NEOSHO BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody/Assessment Unit: Bachelor Creek
Water Quality Impairment: Dissolved Oxygen

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Middle Neosho River **County:** Labette

HUC 8: 10260008

HUC 11 (HUC 14s)**:** **040** (040)

Drainage Area: 29.6 square miles

Main Stem Segment: WQLS: 396 (Bachelor Creek) starting at the confluence with the Labette Creek in northeast Labette County and traveling upstream to the headwaters northwest Labette County (**Figure 1**).

Designated Uses: Expected Aquatic Life Support and Secondary Contact Recreation Main Stem Segment.

Impaired Use: Expected Aquatic Life Support

Water Quality Standard: Dissolved Oxygen (DO): 5 mg/L (KAR 28-16-28e(c)(2)(A))

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 2002 303(d): Not Supporting Aquatic Life

Monitoring Sites: Station 698 near Labette

Period of Record Used: 1997 and 2001 for Station 698 (**Figure 2**)

Flow Record: Lightning Creek near McCune (USGS Station 07184000; 1970-2002) matched to the unit area discharge flow duration for Labette Creek near Chetopa (Station 07184580) and calculated based on drainage area for Bachelor Creek watershed.

Long Term Flow Conditions: 10% Exceedance Flows = 32.6 cfs**,** 95% = 0.00 cfs

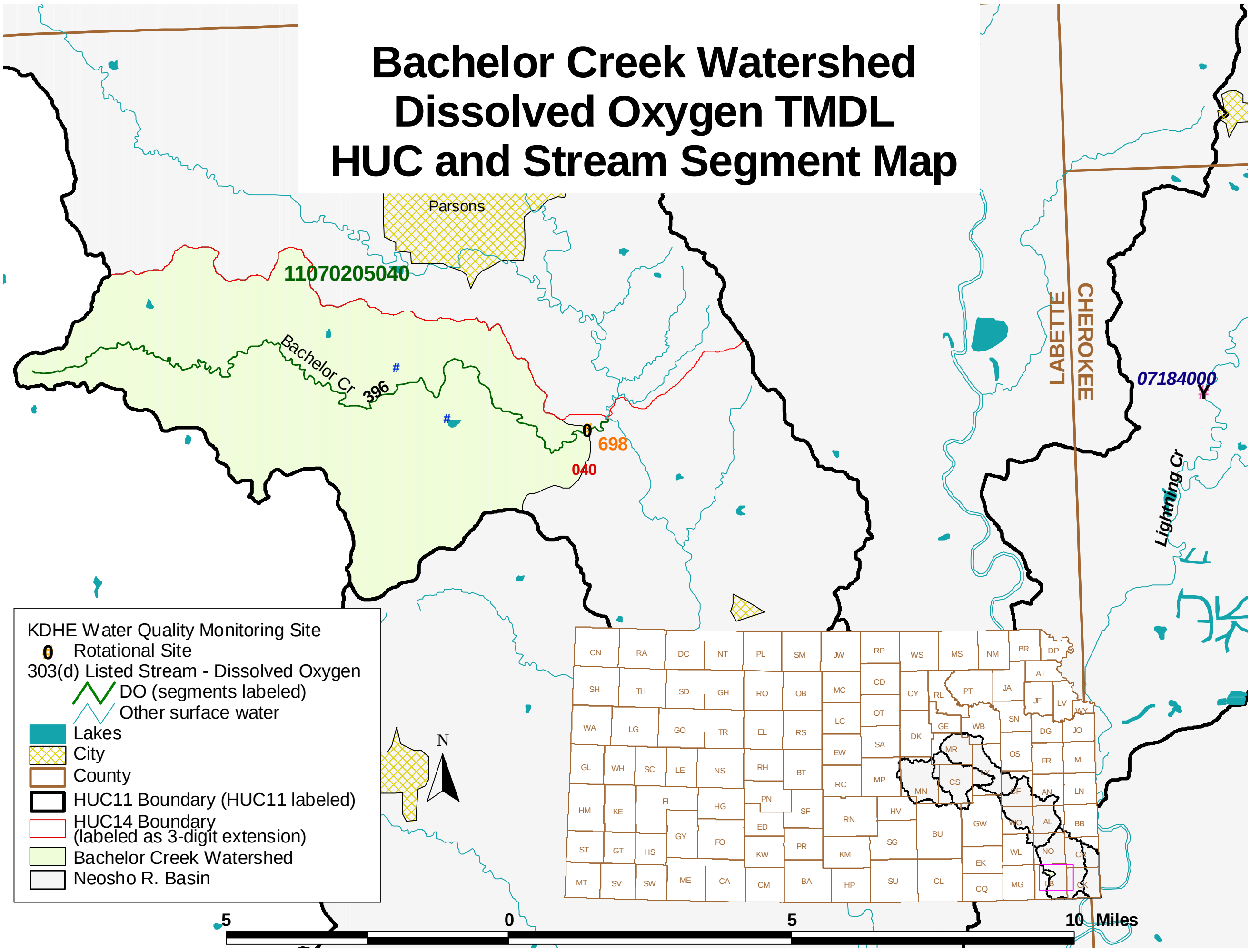


Figure 1

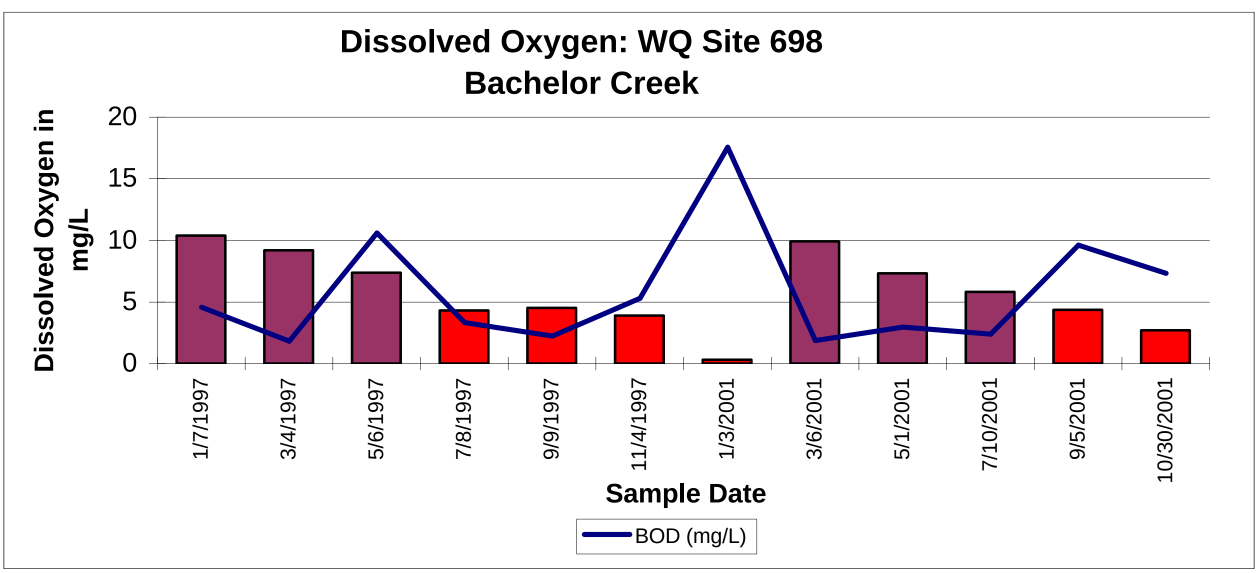


Figure 2

Current Conditions: Since loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired loads over all flow conditions, rather than fixed at a single value. Sample data for the sampling site were categorized for each of the three defined seasons: Spring (Apr-Jul), Summer-Fall (Aug-Oct) and Winter (Nov-Mar). High flows and runoff equate to lower flow durations; baseflow and point source influences generally occur in the 75-99% range. Load curves were established for the Aquatic Life criterion by multiplying the flow values for Bachelor Creek near Labette along the curve by the applicable water quality criterion and converting the units to derive a load duration curve of pounds of DO per day. This load curve graphically displays the TMDL since any point along the curve represents water quality at the standard at that flow. Historic excursions from water quality standards (WQS) are seen as plotted points *below* the load curves. Water quality standards are met for those points plotting *above* the applicable load duration curves (**Figure 3**). In addition, a concentration duration curve was also created to visually aid in the identification of excursions from DO criterion (**Figure 4**).

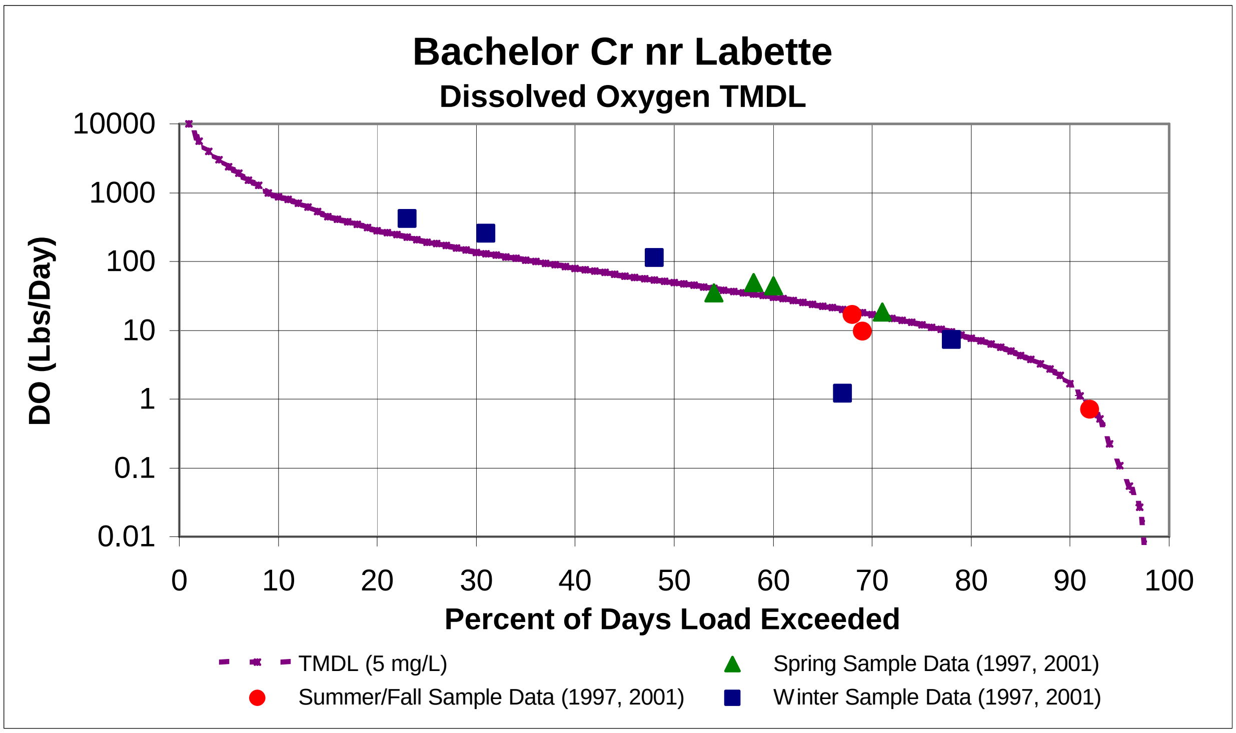


Figure 3

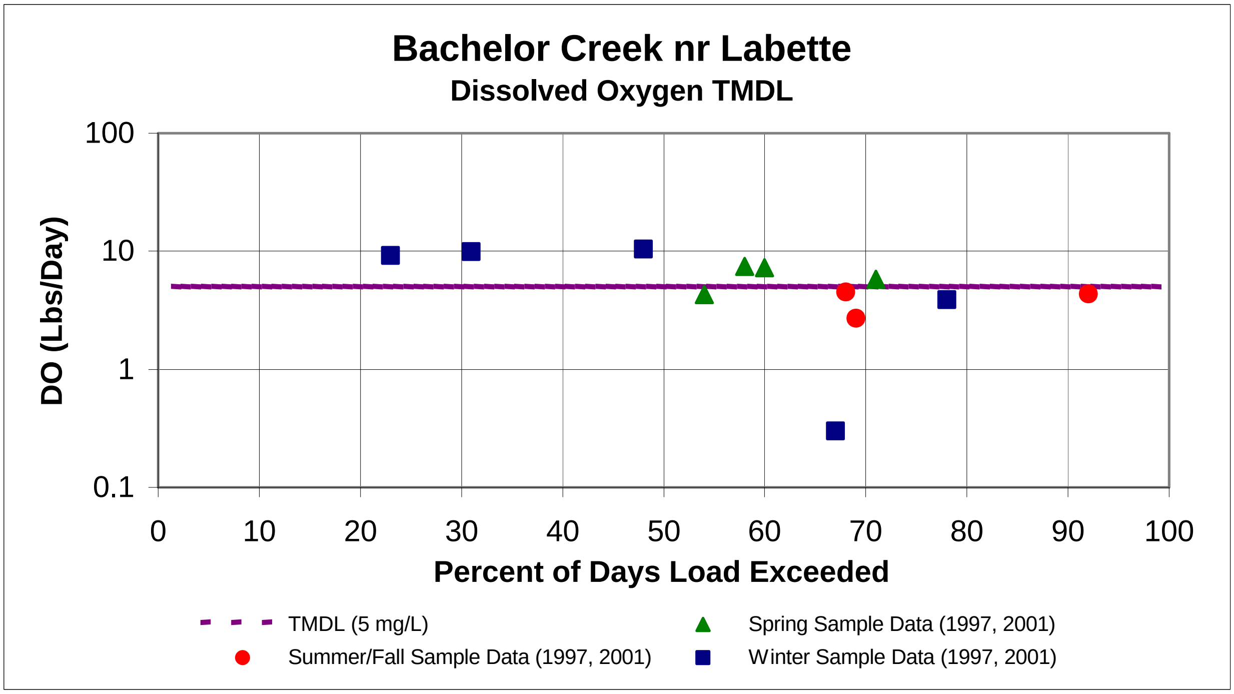


Figure 4

Excursions were seen in each of the three defined seasons and are outlined in **Table 1**. All of the Summer-Fall samples and 25% of Spring samples were below the aquatic life criterion. Forty percent of the Winter samples were under the aquatic life criterion. Overall, 50% of the samples were under the criterion. This would represent a baseline condition of non-support of the impaired designated use.

Table 1

NUMBER OF SAMPLES UNDER DISSOLVED OXYGEN STANDARD OF 5mg/L BY FLOW								
Station	**Season**	**0 to 10%**	**10 to 25%**	**25 to 50%**	**50 to 75%**	**75 to 90%**	**90 to 100%**	**Cum. Freq.**
Bachelor Cr nr Labette (698)	Spring	0	0	0	1	0	0	1/4 = 25%
	Summer/Fall	0	0	0	2	0	1	3/3 = 100%
	Winter	0	0	0	1	1	0	2/5 = 40%

No DO violations have been encountered at flows exceeding 1.5 cfs on Bachelor Creek near Labette, therefore a critical low flow can be identified on Bachelor Creek as those flows of 1.5 cfs or less.

The data from Site 698 were divided into two groups for comparison purposes; those data associated with the DO excursions and those with DO compliant samples. The relationship of DO to ammonia, biochemical oxygen demand (BOD), fecal coliform bacteria (FCB), water temperature, turbidity, nitrate, phosphorus, potassium and pH were used in making the comparisons. KDHE discontinued BOD sampling from its stream compliance water quality network at the end of 2001. Total Organic Carbon (TOC) is now sampled in the place of BOD. Total Kjeldahl Nitrogen (TKN) samples were collected beginning in 2000. Although a statistical comparison of TOC and TKN was performed, because of insufficient sample numbers these factors could not be included in the multiple regression model discussed later. **Table 2** outlines those water quality data used in the comparison.

Table 2

COL_Date	Group	DO	LN (DO)	NH4	BOD	FCB	N	pH	Temp_C	P	Turb	TOC	TKN	Flow
1/7/1997	Compliant	10.4	2.34	0.02	4.56	10	0.06	7.5	5	0.066	4.6	.	.	2.01
3/4/1997	Compliant	9.2	2.22	0.041	1.83	110	1.01	7.4	9	0.16	47	.	.	8.41
7/8/1997	Excursion	4.3	1.46	0.135	3.33	21000	0.3	6.9	24	0.281	57	.	.	1.5
9/9/1997	Excursion	4.5	1.50	0.1	2.25	500	0.22	7.1	27	0.111	12	.	.	0.7
11/4/1997	Excursion	3.9	1.36	0.02	5.31	250	0.54	7	10	0.289	36	.	.	0.35
1/3/2001	Excursion	0.3	-1.20	0.35	17.55	10	0.01	7	1	0.82	7.6	20.60	1.74	0.75
3/6/2001	Compliant	9.9	2.29	0.21	1.89	30	1.96	7.5	5	0.18	42	8.80	1.32	4.8
5/1/2001	Compliant	7.3	1.99	0.115	2.94	130	0.27	7.4	20	0.126	8.7	9.68	0.799	1.12
7/10/2001	Compliant	5.8	1.76	0.02	2.37	150	0.33	7.3	27	0.125	11	7.18	0.488	0.59
9/5/2001	Excursion	4.35	1.47	0.09	9.6	80	0.045	7.6	25	0.104	6.5	11.15	1.01	0.03
10/30/2001	Excursion	2.7	0.99	0.02	7.35	100	0.01	7	15	0.425	17	18.86	1.476	0.66

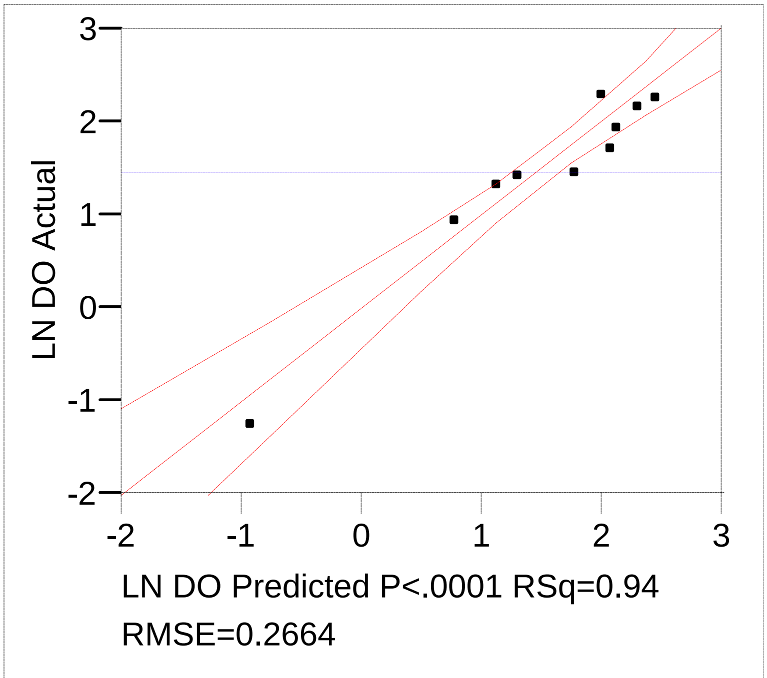
(note: one compliant sample (5/06/97) was removed from analysis: outlier by Jackknife Distance Method)

Parametric (t Test) and non-parametric (Wilcoxon Test) statistical analyses were performed to determine if significant differences existed between the groups in Tables 2. The results (**Appendix**) indicate that there were significant differences in the compliant/excursion groups for some t Test and some Wilcoxon Tests. These significant results include BOD, TOC, pH and pottasium. Borderline, yet non-significant, differences would include nitrogen, phosphorus, and TKN. The current group sample size is so small that additional samples are needed to improve these comparisons.

BOD and pH (and possibly nitrate and phosphorus, if more data are collected) appear to be a good indicator of the DO problems in the watershed. This points to, in addition to the natural component of extremely low flow, an excessive nutrient/organic load issue exists in the watershed and is contributing to the DO problems. That pH is a significant factor is probably an indication of robust stream phytoplankton activity generated by excessive nutrients in the stream.

Both BOD and pH were used to predict LN(DO) in the multiple regression below. This model was used to set the BOD target for the watershed under the critical flow condition. Using a low range pH value of 7.0 typically seen for samples with low DO values and a target DO of 5.0 mg/L, the prediction equation, **LN(DO) = -8.5 - 0.167 BOD + 1.505 pH**, was solved for BOD resulting in a target BOD of 2.5 mg/L. Using the same prediction equation where pH is 7.0 and DO is 5.5, to incorporate a margin of safety in the prediction, yields a target BOD of 2.0 mg/L and establishes the BOD target for the Bachelor Creek watershed under the critical flow conditions (flows less than 1.5 cfs).

Whole Model
Actual by Predicted Plot



LN(DO) = -8.5 - 0.167 BOD + 1.505 pH

Summary of Fit

RSquare	0.941688
RSquare Adj	0.92711
Root Mean Square Error	0.266443
Mean of Response	1.471127
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	9.1716189	4.58581	64.5963
Error	8	0.5679343	0.07099	Prob > F
C. Total	10	9.7395532		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-8.540647	2.546141	-3.35	0.0100
BOD	-0.166962	0.018382	-9.08	<.0001
pH	1.5053566	0.347572	4.33	0.0025

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
BOD	1	1	5.8568431	82.5003	<.0001
pH	1	1	1.3316755	18.7582	0.0025

Press
2.1476427772

Desired Endpoints of Water Quality (Implied Load Capacity) at Site 642 over 2008 – 2012

The ultimate endpoint for this TMDL will be to achieve the Kansas Water Quality Standard of 5 mg/l to fully support Aquatic Life. Seasonal variation is accounted for by this TMDL, since the TMDL endpoint is sensitive to the low flow conditions, usually occurring in the Summer and Fall seasons.

This endpoint will be reached as a result of expected, though unspecified, improvements in tributary buffer strip conditions, which will filter organic laden sediment before reaching the stream, and stream morphology assessments, which will be used to determine if enhancement to reaeriation of flow within the stream is needed. Improvements to buffer strip conditions will result from implementation of corrective actions and Best Management Practices, as directed by this TMDL. Achievement of this endpoint will provide full support of the aquatic life function of the creek and attain the dissolved oxygen water quality standard.

This TMDL will be phased. Although BOD samples are no longer collected from the KDHE stream compliance network, the targets at Site 698 on Bachelor Creek in Phase I will be framed around BOD. Once sufficient TOC samples are collected for intra-watershed comparison purposes at Site 698, the BOD targets for this TMDL will be revised to TOC targets for Phase II. Therefore, to prevent further organic loading that might offset the benefits of future watershed and stream corridor improvements, the BOD target will be to reduce in stream BOD of 2.0 mg/L or less at sampling site 698 for flows less than 1.5 cfs. This target was calculated from the multiple regression equation using BOD and pH as predictors for DO and incorporates a margin of safety in the target (see pages 5 and 6 for explanation). DO impairments have never been observed outside the identified critical flow conditions, therefore, the maintenance of the average historical BOD condition for flows outside that of the critical condition flows is the target for this flow range (4.0 mg/L for flows > 1.5 cfs).

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: There are no NPDES municipal permitted wastewater dischargers within the watershed (**Figure 4**) that would contribute an organic/nutrient substance load to the Bachelor Creek watershed. There is one non-discharging NPDES site in the watershed. Meadow View School has a non-discharging septic tank-lagoon system that may contribute an oxygen demanding substance load to the Bachelor Creek watershed under extreme precipitation events (stream flows associated with such events are typically exceeded only 1 - 5 % of the time). All non-discharging lagoon systems are prohibited from discharging to the surface waters of the state. Under standard conditions of these non-discharging facility permits, when the water level of the lagoon rises to within two feet of the top of the lagoon dikes, the permit holder must notify KDHE. Steps may be taken to lower the water level of the lagoon and diminish the probability of a bypass of sewage during inclement weather. Bypasses may be allowed if there are no other alternatives and 1) it would be necessary to prevent loss of life, personal injury or severe property damage; 2) excessive stormwater inflow or infiltration would damage the facility; or 3) the permittee has notified KDHE at least seven days before the anticipated bypass. Any bypass is immediately report to KDHE.

Livestock Waste Management Systems: There are no permitted livestock facilities in the watershed

Bachelor Creek Watershed
NPDES Sites and
Livestock Waste Managment Facilities (None)

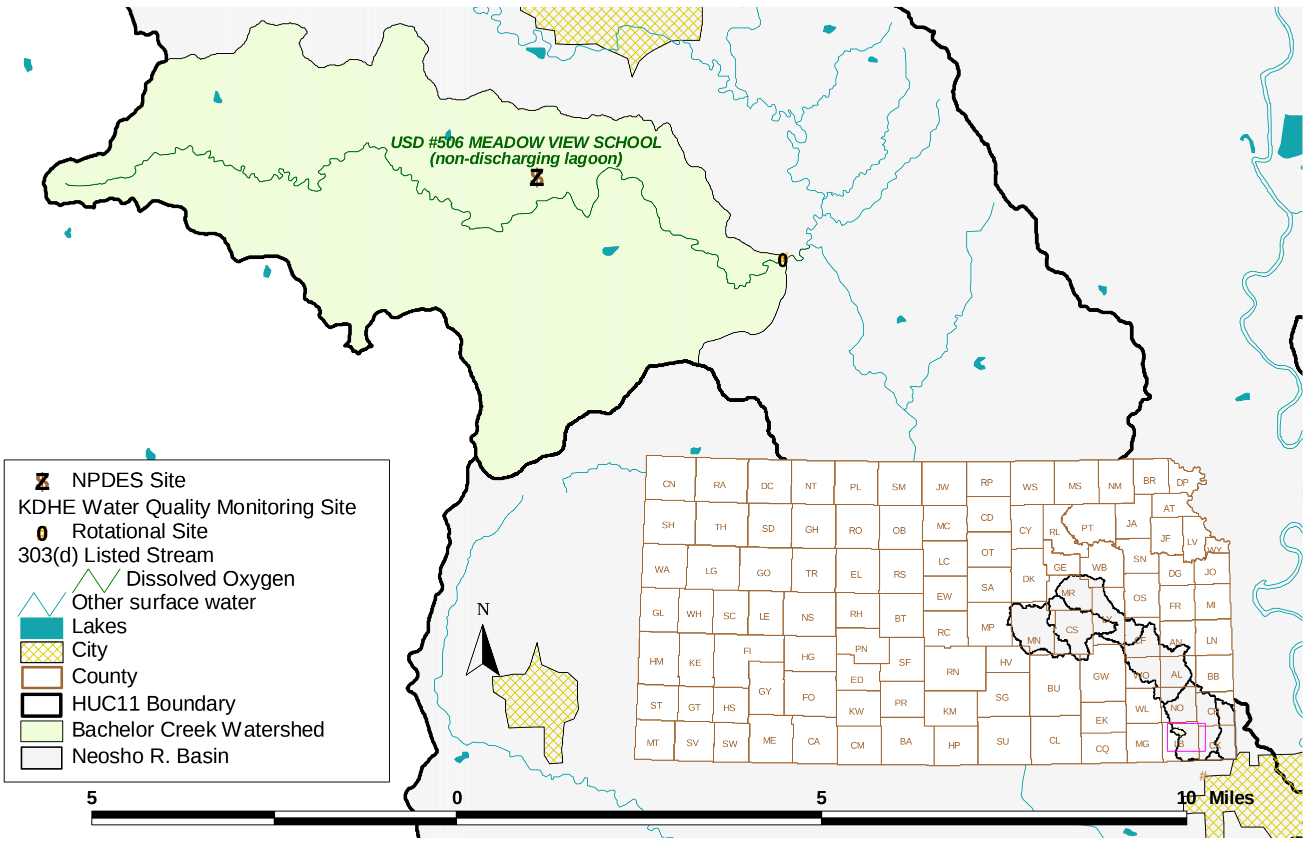


Figure 4

Land Use: Most of the watershed is cropland and grassland (48 and 19% of the area, respectively) and woodland (2%). Most of the cropland is located in the middle third of the watershed. According to the NRCS Riparian Inventory, there are about 2,422 acres of riparian area in the watershed, most of which is categorized as cropland (32%), pasture land (18%), pasture/tree mix (18%), forest land (17%) and crop/tree mix (8%) (**Figure 5**). Summing those riparian categories with a tree component shows that over two-thirds of the riparian area in the water can contribute leaf material to the organic matter load in the Fall, which supports the assertion that most DO excursions are driven by the decomposition of leaves in the stream.

On-Site Waste Systems: The watershed's population density is average (24.5 persons/sq mi) when compared to densities elsewhere in the Neosho Basin (**Figure 5**). The rural population projection for Labette County through 2020 shows a slight increase of about 3%. Based on 1990 census data about 23% of households in Labette County are on septic systems. Failing on-site waste systems can contribute oxygen demanding substance loadings, their impact on the impaired segments may be significant, given the lack of other sources in the watershed.

Bachelor Creek Watershed Land Use, Population Density and Riparian Inventory

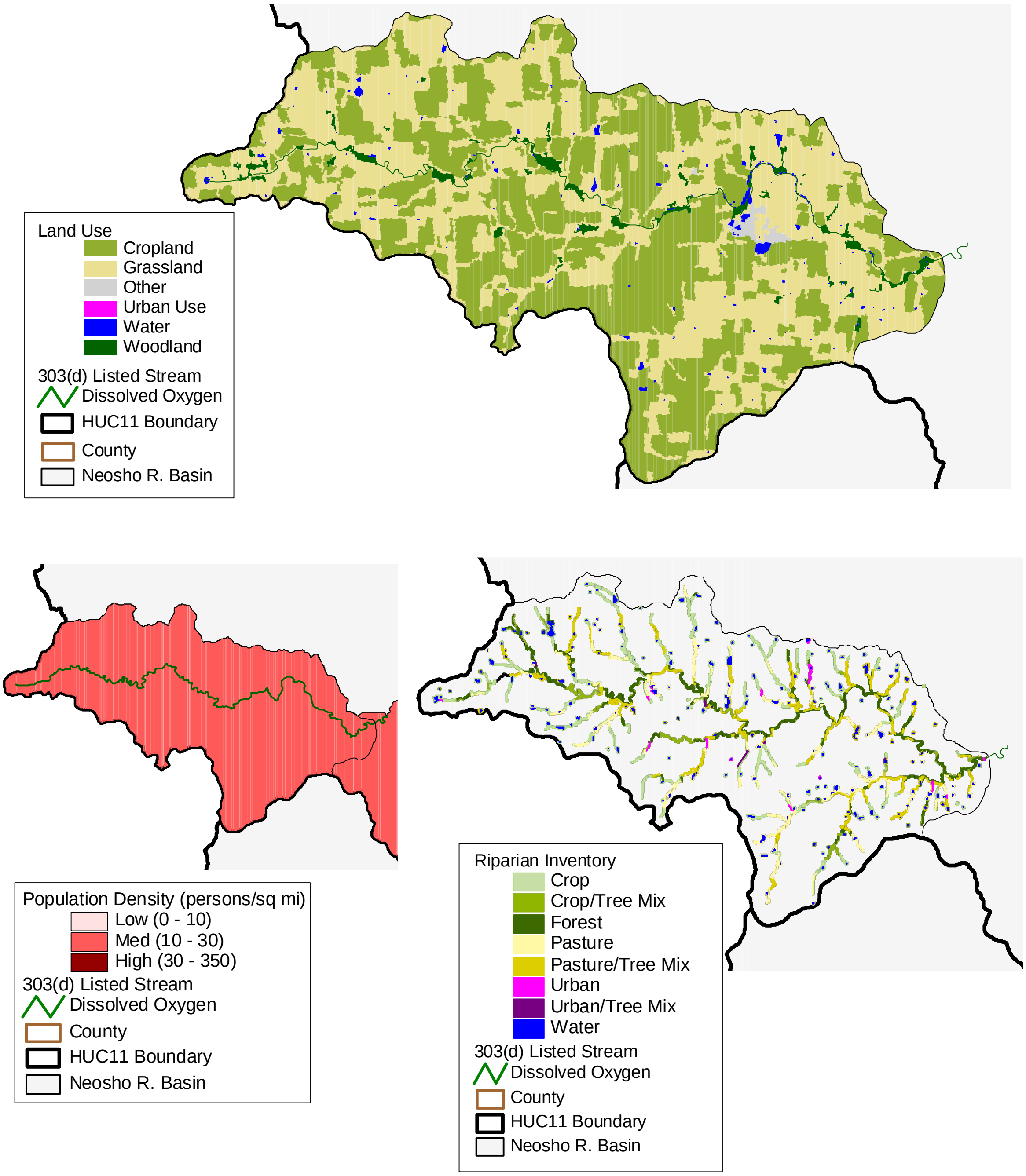


Figure 5

Contributing Runoff: The Labette Creek watershed's, which includes the Bachelor Creek watershed, average soil permeability is 0.5 inches/hour according to NRCS STATSGO database. Practically the entire watershed (99.6 %)produces runoff even under relatively low (1.71"/hr) potential runoff conditions. Under very low (1.14"/hr) potential conditions, this potential contributing area is only reduced to about 82%. Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. As the watersheds' soil profiles become saturated, excess overland flow is produced. Generally, storms producing less than 0.57"/hr of rain still generate runoff from 73% of this watershed.

Background Levels: Some organic enrichment may be associated with environmental background levels, including contributions from wildlife and stream side vegetation, but it is likely that the density of animals such as deer is fairly dispersed across the watershed and that the loading of oxygen demanding material is constant along the stream. In the case of wildlife, this loading should result in minimal loading to the streams below the levels necessary to violate the water quality standards. In the case of streamside vegetation, the loading should be greatest along the main stem of the watershed with its larger proportion of woodland near the stream.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

This is a phased TMDL. Additional monitoring over time will be needed to ascertain the relationship of organic loadings to DO during the critical flow period of concern.

BOD is a measure of the amount of oxygen required to stabilize organic matter in a stream. As such, BOD is presently used as a benchmark measure to anticipate DO levels while it measures the total concentration of DO that will be demanded as organic matter degrades in a stream. In Phase one, any allocation of wasteloads and loads will be made in terms of BOD. The target BOD levels were multiplied by the calculated average daily flow for Bachelor Creek across the hydrologic conditions of concern. This is represented graphically by the integrated area under the BOD load duration curve established by this TMDL (**Figure 6**). The area is generally segregated into allocated areas assigned to point sources (WLA) and nonpoint sources (LA). Future growth in wasteloads should be offset by reductions in the loads contributed by nonpoint sources. This offset along with appropriate limitations is expected to eliminate the impairment. This TMDL represents the "Best Professional Judgment" as to the expected relationship between physical factors, organic matter and DO.

Point Sources: A current Wasteload Allocation of zero is established by this TMDL because of the lack of discharging point sources located upstream of monitoring site 698. There will also be a wasteload allocation of zero for the non-discharging system located in the watershed.

Should future point sources be proposed in the watershed and discharge into the impaired segments, the current Wasteload Allocation will be revised by adjusting current load allocations to account for the presence and impact of these new point source dischargers (**Figure 6**).

Non-Point Sources: Based on the prior assessment of sources, the distribution of excursions from water quality standards at site 698 and the relationship of those excursions to runoff conditions and seasons, non-point sources are seen as a contributing factor to the DO excursions in the watershed.

The samples from the Bachelor Creek watershed show DO violations only occurred under low flow conditions. The Load Allocation assigns responsibility for reducing the in stream BOD levels at site 698 to 2.0 mg/L for flows less than 1.5 cfs (53 – 95% flow exceedance), and maintaining average historic BOD levels at 4.0 mg/L for flows greater than 1.5 cfs. Since the WLA for the watershed is zero, the entire integrated area under the TMDL curve is assigned to the LA for this TMDL (**Figure 6**). Sediment control practices such as buffer strips and grassed waterways should help reduce the non-point source BOD load under higher flows as well as reduce the oxygen demand exerted by the organic matter transported to the stream that may occur during lower flow conditions.

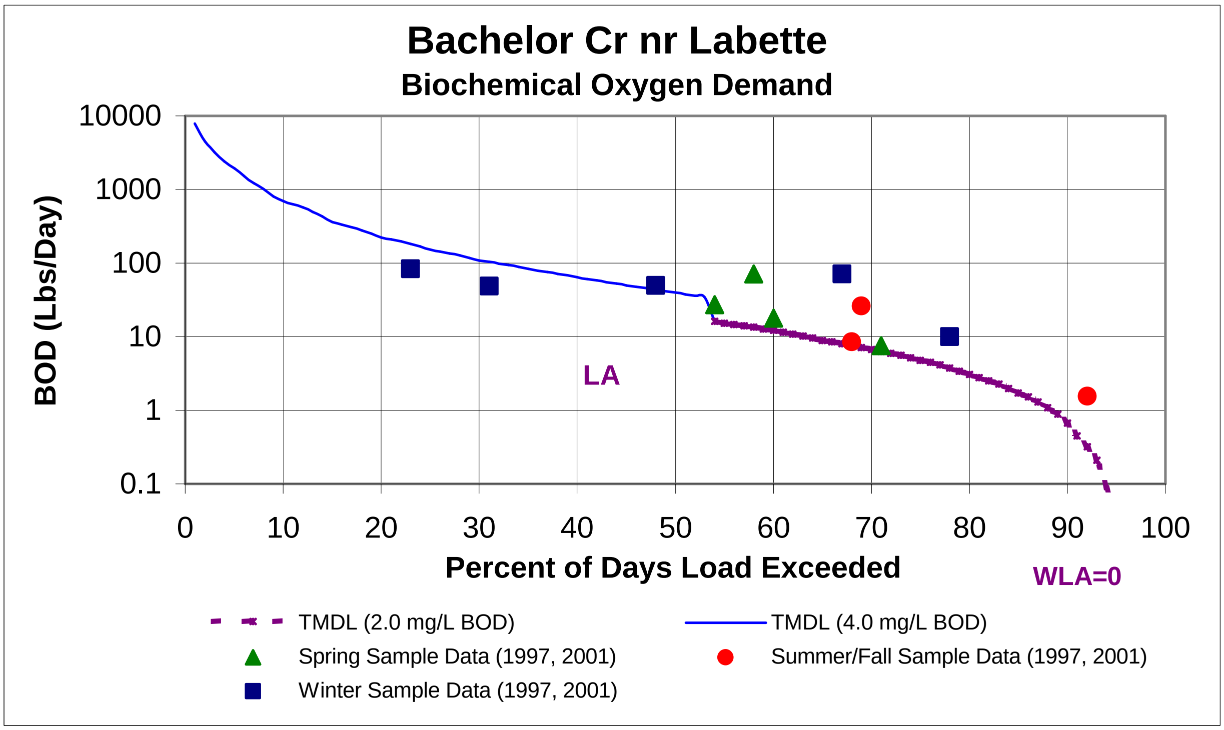


Figure 6

Defined Margin of Safety: The Margin of Safety will be implied based on conservative assumptions and estimates used to set the target BOD concentration under the critical flow condition from the multiple regression model (see MOS discussion on page 5).

State Water Plan Implementation Priority: Because this watershed is 1) located within the Labette Creek watershed which has an existing high priority for implementation TMDL, 2) has indicated some problem with dissolved oxygen which has short term and immediate consequences for aquatic life and 3) the frequency of excursion from DO criteria is higher than other watersheds in the basin, this TMDL will be a High Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Middle Neosho Basin (HUC 8: 11070205) with a priority ranking of 24 (Medium Priority for restoration work).

Priority HUC 11s and Stream Segments: Priority focus of implementation will concentrate on installing best management practices adjacent to main stem segments and flow contributing tributaries in the watershed.

5. IMPLEMENTATION

Desired Implementation Activities

Desired Implementation Activities

1. Where needed, create/restore riparian vegetation along target stream segments.
2. Install grass buffer strips where needed along streams.
3. Insure proper on-site waste system operations in proximity to targeted streams.
4. Insure that labeled application rates of chemical fertilizers are being followed.

Implementation Programs Guidance

Water Quality Special Studies - KDHE - BEFS

a. Initiate a study of dissolved oxygen on Bachelor Creek to ascertain probable causes of violations occurring in watershed.

Non-Point Source Pollution Technical Assistance - KDHE

a. Support Section 319 demonstration projects for pollution reduction from livestock operations in watershed.
b. Provide technical assistance on practices geared to small livestock operations which minimize impact to stream resources.
c. Guide federal programs such as the Environmental Quality Improvement Program, which are dedicated to priority subbasins through the Unified Watershed Assessment, to priority stream segments identified by this TMDL.

Water Resource Cost Share & Non-Point Source Pollution Control Programs - SCC

a. Provide alternative water supplies to small livestock operations.
b. Develop improved grazing management plans.
c. Reduce grazing density on overstocked pasturelands.
d. Install livestock waste management systems for manure storage.
e. Implement manure management plans.
f. Install replacement on-site waste systems close to streams.
g. Coordinate with USDA/NRCS Environmental Quality Improvement Program in providing educational, technical and financial assistance to agricultural producers.

Riparian Protection Program - SCC

a. Develop riparian restoration projects along targeted stream segments, especially those areas with baseflow.

b. Design winter feeding areas away from streams.

Buffer Initiative Program - SCC

a. Install grass buffer strips near streams.

b. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production.

Extension Outreach and Technical Assistance - Kansas State University

a. Educate livestock producers on riparian and waste management techniques.

b. Educate chemical fertilizer users on proper application rates and timing.

c. Provide technical assistance on livestock waste management design.

d. Continue Section 319 demonstration projects on livestock management.

Agricultural Outreach - KDA

a. Provide information on livestock management to commodity advocacy groups.

b. Support Kansas State outreach efforts.

Local Environmental Protection Program - KDHE

a. Inspect and repair on-site waste systems within 500 feet of priority stream segments.

Timeframe for Implementation: Pollution reduction practices and buffer strips should be installed on main steam and directly contributing tributaries over the years 2004-2008.

Targeted Participants: Primary participants for implementation will be the landowners immediately adjacent to the priority stream segments. Implemented activities should be targeted to those stream segments with greatest potential to impact DO conditions. Nominally, this would be most likely be:

1. Areas of denuded riparian vegetation along Labette Creek, Little Labette Creek and their contributing tributaries.
2. Unbuffered cropland adjacent to stream
3. Sites where drainage runs through or adjacent livestock areas
4. Sites where livestock have full access to stream and stream is primary water supply
5. Poor riparian sites
6. Failing on-site waste systems

Some inventory of local needs should be conducted in 2004-2005 to identify such activities. Such an inventory would be done by local program managers with appropriate assistance by commodity representatives and state program staff in order to direct state assistance programs to the principal activities influencing the quality of the streams in the watershed during the implementation period of this TMDL.

Milestone for 2008: The year 2008 marks the mid-point of the ten-year implementation window for the watershed. At that point in time, milestones should be reached which will have at least two-thirds of the landowners responsible for buffer strip restoration or other stream restoration measures, cited in the local assessment, participating in the implementation programs provided by the state. Additionally, sample data from Site 698 should indicate evidence of improved dissolved oxygen levels at the critical flow condition (< 1.5 cfs) relative to the conditions seen in 1997 and 2001.

Delivery Agents: The primary delivery agents for program participation will be the conservation districts for programs of the State Conservation Commission and the Natural Resources Conservation Service. On-site waste system inspections will be performed by Local Environmental Protection Program personnel for primarily Labette county. Producer outreach and awareness will be delivered by Kansas State County staff managing.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution.

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.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.

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

5. K.S.A. 75-5657 empowers the State Conservation Commission to provide financial assistance for local project work plans developed to control non-point source pollution.

6. 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.

7. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.

8. The *Kansas Water Plan* and the Neosho 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 pollution 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.

Effectiveness: Buffer strips are touted as a means to filter sediment before it reaches a stream and riparian restoration projects have been acclaimed as a significant means of stream bank stabilization. The key to effectiveness is participation within a finite subwatershed to direct resources to the activities influencing water quality. The milestones established under this TMDL are intended to gauge the level of participation in those programs implementing this TMDL.

Should participation significantly lag below expectations over the next five years or monitoring indicates lack of progress in improving water quality conditions from those seen over 1997 and 2001 the state may employ more stringent conditions on agricultural producers and urban runoff in the watershed in order to meet the desired endpoints expressed in this TMDL. The state has the authority to impose conditions on activities with a significant potential to pollute the waters of the state under K.S.A. 65-171. If overall water quality conditions in the watershed deteriorate, a Critical Water Quality Management Area may be proposed for the watershed, in response.

6. MONITORING

KDHE will continue to collect bimonthly samples at rotational Station 698 in 2005 and 2009 including dissolved oxygen samples, in order to assess progress and success in implementing this TMDL toward reaching its endpoint. Should impaired status remain, the desired endpoints under this TMDL will be refined and more intensive sampling may need to be conducted under specified lower flow conditions over the period 2008-2012. Use of the real time flow data available at the Lightning Creek near McCune stream gaging station can help direct these sampling efforts.

Local program management needs to identify its targeted participants of state assistance programs for implementing this TMDL. This information should be collected in 2004 -2005 in order to support appropriate implementation projects.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Neosho Basin were held January 30, 2004, in Burlington and April **X**, 2004 in **Y**. An active Internet Web site was established at http://www.kdhe.state.ks.us/tmdl/ to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Neosho Basin.

Public Hearing: A Public Hearing on the TMDLs of the Neosho Basin was held in **Y** on April **X**, 2004.

Basin Advisory Committee: The Neosho Basin Advisory Committee met to discuss the TMDLs in the basin on January 30, 2004, in Burlington.

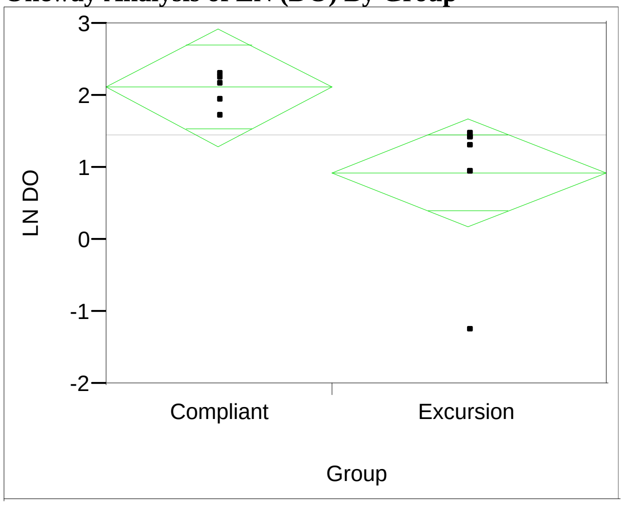
Milestone Evaluation: In 2008, evaluation will be made as to the degree of implementation that has occurred within the watershed and current condition of Bachelor Creek. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

Consideration for 303(d) Delisting: The stream will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2008-2012. Therefore, the decision for delisting will come about in the preparation of the 2012 303(d) list. Should modifications be made to the applicable water quality criteria during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may 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 will come in 2004 which will emphasize implementation of TMDLs. At that time, incorporation of this TMDL will be made into both documents. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process for Fiscal Years 2004-2008.

APPENDIX
Bachelor Creek DO TMDL

Oneway Analysis of LN (DO) By Group



Oneway Anova
Summary of Fit

Rsquare	0.396093
Adj Rsquare	0.328993
Root Mean Square Error	0.808413
Mean of Response	1.471127
Observations (or Sum Wgts)	11

t Test

Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	1.18933	2.430	9	0.0380
Std Error	0.48952			
Lower 95%	0.08197			
Upper 95%	2.29670			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	1.1893	2.659	5.62285	0.0400
Std Error	0.4472			
Lower 95%	-0.0282			
Upper 95%	2.4069			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	5	45	9.00000	2.647
Excursion	6	21	3.50000	-2.647

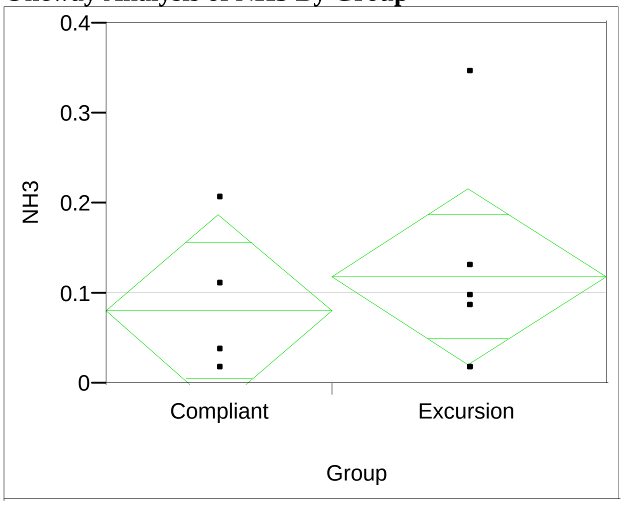
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
45	2.64733	0.0081

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
7.5000	1	0.0062

Oneway Analysis of NH3 By Group



Oneway Anova

Summary of Fit

Rsquare	0.037373
Adj Rsquare	-0.06959
Root Mean Square Error	0.106071
Mean of Response	0.101909
Observations (or Sum Wgts)	11

t Test

Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	-0.03797	-0.591	9	0.5690
Std Error	0.06423			
Lower 95%	-0.18326			
Upper 95%	0.10733			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	-0.03797	-0.614	8.69292	0.5549
Std Error	0.06183			
Lower 95%	-0.18405			
Upper 95%	0.10812			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	5	28	5.60000	-0.280
Excursion	6	38	6.33333	0.280

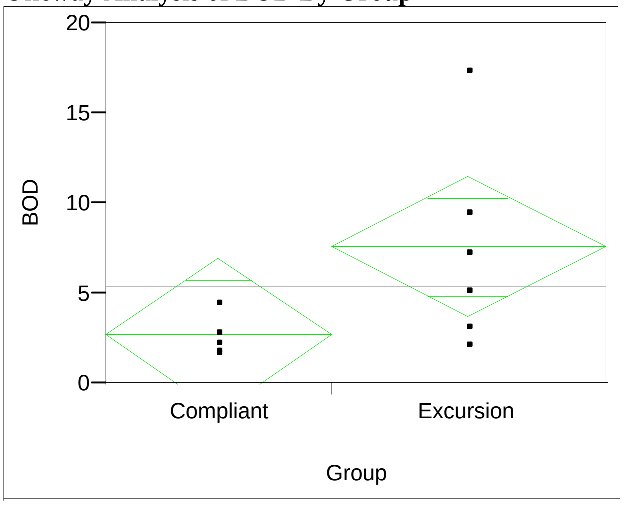
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
28	-0.28031	0.7792

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
0.1397	1	0.7086

Oneway Analysis of BOD By Group



Oneway Anova

Summary of Fit

Rsquare	0.285699
Adj Rsquare	0.206332
Root Mean Square Error	4.218934
Mean of Response	5.361818
Observations (or Sum Wgts)	11

t Test

Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	-4.8470	-1.897	9	0.0903
Std Error	2.5547			
Lower 95%	-10.6261			
Upper 95%	0.9321			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	-4.847	-2.081	5.48261	0.0870
Std Error	2.329			
Lower 95%	-11.244			
Upper 95%	1.550			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	5	19	3.80000	-1.917
Excursion	6	47	7.83333	1.917

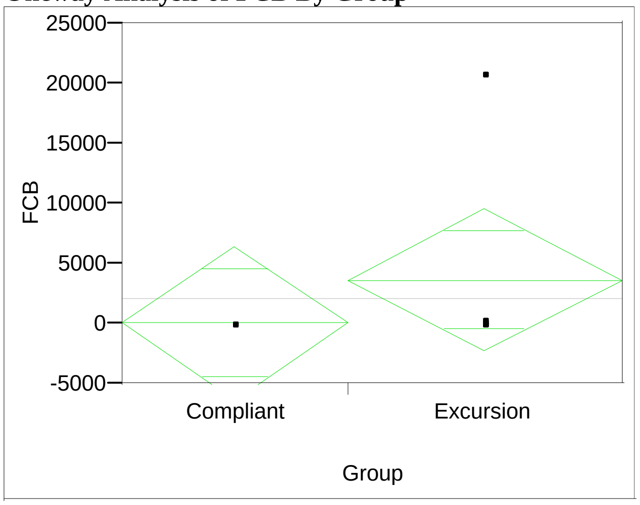
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
19	-1.91703	0.0552

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
4.0333	1	0.0446

Oneway Analysis of FCB By Group



Oneway Anova

Summary of Fit

Rsquare	0.087832
Adj Rsquare	-0.01352
Root Mean Square Error	6334.362
Mean of Response	2033.636
Observations (or Sum Wgts)	11

t Test

Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	-3570.7	-0.931	9	0.3762
Std Error	3835.6			
Lower 95%	-12247.5			
Upper 95%	5106.2			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	-3571	-1.029	5.00064	0.3506
Std Error	3470			
Lower 95%	-13430			
Upper 95%	6289			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	5	25.5	5.10000	-0.732
Excursion	6	40.5	6.75000	0.732

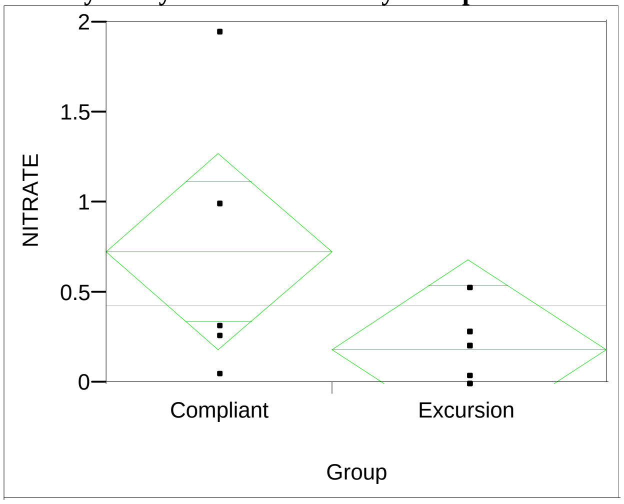
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
25.5	-0.73196	0.4642

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
0.6781	1	0.4102

Oneway Analysis of NITRATE By Group



Oneway Anova
Summary of Fit

Rsquare	0.230985
Adj Rsquare	0.145538
Root Mean Square Error	0.540885
Mean of Response	0.432273
Observations (or Sum Wgts)	11

t Test

Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	0.538500	1.644	9	0.1346
Std Error	0.327522			
Lower 95%	-0.20241			
Upper 95%	1.279406			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	0.5385	1.505	4.49088	0.1990
Std Error	0.3577			
Lower 95%	-0.3330			
Upper 95%	1.4100			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	5	39	7.80000	1.555
Excursion	6	27	4.50000	-1.555

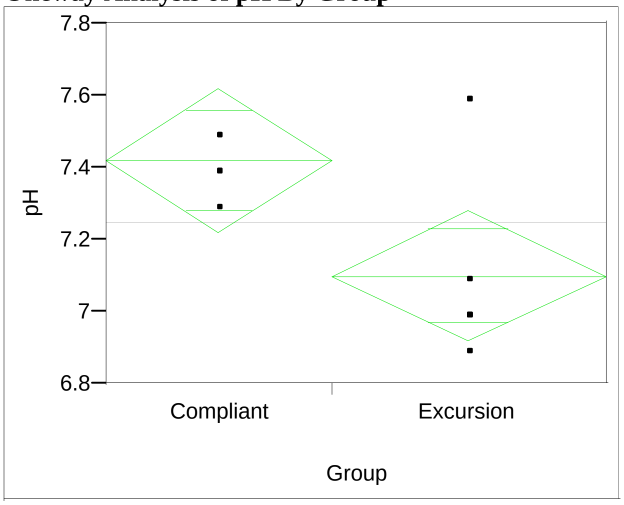
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
39	1.55542	0.1198

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
2.7123	1	0.0996

Oneway Analysis of pH By Group



Oneway Anova
Summary of Fit

Rsquare	0.445217
Adj Rsquare	0.383575
Root Mean Square Error	0.196638
Mean of Response	7.245455
Observations (or Sum Wgts)	11

t Test

Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	0.320000	2.687	9	0.0249
Std Error	0.119070			
Lower 95%	0.050644			
Upper 95%	0.589356			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	0.320000	2.913	6.26375	0.0256
Std Error	0.109848			
Lower 95%	0.031593			
Upper 95%	0.608407			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	5	40	8.00000	1.759
Excursion	6	26	4.33333	-1.759

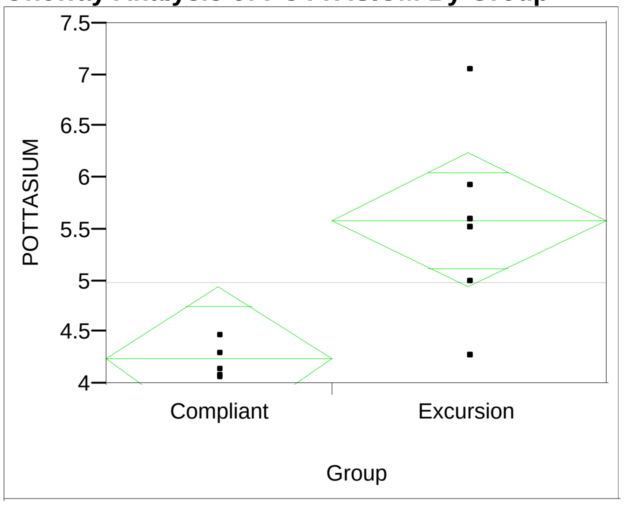
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
40	1.75860	0.0786

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
3.4268	1	0.0641

Oneway Analysis of POTTASIUM By Group



Oneway Anova

Summary of Fit

Rsquare	0.52606
Adj Rsquare	0.4734
Root Mean Square Error	0.705159
Mean of Response	4.973136
Observations (or Sum Wgts)	11

t Test

Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	-1.3496	-3.161	9	0.0115
Std Error	0.4270			
Lower 95%	-2.3155			
Upper 95%	-0.3837			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	-1.3496	-3.470	5.42278	0.0156
Std Error	0.3889			
Lower 95%	-2.4220			
Upper 95%	-0.2772			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	5	17	3.40000	-2.282
Excursion	6	49	8.16667	2.282

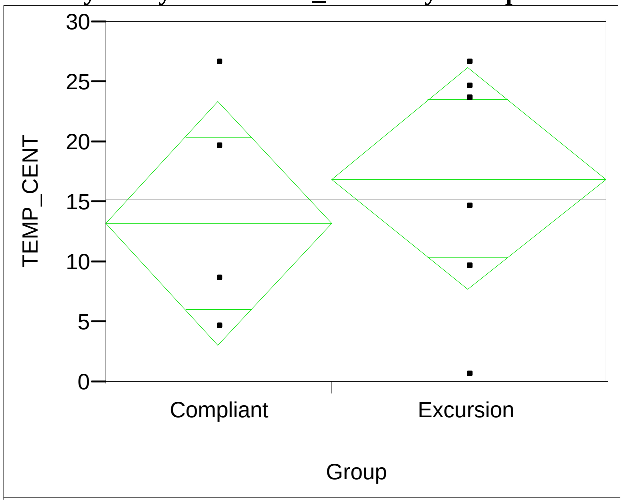
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
17	-2.28218	0.0225

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
5.6333	1	0.0176

Oneway Analysis of TEMP_CENT By Group



Oneway Anova
Summary of Fit

Rsquare	0.041447
Adj Rsquare	-0.06506
Root Mean Square Error	10.05982
Mean of Response	15.27273
Observations (or Sum Wgts)	11

t Test
Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	-3.8000	-0.624	9	0.5482
Std Error	6.0915			
Lower 95%	-17.5800			
Upper 95%	9.9800			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	-3.800	-0.626	8.75432	0.5472
Std Error	6.070			
Lower 95%	-17.639			
Upper 95%	10.039			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	5	26.5	5.30000	-0.550
Excursion	6	39.5	6.58333	0.550

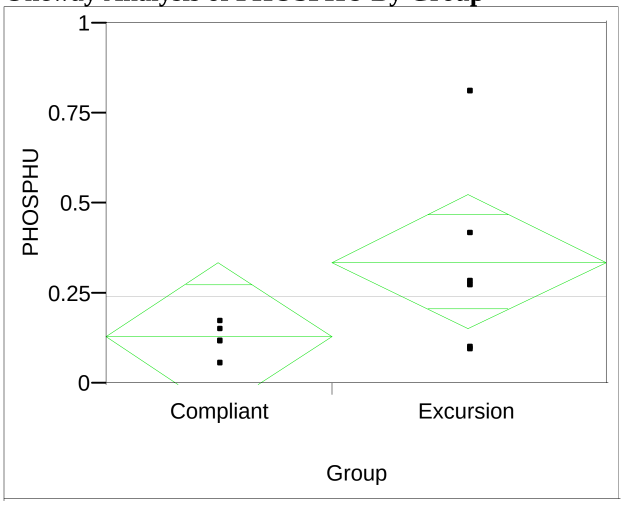
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
26.5	-0.55023	0.5822

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
0.4121	1	0.5209

Oneway Analysis of PHOSPHU By Group



Oneway Anova
Summary of Fit

Rsquare	0.245276
Adj Rsquare	0.161418
Root Mean Square Error	0.199821
Mean of Response	0.244273
Observations (or Sum Wgts)	11

t Test

Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	-0.20693	-1.710	9	0.1214
Std Error	0.12100			
Lower 95%	-0.48065			
Upper 95%	0.06678			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	-0.20693	-1.881	5.31922	0.1152
Std Error	0.11002			
Lower 95%	-0.51244			
Upper 95%	0.09857			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	5	23	4.60000	-1.187
Excursion	6	43	7.16667	1.187

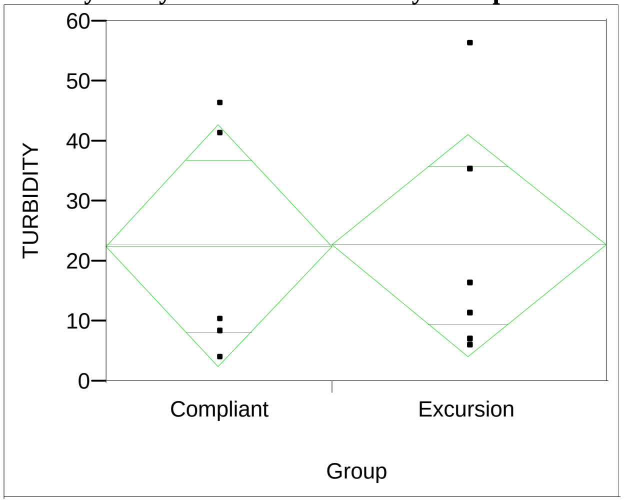
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
23	-1.18673	0.2353

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
1.6333	1	0.2012

Oneway Analysis of TURBIDITY By Group



Oneway Anova

Summary of Fit

Rsquare	4.108e-7
Adj Rsquare	-0.11111
Root Mean Square Error	20.03963
Mean of Response	22.67273
Observations (or Sum Wgts)	11

t Test

Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	-0.023	-0.002	9	0.9985
Std Error	12.135			
Lower 95%	-27.474			
Upper 95%	27.427			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	-0.023	-0.002	8.60998	0.9985
Std Error	12.146			
Lower 95%	-27.664			
Upper 95%	27.618			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	5	29	5.80000	-0.091
Excursion	6	37	6.16667	0.091

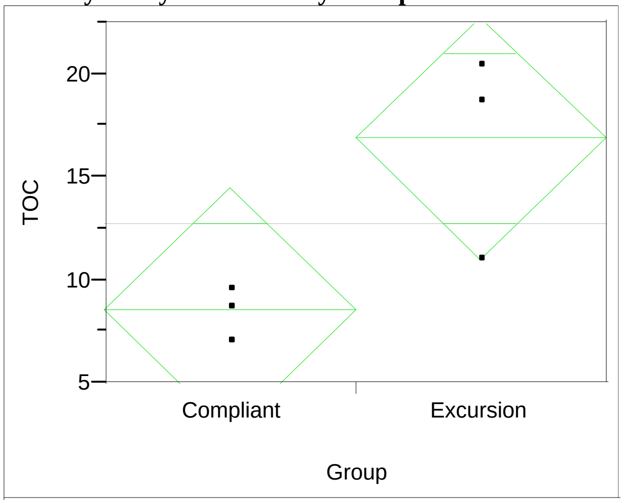
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
29	-0.09129	0.9273

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
0.0333	1	0.8551

Oneway Analysis of TOC By Group



Oneway Anova

Summary of Fit

Rsquare	0.658441
Adj Rsquare	0.573051
Root Mean Square Error	3.666908
Mean of Response	12.71133
Observations (or Sum Wgts)	6

t Test

Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	-8.3140	-2.777	4	0.0500
Std Error	2.9940			
Lower 95%	-16.6267			
Upper 95%	-0.0013			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	-8.314	-2.777	2.25314	0.0955
Std Error	2.994			
Lower 95%	-19.904			
Upper 95%	3.276			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	3	6	2.00000	-1.746
Excursion	3	15	5.00000	1.746

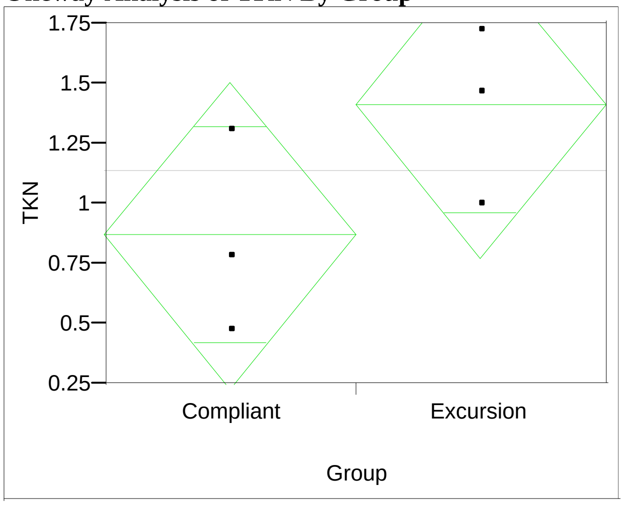
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
15	1.74574	0.0809

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
3.8571	1	0.0495

Oneway Analysis of TKN By Group



Oneway Anova

Summary of Fit

Rsquare	0.410748
Adj Rsquare	0.263435
Root Mean Square Error	0.395826
Mean of Response	1.138833
Observations (or Sum Wgts)	6

t Test

Assuming equal variances

	Difference	t Test	DF	Prob > |t|
Estimate	-0.53967	-1.670	4	0.1703
Std Error	0.32319			
Lower 95%	-1.43699			
Upper 95%	0.35765			

UnEqual Variances

	Difference	t Test	DF	Prob > |t|
Estimate	-0.5397	-1.670	3.93553	0.1714
Std Error	0.3232			
Lower 95%	-1.4428			
Upper 95%	0.3635			

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
Compliant	3	7	2.33333	-1.309
Excursion	3	14	4.66667	1.309

2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
14	1.30931	0.1904

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
2.3333	1	0.1266