent risk to the *E. coli* WLA.
2. Units are *E. coli* organisms/100 ml.
3. The standard die off equation is $C_x = C_o / e^{kt}$

Where: Co = Initial bacteria count organisms/100 milliliters or organisms per day at the discharge.

C_x= Concentration or daily load at a point distance "x" downstream of the discharge.

k = first order decay coefficient, 0.96/day

t = time of travel, days

Built-up or urban land use is 11% of the total impaired segment watershed. Residential, roadway, and commercial land uses may be included in the nonpoint bacteria sources or as point sources under municipal stormwater NPDES permits. There are four MS4 discharge permits in the watershed as shown in Table 22. Stormwater runoff from Coralville and North Liberty and a large part of runoff from Iowa City and the University of Iowa flows to the impaired Iowa River segment. The land areas covered under the MS4 permits are shown in Table 22.

The wasteload allocation targets for the MS4 permit are assumed to be the same as for runoff nonpoint sources as shown in Tables 23 and 24. The State of Iowa has issued MS4 stormwater permits with associated best management practices (BMPs) to control these bacteria contributions.

Table 22 Municipal NPDES MS4 Stormwater Permits and Wasteload Allocations

CITY NAME	EPA NPDES ID	RECEIVING STREAM	MILES TO IMPAIRED REACH	AREA COVERED UNDER MS4, SQ. MI.	WASTELOAD ALLOCATION[1]
Coralville MS4	IA0078646	Clear Creek	3.1 (5.0 km)	10.2	BMP
Iowa City MS4	IA0078298	Iowa River	0	24.4	BMP
North Liberty MS4	IA0078794	Muddy Creek	5.3 (8.5 km)	6.8	BMP
Univ. of Iowa MS4	IA0078182	Iowa River	0	Included in Iowa City area	BMP

1. Wasteload allocations for the MS4 permits are associated with best management practices (BMP) to control bacteria.

There are no permitted feedlots in the impaired Iowa River segment watershed.

Load Allocations

The load allocations for this TMDL apply to the continuous loads (septic tanks and cattle in streams) as well as the fecal materials that wash off during rain events. The allocations are based on the data set that was used in the assessment that found that recreational uses were not supported and are shown in Table 23.

Table 23 Load allocations and needed reductions for Iowa River flow conditions

PERCENT OF TIME FLOW EXCEEDED	20 to 30%		30 to 40%		40 to 60%	
	E. coli, org/100 ml	Flow, cfs	*E. coli*, org/100 ml	Flow, cfs	*E. coli*, org/100 ml	Flow, cfs
Median values	1938	3600	1907	2130	341	1130
Median load/org/day	1.70712E+14		9.93627E+13		9.41461E+12	
Load Allocations, org/day	1.10989E+13		6.56685E+12		3.48382E+12	
Difference	1.59613E+14		9.27959E+13		5.93079E+12	
% reduction needed	93.5%		93.4%		63.0%	

There is an additional condition that requires a load allocation when Iowa River flow is at its lowest. At the lowest discharge rate from the Coralville Reservoir, 130 cfs, a relatively small event in the watershed can adversely impact the Iowa River bacteria concentration. Table 24 shows the load allocation for this low flow condition.

Table 24 Iowa River low flow Load Allocation

	CRITICAL DESIGN FLOW	***E. COLI* CONC., ORG/100 ml**	***E. COLI* LOAD, ORG/DAY**
E. coli WQS	130 cfs	126	4.01 E11
Existing load	130 cfs	22	7.00 E10
Load Allocation, low flow	**130 cfs**	**104**	**3.31 E11**

3.5 Margin of Safety

In 2004, the Iowa Department of Natural Resources converted from fecal coliform to *E. coli* bacteria as the indicator for primary contact recreation assessment. Although *E. coli* may be a better indicator of human health issues for primary contact recreation assessment, it has not always been used in the development of this TMDL because some of the data and many of the bacteria source references use fecal coliform. Because of the data consideration that *E. coli* is a subset of fecal coliform, it follows that in a given sample, the E.coli level will always be less than the corresponding fecal coliform level. This TMDL is expressed as a load reduction set at the *E. coli* standard. The margin of safety is thereby implicit due to targeting fecal coliform reductions at the *E.coli* standard level. An additional implicit margin of safety is included based on the conservative assumptions used throughout the analysis and development of this TMDL. Of these, the most significant is the use of the lowest flow from Coralville Reservoir to determine the critical maximum allowable load (flow * WQS concentration) when there is significant runoff and load from Clear Creek into the Iowa River, a situation that is unlikely to occur.

3.6 Reasonable Assurance

Reasonable assurance is a demonstration that the wasteload and load allocations will be realized through regulatory or voluntary actions. For waterbodies impaired by both point and nonpoint sources, such as the impaired segment of the Iowa River, wasteload allocations may reflect anticipated or expected reductions of pathogen indicators from other sources if those anticipated or expected reductions are supported by a reasonable assurance that they will occur (CFR 40-130.2g).

The TMDL wasteload allocations for the NPDES permitted point sources in the Iowa River watershed require that wastewater treatment plants effluent meet the water quality standards for discharges directly to Iowa River. For wastewater treatment plants that discharge to a tributary of Iowa River, the effluent must meet the water quality standards where it flows into the Iowa River as calculated in this report.

These wasteload allocations are implemented through the Iowa NPDES permitting procedure following rules in the Iowa Administrative Code (567-64). This means that no permitted point sources are allowed to discharge pathogen indicators at a concentration that causes a violation of the pathogen indicator water quality standards. Further pathogen indicator reductions below the wasteload allocations in this document cannot improve Iowa River compliance with the water quality standards.

Reasonable assurance for nonpoint sources will be accomplished through methods and projects that reduce the impacts of livestock as described in *Section 4: Implementation Plan.*

4. IMPLEMENTATION PLAN

This report represents a first phase in the development of a project to improve Iowa River water quality. The value of these evaluations and the effectiveness of their follow-up depend on community activities to improve watershed conditions. Without the efforts of local citizens, the implementation of practices that will solve Iowa River water quality problems will likely result in limited success.

As the first phase of a watershed improvement plan, this report sets specific and quantified targets for pathogen indicator concentrations in the Iowa River and allocates allowable loads to bacteria sources. For an effective second phase, watershed stakeholders will need to participate in the implementation of pollutant controls and to continue evaluating water quality. Initially this will require:

- A much more detailed and systematic assessment of potential nonpoint pollutant sources that shows the source location, magnitude, and relative impact based on proximity to streams and runoff controls in place. This will require knowledgeable persons out in the watershed evaluating and noting what they see.

- An ongoing evaluation of data collected for the MS4 stormwater permit sampling requirements for the three cities in the watershed that have MS4 permits. This aspect will become increasingly important as the watershed becomes more built up.

- Continue targeted monitoring and enhance it as described below in *Section 5. Monitoring*.

- Make better connections between pollutant sources and the streams and the hydrological conditions that lead to impairment using increasingly focused and improved evaluation methods and models.

- This is a watershed that has a relatively large number of USGS gages (five) that could provide information to drive more sophisticated hydrologic and water quality models. This kind of modeling would provide a better understanding of the hydrologic conditions that lead to the pathogen indicator impairment and a better understanding of the relationship of the Coralville dam releases and the loads from Rapid, Muddy, and Clear Creeks. The prospects for this advanced modeling are better here than in other places because of the proximity of the University of Iowa.

- Apply watershed and water quality models to provide information on what implemented best management practices will have the most impact and where they can be most effectively employed.

Existing pathogen loading to the impaired segment of the Iowa River originates primarily from nonpoint sources within the watershed. These sources include septic systems, livestock, and wildlife. Reductions in these loads will require changes in the way manure and other waste is managed and these changes will take time to implement.

If goals are to be accomplished, objectives, and a schedule to reach these goals, must be set. Below is an example of specific objectives and a timetable that suggests how Iowa River water quality might be improved.

1. Identify, assess, and rank the potential nonpoint sources within one half mile of the Iowa River, Rapid Creek, Muddy Creek, and Clear Creek. Select the best management practices for each source. Complete this by the end of 2008.
2. Begin implementation of the best management practices by priority ranking for the nonpoint sources identified in step 1. Reduce the identified nonpoint source pathogen loading by 25% by 2010.
3. Measure *E. coli* in all major storm sewer outfalls to the Iowa River and its tributaries to establish the urban impact and revise MS4 permit conditions to ensure targeted pathogen reductions. This could involve inspecting and repairing leaky or cross-connected sanitary sewers and eliminating sanitary sewer overflow. Complete by the end of 2008.
4. Continue the process of identifying, assessing and ranking nonpoint sources and selecting BMPs outward from the streams in half-mile increments every two years until the entire watershed has been covered.
5. The most critical flow condition occurs when the Coralville discharge is lowest, it rains in the directly draining watershed, and the runoff flows become a significant fraction of the Iowa River volume between the two dams. It might be worth investigating whether or not the Coralville Reservoir discharge can be temporarily increased during this hydrologic condition. The flow records show at least one instance when the runoff from the watershed was twice as high as the Coralville discharge.

Some best management practices for reducing pathogen indicators are:

- Limiting livestock access to waterways in pastures and providing alternate watering sources.
- Controlling manure runoff. Manure application should utilize incorporation or subsurface application of manure while controlling soil erosion. Incorporation

physically separates fecal material from surface runoff. Buffer strips should be installed and maintained along the streams and tributaries to slow and divert runoff.

- Identifying, repairing, or replacing improperly connected and malfunctioning septic tank systems with on-site systems that meet state design standards.
- Discharges from all wastewater treatment facilities should be sampled for pathogen indicators and disinfected if they do not meet wasteload allocation targets.
- Immediate removal of pet feces from the ground in urbanized areas where storm sewers have a direct connection to streams.

An implementation plan is not a required component of a TMDL document but it is a useful and logical extension of TMDL development. It provides IDNR staff, partners, and watershed stakeholders with a general idea of how a specific strategy and work plan can be developed. This strategy should guide stakeholders and the IDNR in the development of a detailed and priority-based plan that implements best management practices, improves Iowa River water quality, and meets TMDL targets.

As a first step, it would be useful to create a local watershed advisory committee that could identify high priority areas within the impaired Iowa River segment watershed where resources can be concentrated for the greatest effect. In addition, priority best management practices based on effectiveness should be identified for implementation. Since the impairment problem occurs at many flow conditions, solutions will need to be implemented for nonpoint sources with event driven transport, nonpoint sources that behave like continuous sources such as cattle in streams and failed septic tank systems, and continuous point sources such as wastewater treatment plants.

5. MONITORING

As noted in the implementation plan, follow-up to this report requires stakeholder driven solutions and more effective management practices. Continuing monitoring plays an important role in determining what practices result in load reductions and the attainment of water quality standards. Continued targeted monitoring will:

- Assess the future beneficial use status;
- Determine if water quality is improving, getting worse, or staying the same;
- Evaluate the effectiveness of implemented best management practices.

Phasing TMDLs is an iterative approach to managing water quality that is used when the origin, nature and sources of water quality impairments are not completely understood. In this first phase, the waterbody load capacity, existing pollutant load in excess of this capacity, and the source load allocations are estimated based on the resources and information available. Follow up phases require monitoring activities that provide information on the water quality changes taking place.

Some of the monitoring projects that provided the data used to create this report will go on. Monitoring of Iowa River bacteria will continue at the upstream (IR1) and Burlington Street dam (IR3) sites as part of the continuing Coralville Water Quality Monitoring Project and the IDNR ambient monitoring program. Data collected at these sites will continue to be used by the IDNR for its biannual water quality assessments (305(b) report) of the Iowa River. There is also a plan to continue the targeted monitoring through 2007, although sampling will be done bi-monthly rather than weekly and it will be only for *E. coli* bacteria and nitrate and ammonia. The two sites on Clear Creek and the one site on Muddy Creek are sampled once a month.

Due to resource limitations, the targeted Iowa River, Rapid Creek, Muddy Creek, and Clear Creek monitoring do not provide all of the data that would enhance modeling and evaluation of the water quality problems in this segment of the Iowa River. Some useful additions to the monitoring design would be:

- More frequent sampling at the gage sites during a wider range of flow conditions, especially at high flows during the rising part of the hydrograph. This would provide a more accurate picture of what the actual bacteria loads are from nonpoint sources.

- Analyze samples for both *E. coli* and fecal coliform. This would do two things; provide some measure of assurance that a single value was not a fluke of the lab work or a particular sample, and provide data that is more easily compared to historical data and source references where the research was reported as fecal coliform.

- Select hydrologic and water quality models to use in future evaluations of the Iowa River and then collect data and samples that speak directly to the data needs of that model. An example of such a model is the Water Quality Analysis Simulation Program (WASP).

- Install an autosampler and continuous flow meter on Muddy Creek near its confluence with the Iowa River. Grab sampling does not provide data that can be used to estimate the loads for mass balances (numbers of organisms).

- Install an autosampler and continuous flow meter on Rapid Creek near the confluence with the Iowa River. The Rapid Creek USGS gage is over five miles upstream and misses a significant part of the sub-watershed.

- Install two autosamplers with stage measurement on the Iowa River, one at the Dubuque Street monitoring site downstream of Rapid Creek, and another just upstream of Clear Creek. The TMDL estimates for loads coming in from the center Iowa River gage sub-watershed are large and it would help to locate and quantify the sources of these loads more accurately.

- Perform an annual trend analysis on the load estimates to provide information on the effectiveness of implemented BMPs. This could be part of an ongoing data analysis program that includes a statistical design for the number of samples required to achieve desired confidence in the results.

6. PUBLIC PARTICIPATION

The department has put together and implemented a plan to inform the public and stakeholders and get input and feedback for the Iowa River watershed TMDL project report and activities. The plan included a public meeting held on September 14, 2005 at the Iowa City Water Supply Plant in Iowa City. Seventeen persons attended the Iowa City meeting, including staff from city, county, state, and federal government agencies; concerned citizens, including three Iowater water quality monitoring volunteers; and one reporter who wrote an article in the University of Iowa newspaper.

A second public meeting was held in Iowa City at the Iowa City Water Plant on January 31, 2007 to present and discuss the draft TMDL. The purpose of this meeting was to provide information related to the draft TMDL and to obtain public and stakeholder input and comment on TMDL development and conclusions. Representatives from the City of Iowa City, University of Iowa, NRCS, Johnson County Board of Supervisors, and the general public attended this meeting. Comments received were reviewed and given consideration and, where appropriate, incorporated into the TMDL.

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Zenner, Guy. IDNR Wildlife Waterfowl Biologist, December 2005. Personal communication with EPA staff.

APPENDIX A – WATERSHED MAPS

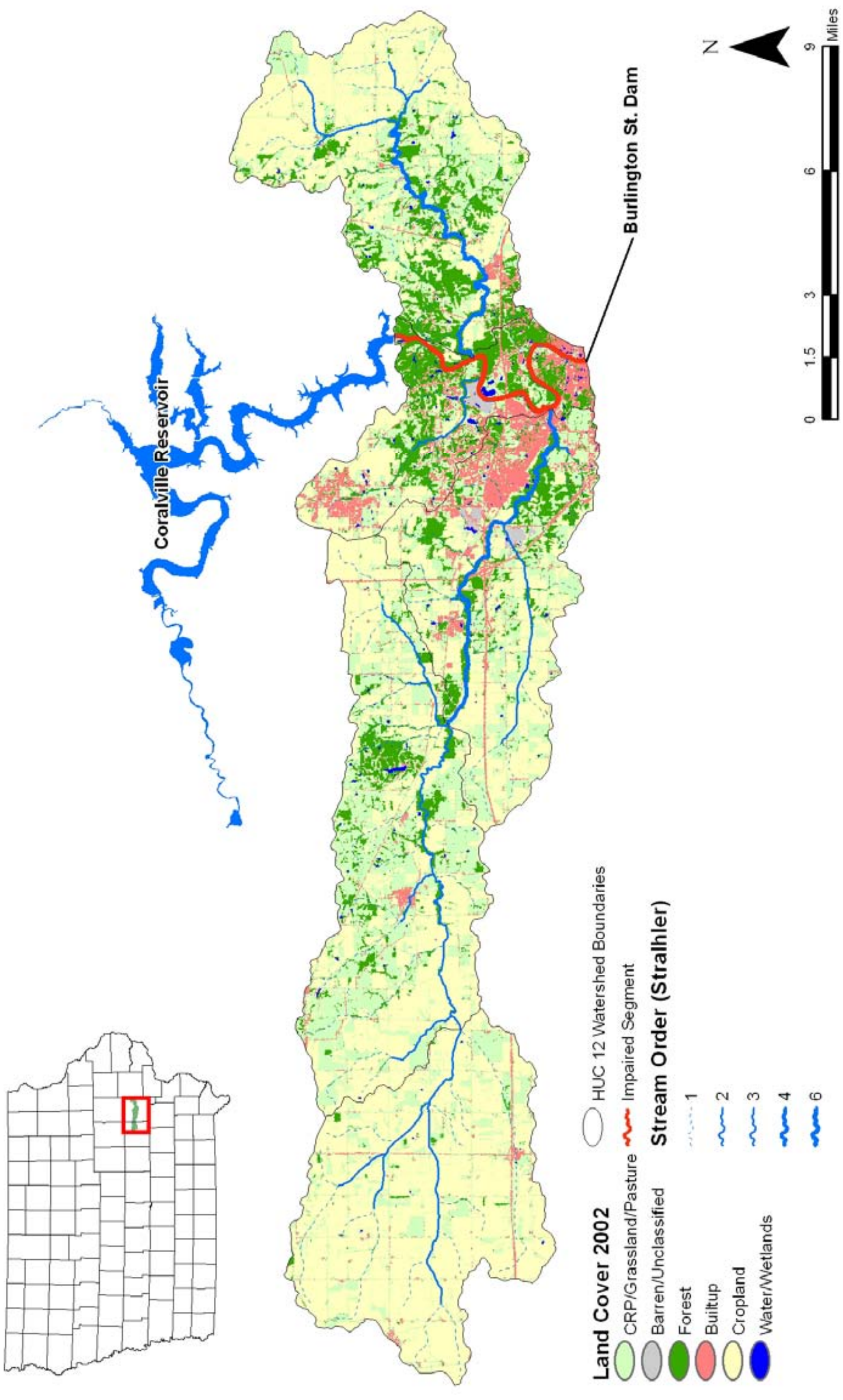

Figure A1 Landuse in the directly draining watershed

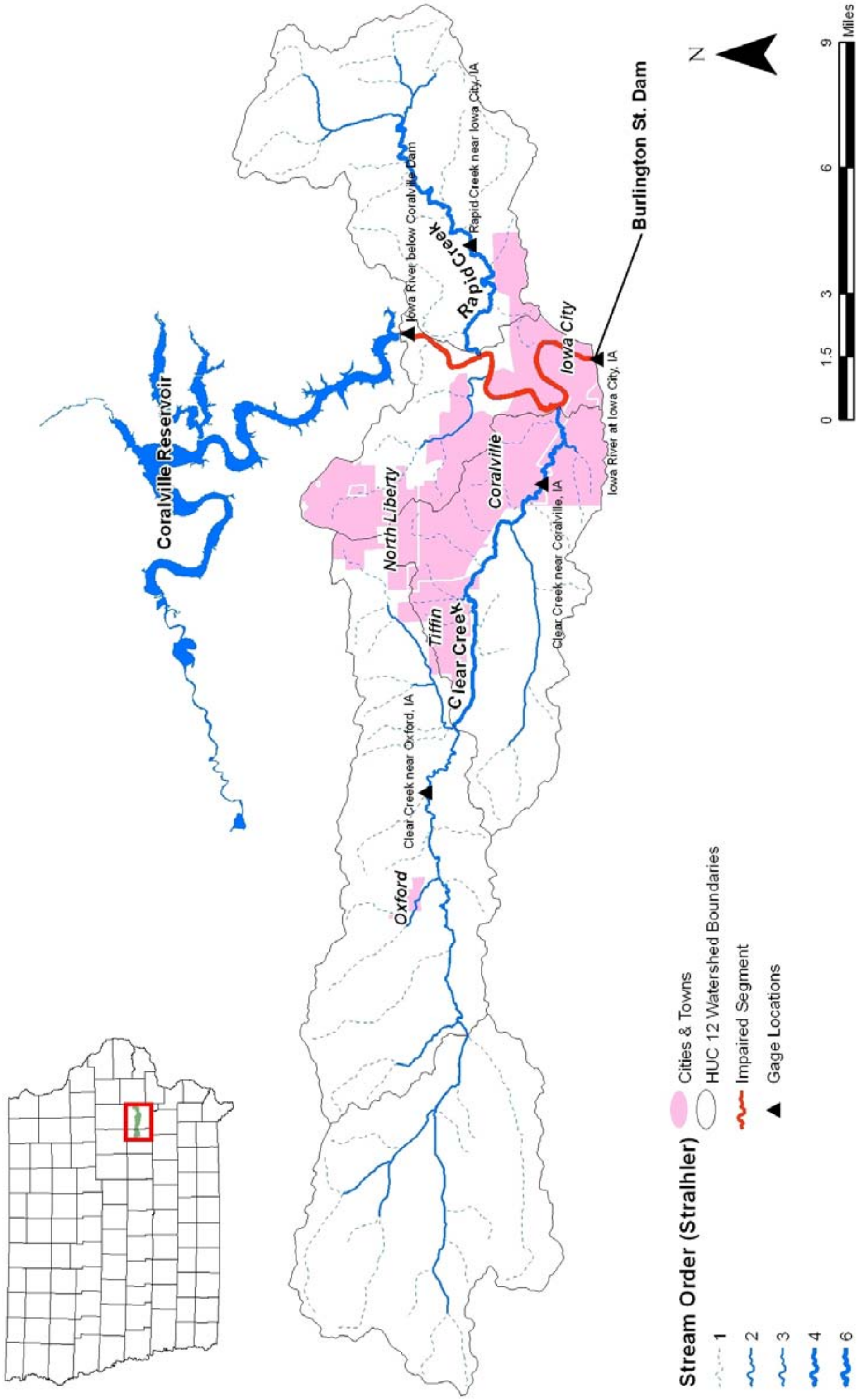

Figure A2 Impaired segment and major tributaries

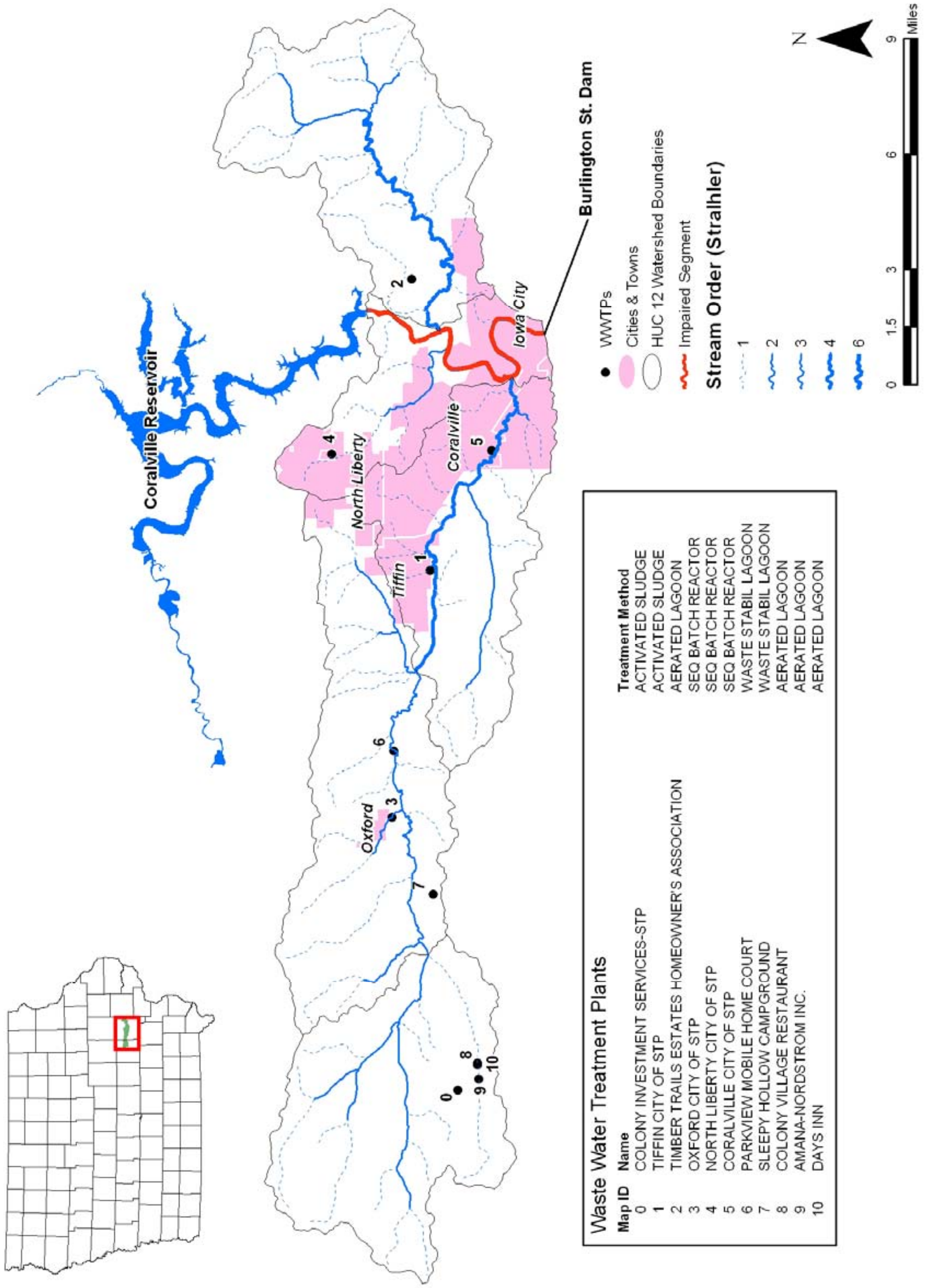

Figure A3 Wastewater treatment plants in the watershed

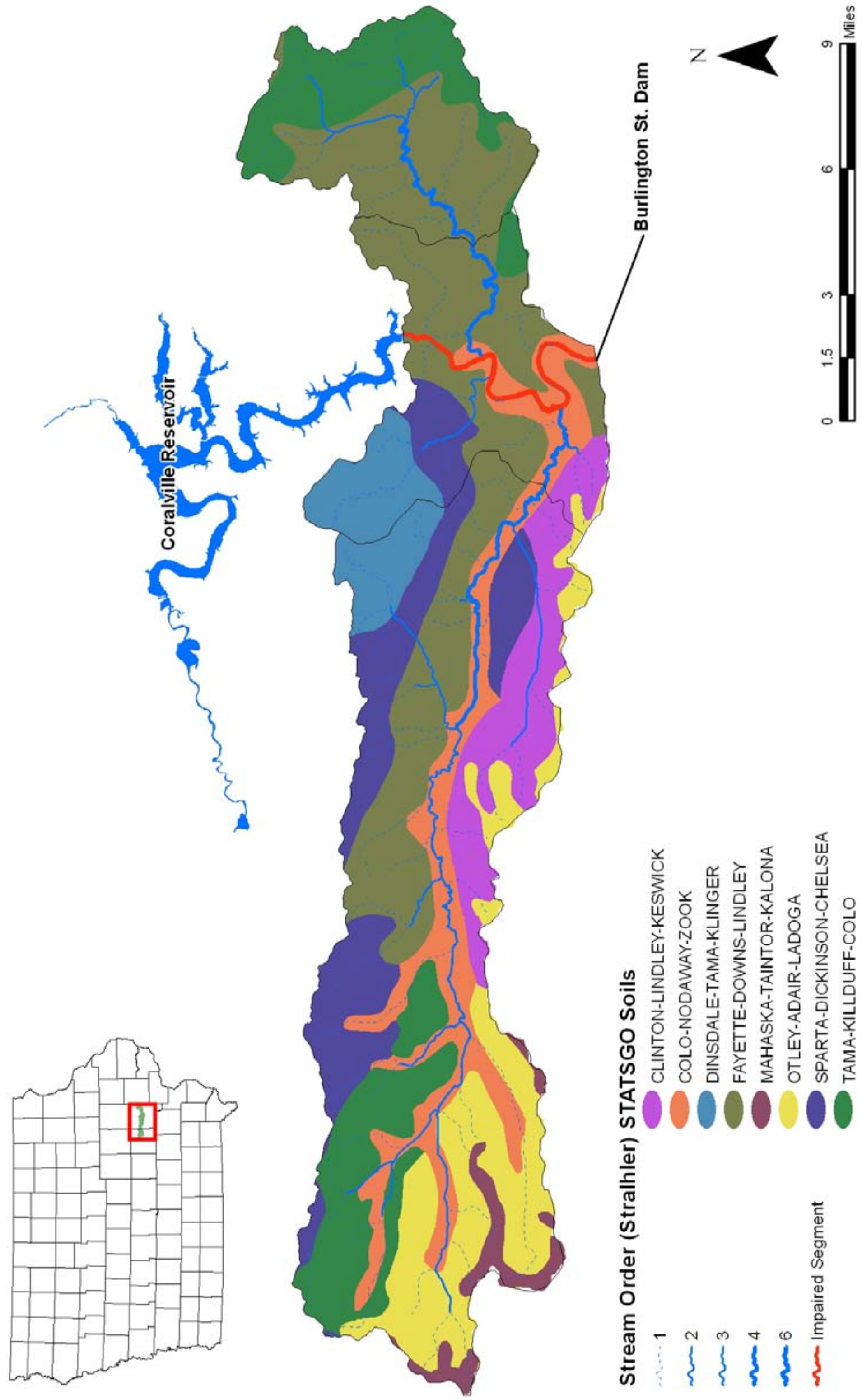

Figure A4 Watershed soil associations (Statsgo soil mapping)

Description Table

- Clinton-Lindley – loess over glacial till and clay paleosol
- Colo-Nodaway – alluvium
- Dinsdale-Tama - thin loess over loamy till
- Fayette-Downs – thicker loess, well drained and gently to steeply sloped
- Mahaska-Taintor – thicker loess, somewhat poorly drained, nearly level on broad upland flats and divides
- Otley-Adair-Ladoga – loess on broad upland flats and ridges moderately well drained
- Sparta-Dickinson – eolian sand deposits, well to excessively drained side slopes and stream benches
- Tama-Colo – thicker loess, well drained on uplands

APPENDIX B - MONITORING DATA

The following tables contain the monitoring data used to develop this report. The first table, Table B1, consists of the data from the Coralville Water Quality Monitoring Project used in the 2002 water quality assessment (305(b) report) of the Iowa River that found the segment to be impaired for pathogen indicators. Table B2 includes the data from the IDNR City Upstream/Downstream Monitoring Project that represents the discharge from Coralville Reservoir. The rest of the tables, B3 to B7, contain data from the IDNR Targeted Monitoring for the impaired segment of the Iowa River and its tributaries, Rapid and Clear Creeks.

Table B1 Coralville Water Quality Monitoring Project Data, Burlington St. dam, Site IR3a

DATE	*E. COLI* CONCENTRATION, ORGANISMS/100 ML	FLOW, CFS
05/25/2000	63	457
06/01/2000	3875	1850
06/08/2000	250	1140
06/26/2000	563	3850
07/05/2000	3313	3610
07/12/2000	188	6480
07/20/2000	63	3990
08/03/2000	438	987
08/10/2000	188	1120
08/26/2000	125	578
06/05/2001	46	7090
06/19/2001	75	6710
06/26/2001	38	6570
07/03/2001	6	5060
07/10/2001	288	2920
07/31/2001	6	2690
08/07/2001	31	1170
08/14/2001	19	478
08/21/2001	194	642
06/13/2002	1813	2420
06/19/2002	51	2600
06/26/2002	269	2080
07/12/2002	2000	2180
07/18/2002	81	1890
07/24/2002	19	785
08/07/2002	431	1540
08/14/2002	88	1620
08/23/2002	3750	3590

Table B2 IDNR Iowa City Upstream/Downstream Monitoring Project, IR1 site data

DATE	*E. COLI* CONCENTRATION, ORGANISMS/100ML	FLOW, CFS
11/30/1999	5	230
05/08/2000	50	271
10/09/2000	5	268
11/07/2000	390	215
04/04/2001	20	7540
05/02/2001	5	6390
06/05/2001	64	6540
07/09/2001	210	2660
08/09/2001	50	1110
09/06/2001	10	277
10/03/2001	5	480
11/07/2001	27	586
04/04/2002	5	657
05/06/2002	10	2400
06/05/2002	100	3210
07/10/2002	20	1330
08/13/2002	91	1510
09/11/2002	10	488
10/01/2002	5	612
11/12/2002	5	1080
04/08/2003	5	717
05/08/2003	80	4900
06/04/2003	5	2190
07/09/2003	240	3030
08/06/2003	18	797
09/04/2003	20	354
10/01/2003	5	145
11/05/2003	3800	1330
04/07/2004	30	2410
05/05/2004	18	1320
06/03/2004	20	5900
07/07/2004	18	5880
08/05/2004	36	2120
09/01/2004	200	4430
10/07/2004	30	161
03/16/2005	5	1510
04/06/2005	10	1430
05/02/2005	5	2920
06/02/2005	10	2830
07/06/2005	30	5630
08/03/2005	10	1270
09/07/2005	10	445
10/10/2005	20	355
11/07/2005	40	373
04/03/2006	130	2340
05/02/2006	36	2570
06/01/2006	5	1840

Table B3 IDNR Targeted Monitoring, Coralville Release data, Site IR1

DATE	*E. COLI* CONCENTRATION, ORGANISMS/100ML	FLOW, CFS
05/05/2005	5	1800
05/12/2005	220	2430
05/19/2005	60	6270
05/26/2005	10	6120
06/02/2005	5	2830
06/08/2005	10	2860
06/14/2005	10	2710
06/23/2005	5	1830
06/28/2005	5	2880
07/05/2005	50	5680
07/12/2005	5	2460
07/20/2005	5	1320
07/27/2005	20	1250
08/03/2005	5	1270
08/10/2005	10	639
08/16/2005	5	912
08/23/2005	5	612
08/29/2005	5	439
09/07/2005	5	445
09/12/2005	5	338
09/19/2005	5	205
09/26/2005	10	305
10/03/2005	5	601
10/10/2005	10	355
10/17/2005	5	289
10/24/2005	5	160
10/31/2005	5	142
11/09/2005	5	447
11/14/2005	5	402
03/28/2006	5	1010
04/13/2006	20	3670
05/04/2006	30	4230
06/06/2006	5	1630

Table B4 IDNR Targeted Monitoring, Burlington St. dam, Site IR3b

DATE	*E. COLI* CONCENTRATION, ORGANISMS/100ML	FLOW, CFS
05/05/2005	20	1890
05/12/2005	35000	2300
05/19/2005	110	6290
05/26/2005	40	6140
06/02/2005	27	3050
06/08/2005	150	3080
06/14/2005	70	2830
06/23/2005	70	1990
06/28/2005	530	2560
07/05/2005	100	5410
07/12/2005	40	2640
07/20/2005	73	1380
07/27/2005	50000	1240
08/03/2005	90	1260
08/10/2005	40	724
08/16/2005	73	920
08/23/2005	80	659
08/29/2005	140	561
09/07/2005	90	386
09/12/2005	160	350
09/19/2005	82	196
09/26/2005	710	345
10/03/2005	190	595
10/10/2005	170	380
10/17/2005	260	296
10/24/2005	50	188
10/31/2005	45	189
11/09/2005	120	391
11/14/2005	45	356
03/13/2006	750	2050
03/28/2006	50	1070
04/13/2006	5	3860
05/04/2006	100	4270
06/06/2006	490	1810

Table B5 IDNR Targeted Monitoring, Rapid Creek, Site RC1

DATE	*E. COLI* CONCENTRATION, ORGANISMS/100ML	FLOW, CFS
05/12/2005	9100	24
05/19/2005	490	16
05/26/2005	380	10
06/02/2005	460	7.2
06/08/2005	2600	15
06/14/2005	2100	12
06/23/2005	490	6.2
06/28/2005	5700	4.9
07/05/2005	780	4.1
07/12/2005	140	1.4
07/20/2005	380	0.72
07/27/2005	520	0.76
08/03/2005	280	0.14
08/10/2005	570	0.01
08/16/2005	190	0.1
08/23/2005	290	0.09
08/29/2005	170	0.03
09/07/2005	470	0.03
09/12/2005	660	0
11/09/2005	320	0.19
11/14/2005	73	0.18
03/13/2006	14000	44
03/28/2006	30	5
04/13/2006	5	12
05/04/2006	130	10
06/06/2006	5900	64

Table B6 IDNR Targeted Monitoring, Clear Creek, Site CC1

DATE	*E. COLI* CONCENTRATION, ORGANISMS/100ML	FLOW, CFS
05/12/2005	130000	81
05/19/2005	2100	71
05/26/2005	580	46
06/02/2005	520	36
06/08/2005	3100	51
06/14/2005	3700	39
06/23/2005	1300	26
06/28/2005	23000	30
07/05/2005	2100	25
07/12/2005	820	13
07/20/2005	550	7.7
07/27/2005	4200	9.3
08/03/2005	450	5.2
08/10/2005	520	5.3
08/16/2005	720	7.5
08/23/2005	1900	5.2
08/29/2005	680	5.2
09/07/2005	1500	4.9
09/12/2005	1100	4.2
09/19/2005	14000	2.9
09/26/2005	1100	3.8
10/03/2005	720	2.5
10/10/2005	580	2.3
10/17/2005	650	2.4
10/24/2005	110	2.4
10/31/2005	120	2.6
11/09/2005	180	3.7
11/14/2005	180	4.5
03/13/2006	1100	75
03/28/2006	480	44
04/13/2006	1000	66
05/04/2006	900	47
06/06/2006	9300	44
06/19/2006	670	16

Table B7 IDNR Targeted Monitoring, Clear Creek, Site CC2

DATE	*E. COLI* CONCENTRATION, ORGANISMS/100ML	FLOW, CFS
05/12/2005	67000	54
05/19/2005	2300	57
05/26/2005	3900	35
06/02/2005	2100	29
06/08/2005	5300	36
06/14/2005	23000	28
06/23/2005	6200	18
06/28/2005	65000	17
07/05/2005	3800	15
07/12/2005	3400	8.4
07/20/2005	2700	4.6
07/27/2005	940	4.9
08/03/2005	2200	2.4
08/10/2005	290	1.4
08/16/2005	4900	3.2
08/23/2005	1700	2.2
08/29/2005	810	1.9
09/07/2005	28000	0.89
09/12/2005	1700	1
09/19/2005	1700	0.76
09/26/2005	5700	1.2
10/03/2005	1500	1.3
10/10/2005	930	0.86
10/17/2005	1600	0.83
10/24/2005	380	0.84
10/31/2005	630	0.81
11/09/2005	580	1
11/14/2005	7800	1.4
03/13/2006	2900	34
03/28/2006	1600	18
04/13/2006	200	52
05/04/2006	1100	38
06/06/2006	39000	20
06/19/2006	2300	9.6

APPENDIX C – PUBLIC COMMENTS AND RESPONSES

February 16, 2007

Mr. Allen Bonini
Watershed Improvement Section
Environmental Services Division
Department of Natural Resources
Wallace State Office Building
Des Moines, IA 50319-0034

RE: Comments on Draft TMDL for the Iowa River

Dear Mr. Bonini:

The Iowa Farm Bureau Federation (IFBF), the state's largest general farm organization with more than 145,000 members, wishes to express its ideas about the proposed draft Total Maximum Daily Load (TMDL) for the Iowa River in Johnson County.

IOWA RIVER COMMENTS

While there have been other TMDLs in the past, this TMDL is critically important to Iowa agriculture. It is imperative that this TMDL for bacteria for the 8.75 mile stretch that seeks *E. coli* bacteria load reductions of as much as 93 be completed in a logical, thoughtful manner that makes sense for the nonpoint source and point source communities. This must be completed in a way that real success can be achieved without exhausting limited financial resources for other state priorities.

Due to the complexity of this particular TMDL, it is nearly impossible in this relatively short public comment timeframe for the IFBF or for any other group or citizen to comprehend and analyze the data used in this regulatory document. Due to the long-term policy significance of this TMDL, it is critical that we all take the time necessary to comprehend and analyze this data.

Therefore, the major comment that the IFBF has, in addition to the overarching policy issues identified later in this comment letter, is with respect to identification of a specific process for revisions to this document. The department has acknowledged the phasing of Iowa's TMDLs. In phase 1, pollutant load sources, allocations and reduction targets are estimated by the department. Phase 2 will consist of follow-up monitoring, evaluation and readjustment of the load allocations and management practices necessary to achieve the prescribed load reductions that will restore the waterbody to its water quality standard.

However, there has been no documentation to-date of how Phase 2 of this and all TMDLs will work in Iowa. All citizens need to have a clearer understanding of this important process.

For example, should there be additional information developed by the department or by voluntary local watershed efforts? How does this new information get incorporated in the load allocations? When will the department accept this information? How much data will be necessary for the department to incorporate it into its revised load calculations? What will be the quality assurance and quality control procedures necessary for data to be colleted and used by the department? What will be the process for submitting this information to EPA for approval (or will approval be necessary?) How and when will this process impact point sources seeking new or reauthorized NPDES permits?

These are just of a few of the questions we have at this time. Until we can work through a process with the department, the point sources and a third-party technical assistance provider to do the necessary review and confirmation of the load sources, allocations and reduction targets, we cannot provide answers to these questions. Therefore, a process needs to be identified and incorporated into this and all future TMDL documents that provides for these events.

<u>Bacteria Indicator Tool</u>

In addition, the complexity of this TMDL begs for more precise information about the modeling of the watershed and its loadings. The draft TMDL does not clearly communicate what changes were made to assumptions of the Bacteria Indicator Tool (BIT) that was used, if any, to estimate load allocations. Also, there are questions about the assumptions and defaults noted in the BIT user guide, including:

Manure Application. "It is assumed that cattle manure is applied to both cropland and pastureland using the same method," and, "Horse manure is assumed to be applied only to pastureland." Does this mean that the model assumes the physical application of manure to pasture? If so, this could negatively skew output results to indicate more bacteria runoff than is actually occurring. The user guide notes that the equation used to calculate the fraction available for runoff can be updated if necessary. Was this done and to what extent?

Grazing. "Dairy cattle are assumed to be kept only in feedlots. Therefore, all of their waste is used for manure application (divided between cropland and pastureland), and "Beef cattle waste is therefore applied as manure to cropland and pastureland...." The assumption that manure is being applied to pasture is not a common practice in Iowa and would most likely skew results.

Wildlife. "This calculation is performed by multiplying the density (animals per acre) of each type of wildlife on each land use by the rate of fecal coliform production for that wildlife type (count per animal per day)." Our experience has been that there is no reliable information available for Iowa that indicates wildlife animals per acre.

Cropland. "Dairy cattle are also assumed to be confined all of the time, and their manure is applied to both cropland and pastureland." Even if they are confined all of the time (which is not always the case), it is rare that manure is being applied to pasture in Iowa. This would skew model results.

Pastureland. "Horse manure that is not deposited in pastureland during grazing is assumed to be collected and applied to pastureland." Given that this is Johnson County, it may be that this is more of a common practice among suburban horse owners. However, any indication of local data that quantifies the extent of this practice is not apparent in the draft TMDL, leading one to question the model output.

Septics. "The estimated rate of septic system failure in the area of interest should be estimated based on local knowledge." The draft TMDL does not indicate the source of the local knowledge used for this calculation.

References. North Carolina Cooperative Extension Service. 1994. *Agri-Waste Management: Livestock Manure Production and Characterization in North Carolina*. Raleigh, NC. This appears to be the only source used by the model's authors regarding manure management assumptions. Manure management practice can vary greatly by place and time. Practices used by outdated, non-resident information sources such as this leads one to seriously question all the assumptions made by the model. The final TMDL should use Iowa data.

These model assumptions lead to our request to have each model field tested before using to draft future TMDLs. Another approach would be to have an independent third party field test all available models, publish the results (a listing of strengths and weaknesses and appropriate uses of the models) to the public understands the assumptions and model output. This will lead to increased support for future implementation activities by watershed residents.

Livestock in the Watershed

The draft TMDL indicates that 2002 county agricultural statistics were used. All cattle and calf numbers (including beef cows and milk cows) and fed cattle for 2004-5 are available on the Iowa Agricultural Statistics Service web site at: http://www.nass.usda.gov/Statistics_by_State/Iowa/Publications/County_Estimates/index.asp. This would be a more up-to-date source than the 2002 ag census data that appears to have been used (note: 2002 ag census data appears to be the only county source of hogs and pigs numbers).

Other Comments

Also, the draft TMDL needs an executive summary section at the beginning to which citizens can refer to find the main problems, load sources, allocations and reduction targets.

The TMDL also does not include a comprehensive long-term monitoring plan that will be needed to verify the data necessary for Phase 2.

Other concerns that need to be addressed in the draft document prior to EPA approval include:

- Assumptions used for bacterial counts (versus actual field numbers);
- An apparent lack of actual bacteria discharge data from the waste treatment plants (to provide a better understanding of background levels);
- A lack of any actual background bacterial data;
- A lack of any characterization of the contributing or processing roles of streams in bordering states; and,
- A lack of a plan for determining the actual loading rate from all sources.

Farm Bureau Policy & Related Issues

Farm Bureau emphasizes our support for the funding of incentive programs that assist farmers in achieving water quality goals. Farm Bureau policy supports voluntary incentive-based approaches based on sound scientific information, technical assistance to landowners and site-specific flexibility. We support a TMDL program that would require:

- The use of monitoring data (not just evaluated data) in determining impairments and sources of impairment;
- The determination, allocation and inclusion of background, natural and/or legacy levels in impairments;
- Use attainability analysis on all waters before initial listing and/or implementation of TMDLs;
- Complete agricultural participation in the listing, assessment, development and implementation of a TMDL;
- Good general public participation;
- Quantitative long-term data to evaluate success;
- A comprehensive watershed and source water monitoring program;
- Acknowledgement of previously adopted conservation measures; and
- Implementation strategies targeted at all sources.

We continue to have concerns about general issues that may have serious long-term impacts on draft TMDLs, the IDNR's TMDL program and the ability of agriculture to successfully deal with these issues in a voluntary fashion. Our overall concerns continue to remain that there is not a clear plan for initial field assessment, long-term monitoring, and model calibration with TMDLs in Iowa. These are critical questions that need to be considered and resolved.

Other concerns have been documented in detail in our previous recent comments, including: Use of the trophic state index in lieu of approved state water quality standards and approved numeric criteria; establishment of arbitrary endpoints that result in defacto water quality standards; a lack of a comprehensive cost-benefit analysis for each TMDL;

and no apparent consideration of the useful life of the waterbody and other physical features of impaired waters.

In addition, the nonpoint source TMDLs we have previously commented on need to include more specific assurances in the Implementation Plan sections that load allocations will be achieved using incentive-based, non-regulatory approaches. As stated in other previous TMDLs with NPS contributions, these sections should also include specific assurances from DNR that TMDL implementation is dependent on application of available technology as much as is practicable by landowners and farmers in the watersheds, and availability of financial resources from the Clean Water Act Section 319 Nonpoint Source Management Program, Iowa Department of Agriculture and Land Stewardship cost-share programs, and USDA-NRCS cost-share programs.

The Implementation Plan sections should also explicitly state that load allocations should be recognized as planning and implementation guides and are not subject to EPA approval.

The IFBF again thanks you for the opportunity to comment and asks for your serious consideration of these issues so that long-term success is ensured for the citizens of Iowa and the agricultural nonpoint source community. If you have any questions, please contact me at 225-5432.

Sincerely,

Rick Robinson

Rick Robinson
Environmental Policy Advisor

Cc: Chris Van Gorp

March 14, 2007

Rick Robinson
Iowa Farm Bureau Federation
5400 University Ave
West Des Moines, IA 50266

Dear Mr. Robinson:

Thank you for your comments dated February 16, 2007 in response to the Draft Iowa River TMDL. The Iowa River TMDL for bacteria has been finalized and submitted to EPA for approval. All written public comments received and Department responses are included in Appendix C. You may view this final document on our website at http://www.iowadnr.com/water/watershed/pubs.html .

We would like to take this opportunity to address some of your comments that are specific to the draft TMDL:

On page one of your comment letter, you indicate that it is difficult to accurately submit public comments on this draft TMDL in the time allotted. If, during your review of a draft TMDL, you find that the normal 30-day comment period is not long enough to adequately review the draft TMDL, we would encourage you to notify us prior to the closing of the public comment period. Extensions of the public comment period are considered on a case-by-case basis. Where we have determined it is warranted, as with the draft Cedar River TMDL, we have provided extended public notice periods rather than the standard 30 days. That was not done for the draft Iowa River TMDL since the technical methods were not new and the watershed area was a reasonable size.

In fact, we are somewhat confuse by your concerns with the technical approach used in the development of the draft Iowa River TMDL since it was not a new approach for Iowa TMDLs. The draft Iowa River TMDL for bacteria was developed using a similar approach as was used in the Big Sioux River, Volga River, and Black Hawk Creek TMDLs. These TMDLs all incorporated the Bacteria Indicator Tool (BIT) spreadsheet in conjunction with other analytical tools that incorporate actual monitoring data linked to the BIT source evaluation, yet this is the first time you have raised these concerns. If you are unclear as to the technical methods utilized in the development of any TMDL, we encourage you to contact us so that we can explain the method and reasoning behind it.

Near the bottom of page one of your comment letter you indicate uncertainty as to how Phase 2 of the completed TMDLs will work. For most of the completed TMDLs at this point, Phase 2 consists of continued monitoring to document current water quality conditions and, ideally, improvements in water quality. Since changes in water quality are generally not immediate and the TMDLs in Iowa are only a few years old, we have not yet moved farther into Phase 2 of any of these TMDLs by recalculating allocations and/or targets. This will be considered, as needed, at the appropriate time.

Bacteria Indicator Tool. As noted above, the EPA Bacteria Indicator Tool (BIT) was used in the development of the Iowa River TMDL. The BIT is a useful bacteria accounting system for quantifying watershed nonpoint sources. The BIT is an Excel spreadsheet and is considered accessible and flexible. There are no macros or embedded VBA coding in the BIT, which makes it transparent to people with moderate spreadsheet knowledge and skills. The assumptions are reasonable and can be easily changed and have been, as warranted, in the development of this TMDL. The Iowa River BIT spreadsheet is available upon request.

It appears as though some of the comments in your letter were based upon reviewing the BIT User Guide, which provides a general picture of how the BIT works. However, it is necessary to look at the specific way that it is utilized for a particular watershed. Many of the details and assumptions specific to the Iowa River can be found in the spreadsheet itself. The development of the Iowa River TMDL was originally begun by EPA R7 staff. EPA obtained local information on the timing and distribution of wildlife and livestock manure from knowledgeable IDNR biologists and ISU faculty ag experts. The Section on nonpoint sources, beginning on page 13 of the TMDL, describes the construction of the BIT, where source information was obtained, and the result of applying it to quantify sources.

To address your specific questions on the assumptions and defaults used in the BIT, we have broken the responses out based on topic.

Manure Application. Animal manure is applied to either cropland or pasture. The total amount applied does not change since the number of animals in the watershed determines the total amount of available manure. If it is not applied to pasture then it is by default applied to cropland. The maximum fraction available for runoff is 1.8 times the daily maximum. For example, if manure with a billion fecal coliform bacteria is applied every day for 30 days, then the maximum accumulation of bacteria is not 30 billion but 1.8 billion due to die off in the field from UV light and predation. Actual delivery of bacteria to the Iowa River and its tributaries is based on monitoring data from the six monitoring and flow gauging sites listed in Tables 12 and 13 on page 21 of the TMDL and shown on the Figures 5 and 6 maps (p20 - 21).

Grazing. As mentioned above, the amount of animal manure is based on animal numbers in the watershed and is applied to either cropland or pasture. Since the actual delivery is determined by monitoring data, whether manure is assumed to be applied to cropland or pasture (or both) would have little impact on the total from ag non-point sources. Animal numbers and the methodology used to determine them can be found on page 14 of the TMDL (also see response below to livestock numbers).

Cropland & Pastureland. As noted above in the manure application response, the total amount of manure in the watershed remains the same based on animal numbers. The only change in the Figure 14 (p29) bacteria source bar chart would be to shift some of the source load from pasture to cropland or vice versa. The overall load attributed to livestock remains the same. As previously noted, bacteria delivery to the stream is determined by direct measurement at the monitoring sites.

Wildlife. Methods and information sources used to estimate wildlife contributions are on page 18 of the TMDL. Estimates of numbers of animals were obtained from IDNR wildlife biologists and wildlife researchers at Iowa State University. We feel they are reasonable assumptions and provide a better result than not accounting for them at all.

Septics. The description of the information sources and methods used to estimate failing septic tank system contributions is on page 17 of the TMDL. The calculations and distribution of these is in the septic worksheet of the Iowa River BIT.

References. References used in development of the BIT and other parts of the TMDL are listed in the References section on page 45 of the document. While the BIT was developed with data from North Carolina for manure management, Iowa specific data was obtained from Jim Russell at ISU and utilized in the model.

Livestock numbers. While 2004-05 data may be available for cattle, it is not available for all livestock numbers (hogs and pigs) and therefore the 2002 ag census data was used to maintain consistency between the livestock numbers. An explanation of how the livestock numbers were interpreted and used begins on page 13 of the TMDL.

Your comment letter also posed some additional concerns with the Draft TMDL. These are addressed below.

- Lack of executive summary: The Draft TMDL includes an executive summary section (Section 1) at the beginning of the document, which summarizes the main problems, pollutant sources, pollutant allocations, and reduction targets.

- Lack of a comprehensive monitoring plan: The monitoring section of the TMDL (Section 5, page 43) includes a summary of the planned monitoring in the Iowa River watershed. The draft TMDL also includes a more comprehensive monitoring plan to provide local stakeholders and agencies with direction in regard to monitoring needs in the watershed.

- Assumptions used for bacterial counts: As noted above and throughout the TMDL, actual flow and bacteria concentration data were used in the development of this TMDL.

- Lack of bacteria discharge data from WWTPs: The bacteria loads from wastewater treatment plants have been estimated using generally accepted engineering principles. The assumptions and calculations for the wwtps are available with the Bacteria Indicator Tool.

- Lack of any background bacterial data: As noted above and throughout the TMDL, actual flow and bacteria concentration data were used in the development of this TMDL.

- Lack of any characterization of the contributing or processing roles of streams in bordering states: Bordering states do not contribute to the bacteria load in the Iowa River, as the entire watershed is within the State of Iowa. Bacteria die off (stream processing) was calculated for each of the wastewater treatment plants from their discharge to the confluence with the Iowa River (Table 21, page 38). Bacteria die off for nonpoint sources was included in the Qual2k modeling of the Iowa River and Clear Creek (Figures 18-21).

- Lack of a plan for determining the actual loading rate for all sources: The Implementation (Section 4) and Monitoring (Section 5) sections provide guidance to local stakeholders on follow-up monitoring to help more accurately determine loading rates, and also for the installation of needed best management practices.

With regard to the Farm Bureau Policy and Related Issues:

- Actual monitoring data is used in the determination of impaired waters and in the development of all TMDLs. Various models are also used to help determine probable pollutant loads from periods when data was not available. The term "evaluated" refers to the assessment of the available data, not to the data itself. Assessments classified as "evaluated" are not used to identify impairments, rather only "monitored" assessments are used.

- Background sources, such as wildlife or naturally occurring sources of pollutants, are accounted for in all TMDLs.

- The TMDL program is charged with enforcing Iowa's water quality standards in those waters where they are not being met. The current Iowa Water Quality Standards were effective March 22, 2006. TMDLs are developed based on these standards in watersheds identified as priorities through discussions with internal and external stakeholders. Local interest and commitment are also used in determining priority watersheds for TMDL development.

- The entire public, including the agricultural sector, is encouraged to participate in the listing of waterbodies and in the development and implementation of

TMDLs. A public notice period is held for both the impaired waters list and draft TMDLs. Generally, for TMDLs two public meetings are held in the local watershed, and many times additional meetings with local stakeholders or agency staff are held as well.

- Watershed assessments have always been completed as part of developing the TMDL on those waterbodies with a manageable watershed size. These assessments include current landuses and management practices, the location of existing best management practices, and the location of all potential pollutant sources. However, due to EPA's consent decree, TMDLs were required to be completed on many waters with larger watersheds. In these cases, satellite imagery was used to determine landuses and implemented best management practices were not always able to be collected and incorporated at that scale.

- The implementation strategies presented in any draft TMDL are designed to address all pollutant sources. Obviously priority needs to be given to the various implementation strategies. A source that contributes only 10% of the pollutant load when an overall reduction of 35% is necessary would be a lower priority to implement than the needed reductions to the source that contributes 80% of the pollutant load.

- For waterbodies not included in EPA's consent decree, the IDNR is selecting waterbodies with smaller, more manageable watersheds to develop TMDLs. As part of the TMDL development, watershed assessments and/or stream assessments are completed to document the current status of the watershed. Additional monitoring data is collected as needed for TMDL development usually over a 1-2 year period, but long-term monitoring, particularly follow-up monitoring, is not feasible at this time, largely due to the need of those resources in generating data for future TMDL development.

Again, we feel it is important to clarify one comment on page 5 of your letter and to which we have responded previously. In your letter you request that the implementation section should state that the load allocations are not subject to EPA approval. EPA's regulations for total maximum daily loads and individual water quality-based effluent limitations are found in 40 CFR §130.7. This regulation states that "All TMDLs established under paragraph [130.7](c) for water quality limited segments shall continue to be submitted to EPA for review and approval".[1] WLAs and LAs are part of TMDLs,

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[1] In 57 FR 33040-01, EPA made it clear that the deletion of WLAs and LAs from 40 CFR 130,7(d) was a non-substantive change. The relevant portion of that Federal Register reads as follows:

therefore including a statement as you have suggested would be inaccurate and violate federal regulations. (See 57 FR 33040-01) If you have questions concerning this regulation, I would encourage you to contact Liz Huston, Legal Counsel, EPA Region 7 at 913-551-7525.

Thank you again for your comments on the Iowa River TMDL. If you have any comments or questions please contact me at 515-281-5107, or Chris Van Gorp at 515-281-4791.

Sincerely,

Allen P. Bonini, Supervisor
Watershed Improvement Section
Iowa Department of Natural Resources

C: John DeLashmit, USEPA
file

> EPA is today making *non-substantive clarifying corrections* to its regulations in part 130 to amend repeated references to 'WLAs/LAs and TMDLs' to read 'TMDLs.' EPA had clearly stated in its definition of WLAs, LAs and TMDLs, and in the preamble to the 1985 final rule establishing part 130, that WLAs and LAs are part of a TMDL. See 50 FR 1775. Accordingly, the references to WLAs and LAs in these passages are not necessary. Since these changes are not substantive, and serve only to clarify existing requirements, EPA finds that notice and comment proceedings regarding these changes are unnecessary. Furthermore, the changes are in the nature of interpretive amendments to EPA rules, which are exempt from notice and comment requirements.

57 FR 33040-01 (emphasis added).