LOWER ARKANSAS BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody: Slate Creek
Water Quality Impairment: E. coli

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Middle Arkansas – Slate **Counties:** Sumner, Sedgwick

HUC 8: 11030013
HUC 10 (12): 02 (01, 02, 03, 04)

Ecoregion: Central Great Plains, Wellington-McPherson Lowland (27d)

Drainage Area: 200 square miles

Main Stem Water Quality Limited Segments: Segment 17 of Slate Creek in Sumner County.

Main Segment	**Tributaries**
Slate Creek (17)	Spring Creek (27)
	Oak Creek (26)
	Hargis Creek (24)
	Beaver Creek (29)

Designated Uses: For Slate Creek (17): Primary Contact Recreation Class C; Expected Aquatic Life Support; Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Use; Irrigation Use; Livestock Watering Use.

For Spring Creek (27) and Beaver Creek (29): Same designated uses as Slate Creek (17) with the exception of being classified as Secondary Contact Recreation Class b.

For Hargis Creek (24): same designated uses as Slate Creek (17) with the exception of being classified as Primary Contact Recreation Class B.

For Oak Creek (26): Primary Contact Recreation Class C; Expected Aquatic Life Support; Food Procurement; Ground Water Recharge; Irrigation Use; Livestock Watering Use.

303(d) Listings: Station SC528, Slate Creek near Wellington
Fecal coliform: 2002 Lower Arkansas River Basin Streams.
E. coli: 2008, 2010 & 2012 Lower Arkansas River Basin Streams.

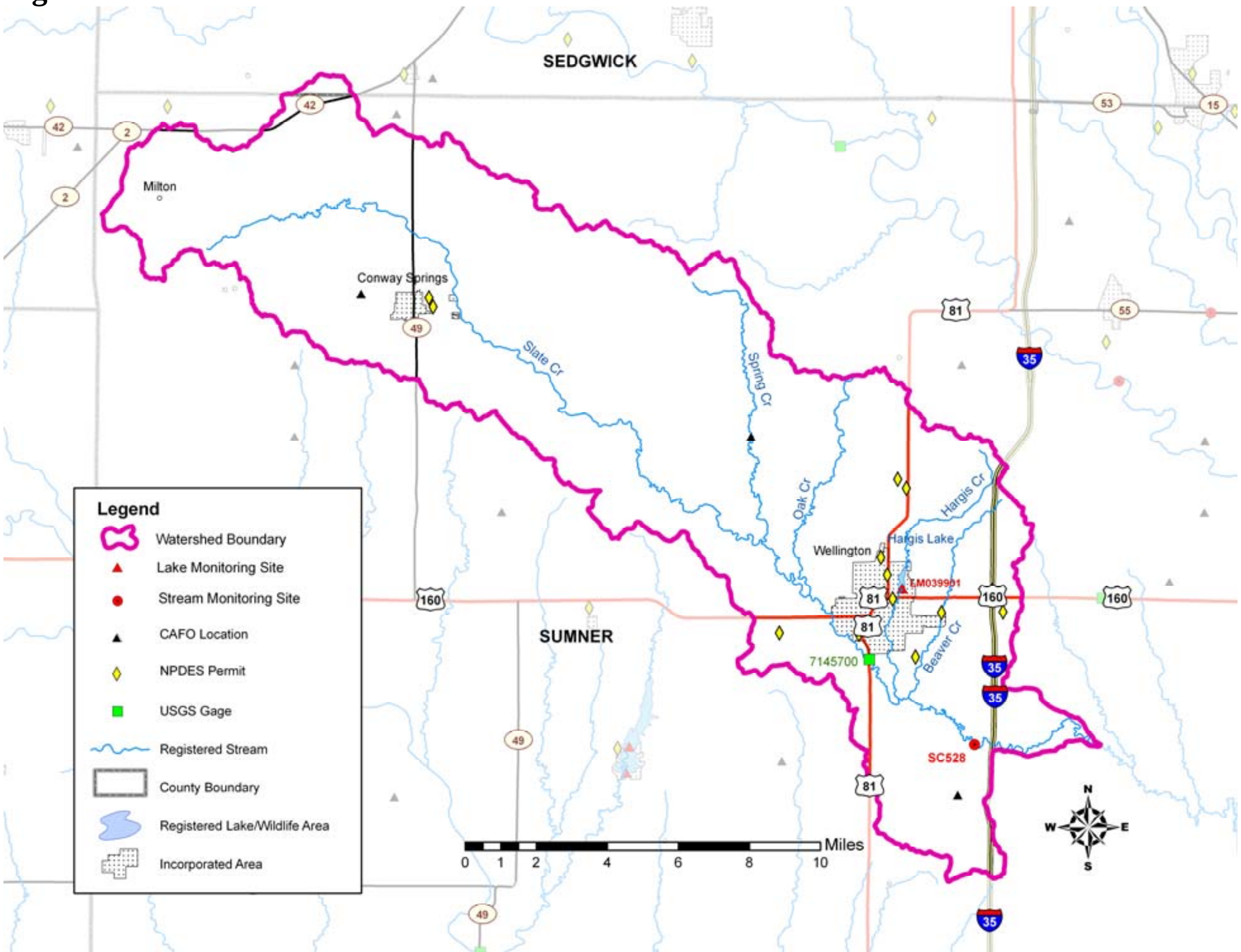
Impaired Use: Primary Contact Recreation Class ‘C’

Water Quality Criteria:

Primary Contact Recreation Class ‘C’:
Geometric Mean April – October:
427 Colony Forming Units (CFU)/100 mL
Geometric Mean November – March:
3,864 Colony Forming Units (CFU)/100 mL

K.A.R. 28-16-28e(c)(7):
(D) Primary contact recreation for classified stream segments. At least five samples shall be collected during separate 24-hour periods within a 30-day period. A geometric mean analysis of these samples shall not exceed the criteria in table 1i, as adopted in subsection (d) of this regulation, beyond the mixing zone.
(E) Secondary contact recreation for classified stream segments. The following criteria shall be in effect from January 1 through December 31 of each year. At least five samples shall be collected during separate 24-hour periods within a 30-day period. A geometric mean analysis of these samples shall not exceed the criteria in table 1i, as adopted in subsection (d) of this regulation, beyond the mixing zone.
(F) Wastewater effluent shall be disinfected if it is determined by the department that the discharge of non-disinfected wastewater constitutes an actual or potential threat to public health. Situations that constitute an actual or potential threat to public health shall include criteria supporting the assigned recreational use designation or if a water body is known or likely to be used for either of the following:
(i) Primary or secondary contact recreation; or
(ii) Any domestic water supply.

Figure 1. Slate Creek Watershed.



2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Uses under 2010-303(d): Bacteria levels in Slate Creek near Wellington exceeded the geometric mean criteria in 2006 and 2009 with routine data over 2003-2011 indicating regular digressions from the criteria during the primary recreation season (April through October).

Stream Monitoring Site and Period of Record: KDHE permanent ambient Stream Chemistry sampling station SC528 located on Slate Creek near Wellington sampled bi-monthly from 7/22/03 through 11/3/2009 and quarterly from 3/29/2010 through 6/1/2012 for E. coli (Figure 1). Supplementing the routine KDHE sampling, intensive sampling (five samples in 30 days) was conducted twice in 2006 and once in 2009 during the primary recreation season at SC528, Slate Creek near Wellington.

Flow Record: USGS Gage 07145700, Slate Creek at Wellington, 1990-2011.

Flow Conditions: The USGS has maintained a gaging station on Slate Creek at Wellington since 1990. The gage is located above KDHE sampling station SC528 and the ratio of the watershed size at SC528 (200 mi^2) to the watershed size at USGS 07145700 (154 mi^2) was used to estimate the flow at KDHE sampling site SC528 on Slate Creek. Figure 2 displays the flow duration curve for the estimated flow at SC528 while Table 1 details an average and median flow of 115 cfs and 14.3 cfs, respectively at the KDHE sampling site.

Figure 2. Flow duration for Slate Creek (1990-2011) based on USGS gage 07145700.

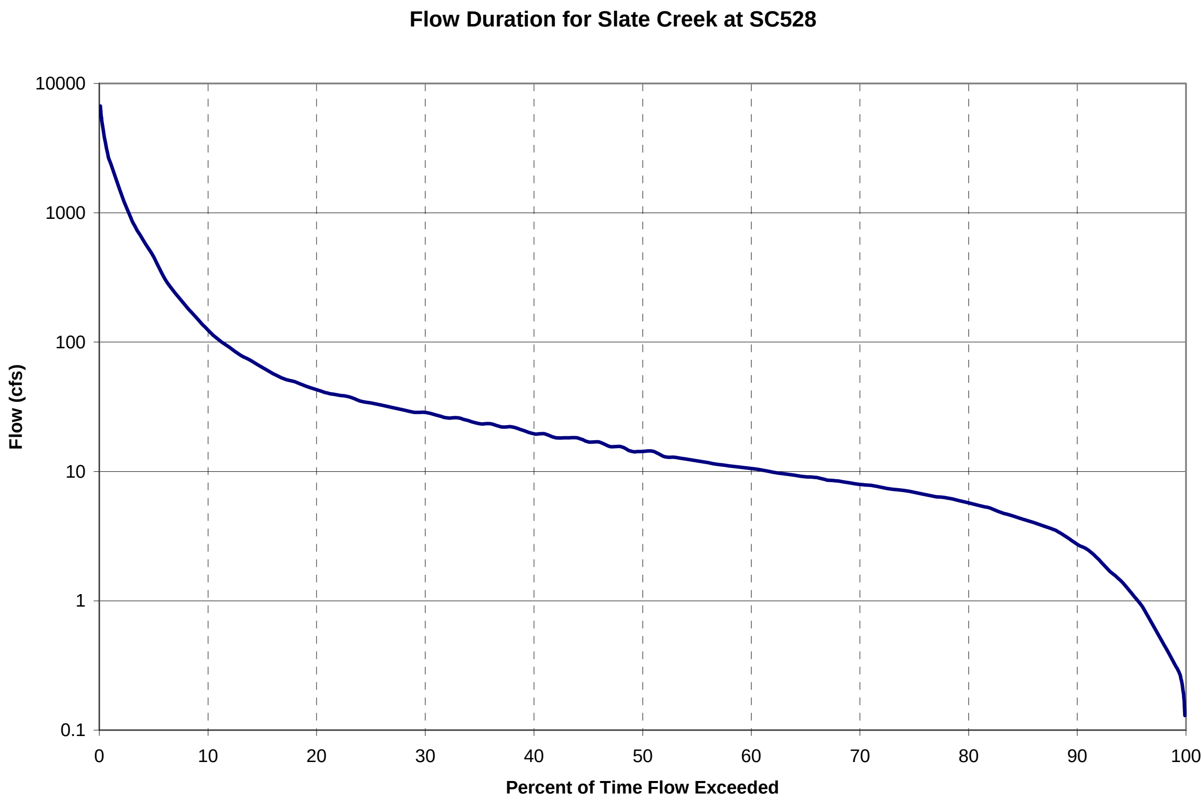


Table 1. Long term flow conditions (cfs) for Slate Creek at SC528 based on USGS gage 07145700, 1990-2011.

Stream Name	Drainage Area (mi^2)	Mean Flow	90%	75%	50%	25%	10%
Slate Creek at USGS Gage 07145700	154	88.5	2.10	5.30	11.0	26.0	95.0
Slate Creek at SC528	200	115	2.73	6.89	14.3	33.8	124

Flow values for the four classified streams contributing flow to Slate Creek above SC528 are shown in Table 2. According to Perry, et al., three of the tributaries, Spring Creek, Oak Creek and Hargis Creek have similar flow patterns with an average flow of about 6.6 cfs. Beaver Creek, with a smaller contributing drainage area has an average flow of 3.43 cfs.

Table 2. Long term estimated flows for Slate Creek and its tributaries (Sumner County, Perry et al., 2004).

Stream (USGS Segment ID)	Drainage Area (mi^2)	Flow (cfs)						
		Mean	90%	75%	50%	25%	10%	2-year Peak
Slate Creek (4876)	97.3	36.6	0.27	1.60	4.30	11.2	36.6	2,252
Spring Creek (4874)	22.2	6.51	0.01	0.03	0.23	1.11	5.06	1,281
Slate Creek (4914)	123	51.8	0.46	2.30	5.83	15.3	51.8	2,887
Oak Creek (4912)	21.1	6.68	0.01	0.03	0.35	1.34	5.50	1,285
Slate Creek (5004)	154	73.2	0.91	3.30	8.00	21.0	73.2	3,620
Hargis Creek (5000)	20.9	6.67	0.0	0.0	0.55	1.80	6.13	1,293
Beaver Creek (4999)	11.5	3.43	0.0	0.0	0.0	0.21	2.13	924
Slate Creek (5051)	207	88.7	1.32	4.18	10.5	28.4	94.7	4,103

Annual flow averages in Slate Creek are variable with years of aggregated dryness in 1990, 1991, 1994, 2006 and 2011 resulting in average flows of less than half of the long term average of 115 cfs (Figure3).

Average monthly flows in Slate Creek reflect seasonal rainfall patterns with the average flow in May and June reflecting high intensity rainfall events while the higher median flows during March and April indicate snow melt and more frequent spring rainfalls (Figure 4). The average and median flow in Slate Creek at SC528 for the primary recreational season of April through October are 138 cfs and 12.5 cfs, respectively. November though March, the primary recreation off-season, has a higher median flow at 15.6 cfs but a lower average flow of 82.2 cfs reflecting the diminished frequency of both high intensity rainfall events and periods of excessive dryness.

Figure 3. Average annual flow in Slate Creek near Wellington based on USGS gage 07145700.

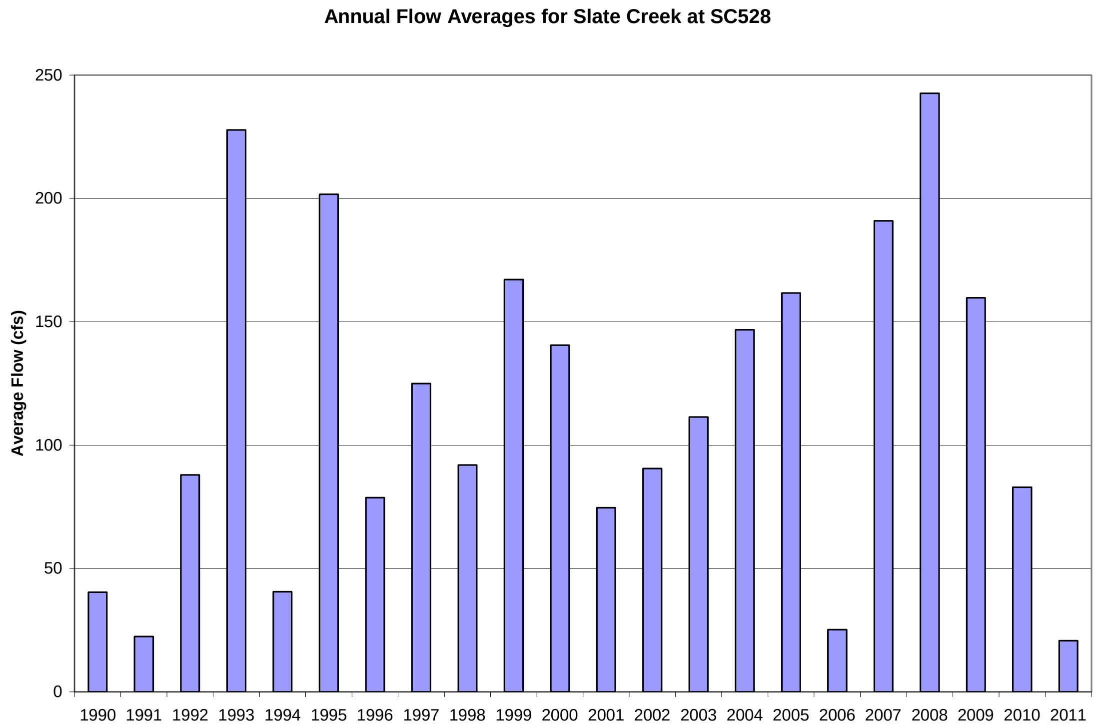
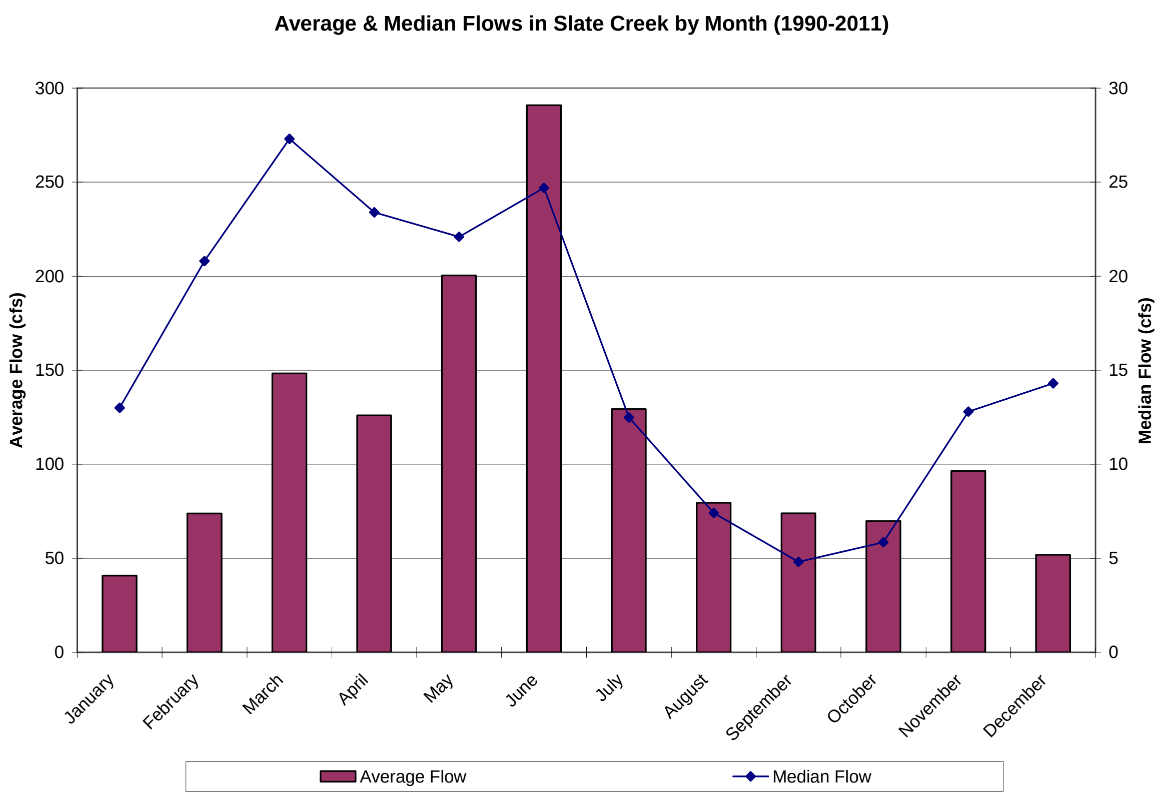


Figure 4. Average and median monthly flows in Slate Creek at SC528.



Current Conditions: Fecal coliform bacteria (FCB) have been sampled in Slate Creek near Wellington since 1990 through May 2003 (Figure 5). The geometric mean of all FCB data was 402 CFU/100 mL while geometric mean for samples collected during the primary recreation season months of April through October reached 607 CFU/100 mL in the creek.

KDHE adopted E. coli bacteria (ECB) recommended by the US EPA to replace FCB in 2003 as E. coli bacteria are seen to be a better indicator for potential human illness. Routine collection of ECB samples in Slate Creek since mid-2003 resulted in an overall geometric mean of 272 Most Probable Number (MPN)/100 mL, rising to 464 MPN/100 mL during the primary recreation season of April through October (Figure 6). For the remainder of this TMDL, the term "counts" will represent the units of Colony Forming Unit (CFU)/100 mL as expressed in the water quality standards or Most Probable Number (MPN)/100 mL, the measured parameter for ECB.

Figure 5. Fecal Coliform Bacteria in Slate Creek, 1990 – 2003.

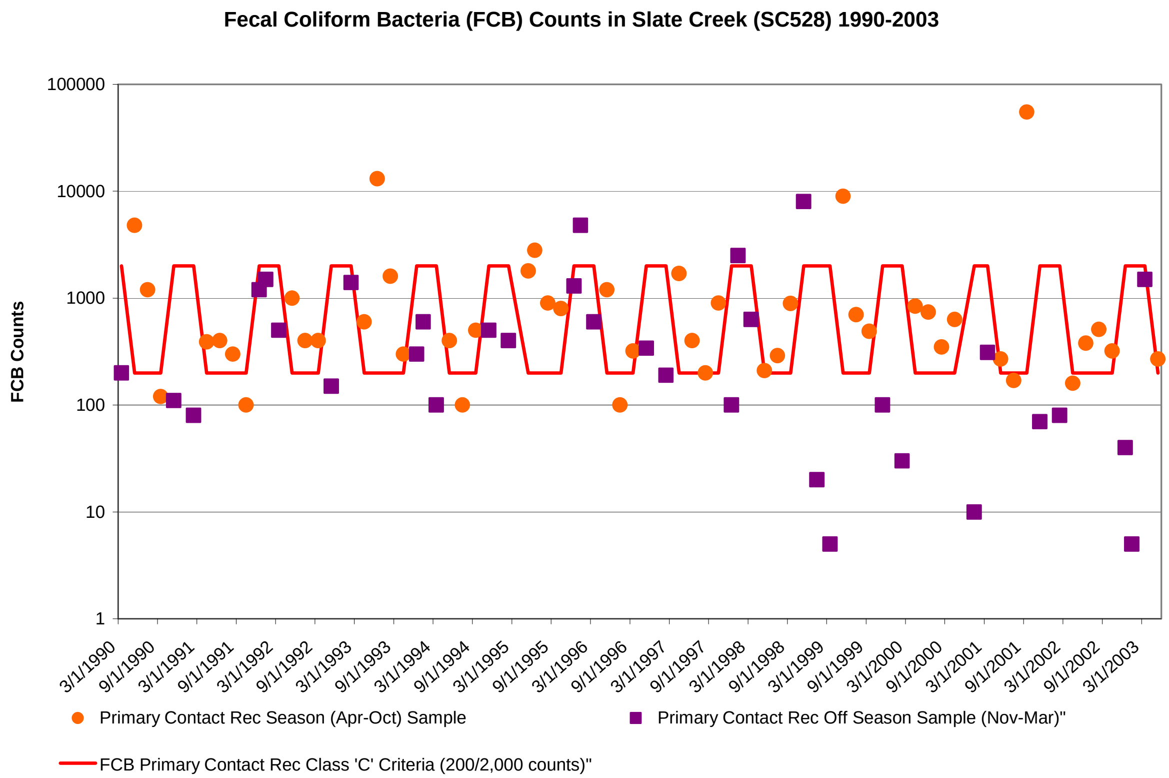
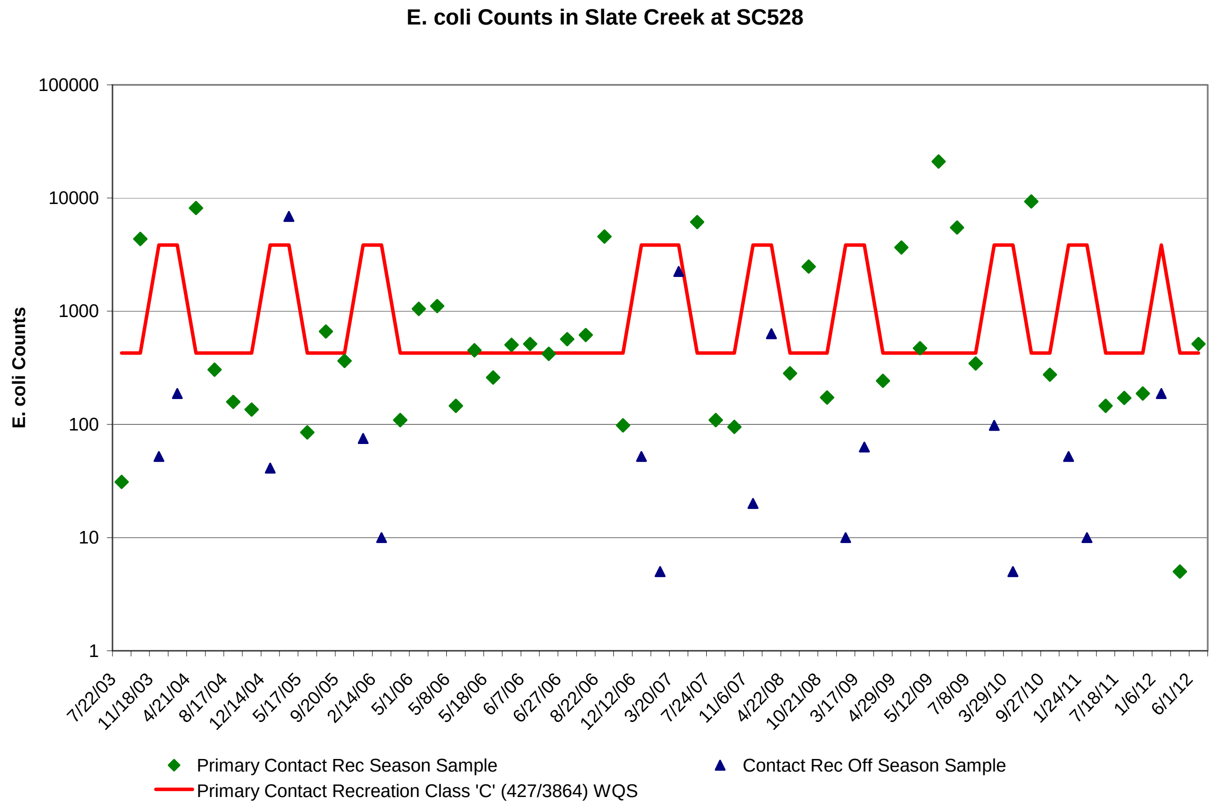


Figure 6. E. coli counts in Slate Creek near Wellington by sampling date, 7/22/2003 – 6/1/2012.



Sample collection occurred across the range of flow conditions with increased flow in Slate Creek generally leading to higher E. coli counts (Figure 7). Samples collected from November through March broke the off-season recreation standard of 3,864 counts one time coinciding with a high flow event. Single sample digressions above the geometric mean standard of 427 counts for the April through October season occurred 19 times (46%) over the period of record and across the range of flow conditions (Table 3). The rate of exceedances during the April-October season increases with increased flow as one would expect however the rate of exceedances under low to moderate flow conditions may indicate occurrences of livestock watering in the creek.

Figure 7. E. coli counts vs. Percent Flow Exceedance in Slate Creek, 7/22/2003 – 6/1/2012.

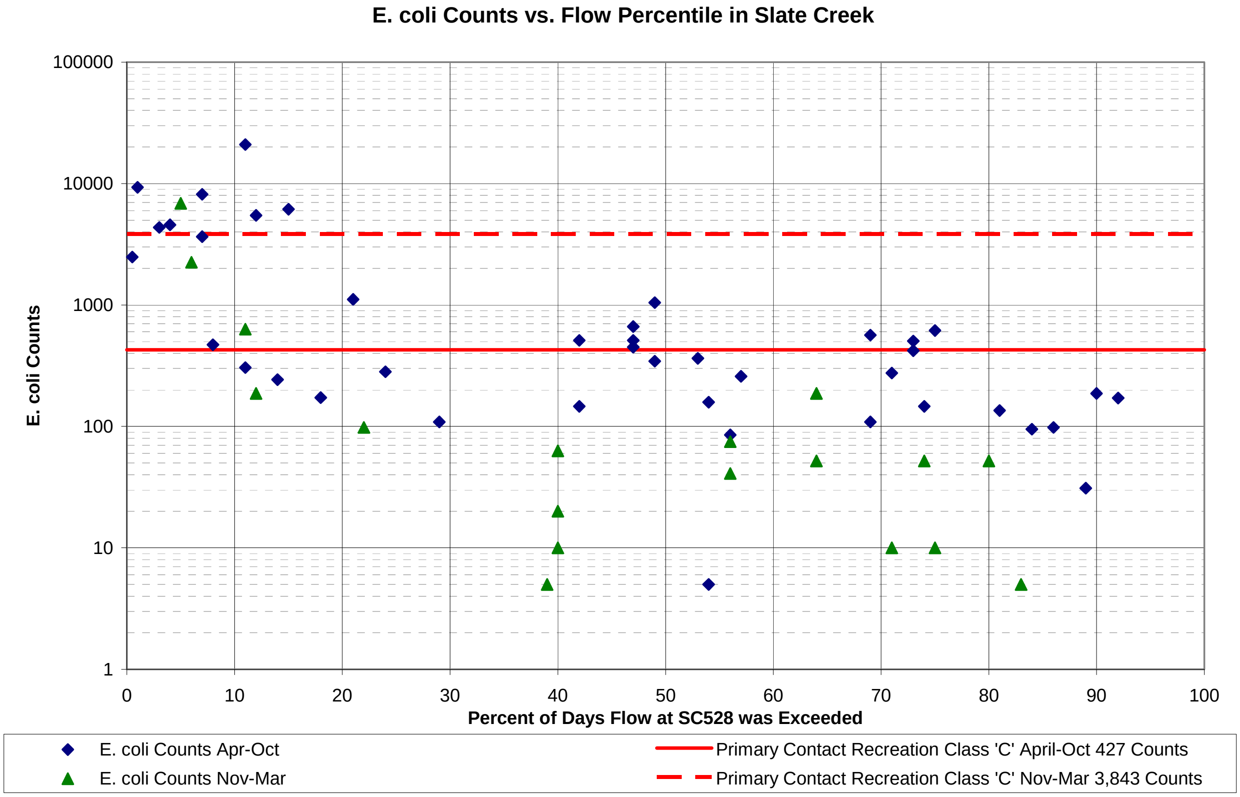
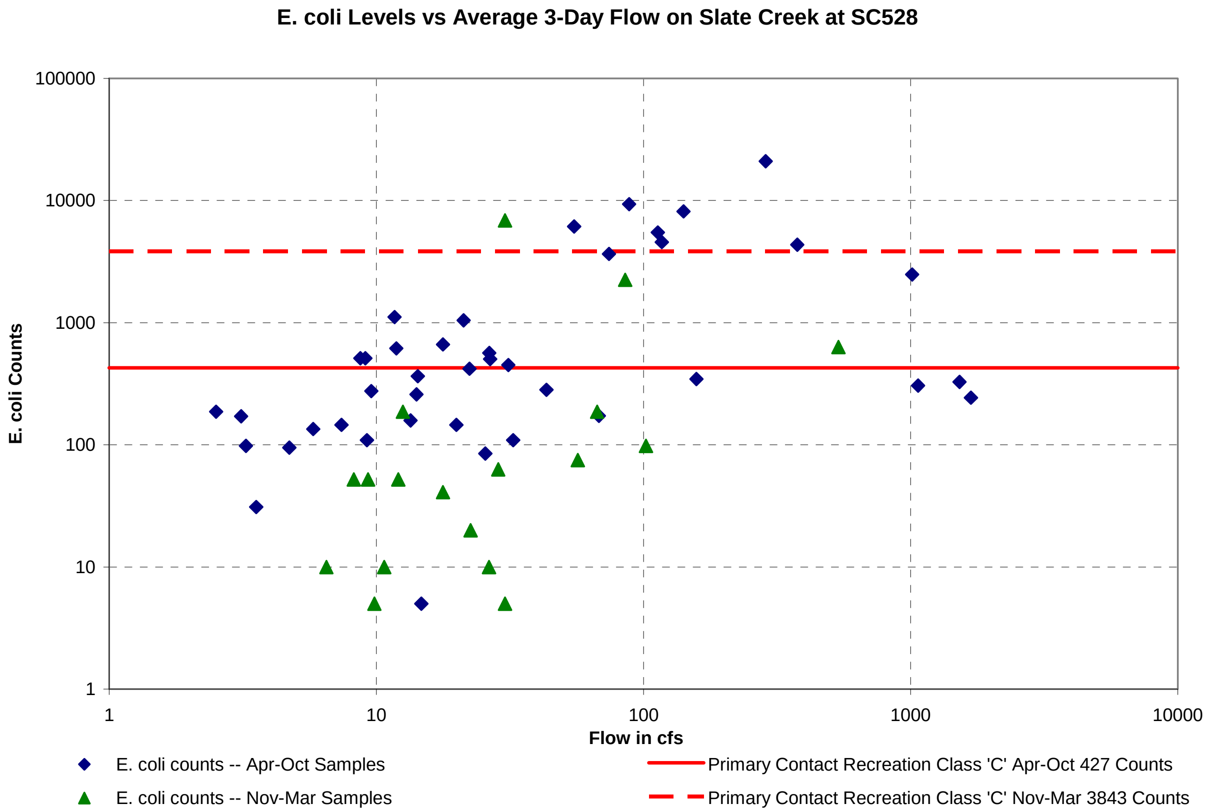


Table 3. Single sample excursions from the April-October water quality standard of 427 counts and the November-March water quality standard of 3,843 counts by flow.

	Low Flow		Moderate Flow		High Flow		Total for All Flow Conditions	
Percentile	75-100%		26-74%		0.1-25%			
Flow (cfs)	6.89-0 cfs		32.5-7.15 cfs		6,687-33.8			
Season	**Apr-Oct**	**Nov-Mar**	**Apr-Oct**	**Nov-Mar**	**Apr-Oct**	**Nov-Mar**	**Apr-Oct**	**Nov-Mar**
# Exceeds/# Samples	3/13	0/3	6/15	0/10	10/13	1/5	19/41	1/18
Percentage of Exceedances	23%	0%	40%	0%	77%	20%	46%	5.5%
E. Coli Geometric Mean	189	13.8	249	31.6	2,326	709	464	65.2

Figure 8 displays E. coli counts versus the average of flow in Slate Creek for three days prior to sampling. Many of the samples that break the standard can be attributed to precipitation runoff events; however, there are nine exceedances of the April-October standard that occurred during a period of low to moderate flow in Slate Creek. Seven of the nine samples above 427 counts, occurred during intensive sampling in May and June of 2006 when flow conditions averaged between 11.7 and 31.2 cfs in the three days prior to sampling indicating these samples were influenced by a brief runoff event. 2006 was a dry year with an average flow of 25.2 cfs, or about 33% flow exceedance, indicating the creek may have been used for livestock watering during and around the time KDHE was performing intensive bacterial sampling in the creek.

Figure 8. E. coli counts in Slate Creek vs. Average Flow (cfs) for 3 days prior to sampling.



KDHE conducted intensive sampling (5 samples in 30 days) on Slate Creek twice in 2006 and once in 2009 (Figure 9). Samples were collected in May 2006, June 2006 and April/May 2009 resulting in geometric mean values of 456; 519; and 2,017 E. coli counts, respectively (Table 4).

Figure 9. Intensive sampling for E. coli bacteria at SC528, Slate Creek near Wellington.

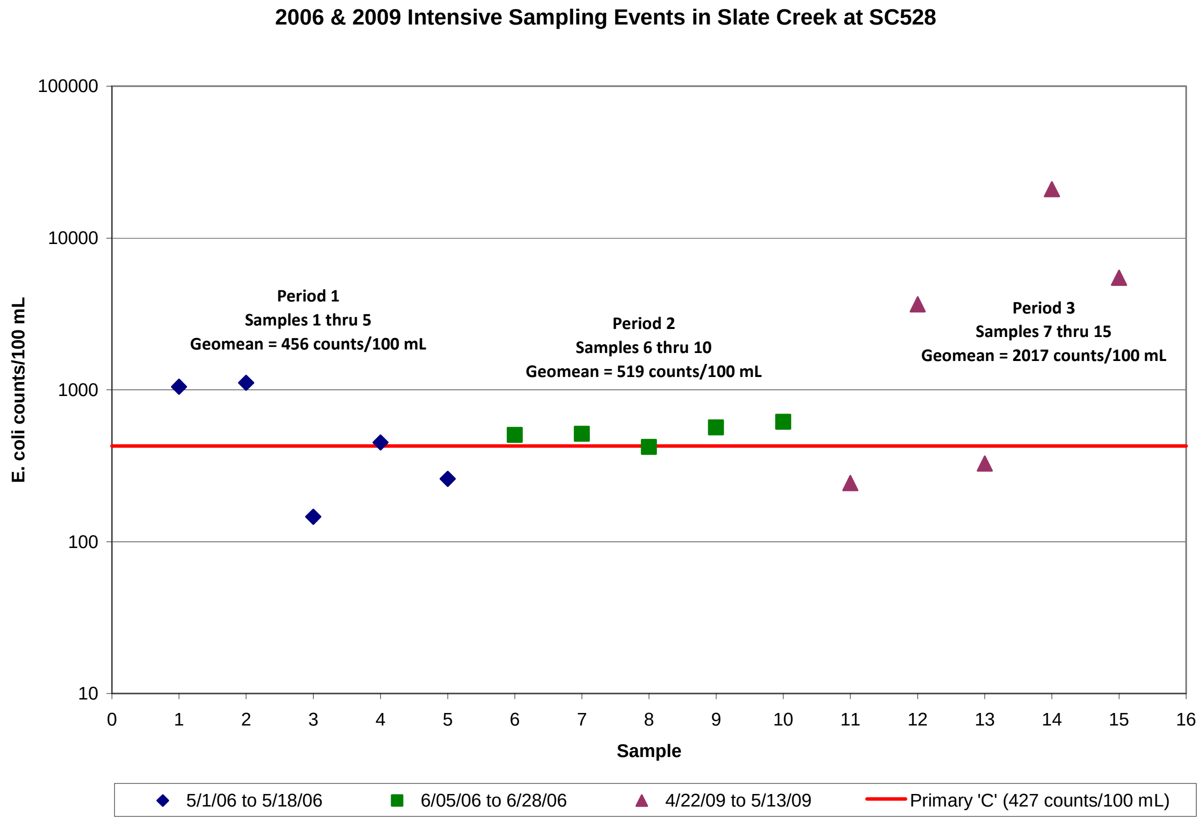


Table 4. Individual sample results and geometric mean values for intensive sampling periods on Slate Creek at SC528 along with daily average flow for individual samples and the average flow for the days the stream was sampled.

Period 1			Period 2			Period 3		
Sample Date	E. coli Counts	% Flow	Sample Date	E. coli Counts	% Flow	Sample Date	E. coli Counts	% Flow
5/1/06	1,046	59	6/5/06	504	81	4/22/09	243	16
5/4/06	1,112	28	6/7/06	512	56	4/29/09	3,654	8
5/8/06	146	52	6/20/06	420	81	5/5/09	327	9
5/15/06	450	56	6/27/06	565	78	5/12/09	20,982	12
5/18/06	259	67	6/28/06	616	82	5/13/09	5,475	14
Geo Mean 456 counts		Avg Flow 20.0 cfs	Geo Mean 519 counts		Avg Flow 9.1 cfs	Geo Mean 2,017 counts		Avg Flow 157 cfs

A comparison of E. coli counts versus the average flow on the day Slate Creek was sampled reveals that although the 2006 samplings were made when flow was below average the primary recreation criterion was still exceeded (Figure 10). The 2009 intensive sampling event, however, occurred while the creek was well above average flow conditions resulting in a high geometric mean of 2,017 counts indicating E. coli counts in Slate Creek are influenced by precipitation runoff events in the watershed (Figure 11).

Figure 10. 2006 Intensive sampling for E. coli in Slate Creek at SC528 vs. Average Daily Flow.

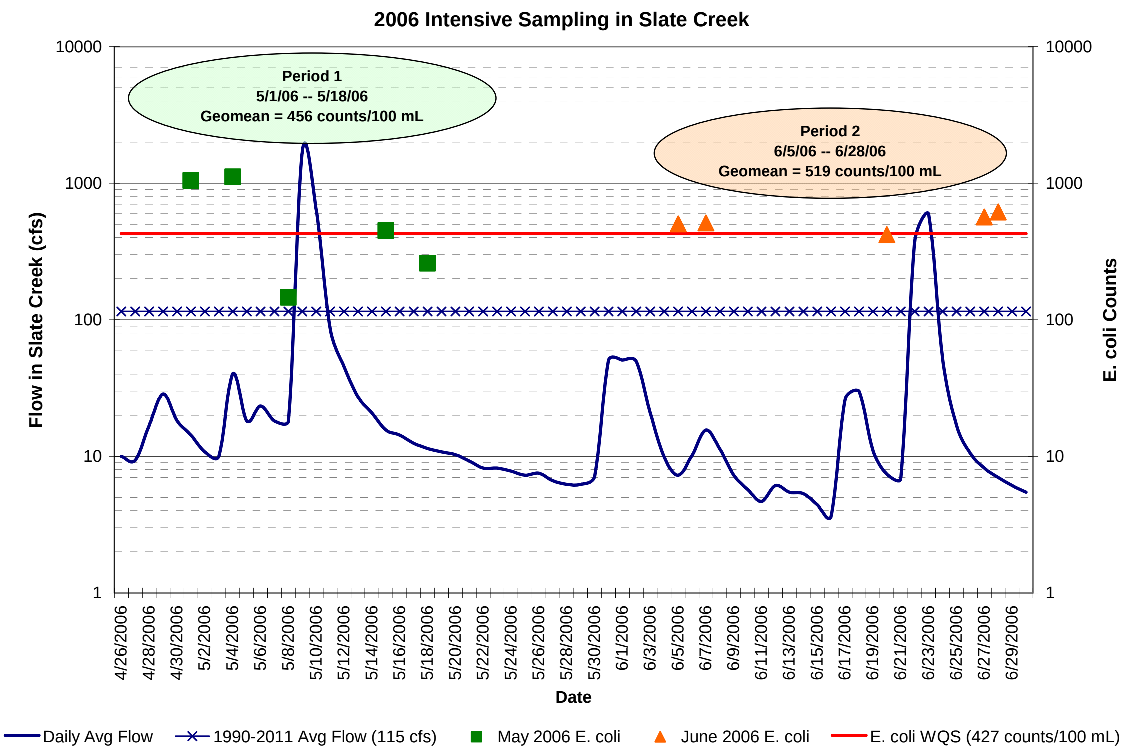
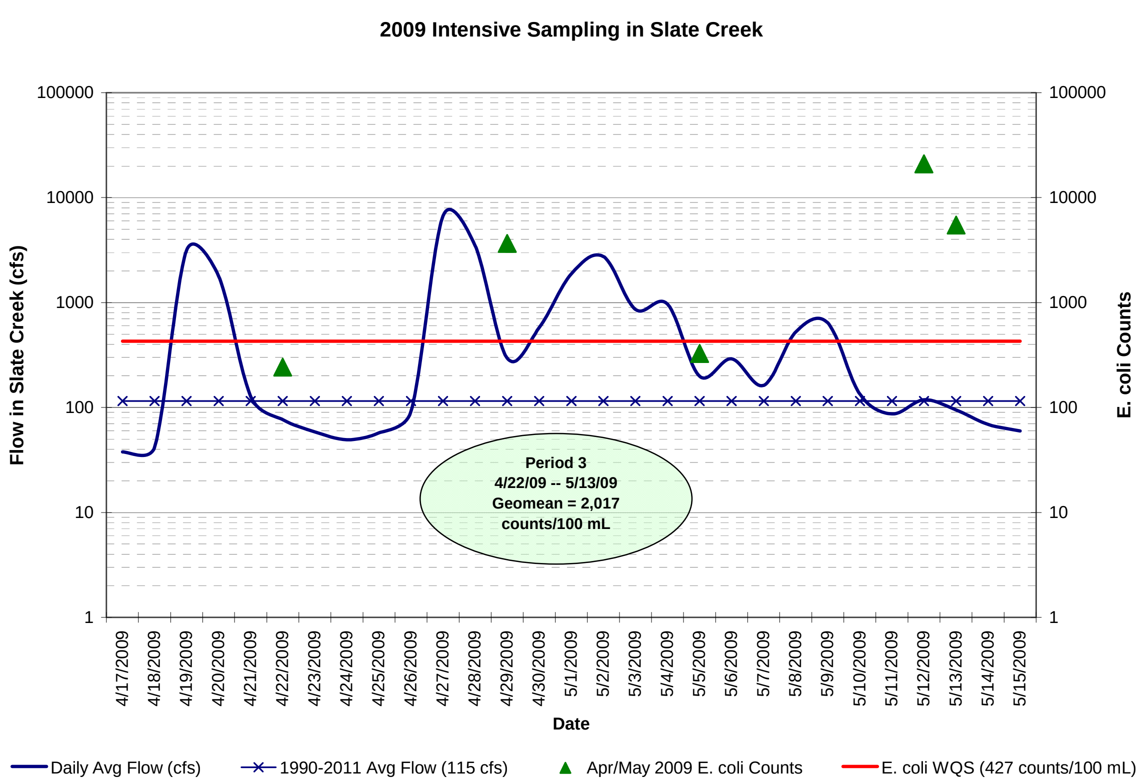
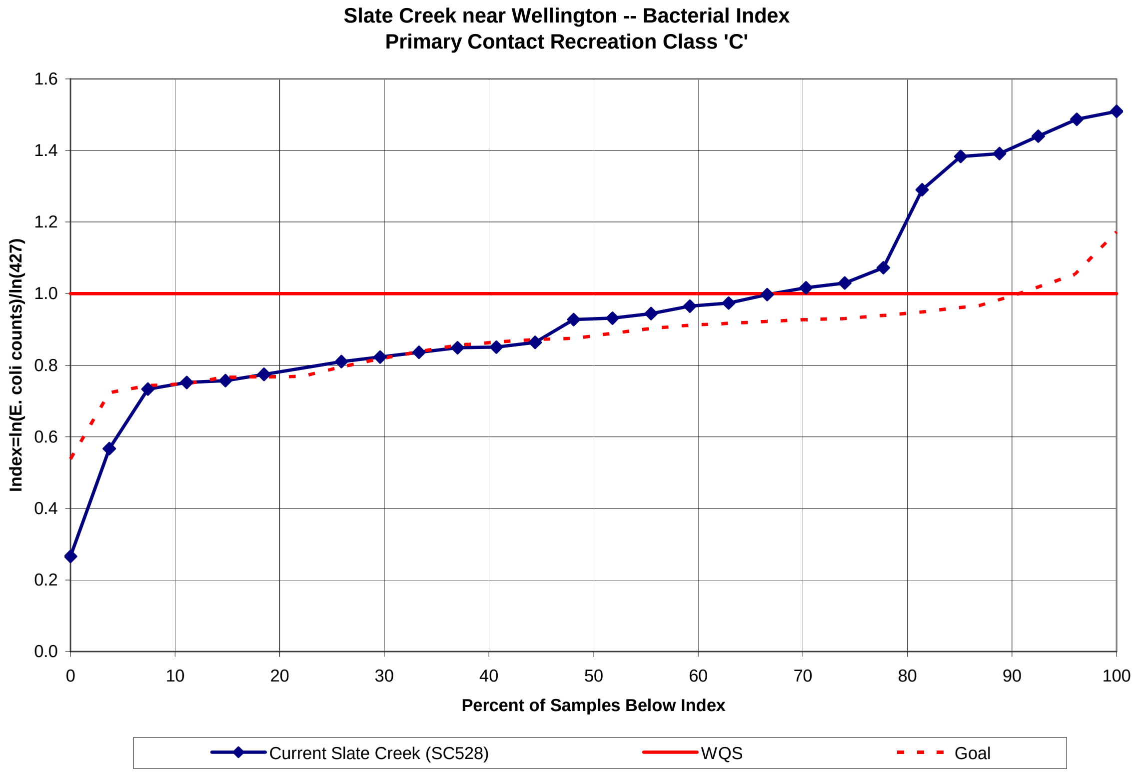


Figure 11. 2009 Intensive sampling for E. coli in Slate Creek at SC528 vs. Average Daily Flow.



E. Coli Index values for individual samples are computed as the ratio of the sample count to the contact recreation criteria. An index value of one or below indicates the sample was below the criterion. The calculated index is the natural logarithm of each sample value taken during the April-October primary recreation season divided by the natural logarithm of the bacteria criteria (427 counts/100 mL). Plotting the ECB ratio against the percentile for each individual sample within the respective data set illustrates the frequency distribution and magnitude of the bacteria impairment for the sampling location. Higher bacteria frequencies are evident when the ECB index values (or ratios) are over one for an extended percentage of the data set. The magnitude of the E. coli index is assessed by noting how high the ratios are for the samples with ratios greater than one within the data set. Currently, about 70% of the ECB index values for Slate Creek are below one (Figure 12).

Figure 12. E. coli bacteria profile for Slate Creek for April – October.



Desired Endpoints of Water Quality in Slate Creek (SC528): The ultimate endpoint for this TMDL will be to achieve the Kansas Water Quality Standards fully supporting primary contact recreational uses on Slate Creek. This requires the geometric mean of five samples taken within a 30-day period to be below the primary recreation class 'C' criterion of 427 counts during April to October. Hargis Creek will remain subject to the primary contact recreation class 'B' criteria for E. coli and it is expected that the water quality in Hargis Creek will continue to fully support the use of primary contact recreation class 'B'. Should the use attainability for primary contact recreation class 'B' come into question in Hargis Creek, a separate assessment of bacteria levels in the creek will take place.

The endpoints will be reached as a result of collective reductions in bacteria loading from various sources in the watershed, resulting from the implementation of corrective actions and best management practices, as directed by this TMDL. Achievement of the endpoints indicates either bacteria loads are within the loading capacity of the stream, water quality standards are attained, or full support of the designated uses of the stream has been restored. For Slate Creek, these endpoints are 427 counts/100 mL for the recreation season from April to October and 3,864 counts/100 mL for non-recreational season between November and March. As a result, the ECB index values will shift downward over an extended period of time and the percentage of samples below the index value of one will increase.

3. SOURCE INVENTORY AND ASSESSMENT

Point Sources: There are thirteen NPDES permitted facilities in the Slate Creek watershed (Appendix A). Of these facilities, four are manufacturers with pretreatment permits to discharge to the City of Wellington municipal sewer, one is a manufacturer with a pretreatment permit to discharge to Conway Springs' municipal sewer, one is a ready-mix concrete plant and five are non-overflowing lagoon systems. These eleven facilities are prohibited from discharging to the Slate Creek watershed with the concrete plant and non-overflowing lagoons potentially contributing a waste load under extreme precipitation or flooding events.

The remaining two, the City of Conway Springs and the City of Wellington are permitted to discharge to the watershed and are required to monitor for E. coli when discharging (Table 5). The City of Conway Springs has a three cell lagoon that regularly discharges to Slate Creek. While no limits are present for E. coli, there is a quarterly monitoring requirement and the facility has discharged eighteen times from September 2008 through July 2012 with E. coli values ranging from 3,260 counts in December 2011 to 2.0 counts in June 2012 (Figure 13). The E. coli geometric mean for the City of Conway Springs effluent is 1,209 counts for the recreation off season and 193 counts for the primary recreation season (Table 5).

The City of Wellington has an activated sludge plant with UV disinfection with monthly monitoring of the effluent and permit limits of 160 and 2,358 counts during the primary recreation and recreation off-seasons, respectively. In August 2010 the City of Wellington commissioned a new wastewater treatment facility and E. coli counts have ranged from 2,420 in November 2010 and July 2011 to less than 1.0 in November and December 2010, February 2011 and April 2012 (Figure 13). The effluent from the new plant at Wellington has an E. coli geometric mean of 12.7 counts for the recreation off season and 15.0 counts for the primary recreation season of April through October (Table 5).

Figure 13. E. coli counts in effluent from wastewater treatment facilities at Conway Springs and Wellington.

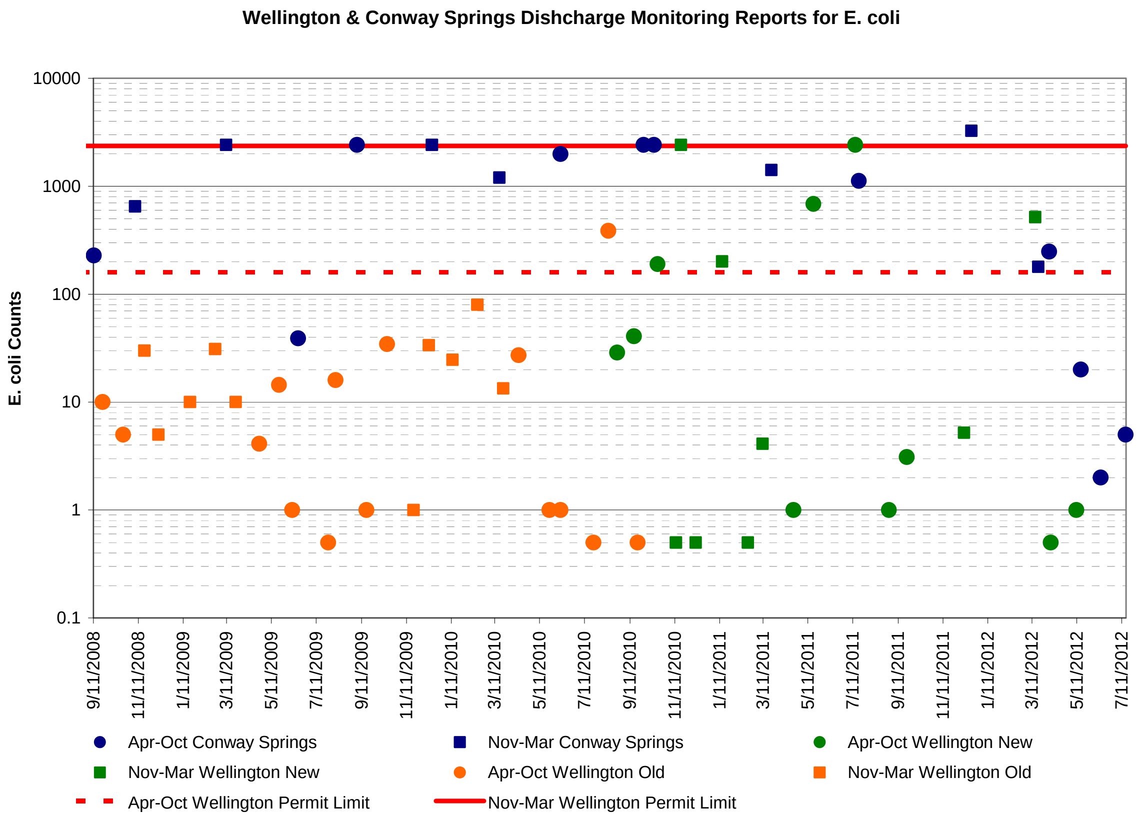


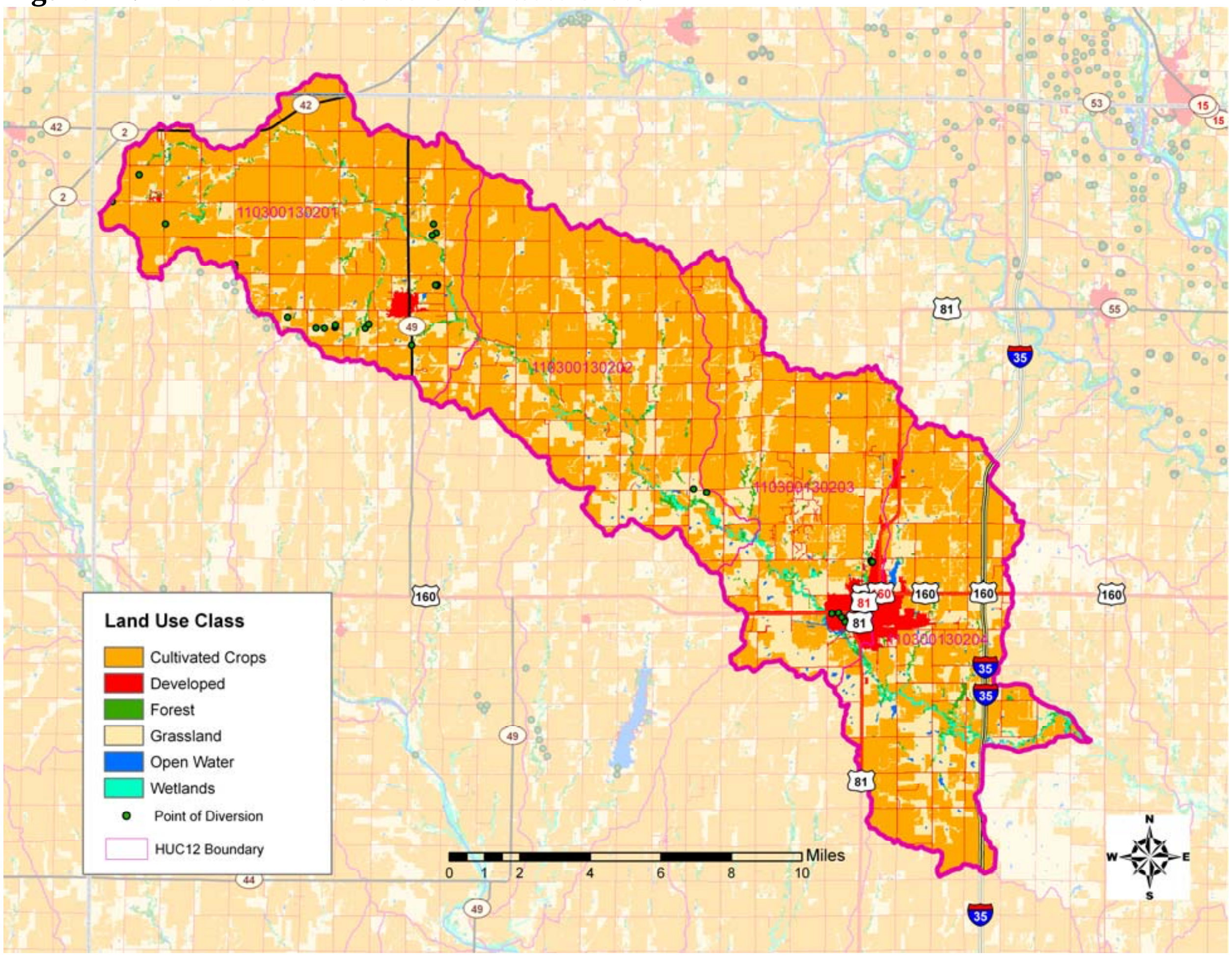
Table 5. Discharging facilities in the Slate Creek watershed.

Name	NPDES Permit #	State Permit #	Type	Design Capacity (MGD)	Monitoring Frequency	E. coli Geometric Mean Apr-Oct
City of Conway Springs WWTF	KS0030651	M-AR25-OO01	3 Cell Lagoon	0.168	Quarterly when discharging	193
City of Wellington WWTF	KS0099571	M-AR92-OO02	Activated Sludge/UV	1.71	Monthly	15.0

On-Site Waste Systems: Much of the Slate Creek watershed is a rural agricultural area that falls primarily into Sumner County. It can be assumed that all of the rural residences in the watershed are not connected to public sewer systems and failing on-site septic systems may contribute nutrient and bacteria loadings to the watershed. Additionally, it is unclear what controls are in place that assure proper disposal of the septic tank waste collected by septage haulers in Sumner County. According to 1990 census data from the U.S.Census Bureau, there are 3,336 septic systems in Sumner County.

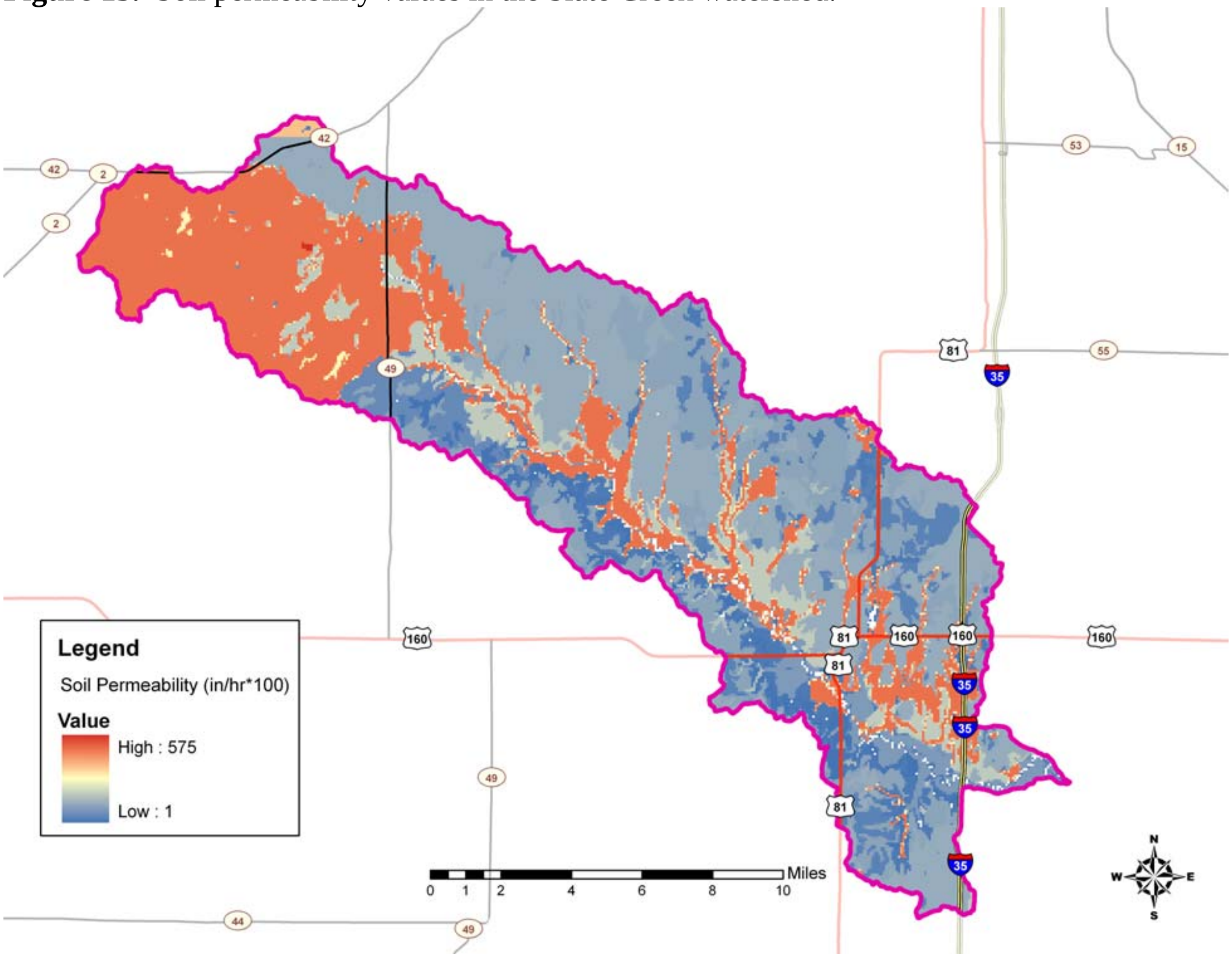
Land Use: The predominant land uses in the Slate Creek watershed are cultivated cropland (69%) and grassland (21%), according to the 2001 National Land Cover Data. Together they account for 90% of the total land area in the watershed with the remaining land area composed of developed land (7.0%), forest (1.6%), wetlands (1.0%), and open water (0.40%) (Figure 14). Manure application to the cultivated cropland and grassland in the watershed is a likely source of bacterial loading in the creek particularly if a runoff event occurs soon after the manure is applied.

Figure 14. Land use in the Slate Creek watershed.



Contributing Runoff: The watershed of Slate Creek has a mean soil permeability value of 0.59 inches/hour, ranging from 0.01 inches/hour to 5.75 inches/hour according to NRCS STATSGO database (Figure 15). About 34% of the watershed has a permeability value less than 0.57 inches/hour, which contributes to runoff during extremely low rainfall intensity events while nearly 60% has a permeability value of 1.29 inches/hour which contributes runoff during low and very low rainfall intensity events. According to a USGS open-file report (Juracek, 2000), the threshold soil-permeability values are set at 3.43 inches/hour for very high, 2.86 inches/hour for high, 2.29 inches/hour for moderate, 1.71 inches/hour for low, 1.14 inches/hour for very low, and 0.57 inches/hour for extremely low soil-permeability. Runoff is primarily generated as infiltration excess when soil profiles become saturated and produce excess overland flow due to rainfall intensities that are greater than soil permeability. The low soil permeability in the Slate Creek watershed is likely contributing to bacteria loading as even low magnitude precipitation events are likely to cause runoff. The lower portion of the watershed is particularly susceptible to runoff due to its extremely low soil permeability as seen in Figure 15.

Figure 15. Soil permeability values in the Slate Creek watershed.



Livestock and Waste Management Systems: There are three certified or permitted confined animal feeding operations (CAFOs) within Slate Creek watershed (Table 6). These livestock facilities have waste management systems designed to minimize runoff entering their operation or detaining runoff emanating from their facilities. In addition, they are designed to retain a 25-year, 24-hr rainfall/runoff event as well as an anticipated two weeks of normal wastewater from their operations. Typically, this rainfall event coincides with stream flow occurring less than 1-5% of the time. According to the 2002 USDA Census of Agriculture there were 2,358 head of cattle contributing to a total of 4,520 head of livestock in the HUC 12s that make up the Slate Creek watershed indicating there are small, unregistered livestock operations in the watershed (Table 7). Livestock operations that use the riparian stretches along Slate Creek and its tributaries for grazing or for direct access watering are likely contributors to the bacteria load in the creek.

Table 6. Animal feeding operations in the Slate Creek watershed.

Kansas Permit Number	Type	County	Animal Total	HUC 12
A-ARSU-M002	Dairy	Sumner	75	1103001030201
A-ARSU-BA02	Beef	Sumner	800	1103001030203
A-ARSU-BA04	Beef	Sumner	300	1103001030204

Table 7. Livestock numbers by HUC 12. USDA, 2002.

HUC 12	Beef Cattle	Dairy Cattle	Hogs	Sheep	Chickens	Ducks	Total
110300130201	653	51	366	144	39	1	**1,254**
110300130202	640	50	359	141	36	1	**1,227**
110300130203	522	41	292	115	29	1	**1,000**
110300130204	543	42	304	120	31	1	**1,041**
Watershed Total	**2,358**	**185**	**1,321**	**519**	**133**	**4**	**4,522**

Population: The population in the watershed is approximately 11,705 people (59 people/mi^2) according to the 2000 U.S. Census Block information with 1,322 people residing within Conway Springs and 8,647 people residing within Wellington. Population in the cities in the watershed is diminishing as the 2010 U.S. Census data shows a loss of 50 people in Conway Springs and a loss of 475 people in Wellington over the decade.

Background: Bacteria are present from wildlife, but typically dispersed enough to not be a significant source of loading. If high densities of wildlife, particularly geese, settle in a confined area, the background levels of bacteria can be expected to increase significantly.

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

This TMDL will be established to meet the Primary Contact Recreation class ‘C’ geometric mean criteria for bacteria counts in Slate Creek at SC528. For Slate Creek, the geometric mean of five samples taken within 30 days should be below 427 counts during the primary recreation season of April through October and below 3,864 counts during the recreation off-season of November through March. All other classified streams in the watershed are categorized as primary contact recreation ‘C’ or secondary contact recreation ‘b’, with the exception of Hargis Creek which is categorized as primary contact recreation class ‘B’ as it flows near a school yard in the City of Wellington where access is possible. The purpose of this TMDL is to restore the water quality at SC528 to meet the primary contact recreation class ‘C’ criteria of 427 counts during April through October. Hargis Creek will remain subject to the primary contact recreation class ‘B’ criteria for E. coli and it is expected that the water quality in Hargis Creek will continue to fully support the use of primary contact recreation class ‘B’.

While the water quality standards are based on the geometric means, this TMDL will look to reduce the duration, frequency and magnitude of individual E. coli samples taken during the primary recreation season such that a majority will be below the nominal value of the criterion. Figure 15 displays the distribution of E. coli samples taken during the primary recreation months since 2003 over the range of flow percentages at SC528. Elevated bacteria counts occur in Slate Creek across flow conditions indicating bacterial loading from manure applications, livestock watering and runoff events.

Point Sources: In accordance with the Surface Water Quality Standards at K.A.R. 28-16-28e(c)(7)(F), "Wastewater effluent shall be disinfected if it is determined by the department that the discharge of non-disinfected wastewater constitutes an actual or potential threat to public health". Therefore, wastewater released from the discharging lagoon system in the City of Conway Springs should have sufficient retention time prior to discharge to ensure bacteria die-off. The mechanical plant operated by the City of Wellington has ultraviolet disinfection of their wastewater to effectively eliminate any bacterial loading to the receiving waters.

The Wasteload Allocations will reflect the applicable permit limits of colonies of bacteria per 100 mL (Table 8). As a lagoon facility, the Conway Springs WWTF is assigned a limit of 427 CFU/100 mL at the end of the outfall as there is no limit currently in place. A limit of 160 CFU/100 mL is established in the discharge permit for the City of Wellington WWTF and is reflected in this TMDL. The eleven other permitted facilities in the watershed will have a wasteload allocation of zero as they are either pre-treatment permittees that discharge municipal sewers or are non-discharging facilities (Appendix A).

Table 8. Bacteria Wasteload Allocation for cities in the Slate Creek watershed.

Name	State Permit #	Design Flow (MGD)	Design Flow (cfs)	E. coli counts/100 mL	WLA E. coli giga-counts/day
City of Conway Springs WWTF	M-AR25-OO01	0.168	0.260	427	2.72
City of Wellington WWTF	M-AR92-OO02	1.71	2.65	160	10.4

Future dischargers to Hargis Creek (24) will be subjected to at least the primary contact class 'B' criteria of 262 counts during the primary recreation season of April through October and 1,310 counts during the recreation off-season of November through March.

Nonpoint Sources: The Load Allocation (LA) assigns responsibility for nonpoint source contributors for the bacteria input into Slate Creek from rural settings. The Load Allocations displayed in Table 9 lie between the total wasteload allocations and the TMDL line for both the primary recreation season and the recreation off-season water quality criteria for Slate Creek. Figure 16 shows the bacteria load duration TMDL for Slate Creek with the wasteload allocation from the two municipal dischargers. The load allocation for Hargis Creek will be subjected to the primary contact recreation class 'B' criteria of 262 and 2,358 counts (Table 10).

Table 9. Wasteload allocation, non-point source load allocation and TMDL for Slate Creek for both the primary recreation season of April through October and the recreation off-season of November through March under varying flow conditions.

	Percent of Time Flow Exceeded	Flow (cfs)	Bacteria Giga-Counts/Day		
			WLA	LA	TMDL
April-October WQS 427 CFU/100 mL	90	2.73	13.1	15.4	28.5
	75	6.89	13.1	58.9	72.0
	50	14.3	13.1	136.3	149.4
	25	33.8	13.1	340.0	353.1
	10	124	13.1	1277.1	1290.2
November-March WQS 3,843 CFU/100 mL	90	2.73	13.1	245.0	258.1
	75	6.89	13.1	638.3	651.4
	50	14.3	13.1	1338.8	1351.9
	25	33.8	13.1	3182.2	3195.3
	10	124	13.1	11662.1	11675.2

Figure 16. Bacteria TMDL curve for Slate Creek near Wellington.

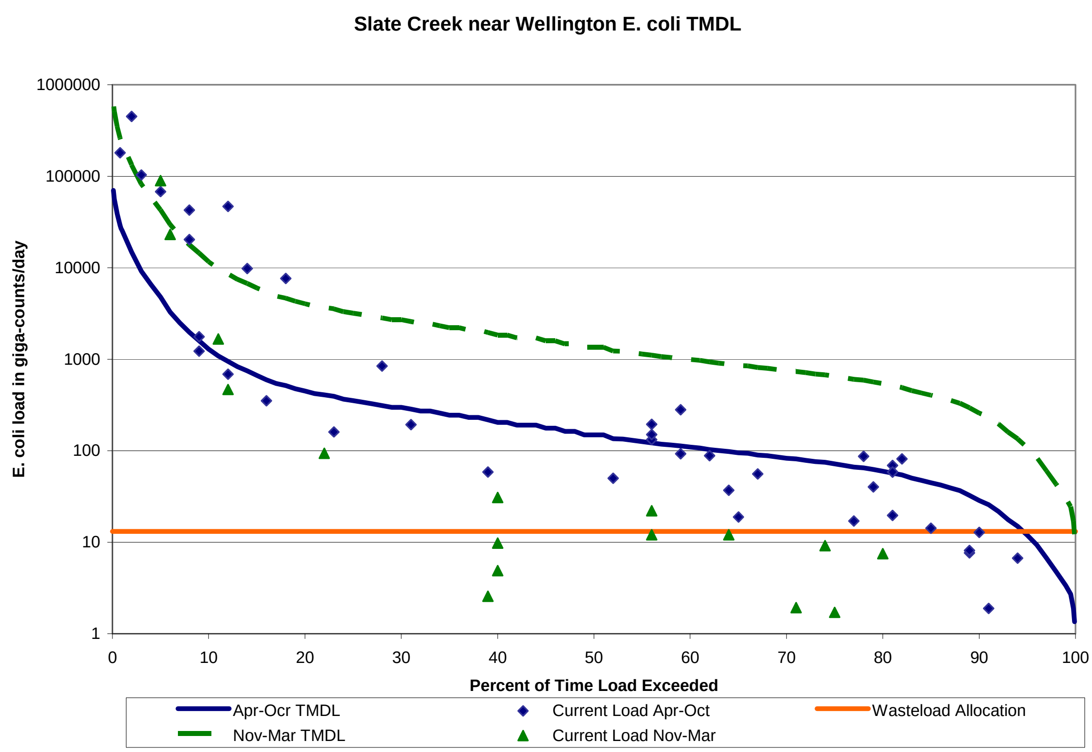


Table 10. Hargis Creek load allocation based on estimated flow (Perry et al., 2004) and primary contact recreation class 'B' criteria.

	Percent of Time Flow Exceeded	Flow (cfs)	Bacteria Giga-Counts/Day
April-October WQS 262 CFU/100 mL	90	0	0
	75	0	0
	50	0.55	3.53
	25	1.80	11.5
	10	6.13	39.3
November-March WQS 2,358 CFU/100 mL	90	0	0
	75	0	0
	50	0.55	31.7
	25	1.80	104
	10	6.13	354

Defined Margin of Safety: The Margin of Safety provides some hedge against the uncertainty of bacteria loading in Slate Creek. The margin of safety for this TMDL is implicit, which accounts for conservative assumptions tied to assessing attainment to the primary recreation class C criteria (427 CFU/100 mL). The TMDL is established using profiles of individual samples against that criterion over time, although the criterion is meant to be assessed by geometric means of samples taken in short (30-day) periods of time. The conservative approach ensures that the water quality standard will be attained as assessing individual sample profiles is much more stringent than assessing the geometric mean.

State Water Plan Implementation Priority: Due to the concurrent mechanisms of loading bacteria into Slate Creek along with phosphorus and sediment, this TMDL will be designated as **High Priority** for implementation to direct stormwater and non-point source management to abate such pollutant loads.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Middle Arkansas-Slate Basin (HUC 8: 11030013) with a priority ranking of 6 (High Priority for restoration work).

Priority HUC 12: Due to low soil permeability and the location of registered livestock operations, this TMDL will initially concentrate on conditions in the lower portion of the watershed in the HUC 12 subwatersheds 110300130204 and 110300130203 along with any riparian stretches along Slate Creek and its tributaries identified as winter feeding or summer watering grounds. As improved conditions are noted at KDHE site SC528, implementation of this TMDL will expand to the upper two HUC 12s of the watershed (110300130202 and 110300130201). Livestock management may be a principal driver of the bacteria impairment so implementation will involve both livestock access and isolation of livestock areas from runoff events.

5. IMPLEMENTATION

Desired Implementation Activities:

1. Maintain disinfection through operations under state and federal permits, inspect permitted facilities, continue monitoring requirements and evaluate compliance with permit limits.
2. Improve riparian conditions along stream systems by limiting overuse from grazing livestock along and in the stream.
3. Provide alternative water sources for livestock to limit their use of streams as a water source.
4. Ensure land applied manure is being properly managed and is not susceptible to runoff into nearby streams.
5. Install pasture management practices, including proper stock density, to reduce soil erosion and storm runoff.
6. Ensure proper on-site waste system operations in proximity to the main stream segments.

Implementation Programs Guidance:

NPDES and State Permits – KDHE

a. Monitor effluent from the discharging permitted wastewater treatment facilities, continue to encourage wastewater reuse and ensure compliance and proper operation to control bacteria in wastewater discharges.
b. Maintain permit limits after 2015 and effective operation of lagoons.
c. Inspect permitted livestock facilities to ensure compliance.
d. New livestock permitted facilities will be inspected for integrity of applied pollution prevention technologies.
e. New registered livestock facilities with less than 300 animal units will apply pollution prevention technologies.
f. Manure management plans will be implemented to include proper land application rates and practices that will prevent runoff of applied manure.

Nonpoint Source Pollution Technical Assistance – KDHE

a. Support Section 319 activities including demonstration projects and outreach efforts for reduction of bacteria loading from agricultural lands through livestock management.
b. Provide technical assistance on practices geared to the establishment of vegetative buffer strips.

c. Provide technical assistance on bacteria management for livestock facilities in the watershed and practices geared toward small livestock operations which minimize impacts to stream resources.

Water Resource Cost Share and Nonpoint Source Pollution Control Program – Kansas Department of Agriculture, Division of Conservation

a. Install livestock waste management systems for manure storage.
b. Implement manure management plans.
c. Support terracing, grass waterways and buffers along cropland,
d. Repair or replace failing septic systems which are located with 100 feet of Slate Creek or its tributaries.

Riparian Protection Program – Kansas Department of Agriculture, Division of Conservation

a. Establish or reestablish natural riparian systems, including vegetative filter strips and stream bank vegetation.
b. Develop riparian restoration projects along targeted stream segments, initially along Slate Creek and its tributaries in the lower two HUC 12s (110300130203 & 110300130204) in the watershed and moving to the upper two HUC 12s (110300130201 & 110300130202).
c. Promote wetland construction to reduce runoff and assimilate loadings in Slate Creek.

Buffer Initiative Program – Kansas Department of Agriculture, Division of Conservation

a. Install and maintain grass buffer strips near Slate Creek and its tributaries beginning in the lower two HUC12s (110300130203 & 110300130204) in the watershed and moving to the upper two HUC 12s (110300130201 & 110300130202).
b. Mitigate removal of riparian lands from Conservation Reserve Program to hold streamside land out of production.

Extension Outreach and Technical Assistance – Kansas State University

a. Educate agricultural producers on sediment, nutrient, bacteria and pasture management.
b. Educate livestock producers on livestock waste management and land applied manure applications.
c. Provide technical assistance on livestock waste management systems.
d. Provide technical assistance on buffer strip design and minimizing rural runoff.
e. Educate residents, landowners, and watershed stakeholders about homestead waste management.

Time Frame for Implementation: Implementation of abatement practices and rural runoff management should commence in 2012 and should continue through 2016. Additional implementation may be required over 2017 to 2022 to achieve the endpoints of this TMDL.

Targeted Participants: The primary participants for implementation will be the Sumner County Conservation District and agricultural producers and stakeholders within the Slate Creek watershed directed toward agricultural and livestock operations immediately adjacent to Slate Creek and its tributaries and the Sumner County Environmental Health unit directed toward the assessment of septic tank waste disposal practices and protocols.. All will be encouraged to implement appropriate practices. Conservation District Personnel and county extension agents should target possible sources adjacent to Slate Creek over 2012. Non-point source implementation activities should focus in the areas with the greatest potential to impact bacteria concentrations along Slate Creek.

Targeted activities to focus attention toward include:

1. Overused grazing land adjacent to the stream.
2. Sites where drainage runs through or adjacent to livestock areas.
3. Sites where livestock have full access to the stream and it is their primary water supply.
4. Poor riparian area and denuded riparian vegetation along the stream.

Milestone for 2016: Because bacteria daily loads are nonsensical, the preferred manner to track progress in implementing this TMDL is through alterations to the ECB index profile for KDHE sampling station SC528 (Figure 12). As the ECB index profiles decline, it will indicate reductions in duration, frequency and magnitude of future E. coli bacteria samples such that a majority will be below the nominal criterion value applied at both stations. As the profile approaches the desired distribution indicated in the figure, intensive sampling during the primary recreation season can be done to ascertain whether the primary season geometric means are in compliance with the bacteria criterion.

In accordance with the TMDL development schedule for the State of Kansas, the year 2016 marks the next cycle of 303(d) activities in the Lower Arkansas Basin. At that point in time, the bacteria profile from site SC528 should show decline.

Delivery Agents: The primary delivery agents for program participation will be the Kansas Department of Health and Environment, State Extension Service and the Sumner County Conservation District.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollutants and to assure allocations of pollutant to point and nonpoint sources can be attained.

1. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.

2. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.

3. K.S.A. 2002 Supp. 82a-2001 identifies the classes of recreation use and defines impairment for streams.

4. K.S.A. 2-1915 empowers the Kansas Department of Agriculture – Division of Conservation to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.

5. K.A.R. 28-16-69 to 71 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.

6. K.S.A 75-5657 empowers the Kansas Department of Agriculture – Division of Conservation to provide financial assistance for local project work plans developed to control nonpoint source pollution.

7. K.S.A. 82a-901, et. seq. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.

8. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*, including selected Watershed Restoration and Protection Strategies.

9. The Kansas Water Plan and the Lower Arkansas Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority in implementation.

Funding: The State Water Plan Fund annually generates $16-18 million and is the primary funding mechanism for implementing water quality protection and pollutant reduction activities in the state through the *Kansas Water Plan*. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This watershed and its TMDL are a **High** priority consideration and should receive support for pollution abatement practices that lower the loading of bacteria and associated pollutants of sediment and nutrients to Slate Creek.

Effectiveness: Use of retention and buffers that isolate streams from nearby uses and potential loadings ahs been effective in reducing the bacteria levels in streams, including under wet weather conditions. In addition, the proper implementation of comprehensive livestock waste management plans have proven effective at reducing runoff associated with livestock facilities.

6. MONITORING

KDHE will continue to collect quarterly to bimonthly samples every year at station SC528 in the watershed. The streams in the watershed will be evaluated for possible delisting during the development of the 2022 303(d) list. Once bacteria index profiles (Figure 13) decline sufficiently, a series of intensive (5 in 30 days) sampling will commence to evaluate if impairment remains.

7. FEEDBACK

Public Notice: An active Internet Web site was established at www.kdheks.gov/tmdl/ to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Lower Arkansas Basin.

Public Hearing: A Public Hearing was held on September 21st, 2012 in Wellington to receive comments on this TMDL. None were received throughout the August 20, 2012 through September 26, 2012 comment period.

Basin Advisory Committee: The Lower Arkansas River Basin Advisory Committee met to discuss these TMDLs on May 31, 2012 in Hutchinson and September 12, 2012 in Halstead.

Milestone Evaluation: In 2016, evaluation will be made as to the degree and impact of implementation which has occurred within the watershed. Subsequent decisions will be made regarding the implementation approach, priority of allotting resources for implementation and the need for additional or follow up implementation in this watershed at the next TMDL cycle for this basin in 2016 with consultation from local stakeholders.

Consideration for 303d Delisting: Slate Creek will be evaluated for delisting under section 303(d), based on the monitoring data over 2012-2020. Therefore, the decision for delisting will come about in the preparation of the 2022-303(d) list. Should modifications be made to the applicable water quality criteria during the implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities might be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality, Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision would come in 2012. Recommendations of this TMDL will be considered in the Kansas Water Plan implementation decisions under the State Water Planning Process for Fiscal Years 2012-2021.

Developed 3/22/13

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Appendix A. NPDES permitted facilities in the Slate Creek watershed.

Kansas Permit No.	Federal Permit No.	Facility	Type	Receiving Stream	Design Flow MGD	Permit Expires	WLA E. coli giga-counts/ day
C-AR92-NO02	KSJ000604	Reed Estates	1 Cell Lagoon	N/A	0.002	5/31/13	0
C-AR92-NO04	KSJ000606	Xanadu Acres	1 Cell Lagoon	N/A	0.0019	8/31/13	0
C-AR92-NO05	KSJ000172	Wellington KOA	1 Cell Lagoon	N/A	N/A	7/31/13	0
C-AR92-NO06	KSJ000154	Wellington KTA	2 Cell Lagoon	N/A	0.0019	12/31/13	0
I-AR92-PR01	KSG110016	APAC-Kansas/Shears	Concrete Plant Retention Pit	N/A	N/A	9/30/12	0
M-AR25-OO01	KS0030651	Conway Springs WWTF	3 Cell Lagoon	Slate Creek	0.168	6/30/12	2.72
M-AR92-NO05	KSJ000432	Wellington Airport	2 Cell Lagoon	N/A	0.00176	5/31/13	0
M-AR92-OO02	KS0099571	City of Wellington WWTF	Activated Sludge/UV	Slate Creek	1.71	12/31/12	10.4
P-AR25-OO01	KSP000048	D-J Extruding	Pretreatment	N/A	N/A	6/30/16	0
P-AR92-OO01	KSP000062	Oxwell, Inc.	Pretreatment	N/A	N/A	6/30/16	0
P-AR92-OO03	KSP000003	Diversified Services, Inc.	Pretreatment	N/A	N/A	12/31/15	0
P-AR92-OO04	KSP000007	Clark Manufacturing	Pretreatment	N/A	N/A	12/31/11	0
P-AR92-OO05	KSP000087	Triumph Accessory Services	Pretreatment	N/A	N/A	6/30/15	0