ESCHERICHIA COLI (*E. coli*) ADDENDUM TO THE FECAL COLIFORM BACTERIA TOTAL MAXIMUM DAILY LOAD (TMDL) FOR WILLOW CREEK SEGMENT 01, DEUEL AND CODINGTON COUNTIES, SOUTH DAKOTA

Watershed Protection Program

Division of Resource Conservation and Forestry

South Dakota Department of Agriculture and Natural Resources

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INTRODUCTION

The South Dakota Department of Agriculture and Natural Resources (SDDANR) adopted a conversion process to translate existing fecal coliform TMDLs and allocations to *E. coli* to satisfy Clean Water Act section 303(d) requirements. The 2020 bacteria TMDL translation included *E. coli* TMDLs for four impaired waterbodies. The conversion process and resulting *E. coli* TMDLs were formally approved by the United States Environmental Protection Agency (EPA) November 8, 2020, reissued following the correction of a minor clerical error on June 6, 2022 (SD DANR A, 2022).

Willow Creek segment 01 (Big Sioux River to S7, T117N, R50W) or **SD-BS-R-WILLOW_01** is considered impaired for the designated limited contact recreation use due to *E.coli* in South Dakota's most recent 303(d) list documented in the 2024 Integrated Report (IR) and is considered high priority for TMDL development (SD DANR, 2024). The purpose of this addendum is to convert the previous fecal coliform TMDL (North Central Big Sioux TMDL; SD DANR, 2005), to the *E.coli* standard.

Several factors must be met to determine whether an existing fecal coliform TMDL can be converted to *E. coli* for a given waterbody in accordance with the methods and assumptions established in the 2020 bacteria TMDL translation:

- Waterbody must fall entirely within state jurisdiction,
- If jurisdiction is shared, TMDL only applies to portion of the water under South Dakota's jurisdiction,
- The TMDL will meet applicable water quality standards,
- Wastewater discharges to the stream are expected to meet effluent limits in accordance with an authorized NPDES permit, and
- The 2005 North Central Big Sioux fecal coliform TMDL assumptions (e.g., source contributions, loading capacity, etc.) are still valid.

This addendum demonstrates the factors are met and it is appropriate to apply the process and rationale described in the 2020 bacteria translation TMDL (SD DANR, 2022). Appendix B of the 2005 North Central Big Sioux River TMDL document contains the bacteria sample data used for analysis. Appendix B of this addendum also contains *E.coli* data that has been sampled for Willow Creek segment 01 since 2015, confirming the waterbody is still consistently demonstrating impairment for *E.coli*. Willow Creek segment 01 was listed as impaired for *E.coli* in 2018. The intent of this document is to convert the existing fecal coliform TMDL and allocations for Willow Creek segment 01 to *E.coli* using the conversion process and rationale described in the 2020 bacteria TMDL translation. Hereby, this document serves as an addendum to the Willow Creek fecal coliform TMDL (TMDL ID# 34507; approved by EPA in June 2008) by incorporating an *E.coli* TMDL and allocations for Willow Creek segment 01 (SD DANR, 2005).

JURISDICTION

Willow Creek segment 01 originates in South Dakota where it is the outlet of Round Lake extending 32.89 miles meeting the Big Sioux River (SD-BS-R-BIG_SIOUX_02) about 1 mile south of the City of Watertown. SD-BS-R-Willow_01 falls entirely within state jurisdiction (Figure 1 pg. 335 North Central Big Sioux TMDL; SD DANR, 2005). The HUC 12 (101702010702) has an area of 39,236 acres.

WATER QUALITY STANDARDS AND TMDL TARGETS

South Dakota *E. coli* criteria for immersion (ARSD 74:51:01:50) and limited contact recreation (ARSD 74:51:01:51) consist of a single sample maximum (SSM) and a monthly geometric mean (GM) both of

which include distinct numeric limits. The SSM requires that no single daily sample exceed the associated numeric limit. The monthly GM also must not be exceeded and is calculated based on a minimum of 5 samples collected during separate 24-hr periods over a 30-day period. Former fecal coliform SSM and GM criteria were similar for *E. coli*, however, numeric limits deviate between the bacteria indicators (Table 1).

Impaired waters require TMDL development based on the most protective criteria. Selecting the most protective numeric target for TMDL development ensures attainment with the water quality criteria. The fecal coliform TMDL for Willow Creek 01 used the SSM as the TMDL target for Limited Contact Recreation (Table 1). Appendix A of the 2020 bacteria TMDL translation outlines that the GM and SSM *E. coli* criteria are equally protective. As a result, the *E. coli* TMDL and allocations can be translated based on the SSM *E. coli* criterion consistent with the segment identified in the 2005 Willow Creek TMDL. In addition to the daily load, the geometric mean criteria must be attained on a longer (i.e., monthly) basis.

Table 1. Designated recreation uses and associated bacteria criteria designated Willow Creek.

Impaired Stream Segment AUID	Designated Recreation Use	Fecal Coliform Geomean CFU/100mL	Fecal Coliform SSM CFU/100mL	E. *coli* Geomean CFU/100 mL	*E. coli* SSM CFU/ 100mL
SD-BS-R-WILLOW_01	Limited Contact Recreation	≤1,000	*≤2,000	≤630	*≤1,178

*Refers to numeric criteria used for TMDL development

SOURCE ASSESSMENT

POINT SOURCES

All active permits within Willow Creek segment 01 drainage basin can be found in Appendix A. The permits do not contribute to any violations of surface water quality criteria. Any Stormwater Permits (SWP) located in this watershed are not contributors to bacteria loading. The only point source that was identified within the original TMDL document, Benchmark Foam, Inc. (SD0025895), no longer is a permitted facility. At the time the original TMDL was written the facility did not discharge and was not a source of bacteria contribution. The Watertown MS4 does not apply to this specific segment since none of the outfalls drain into Willow Creek. All outfalls drain into the Big Sioux River segment 2 (SD-BS-R-BIG_SIOUX_02). A Waste Load Allocation (WLA) was not assigned since these permits are not expected to be a source of bacteria loading pollution within the stream.

Concentrated Animal Feeding Operations (CAFOs)

A recent search found that there is one facility located in the Willow Creek segment 01. Modak Dairy (SDG-100416) is a dairy cattle facility that is in a housed lot. All CAFO's are required to maintain compliance with provisions of the Water Pollution Control Act (SDCL 34A-2). SDCL 34A-2-36.2 requires each concentrated animals feeding operations, as defined by Title 40 Codified Federal Regulations Part 122.23 Dated January 1, 2007, to operate under a general or individual water pollution control permit issued pursuant to 34A-2-36. The general permit ensures that all CAFO's in SD have permit coverage regardless of if they meet conditions for coverage a NPDES permit.

All facilities with a general permit number that starts with SDG-1* are covered under the 2017 General Water Pollution Control Permit for Concentrated Animal Feeding Operations. The 2017 general permit allows no discharge of manure or process wastewater from operations with state permit coverage or NPDES permit coverage for new source swine, poultry, and veal operations, and other housed lots with covered manure containment systems. Operations also have the option to apply for a state issued NPDES permit. Operations covered by the 2017 general permit or NPDES permit for open or housed lots with uncovered manure containment systems can only discharge manure or process wastewater from properly designed, constructed, operated and maintained manure management systems in the event of 25-year, 24-hour storm event if they meet the permit conditions. Both the 2003 and 2017 general permits have nutrient management planning requirements based on EPA's regulations and the South Dakota Natural Resources Conservation Services 590 Nutrient Management Technical Standard to ensure the nutrients are applied at agronomic rates with management practices to minimize the runoff of nutrients. Additionally, the general permits include design standards, operation, maintenance, inspection, record keeping, and reporting requirements. (https://danr.sd.gov/Agriculture/Livestock/FeedlotPermit/default.aspx)

As long as a CAFO complies with the general permit requirements ensuring their dischargers are unlikely and indirect loading events, the TMDL assumes their *E.coli* contribution is minimal, and unless found otherwise, on additional permit conditions are required by this TMDL.

NONPOINT SOURCES

The nonpoint source assessment for Willow Creek segment 01 is documented in the 2005 Willow Creek fecal coliform TMDL and the conclusions of that 2005 assessment are still accurate today. Fecal coliform source contributions are considered synonymous with *E.coli* based on the close statewide paired bacteria data relationship documented in the 2020 bacteria TMDL translation.

The 2005 TMDL breaks down Willow Creek's Watershed as follows, with 62% (49,319 acres) of land being used for cropland, 33% (26,511 acres) being used for range/grassland, 4% (2887 acres) being occupied by water, and 1% (1214 acres) claimed as building/ farmstead. This land use data is derived using the AnnAGNPS Model (https://www.ars.usda.gov/southeast-area/oxford-ms/national-sedimentation-laboratory/watershed-physical-processes-research/docs/annagnps-pollutant-loading-model/) . Today, we use Earth Resources Observation and Science (EROS) Center, National Land Cover Database (NLCD) to assess land use in South Dakota. Using the EROS's NLCD layer for 2004 we find the land use distribution similar to the AnnAGNPS estimates, but with forest and urban being added used as designation classes. Using the 2004 NLCD layer the Willow Creek Watershed breaks down as follows, with 57.18% of land being used as cropland, 34.12% as pasture/grass, 6.38% for urban areas, 1.15% for non-use such as water and barren land and finally 0.57% of land covered in some sort of forested vegetation. The 2021 NLCD layer showed similar percentages with 57.05% cropland, 33.86% pasture, 7.26% urban, 1.21% non-use, and 0.61% forest. The NLCD layer shows insignificant changes between the years 2004 and 2021. Land use and bacteria production characteristics in the impaired watersheds are expected to be similar to that documented during the respective Fecal Coliform TMDL assessment.

TMDL AND ALLOCATIONS

A Load Duration Curve method was used to develop the fecal coliform bacteria loading, (concentration) x (flow), using zones based on hydrologic conditions to develop the fecal coliform TMDL for the 2005 Willow Creek segment. The criteria approach was used to convert the existing fecal coliform TMDL and allocations to *E.coli* for each flow zone. The *E.coli* TMDL, WLA, load allocation (LA), and margin of safety (MOS) were calculated by multiplying the existing fecal coliform values by the ratio (EC:FC) for the SSM (Table 2). The *E.coli* TMDL allocations (TMDL=WLA+LA+MOS) were based on the same percent contribution as established for the fecal coliform TMDL allocations in each flow zone.

The fecal coliform current load from the Willow Creek 01 fecal coliform TMDL was converted to *E.coli* using the ratio (EC:FC) for the SSM. The percent reduction was then calculated as the converted *E.coli* current load minus the *E.coli* converted TMDL divided by the converted *E.coli* current load (Table 4). This calculation results in percent reductions identical to the Willow Creek 01 fecal coliform TMDL (Table 3).

Table 2. Applicable bacteria criteria and ratio for the limited contact recreation use.

Fecal coliform criteria	*E. coli* criteria	EC:FC ratio
GM 1000	GM 630	0.63
SSM 2000	SSM 1178	0.589

The *E. coli* TMDL is protective of applicable criteria assigned to the limited contact recreation use designated to Willow Creek segment 01. The 2005 fecal coliform TMDL contains supporting information necessary to implement the *E. coli* TMDLs. The original fecal coliform and converted *E. coli* TMDL allocations and reductions are provided for Willow Creek segment 01 in Tables 3 and 4, respectively. In addition to the daily load, the geometric mean criteria must be attained on a longer (i.e., monthly) basis.

While in the process of translating the data from fecal coliform to *E.coli* some minor rounding errors occurring resulting in a percent reduction being approximately 1.9% less in this document than what was in the original 2005 fecal coliform TMDL.

Table 3. Existing fecal coliform TMDL and allocations for Willow Creek segment 01 based on the applicable bacteria criteria for limited contact recreation from the 2005 fecal coliform TMDL.

Flow Zone	Fecal TMDL (CFU/day)	WLA (CFU/day)	LA (CFU/day)	MOS (CFU/day)	Current Load (CFU/day)	% Reduction
High	5.33E+12	0.00E+00	4.80E+12	5.33E+11	2.23E+13	76.10%
Moist	4.89E+11	0.00E+00	4.40E+11	4.89E+10	1.74E+11	0.00%
Mid-Range	9.79E+10	0.00E+00	8.81E+10	9.79E+09	1.44E+10	0.00%
Dry	1.86E+10	0.00E+00	1.67E+10	1.86E+09	1.78E+10	0.00%
Low	2.45E+09	0.00E+00	2.21E+09	2.45E+08	0.00E+00	0.00%

Table 4. E. coli TMDL and Load allocations for Willow Creek segment 01 based on the applicable bacteria criteria for limited contact recreation.

Flow Zone	*E. coli* TMDL (CFU/day)	WLA (CFU/day)	LA (CFU/day)	MOS (CFU/day)	*E. coli* Current Load (CFU/day)	% Reduction
High	3.13E+12	0.00E+00	2.82E+12	3.13E+11	1.31E+13	76.10%
Moist	2.87E+11	0.00E+00	2.59E+11	2.87E+10	1.02E+11	0.00%
Mid-Range	5.75E+10	0.00E+00	5.18E+10	5.75E+09	8.46E+09	0.00%
Dry	1.09E+10	0.00E+00	9.83E+09	1.09E+09	1.05E+10	0.00%
Low	1.44E+09	0.00E+00	1.30E+09	1.44E+08	0.00E+00	0.00%

SUMMARY

The 2020 bacteria TMDL translation provided a framework to convert fecal coliform TMDLs and allocations to *E. coli* to address impaired streams designated recreation uses in South Dakota. This framework was used to convert the existing fecal coliform TMDL and allocations set forth in the 2005 fecal coliform TMDL for Willow Creek segment 01 (**SD-BS-R-WILLOW_01**) to *E. coli*. Therefore, this document serves as an *E. coli* TMDL addendum to the 2005 fecal coliform TMDL for Willow Creek segment 01 (TMDL # 34507). The addended *E. coli* TMDL and allocations follow the assumptions of the 2005 fecal coliform TMDL. The fecal coliform and *E. coli* TMDLs for Willow Creek segment 01 were developed in accordance with Section 303(d) of the federal Clean Water Act and guidance provided by the US EPA.

The South Dakota DANR partners with Day County Conservation District, helping implement the Prairie Couteau Project with section 319 funds to help landowners with Best Management Practices (BMP) within the Big Sioux River Watershed. Willow Creek Segment 01 is located in this watershed, and the project is working to reduce *E.coli* numbers within the watershed.

PUBLIC COMMENT

This TMDL addendum was made available for public comment in accordance with section 303(d) requirements. A public notice letter was published in the Watertown Public Opinion, Brookings Register, and the Sioux Falls Argus Leader newspapers to announce the availability of the addendum for public comment. The TMDL addendum document and comment process was made available on the South Dakota Department of Agriculture and Natural Resources webpage at https://danr.sd.gov/public/default.aspx. The public comment period began October 29, 2024 and ended November 29, 2024.

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APPENDIX A: PERMITS

segment	#	CWPName	Watertown Permits	SourceID	RegistryID	DFR URL
willow	1	10TH AVE SE EXTENSION	General Permit Covered Facility	SDR10K037	110071322679	https://echo.epa.gov/detailed-facility-report?fid=SDR10K037&sys=ICP
willow	2	LOTS 1 & 2 MORRIS FIRST ADDITION	General Permit Covered Facility	SDR10K266	110071323012	https://echo.epa.gov/detailed-facility-report?fid=SDR10K266&sys=ICP
willow	3	LOTS 1-2 BLOCK MORRIS ADDITION	General Permit Covered Facility	SDR10I190	110071323938	https://echo.epa.gov/detailed-facility-report?fid=SDR10I190&sys=ICP
willow	4	NORTH AMERICAN TRUCK & TRAILER	General Permit Covered Facility	SDR10K734	110071320920	https://echo.epa.gov/detailed-facility-report?fid=SDR10K734&sys=ICP
willow	5	THE LAKES OF WILLOW CREEK FIRST ADDITION	General Permit Covered Facility	SDR10J730	110071279104	https://echo.epa.gov/detailed-facility-report?fid=SDR10J730&sys=ICP
willow	6	WQCV PROJECT	General Permit Covered Facility	SDR10J536	110071275546	https://echo.epa.gov/detailed-facility-report?fid=SDR10J536&sys=ICP
willow	7	CO-HO REGIONAL POND	General Permit Covered Facility	SDR10I327	110071324437	https://echo.epa.gov/detailed-facility-report?fid=SDR10I327&sys=ICP
willow	8	CROWNED RIDGE II TRANSMISSION LINE	General Permit Covered Facility	SDR10J564	110071280140	https://echo.epa.gov/detailed-facility-report?fid=SDR10J564&sys=ICP

APPENDIX B: *E.COLI* DATA

SampleDate	***E.coli*** **(CFU/100mL)**
08/08/2019	365
08/21/2019	435
09/04/2019	323
09/16/2019	770
09/23/2019	727
10/07/2019	260
05/07/2020	1260
06/02/2020	231
06/08/2020	365
06/22/2020	727
07/06/2020	435
07/08/2020	107
07/20/2020	228
08/03/2020	109
08/06/2020	39
08/17/2020	37
09/01/2020	110
09/08/2020	299
09/21/2020	270
10/19/2020	143
04/19/2021	13
04/19/2021	19
04/19/2021	<1
05/03/2021	25
05/10/2021	11
05/24/2021	20
06/07/2021	199
06/08/2021	272
06/23/2021	1550
07/08/2021	145
07/12/2021	1120

SampleDate	***E.coli*** **(CFU/100mL)**
07/19/2021	1120
08/02/2021	2760
08/16/2021	23
08/17/2021	51
09/09/2021	24
09/14/2021	261
09/20/2021	122
09/20/2021	<1
10/18/2021	1730
05/11/2022	26
05/23/2022	30
06/01/2022	14100
06/13/2022	488
07/06/2022	167
07/11/2022	435
08/10/2022	65
08/15/2022	99
08/15/2022	150
08/15/2022	<1
09/14/2022	7
09/19/2022	161
05/08/2023	1720
05/22/2023	46
06/05/2023	219
06/26/2023	548
07/10/2023	1410
07/17/2023	62
08/07/2023	23
08/09/2023	33
09/06/2023	293
09/11/2023	35