Benthic TMDL Development for North Creek

Public Meeting Number 1

Central Virginia Community Health Center

New Canton, VA

April 7, 2011

THE Louis Berger Group, INC.

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Agenda

- Explain Meeting Objective
- Review Impaired Segments
- Watershed Characterization
- Stressor Identification Process
- Next Steps

Objective

- To present and review the steps and the data used in the development of a Benthic TMDL for the 303(d) listed segment in the North Creek watershed

Benthic Impairments

Based on VADEQ 2010 303(d) List

TMDL ID: VAC-H2OR_NOR01A2

Length 3.25 miles

Benthic Impairment includes the entire headwaters of North Creek and extends 3.25 miles downstream.

The segment was first listed in 2008 for benthic impairment.

North Creek Total area: 2,569.3 acres

Located within the Borders of Fluvanna County

Major Roads: State Highway 15 (James Madison Hwy) & State Highway 6 (West/East River Road)

Biological Monitoring

- Based on Biological Monitoring
  - Assessments indicate the benthic community is impaired.
  - Therefore, the listed segments do not meet the Aquatic Life Use support goal.

The General Water Quality Standard: "All state waters shall be free from substances [...] which are harmful to human, animal, plant or aquatic life." (9 VAC 25-260-20).

Biological and Habitat Metrics

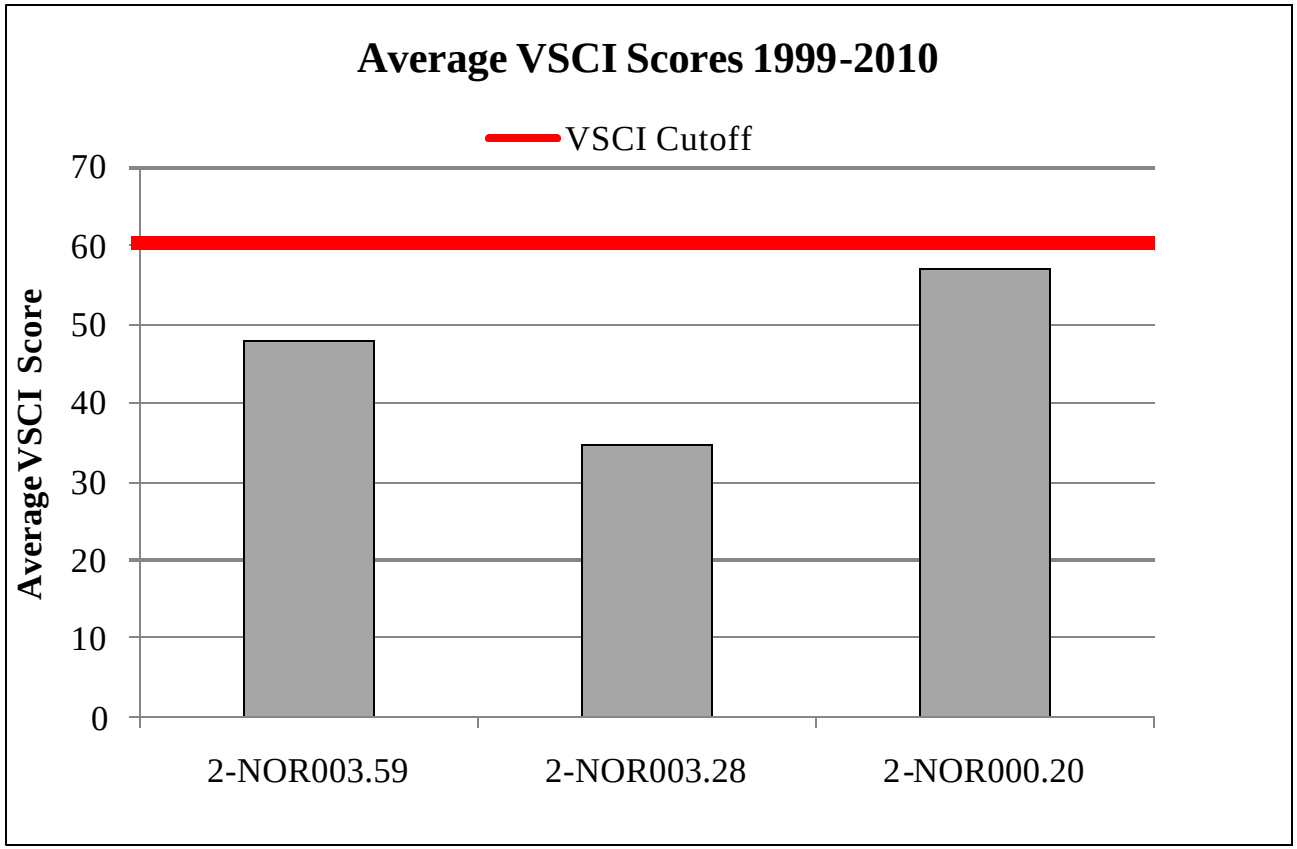
- Virginia Stream Condition Index (VSCI)
  - Incorporates 8 standard metrics based on the abundance and types of macroinvertebrates present at each station
  - Metrics are taken from stations located in the impaired segment as well as from several reference stations in non-impaired streams
  - Final score is based on a comparison of the combined reference sites with the impaired segment

- Habitat Assessment Scores
  - Suite of habitat variables were visually inspected at monitoring stations as part of the biological assessments
  - Habitat parameters examined include: epifaunal substrate, embeddedness, velocity, sedimentation, channel flow, channel alteration, frequency of riffles, bank stability, vegetation protection, and riparian zone
  - Parameters were assigned a score from 0 to 20, with 0 indicating very poor conditions and 20 indicating optimal conditions

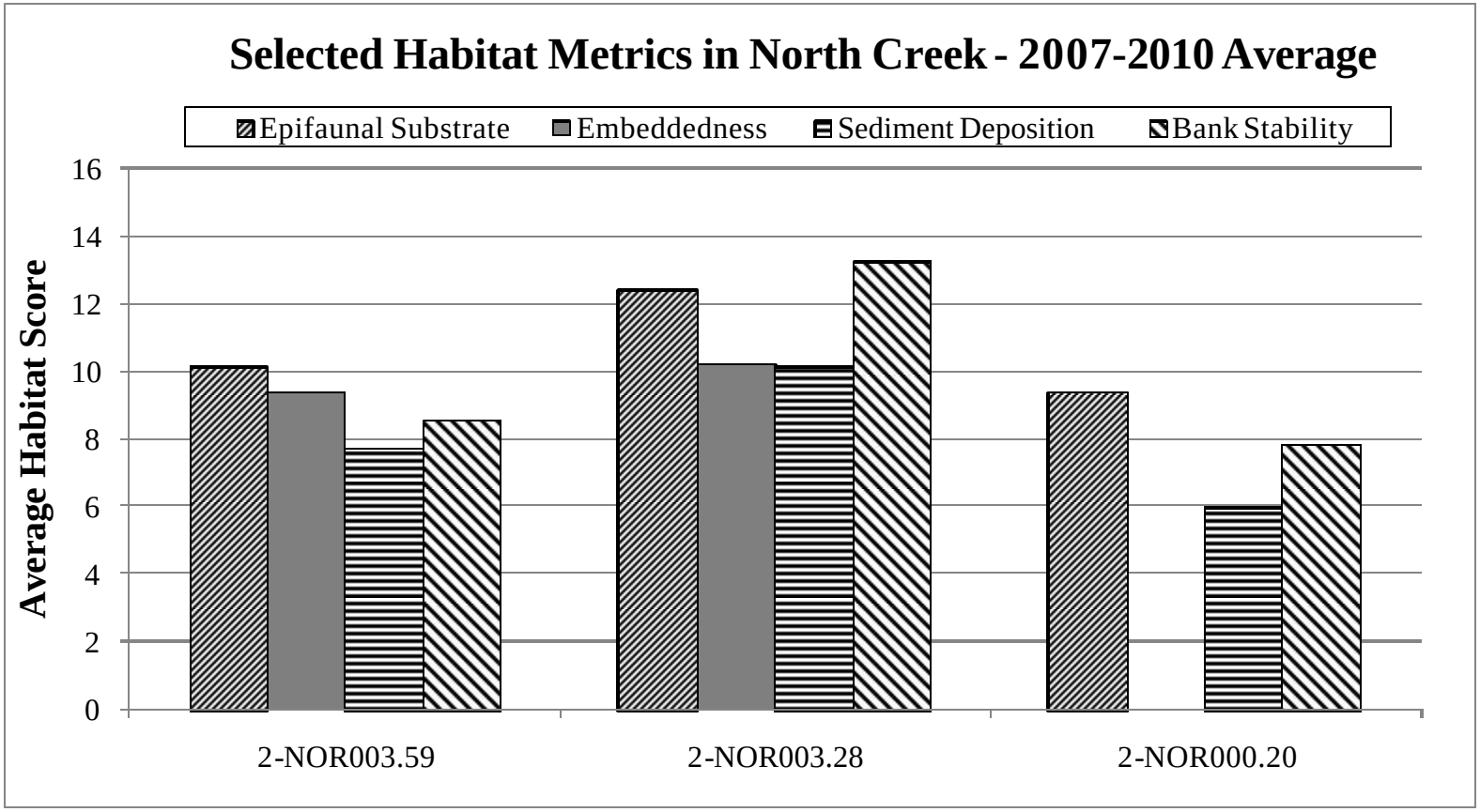
VA Stream Condition Index (VSCI)

Virginia SCI Scores for North Creek			
Collection Period	**2-NOR003.59**	**2-NOR003.28**	**2-NOR000.20**
Spring 1999	31.0	38.4	
Fall 1999	48.2	32.4	35.4
Spring 2000	47.8	30.3	
Fall 2000	32.7	31.9	
Fall 2001	58.0	37.7	
Spring 2007	56.8	31.8	71.2
Fall 2007	53.6		47.7
Spring 2008	36.5	30.2	68.9
Fall 2008	66.3	43.1	66.7
Spring 2009	57.2	33.0	67.1
Fall 2009	55.6	33.1	57.9
Spring 2010	29.3	41.0	43.6
Fall 2010	48.4	32.5	56.1
Average 1999-2001	43.5	34.1	35.4
Average 2007-2010	50.5	35.5	59.9
Overall Average	47.8	34.6	57.2

VSCI (Continued)



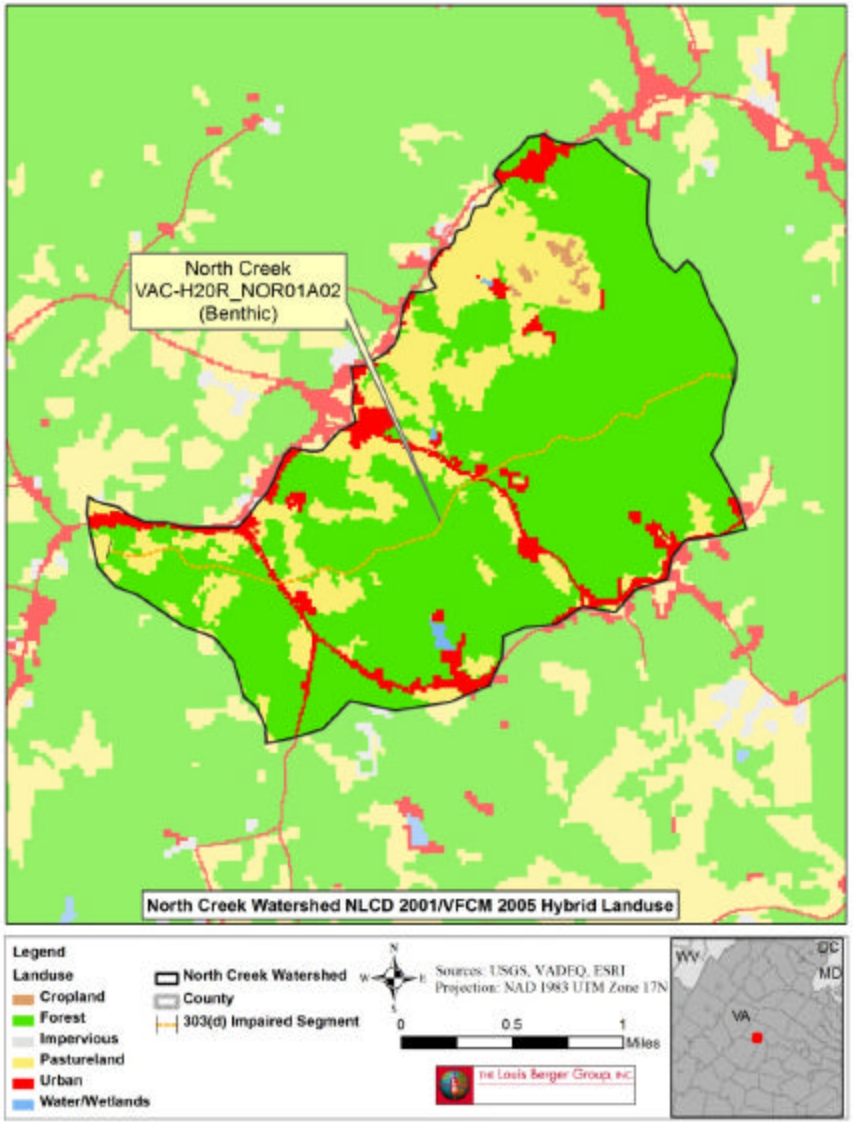
Habitat Assessment Scores



Habitat parameters are scored on a scale of 0-20, with 0 being the poorest condition and 20 being the most optimal condition

Watershed Characterization

Landuse

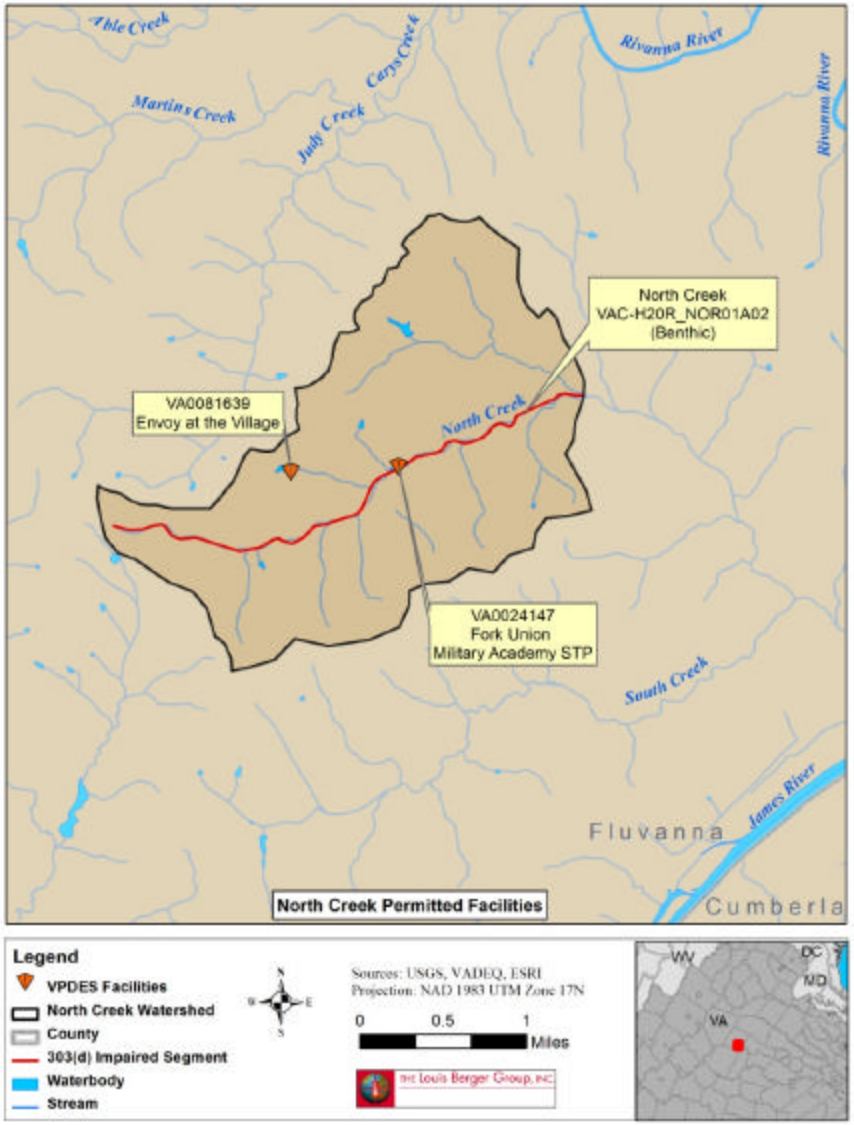


North Creek: Total Acres: 2,569.3

70.8% Forest	(1,819.6 acres)
21.5% Agriculture	(552.9 acres)
7.4% Urban	(190 acres)
0.3% Water/Wetland	(6.8 acres)

Based on National Land Cover Database 2001 and Virginia Forest Cover Map 2005 land use data

Permitted Facilities

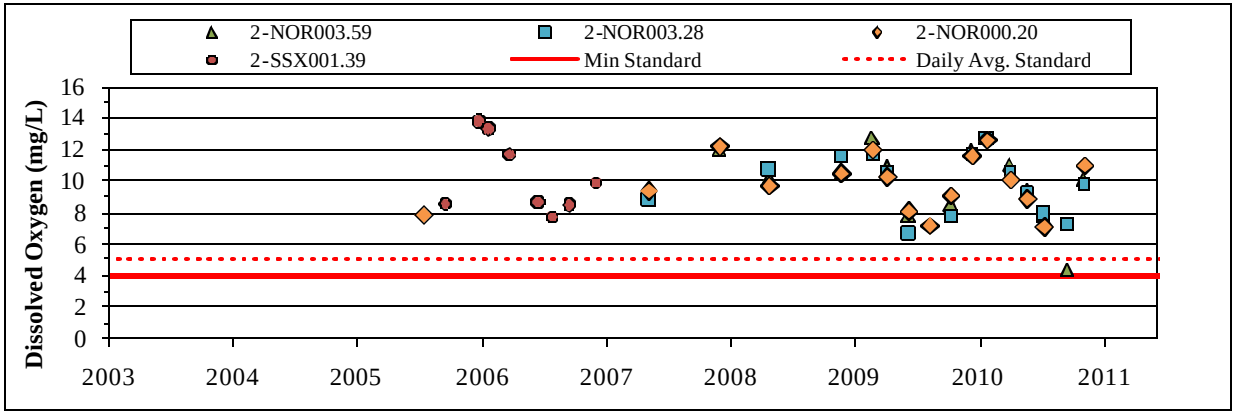


Permitted Facilities in the North Creek Watershed			
Permit Number	**Facility Name**	**Design Flow (MGD)**	**Receiving Stream**
VA0081639	Envoy at the Village	0.02	North Creek Tributary
VA0024147	Fork Union Military Academy (F.U.M.A.) STP	0.099	North Creek

Available Water Quality Data

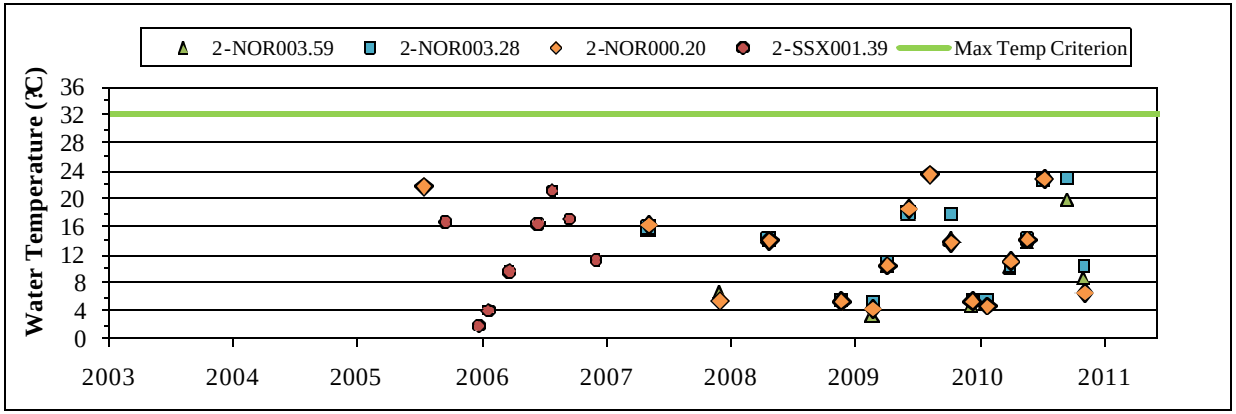
- Parameters:
  - Dissolved Oxygen
  - Water Temperature
  - pH
  - Ammonia (NH_3)
  - Nitrite (NO_2)
  - Nitrate (NO_2)
  - Ortho-Phosphorus (PO_4)
  - Total Suspended Solids (TSS)
  - Biological Oxygen Demand (BOD_5)
  - Metals in water column

Instream Chemical Parameters (cont)



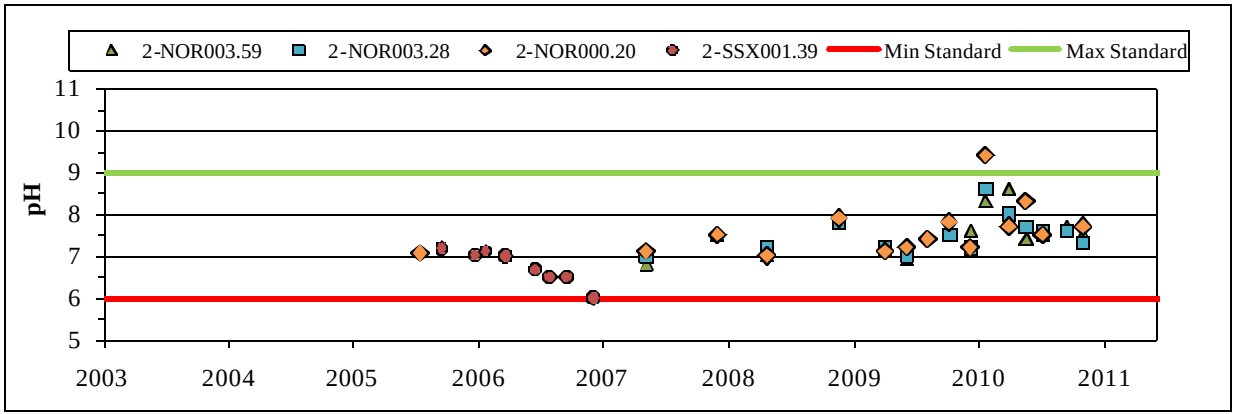
DO (mg/L)

- Min: 4.4
- Max: 13.9
- Average: 9.9



Water Temperature (ºC)

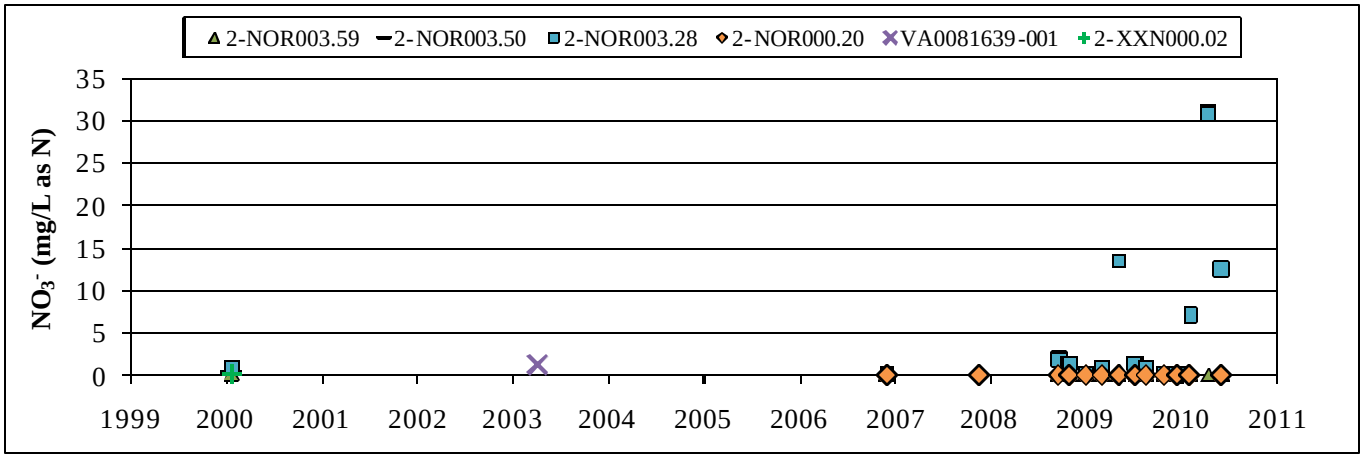
- Min: 1.84
- Max: 23.4
- Average: 12.3



pH

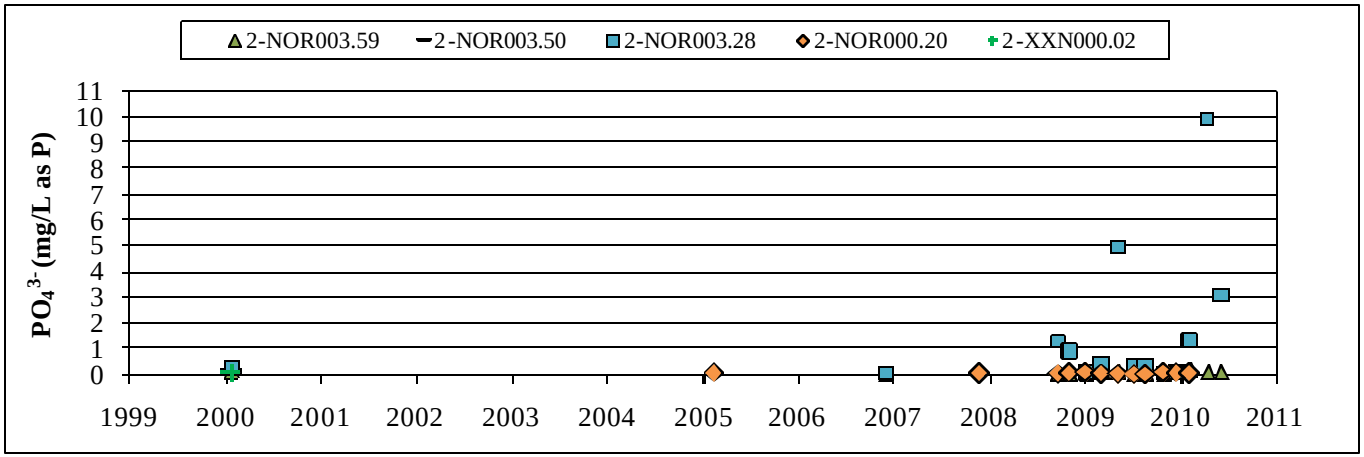
- Min: 6
- Max: 9.4
- Average: 7.4

Instream Chemical Parameters (cont)



Nitrate (mg/L)

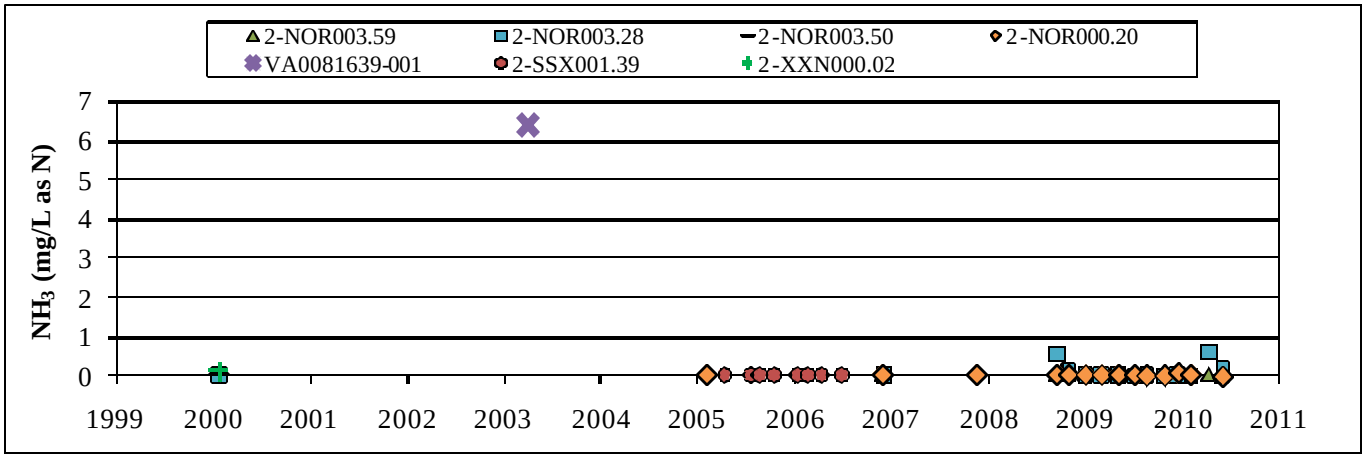
- Min: 0.02
- Max: 31
- Average: 1.73



Ortho-P (mg/L)

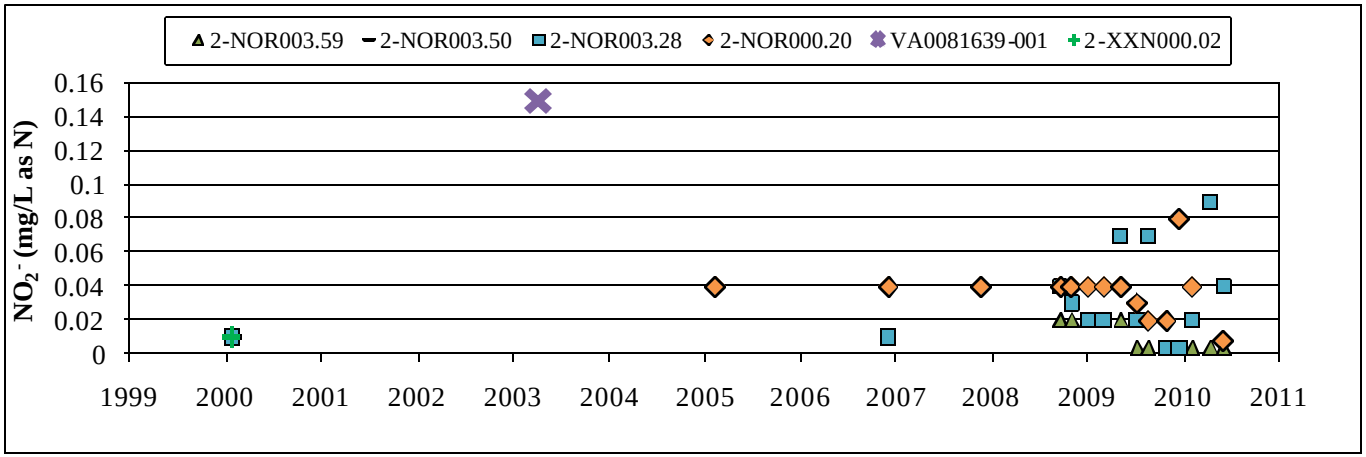
- Min: 0.02
- Max: 9.91
- Average: 0.58

Instream Chemical Parameters (cont)



Ammonia (mg/L)

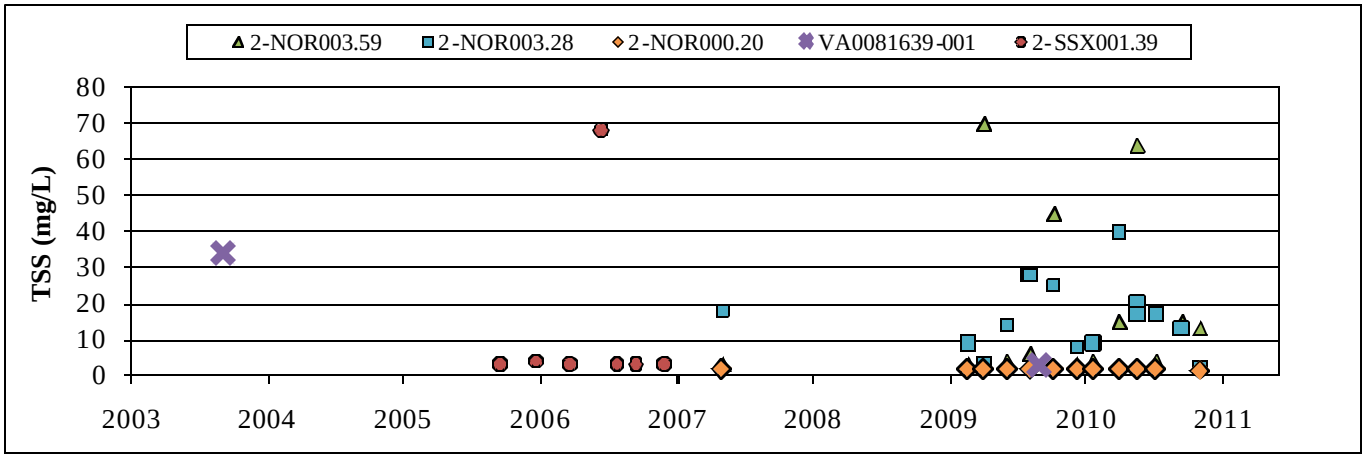
- Min: 0.008
- Max: 0.64
- Average: 0.18



Nitrite (mg/L)

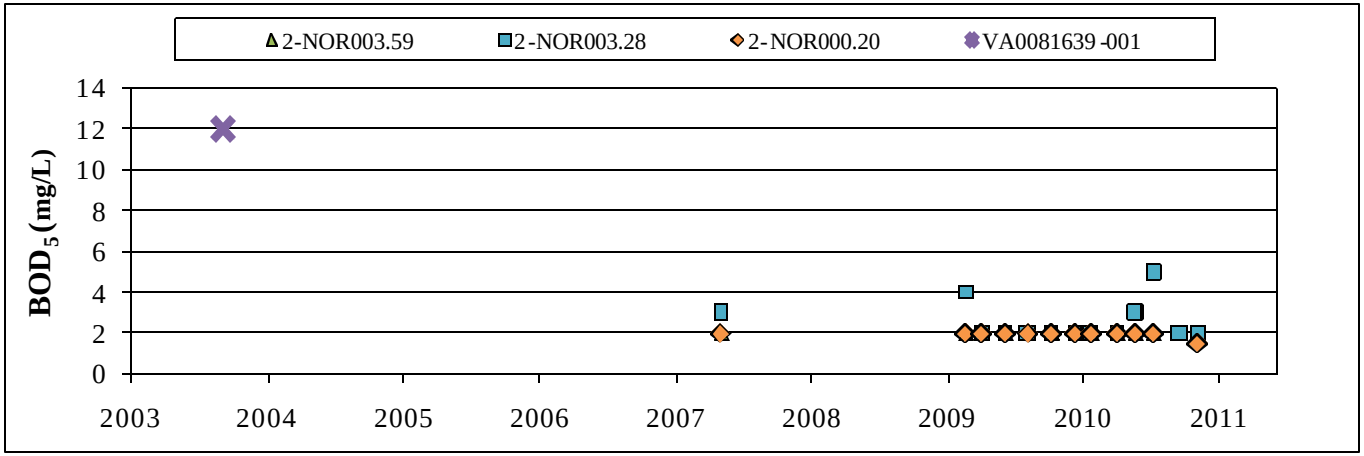
- Min: 0.004
- Max: 0.15
- Average: 0.02

Instream Chemical Parameters (cont)



TSS (mg/L)

- Min: 2
- Max: 70
- Average: 16



BOD_5 (mg/L)

- Min: 1.5
- Max: 12
- Average: 2.4

Instream Metal Parameters

- One sample collected at 2-NOR003.28 on May 18th, 2010

- Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Silver, Thallium

- No exceedances of VADEQ's water quality standards

TMDL Process: Benthic Impairment

Stressor Identification

- Instream water quality
- Biological Monitoring

Stressor Sources

- Point Sources
- Nonpoint Sources

Stream/River

Loading

Reference Condition

End points

Stressor Load

Response?

Instream WQ

Benthic community

Common stressors include:

- Dissolved Oxygen
- Nutrients
- pH
- Temperature
- Sediment
- Toxics

Benthic Stressor Identification

- What pollutant(s) is causing the impairment of the benthic community?
- Common stressors include:
  - Dissolved Oxygen
  - Nutrients
  - pH
  - Temperature
  - Sediment
  - Toxics

Each candidate stressor will be evaluated based on available monitoring data, field observations, and consideration of potential sources in the watershed

Potential stressors are further classified as a *non-stressor*, *possible stressor*, or *most probable stressor.*

Classification of Stressors

- Non-stressors: Data indicates no apparent impact and no water quality violations
- Possible stressors: Data indicates possible direct impact on the benthic
- Most probable stressors: Conclusive data linking them to the poorer benthic community

Next Steps

- Stressor Identification
- Technical Approach
- Technical Advisory Meeting (TAC)
- Draft Allocation Scenarios
- Draft TMDL Report
- 2nd Public Meeting

Local TMDL Contacts

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Comment period: April 8 through May 7

Reports/presentations available at:
www.deq.virginia.gov/tmdl/mtgppt.html

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Additional Slides

Monitoring Stations Summary

North Creek Monitoring Station Summary						
Stream	Station	Description	Available Data	Sampling Dates		Count
				Start	End	
North Creek - Impaired Segment	2-NOR003.59	Upstream of F.U.M.A Discharge	Macroinvertebrates & Habitat	6/2/1999	11/2/2010	13
			Instream chemical parameters	6/22/2000	11/2/2010	14
	2-NOR003.50	Between XXB and F.U.M.A. STP Discharge	Instream chemical parameters	6/22/2000	6/22/2000	1
	2-NOR003.28	Downstream of F.U.M.A. STP Discharge	Macroinvertebrates & Habitat	6/2/1999	11/2/2010	12
			Instream chemical parameters	6/22/2000	11/2/2010	15
North Creek - Non-Impaired	2-NOR000.20	Rt. 654 bridge	Macroinvertebrates & Habitat	10/21/1999	11/2/2010	9
			Instream chemical parameters	7/11/2005	11/2/2010	14
	2-SSX001.39	South Creek - Rt. 656	Instream chemical parameters	9/13/2005	11/30/2006	8
Tributaries	2-XXN000.02	Upstream of confluence with North Creek	Instream chemical parameters	6/22/2000	6/22/2000	1
	VA0081639-001	The Village Nursing Center	Instream chemical parameters	9/4/2003	8/26/2009	2

Habitat Scores – Station 2-NOR003.59

Sampling Season	Epifaunal Substrate	Embeddedness	Velocity	Sediment Deposition	Channel flow	Channel Alteration	Frequency of Riffles	Bank Stability[1]	Vegetative Protection[1]	Riparian Zone [1]	Sinuosity	Pool Substrate	Pool Variability	Total Habitat Score
Fall 1999	13	8	13	8	17	20	11	12	14	15	-	-	-	131
Spring 2000	16	11	10	12	10	17	16	16	16	15	-	-	-	139
Fall 2000	13	10	13	13	18	14	10	16	16	16	-	-	-	139
Fall 2001	3	12	7	6	7	18	5	7	20	5	-	-	-	90
Spring 2007	11	6	16	4	7	18	12	14	16	12	-	-	-	116
Fall 2007	9	-	-	6	7	12	-	8	10	6	12	7	7	84
Spring 2008	13	5	16	5	16	17	13	6	6	14	-	-	-	111
Fall 2008	15	12	16	10	14	16	10	8	8	6	-	-	-	115
Spring 2009	11	11	14	10	16	16	12	10	10	6	-	-	-	116
Fall 2009	9	-	-	8	10	17	-	10	8	4	17	6	16	105
Spring 2010	7	-	-	7	14	17	-	8	8	4	14	8	10	97
Fall 2010	7	-	-	8	6	16	-	10	10	4	15	10	10	96
Avg 2007-2010	**10**	**9**	**15**	**8**	**12**	**16**	**12**	**9**	**9**	**6**	**15**	**8**	**11**	**103**

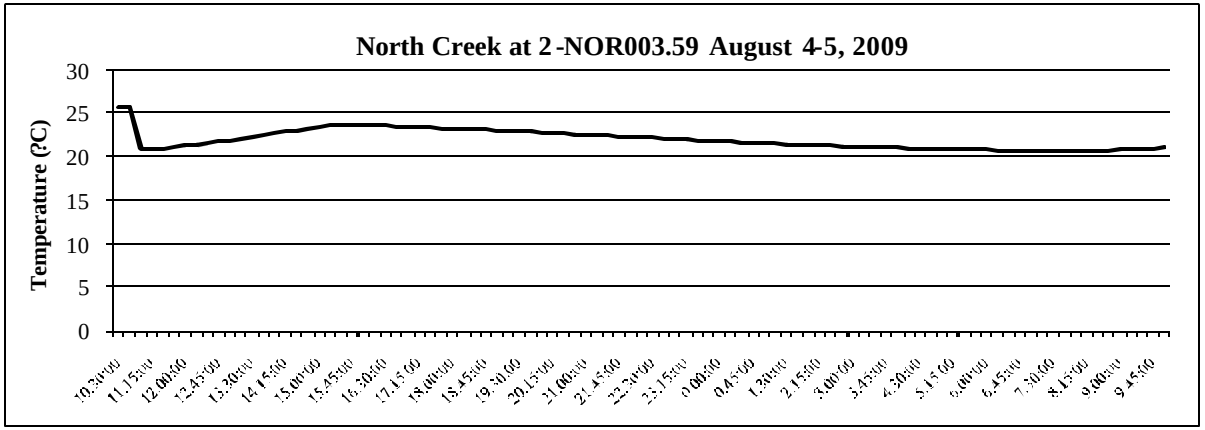
Habitat Scores – Station 2-NOR003.28

Sampling Season	Epifaunal Substrate	Embeddedness	Velocity	Sediment Deposition	Channel flow	Channel Alteration	Frequency of Riffles	Bank Stability[1]	Vegetative Protection[1]	Riparian Zone [1]	Sinuosity	Pool Substrate	Pool Variability	Total Habitat Score
Fall 1999	16	14	15	11	18	20	17	16	18	20	-	-	-	165
Spring 2000	16	11	15	12	13	18	11	18	18	19	-	-	-	151
Fall 2000	13	13	16	16	18	19	8	20	20	20	-	-	-	163
Fall 2001	10	12	13	5	9	18	12	14	20	20	-	-	-	133
Spring 2007	16	11	8	12	10	14	16	18	18	20	-	-	-	143
Spring 2008	10	10	16	10	16	16	16	4	4	20	-	-	-	122
Fall 2008	16	14	16	13	13	16	16	15	15	18	-	-	-	152
Spring 2009	11	10	16	10	16	14	15	14	14	14	-	-	-	134
Fall 2009	12	10	17	10	12	16	18	16	14	18	-	-	-	143
Spring 2010	11	-	-	8	13	17	-	16	16	16	11	9	16	133
Fall 2010	11	6	16	8	12	16	17	10	10	16	-	-	-	122
Avg 2007-2010	**12**	**10**	**15**	**10**	**13**	**16**	**16**	**13**	**13**	**17**	**11**	**9**	**16**	**136**

Habitat Scores – Station 2-NOR000.20

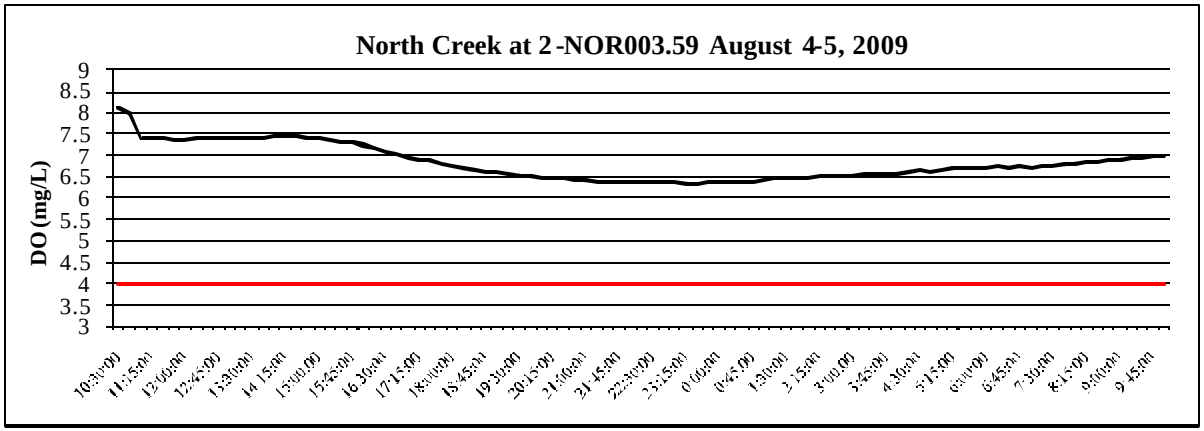
Sampling Season	Epifaunal Substrate	Embeddedness	Velocity	Sediment Deposition	Channel flow	Channel Alteration	Frequency of Riffles	Bank Stability[1]	Vegetative Protection[1]	Riparian Zone [1]	Sinuosity	Pool Substrate	Pool Variability	Total Habitat Score
Fall 1999	14	15	10	10	18	18	16	8	9	19	-	-	-	137
Spring 2007	6	-	-	5	7	18	-	12	16	11	13	6	6	100
Fall 2007	6	-	-	4	8	14	-	4	4	16	11	6	7	80
Spring 2008	11	-	-	6	16	16	-	4	4	19	12	6	8	102
Fall 2008	13	-	-	7	13	15	-	9	9	14	15	7	7	109
Spring 2009	10	-	-	7	15	15	-	8	8	17	14	8	8	110
Fall 2009	10	-	-		7	15	-	10	10	17	15	11	8	103
Spring 2010	11	-	-	7	16	16	-	6	6	16	14	8	9	109
Fall 2010	8	-	-	6	7	16	-	10	10	13	14	8	9	101
Avg 2007-2010	**9**	**N/A**	**N/A**	**6**	**11**	**16**	**N/A**	**8**	**8**	**15**	**14**	**8**	**8**	**102**

Diurnal Study – Station 2-NOR003.59



Water Temperature (SC)

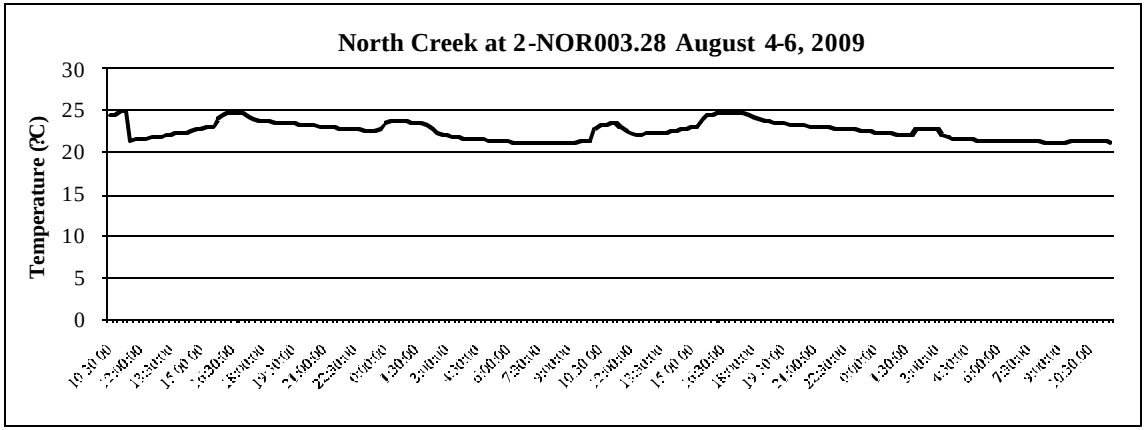
- Min: 20.7
- Max: 25.8
- Average: 22.0
- Swing: 5.1



DO (mg/L)

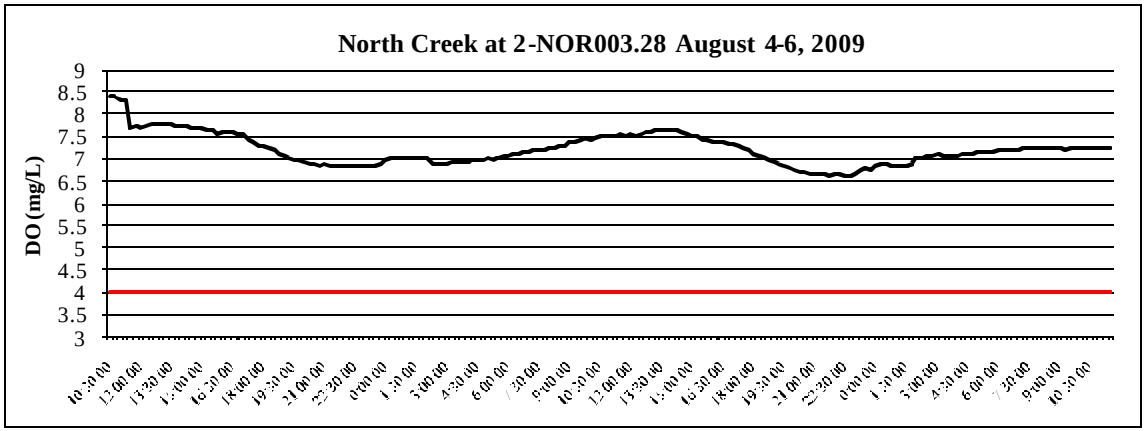
- Min: 6.3
- Max: 8.1
- Average: 6.8
- Swing: 1.8

Diurnal Study – Station 2-NOR003.28



Water Temperature (SC)

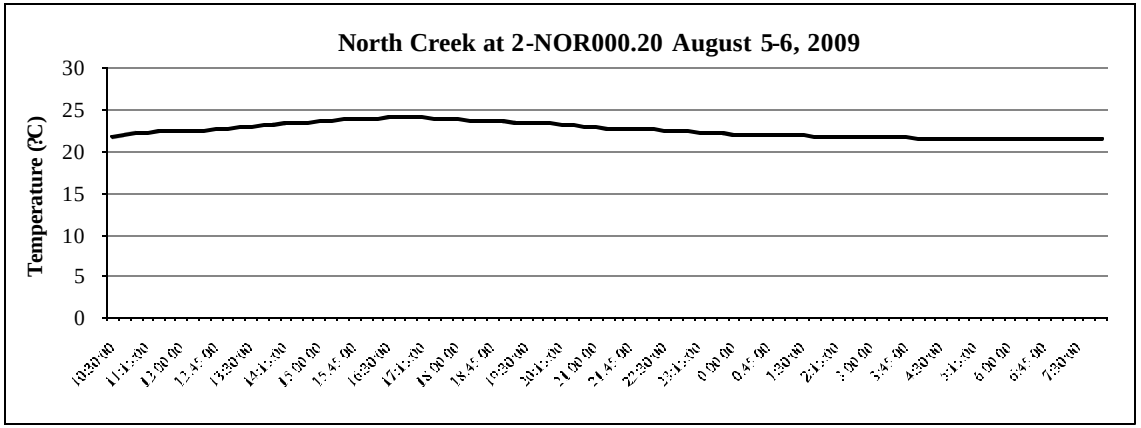
- Min: 21.1
- Max: 24.9
- Average: 22.6
- Swing: 3.9



DO (mg/L)

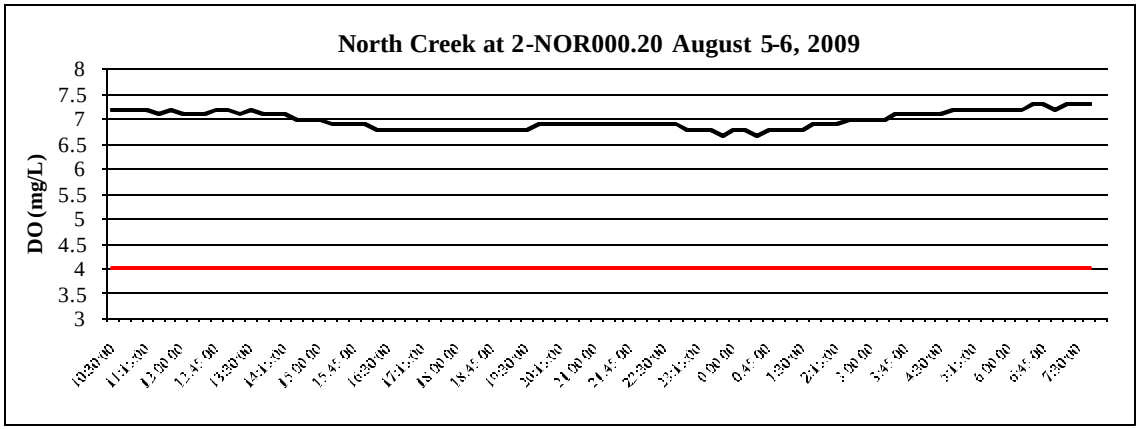
- Min: 6.6
- Max: 8.4
- Average: 7.2
- Swing: 1.6

Diurnal Study – Station 2-NOR000.20



Water Temperature (SC)

- Min: 21.5
- Max: 24.1
- Average: 22.6
- Swing: 2.6



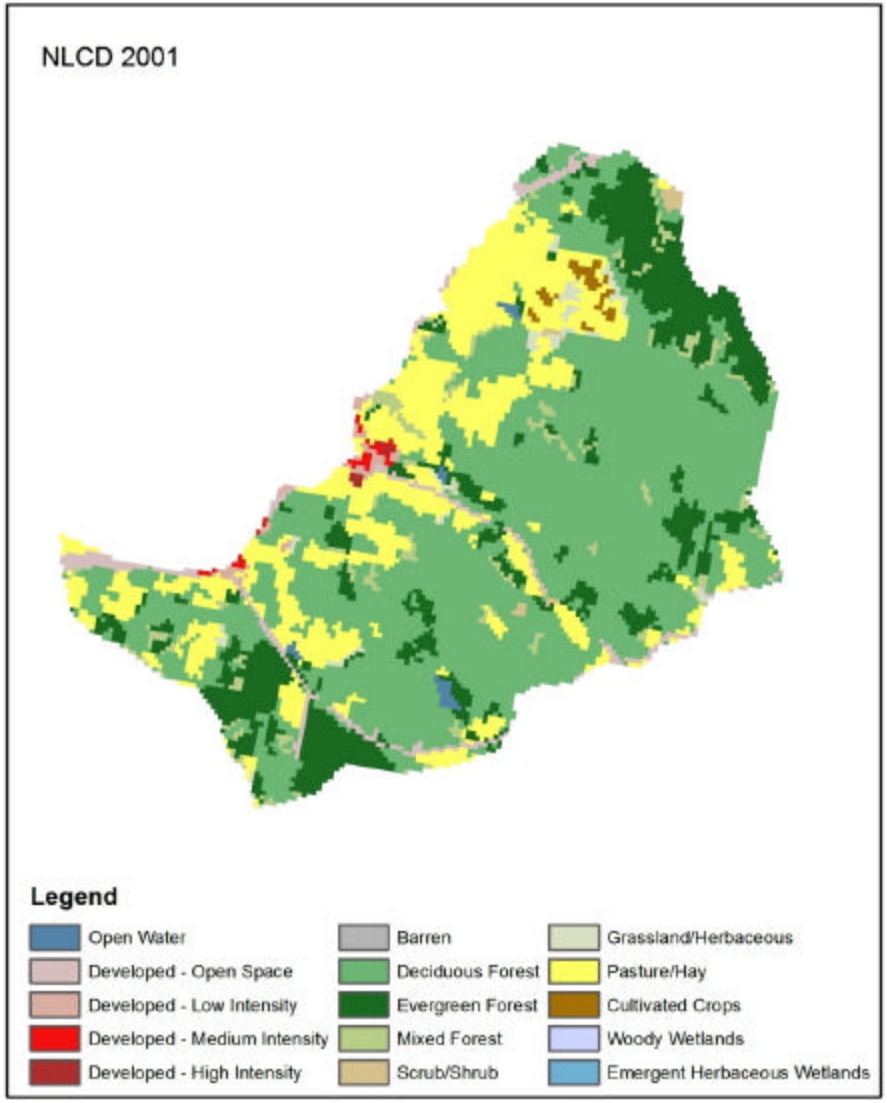
DO (mg/L)

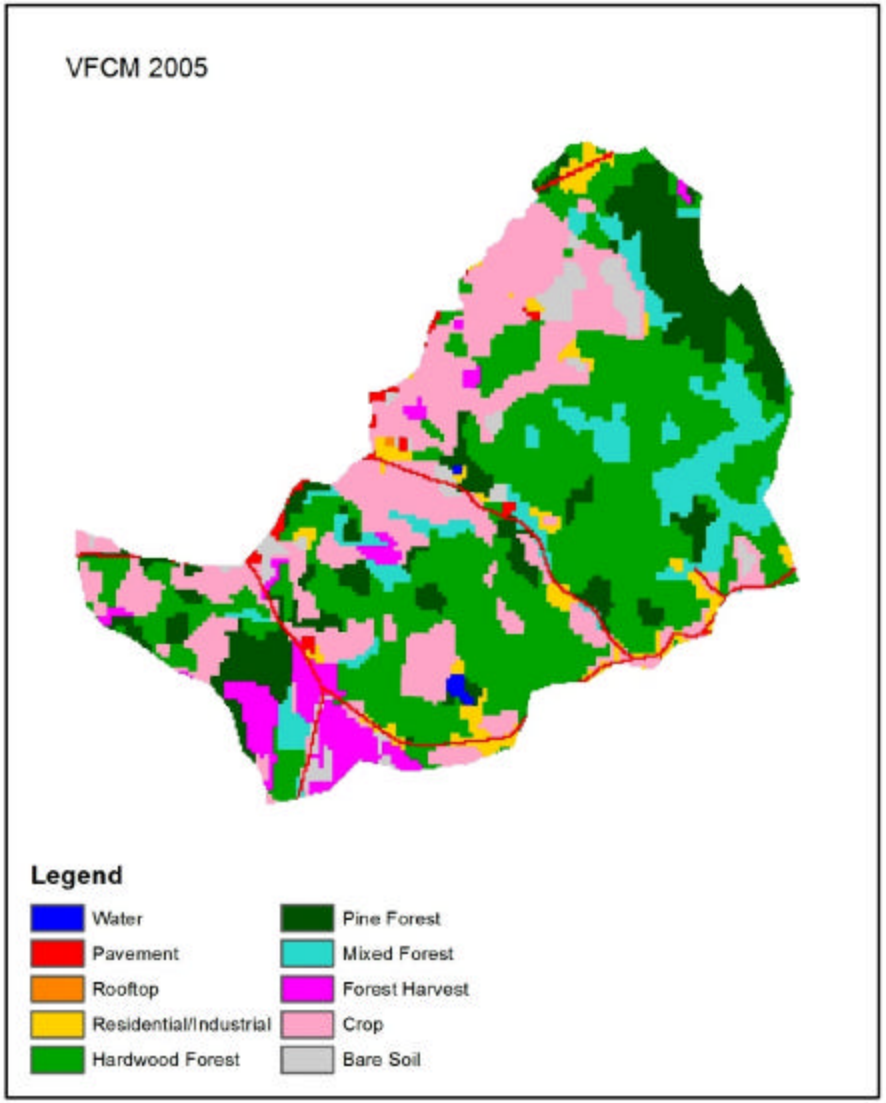
- Min: 6.7
- Max: 7.3
- Average: 7.0
- Swing: 0.6

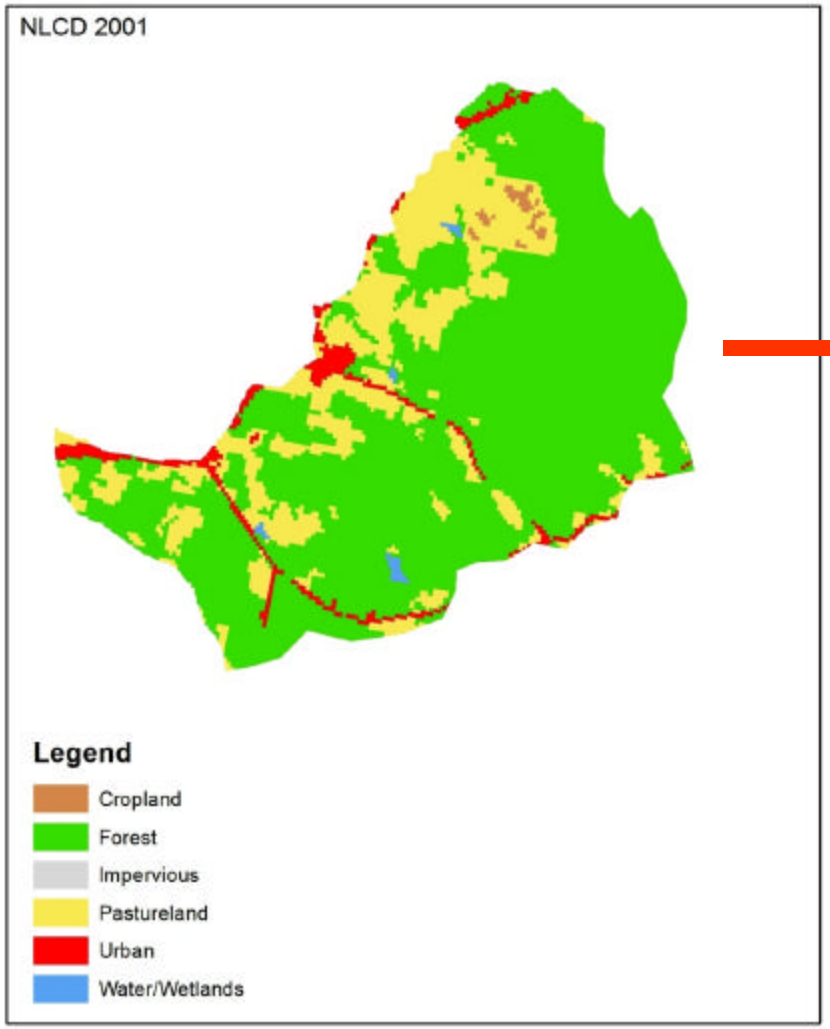
NLCD 2001 vs. VFCM 2005

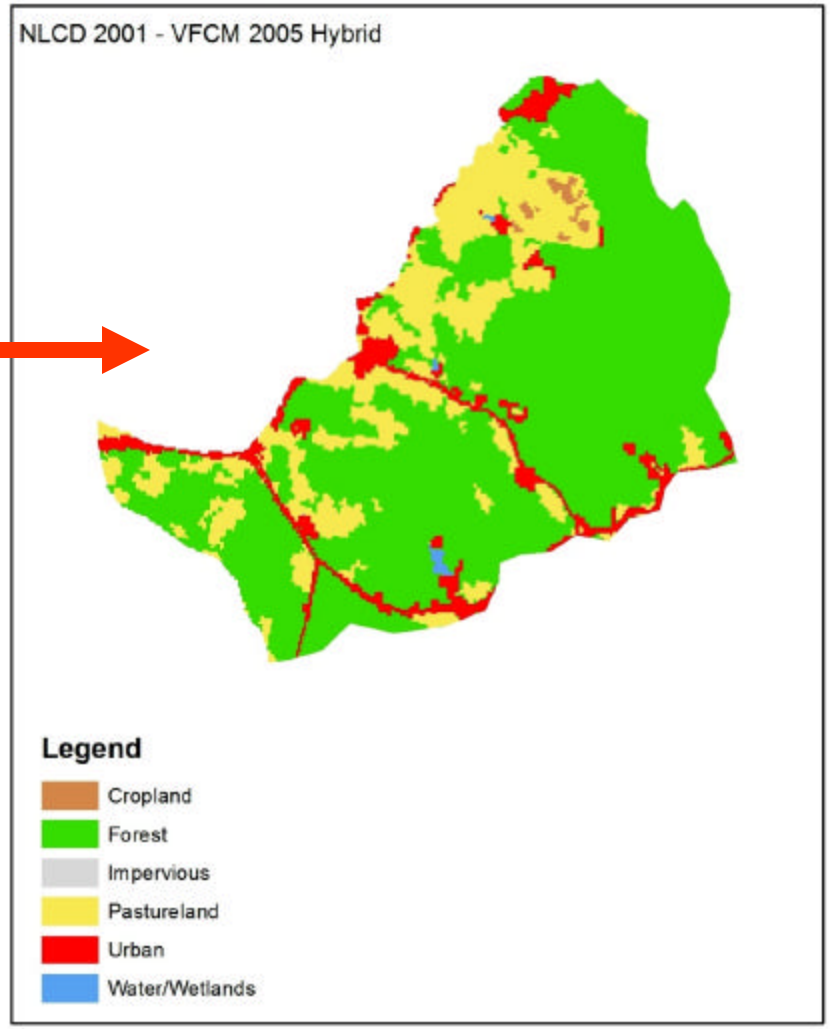
- Most recent NLCD is 2001
- More recent Virginia Department of Forestry 2005 land use data
- DOF and NLCD land use classifications are very different
  - For example urban: pavement, rooftop, and residential/industrial (DOF) vs. low, medium, and high intensity development (NLCD)
- Urban (impervious surface) area has a large impact on watershed hydrology and is therefore important to have the most recent information.
- *Solution: Incorporate the DOF 2005 urban data into the NLCD 2001 data.*

NLCD 2001 vs. VFCM 2005









Land Cover Type	NLCD 2001	Hybrid	Change in Acreage
Cropland	14.1	14.0	-0.1
Forest	1883.0	1819.6	-63.4
Pastureland	561.8	538.9	-22.9
Urban	100.0	190.0	90.0
Water/Wetlands	10.5	6.8	-3.7