Alabama Department of Environmental Management

DRAFT
DELISTING DECISION
FOR

MUD CREEK, FALL CREEK, AND WIDNER CREEK

ASSESSMENT UNIT ID #S AL06030002-0602-200,

AL06030002-0602-900, AND AL06030002-0602-800

ORGANIC ENRICHMENT (CBOD, NBOD)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
September 2015

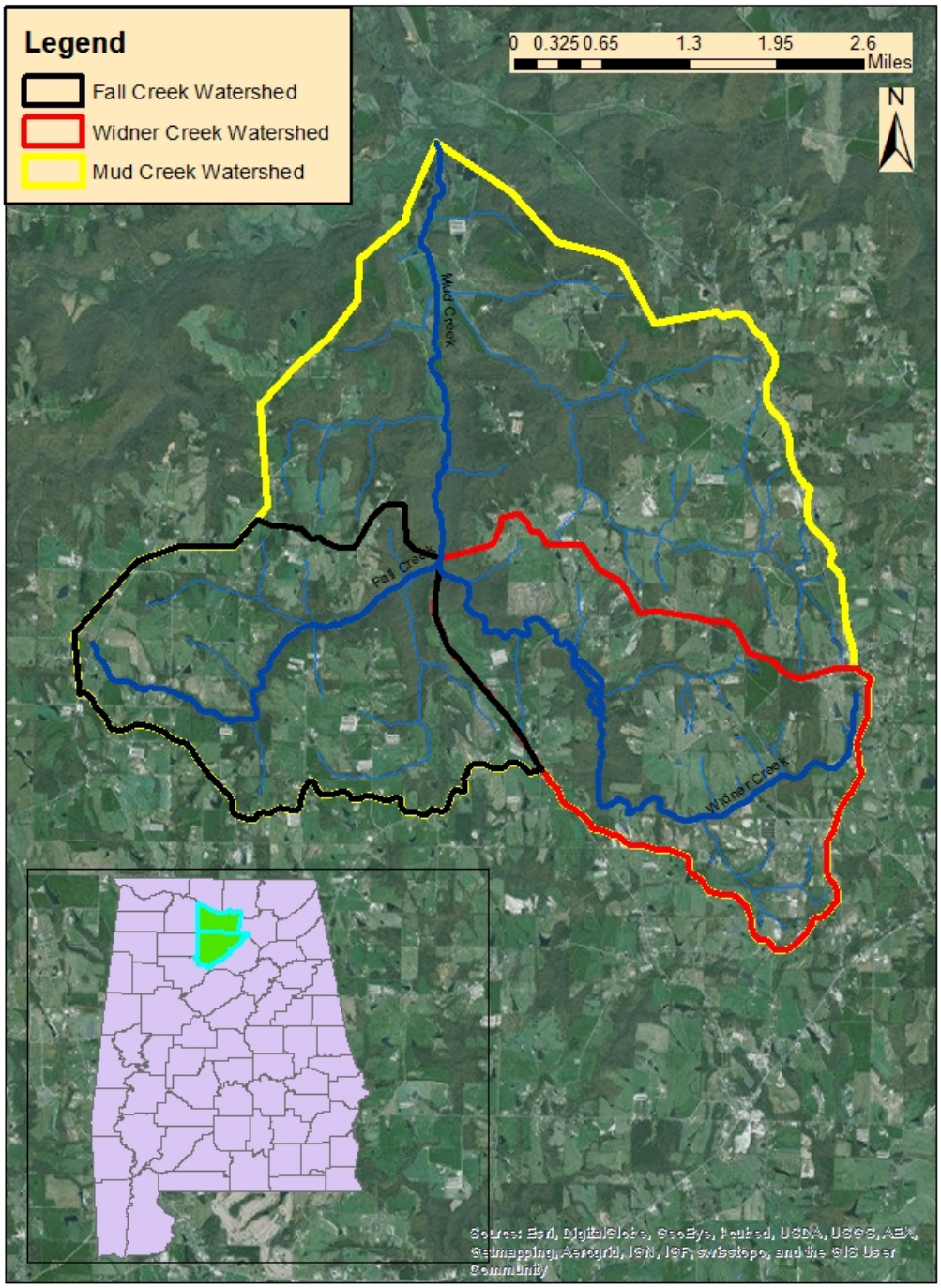


Figure 1: Mud, Fall, and Widner Creeks in the Tennessee River Basin

Contents

1.0 Executive Summary

Mud, Fall, and Widner Creeks are located in the Tennessee River Basin in northern Alabama. The listed portions of Mud, Fall, and Widner Creeks are in Cullman County and Morgan County, Alabama. The segment Mud Creek from the West Fork of Cotaco Creek to its source was placed on the State of Alabama's §303(d) use impairment list in 2006 for organic enrichment/dissolved oxygen (OE/DO). The segments Fall Creek from Mud Creek to its source and Widner Creek from Mud Creek to its source were placed on the State of Alabama's §303(d) use impairment list in 2012 for organic enrichment (CBOD, NBOD). The causes of the impairments were listed as agriculture for Mud Creek, and pasture grazing for Fall and Widner Creeks.

The listed portions of Mud, Fall, and Widner Creeks have a designated use classification of Fish and Wildlife. In accordance with ADEM water quality standards, the minimum dissolved oxygen concentration in a stream classified as Fish and Wildlife is 5 mg/L, except under extreme natural conditions, then a minimum of 4 mg/L is allowed. Compliance with water quality criteria for dissolved oxygen is measured at 5 feet below the surface or at mid-depth when the total depth is less than 10 feet.

Mud Creek was placed on the State of Alabama's 2006 §303(d) use impairment list based on data collected in 2004 and 2005. Fall and Widner Creeks were placed on the State of Alabama's 2012 §303(d) use impairment list based on data collected in 2009.

This report addresses the results of the delisting analysis for organic enrichment/dissolved oxygen for the listed segments of Mud Creek from the West Fork of Cotaco Creek to its source, Fall Creek from Mud Creek to its source, and Widner Creek from Mud Creek to its source. Based on the assessment of all available water quality data, ADEM has determined that a dissolved oxygen impairment for Mud Creek does not exist. Additionally, ADEM has determined that the low dissolved oxygen levels that are occurring in Fall and Widner Creeks are due to natural conditions. Therefore, ADEM will not develop a TMDL due to "more recent or accurate data," which is just cause for not listing a waterbody on the §303(d) list as stated in Title 40 of the Code of Federal Regulations (CFR), Part 130.7(b)(6)(iv).

2.0 Basis for §303(d) Listing

Section 303(d) of the Clean Water Act (CWA), as amended by the Water Quality Act of 1987 and EPA's Water Quality Planning and Management Regulations [Title 40 of the Code of Federal Regulations (CFR), Part 130], requires states to identify waterbodies which are not meeting water quality standards applicable to their designated use classifications. The identified waters are prioritized based on severity of pollution with respect to designated use classifications. Total maximum daily loads (TMDLs) for all pollutants causing violation of applicable water quality standards are established for each identified water. Such loads are established at levels necessary to implement the applicable water quality standards with seasonal variations and margins of safety. The TMDL process establishes the allowable loading of pollutants, or other quantifiable parameters for a waterbody, based on the relationship between

pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Alabama has identified the 3.42 mile segment of Mud Creek from the West Fork of Cotaco Creek to its source as being impaired for organic enrichment (CBOD, NBOD). The §303(d) listing was originally reported on Alabama's 2006 List of Impaired Waters and subsequently included on the 2006 through 2014 lists. The cause of the impairment on the 2014 §303(d) list is agriculture. Additionally, the state of Alabama has identified the 6.79 mile segment of Widner Creek from Mud Creek to its source and the 3.62 mile segment of Fall Creek from Mud Creek to its source as being impaired for organic enrichment (CBOD, NBOD). These two creeks were originally reported on Alabama's 2012 List of Impaired Waters and subsequently included on the 2014 list. The cause of the impairment on the 2014 §303(d) list is pasture grazing.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

According to ADEM's Water Quality Criteria (Administrative Code 335-6-10), the minimum dissolved oxygen concentration allowed in a stream classified as Fish and Wildlife is 5.0 mg/L, except under extreme natural conditions where a minimum of 4.0 mg/L is allowed. For the purpose of this delisting decision, a minimum dissolved oxygen level of 5.0 mg/L will be implemented. The dissolved oxygen criterion is applied at a depth of 5 feet in waters 10 feet or greater in depth. For waters less than 10 feet in depth, the dissolved oxygen criterion is applied at mid-depth.

Station MUDM-2 is located within the 68d ecoregion. Stations MARM-1 and MUDM-1 are located within the 68c ecoregion. In 2010, the Department established ecoregional reference guidelines for ecoregion 68d and for ecoregion 68 in general. The table below shows the reference guidelines for these ecoregions for the parameters relevant to this delisting document.

Table 1: Alabama 2010 Ecoregional Reference Guidelines for Ecoregion 68d and 68

Alabama's 2010 Ecoregional Reference Guidelines				
Parameters	Basis of comparison	Result to compare	68d	68
Dissolved Oxygen (mg/L)	10th %ile	Median	5.609	6.79
Ammonia Nitrogen (mg/L)	90th %ile	Median	0.119	0.1007
Nitrate+Nitrite Nitrogen (mg/L)	90th %ile	Median	1.202	0.6191
Total Kjeldahl Nitrogen (mg/L)	90th %ile	Median	1.46	0.733
Total Nitrogen (mg/L)	90th %ile	Median	2.269	1.41685
Dissolved Reactive Phosphorus (mg/L)	90th %ile	Median	0.0109	0.0182
Total Phosphorus (mg/L)	90th %ile	Median	0.0491	0.05
CBOD-5 (mg/L)	90th %ile	Median	1.86	1.9

3.2 Data Availability and Analysis

3.2.1 Mud Creek

Water quality data for Mud Creek is available from ADEM station MUDM-1. Station MUDM-1 was sampled in 2009 and 2013. The station's location is depicted in Figure 5.

Mud Creek was grab sampled at MUDM-1 eighteen times in 2009 and six times in 2013. During that time, only one of twenty four grab dissolved oxygen samples was less than 5.0 mg/L. Alongside the grab samples, five-day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$), Ammonia (NH_3-N), and Total Kjeldahl Nitrogen (TKN) data were also collected. Only one $CBOD_5$ sample collected exceeded the Method Detection Limit of 1 mg/L or 2 mg/L. The median ammonia value was 0.07 mg/l in 2009 and 0.056 mg/L in 2013, both of which are below the ecoregional reference value of 0.1007 mg/L. TKN samples returned a median result of 0.4845 mg/L in 2009 and 0.47 mg/L in 2013. Both of these are below the ecoregional reference guideline of 0.733 mg/l.

During August of 2013, a 72 hour diurnal study was performed at station MUDM-1. From August 19-22, a data sonde was deployed at station MUDM-1 to collect diurnal dissolved oxygen data. At no time during this study did the sonde record any dissolved oxygen levels below the standard of 5 mg/L. A graph of the 72 hour data is presented below in Figure 2.

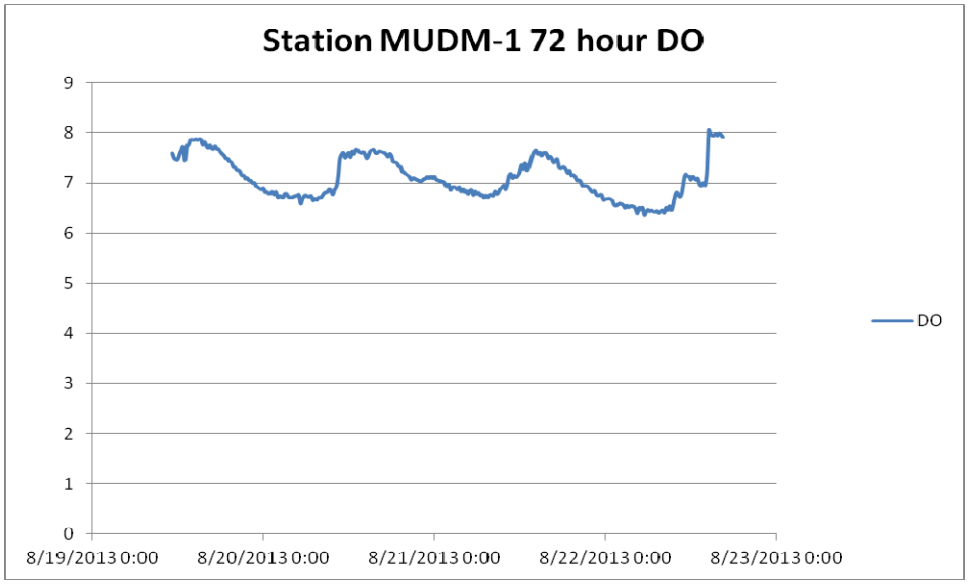


Figure 2: Station MUDM-1 72 hour DO

3.2.2 Fall Creek

Water quality data for Fall Creek is available from ADEM station MARM-1. Station MARM-1 was sampled in 2009 and 2013. The station's location is depicted in Figure 5.

Fall Creek was grab sampled at MARM-1 eighteen times in 2009 and eight times in 2013. During that time, seven of twenty six grab dissolved oxygen samples were less than 5.0 mg/L. Alongside the grab dissolved oxygen samples, $CBOD_5$, NH_3-N, and TKN data were also collected. Of the sixteen $CBOD_5$ samples collected, none exceeded the Method Detection Limit of 1 mg/L or 2 mg/L. The median ammonia value was 0.03 mg/l in 2009 and 0.02325 mg/L in 2013, both of which are below the ecoregional reference value of 0.1007 mg/L. TKN samples returned a median result of 0.4415 mg/L in 2009 and 0.56 mg/L in 2013. Both of these are below the ecoregional reference guideline of 0.733 mg/l.

It should be noted that when the single sample dissolved oxygen violations did occur, they were at times of extremely low flow at the station. Comments recorded by field personnel during sampling visits indicate a population of beavers is partially responsible for the lack of flow and subsequent low dissolved oxygen levels. The date, dissolved oxygen levels, flow, and station visit comments, when present, are presented in Table 2 below.

Table 2: Flow, Dissolved Oxygen levels and Station Visit Comments for Station MARM-1 on Fall Creek

Activity Date	Flow CFS	DO mgl	Station Visit Comments
3/30/2009	13.3	10	
4/15/2009	8.0451	9.39	
5/7/2009	26.603	8.38	
6/11/2009	1.1999	6.99	
6/23/2009	0.592	5.8	
6/24/2009	0.3428	5.88	
7/8/2009	0.7971	4.84	
7/9/2009	0.4355	4.36	
7/9/2009	0.6333	6.92	
7/15/2009	0.6079	5.18	
8/3/2009	Not Recorded	6.79	
8/11/2009	0.3368	3.92	
8/12/2009	0.3359	4.89	
8/12/2009	0.3359	4.53	
8/24/2009	1.0387	6.98	
8/25/2009	0.7507	6.6	
8/26/2009	0.4289	6.25	
9/10/2009	0.213	4.21	
10/14/2009	Not Recorded	7.93	
3/19/2013	5.5806	11.07	
4/9/2013	5.829	10.89	
5/8/2013	21.5522	9.05	
6/4/2013	Not	5.2	Beaver dam upstream of the bridge has a small amount of flow over the top. Not

	Recorded		enough flow to measure.
7/9/2013	Not Recorded	4.08	Creek was dammed upstream of the bridge by beavers. Area of flow was one foot wide and one inch deep. Very little flow, samples and parameters were taken in this area.
8/20/2013	2.6977		
8/21/2013	3.324		
8/22/2013	2.7971		
8/28/2013	Not Recorded	6.09	Large beaver dam upstream of the bridge restricting flow. Flow was visible but too low for the meter.
9/10/2013	Not Recorded	5.64	There is a large beaver dam approximately 60 yards upstream of bridge and water level is 2 feet higher on the upstream side. Dam has almost completely blocked flow.
10/17/2013	Not Recorded	3.46	Large beaver dam upstream of the bridge has restricted flow. Area of visible flow is 10 inches wide and 1/4 inch deep. See picture for area of flow. D.O. is very low due to ultra-low flow conditions.

During August of 2013, a 72 hour diurnal study was performed at station MARM-1. From August 19-22, a data sonde was deployed at station MARM-1 to collect diurnal dissolved oxygen data. At no time during this study did the sonde record any dissolved oxygen levels below the standard of 5 mg/L. A graph of the 72 hour data is presented below in Figure 3.

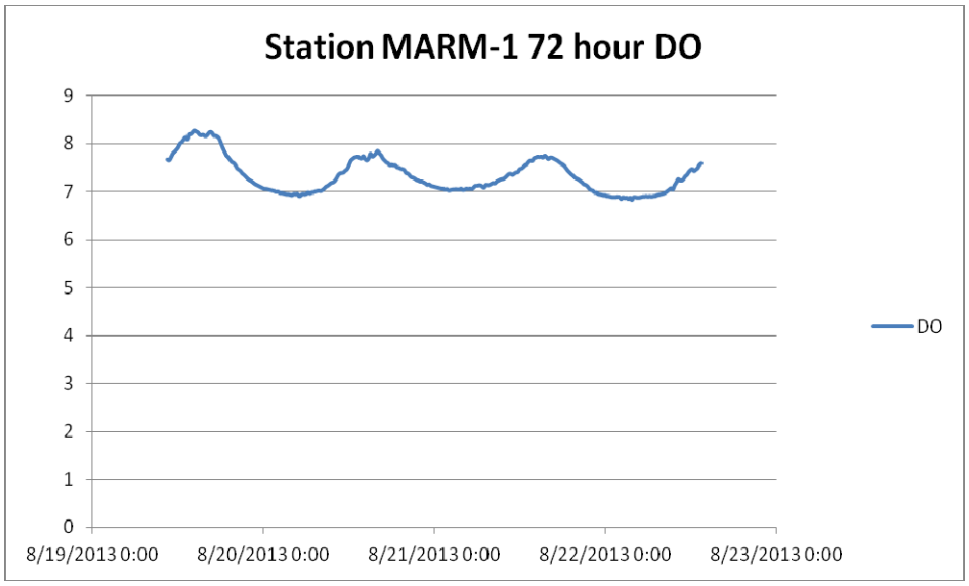


Figure 3: Station MARM-1 72 hour DO

3.2.3 Widner Creek

Water quality data for Widner Creek is available from ADEM station MUDM-2. Station MUDM-2 was sampled in 2009 and 2013. The station's location is depicted in Figure 5.

Widner Creek was grab sampled at MUDM-2 seventeen times in 2009 and ten times in 2013. During that time, nine of twenty seven grab dissolved oxygen samples were less than 5.0 mg/L. Alongside the grab dissolved oxygen samples, $CBOD_5$, NH_3-N, and TKN data were also collected. Of the thirteen $CBOD_5$ samples collected, only one exceeded the Method Detection Limit of 1 mg/L or 2 mg/L. The median ammonia value was 0.081 mg/l in 2009 and 0.04 mg/L

in 2013, both of which are below the ecoregional reference value of 0.119 mg/L. TKN samples returned a median result of 0.965 mg/L in 2009 and 0.931 mg/L in 2013. Both of these are below the ecoregional reference guideline of 1.46 mg/L.

It should be noted that when the single sample dissolved oxygen violations did occur, they were at times of extremely low flow at the station. The date, dissolved oxygen levels, flow, and station visit comments, when present, are below.

Table 3: Flow, Dissolved Oxygen levels and Station Visit Comments for Station MUDM-2 on Widner Creek

Activity Date	Flow CFS	DO mgl	Station Visit Comments
3/30/2009	20.9	10.15	
4/15/2009	8.4443	8.53	
5/7/2009	Not Recorded	6.96	
6/11/2009	Not Recorded	5.59	No flow, Lightning in area
6/23/2009	2.9202	6.52	
6/24/2009	0.6181	5.84	
7/15/2009	0.4528	4.71	
7/16/2009	0.8088	4.66	
7/20/2009	0	5.05	
8/3/2009	Not Recorded	6.17	
8/11/2009	0.2969	4.46	
8/12/2009	0.7134	4.26	
8/12/2009	Not Recorded	4.82	
8/24/2009	0.2801	5.25	
8/25/2009	0.1555	5.38	
8/26/2009	0.0648	4.78	
10/14/2009	Not Recorded	7.14	
3/19/2013	11.03	9.47	Creek was braided upstream of the bridge, so samples and flow were taken downstream of the bridge. We could only filter 100 ml of chlorophyll-a.
4/9/2013	8.1304	8.37	
5/8/2013	31.2461	8.64	
6/4/2013	Not Recorded	6.75	Creek is almost pooled, only a small amount of water flowing over the rocks.
7/9/2013	0.6737	5.6	We could only filter 200ml of chlorophyll-a.
8/20/2013	1.1907	4.89	Tuesday - Day 2 of 72hr Diurnal Study. Flow and Turbidity Measurement Taken.
8/21/2013	1.4118	4.67	Wednesday - Day 3 of 72hr Diurnal Study. Flow and Turbidity Measurement Taken.
8/22/2013	1.261	4.6	Thursday - Day 4 of 72hr Diurnal Study. Flow and Turbidity Measurement Taken. Started raining early Thursday morning, creek began to rise and flow increased throughout the day.
8/28/2013	Not Recorded	5.1	Creek is almost pooled, small amount of water flowing over the rocks. There is a heavy sheen of scum upstream of the bridge.
9/10/2013	Not Recorded	6.06	Area of flow is 14" wide and 1/2" deep, through rocks. Creek has thick scum layer on top of the upstream side.

During August of 2013, a 72 hour diurnal study was performed at station MUDM-2. From August 19-22, a data sonde was deployed at station MUDM-2 to collect diurnal dissolved oxygen data. A graph of the 72 hour data is presented below in Figure 4.

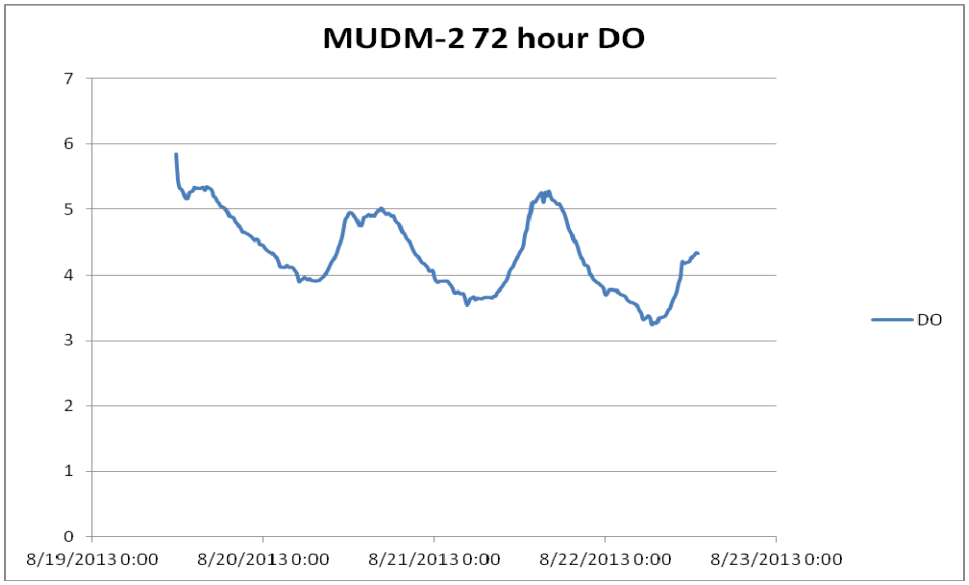
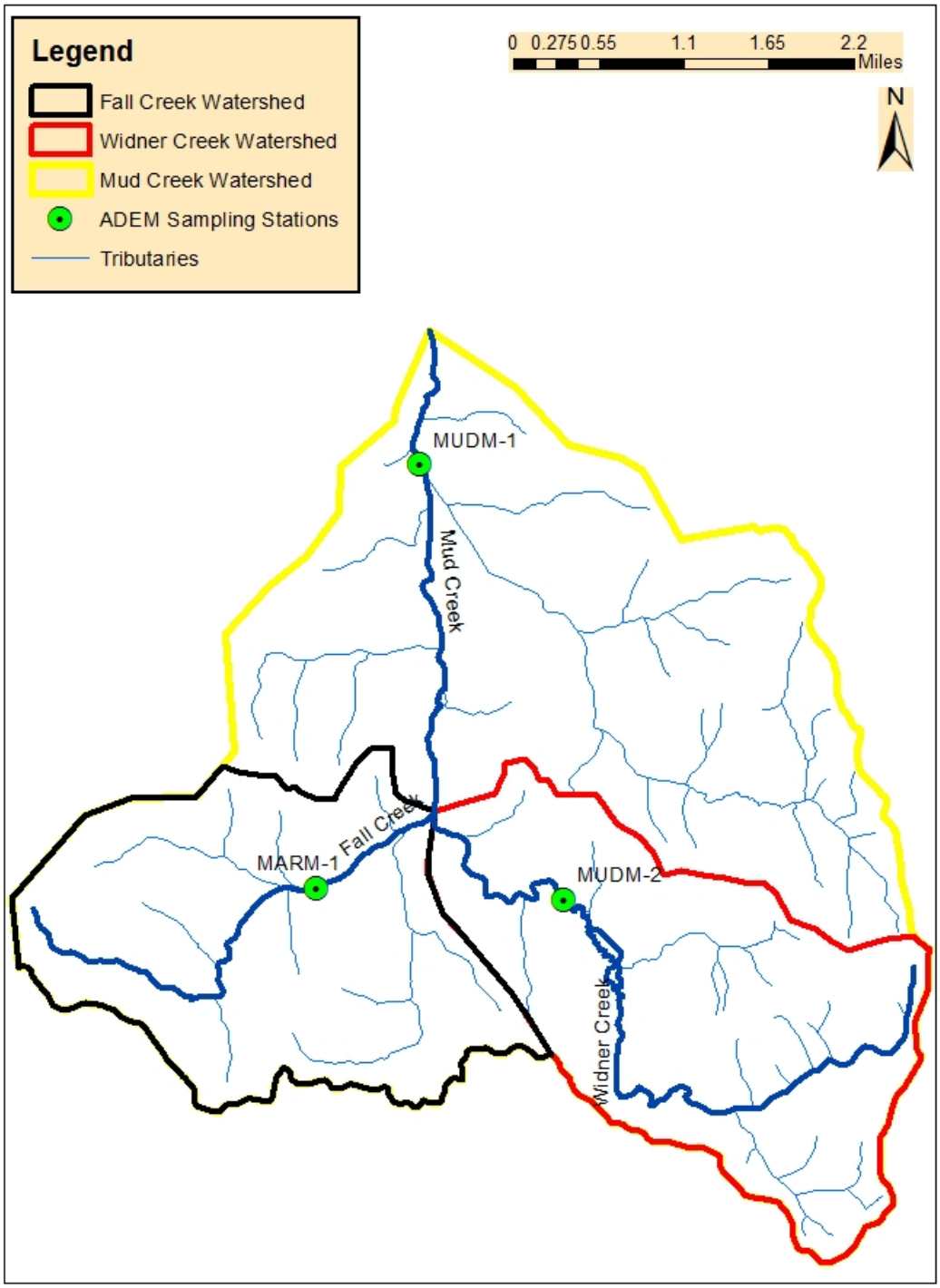


Figure 4: Station MUDM-2 72 hour DO

While the 72 hour study only recorded values above the 5 mg/L dissolved oxygen standard for a short portion of the study, it should be noted that the recorded flows during the three days of the study were 1.1907 cfs, 1.4118 cfs, and 1.261 cfs.

Figure 5: ADEM sampling stations on Mud, Fall, and Widner Creeks



4.0 Source Analysis

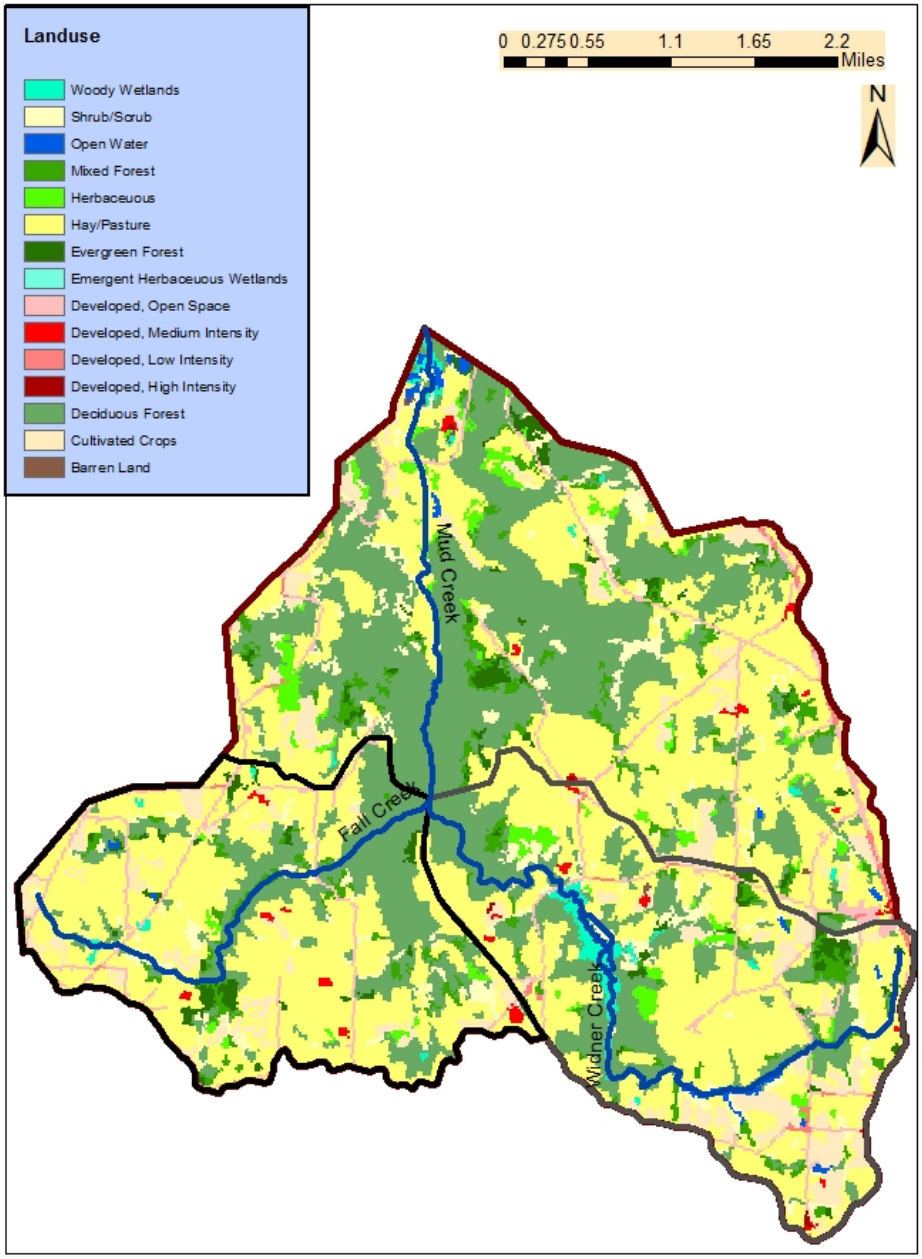
Land use for the Mud, Fall, and Widner Creek watersheds was determined using Arc View. Land use information for this assessment was derived from the 2011 National Land Cover Dataset (NLCD). Figure 6 is a map of the land use in the Mud, Fall, and Widner Creek watersheds. The table below contains a breakdown of the land uses within the Mud, Fall, and Widner Creek watersheds. The total drainage area for the Mud Creek watershed is 19.48 square miles. Within the Mud Creek watershed is the Widner Creek watershed, which covers 5.32 square miles, and the Fall Creek watershed, which covers 5.04 square miles. Overall, the Mud, Fall, and Widner Creek watersheds can be considered rural. It should be noted that developed areas only comprise about 5% of the watershed. Therefore, the pollution load from developed areas is believed to be of minimal impact upon the dissolved oxygen levels in these creeks. There is very little row crop agriculture in the whole watershed. However, there is extensive hay/pasture grazing lands. The remainder of the Mud, Fall, and Widner Creek watersheds is forested and other natural land uses. There is no reason to suspect these natural areas are contributing, more than natural levels of oxygen demanding pollutants, to the dissolved oxygen levels observed in the creeks.

There are no NPDES discharges, Municipal Separate Storm Sewer Systems, or permitted stormwater facilities within the Mud, Fall, and Widner Creek watersheds.

Table 4: Land Use throughout the Mud, Fall, and Widner Creek Watershed

Land Cover	Whole Watershed	Widner Creek	Fall Creek	Mud Creek
Open Water	0.6%	1.1%	0.1%	0.5%
Developed, Open Space	3.9%	3.5%	4.3%	3.9%
Developed, Low Intensity	0.5%	0.8%	0.1%	0.6%
Developed, Medium Intensity	0.5%	0.5%	0.6%	0.4%
Developed, High Intensity	0.0%	0.1%	0.0%	0.0%
Barren Land	0.0%	0.0%	0.0%	0.1%
Deciduous Forest	30.4%	22.8%	22.9%	39.0%
Evergreen Forest	1.8%	1.5%	2.2%	1.7%
Mixed Forest	3.6%	3.5%	3.1%	3.9%
Shrub/Scrub	4.8%	5.3%	4.2%	4.9%
Herbaceous	2.0%	2.2%	0.7%	2.7%
Hay/Pasture	44.7%	47.5%	55.4%	37.1%
Cultivated Crops	6.1%	8.6%	5.9%	4.8%
Woody Wetlands	1.0%	2.4%	0.4%	0.5%
Emergent Herbaceous Wetlands	0.0%	0.0%	0.0%	0.0%
Agriculture	50.8%	56.1%	61.3%	41.9%
Forest	35.8%	27.9%	28.2%	44.6%
Developed	4.9%	4.9%	5.1%	4.9%
Other	8.5%	11.2%	5.4%	8.7%
Total	100.0%	100.0%	100.0%	100.0%

Figure 6: Land Use Map for the Mud, Fall, and Widner Creek Watersheds



5.0 Conclusions

Based on an examination of all available water quality data and information related to Mud, Fall, and Widner Creeks, ADEM has determined that an organic enrichment/dissolved oxygen impairment does not currently exist. The low dissolved oxygen concentrations observed in Fall and Widner Creeks are believed to be a result of natural conditions. Examination of water quality data in Mud Creek indicates that it is fully supporting its 5 mg/L dissolved oxygen criteria. Water quality concentrations of oxygen-demanding pollutants ($CBOD_5$, NH_3-N, and TKN) in Mud, Fall, and Widner Creeks were low, in the range of background conditions for such pollutants.

Hydrologic conditions that affect surface-water quality in Fall and Widner Creeks include long hydraulic residence times during low flow conditions and heating of the surface waters. Although oxygen-consuming organic matter exerts an unknown level of sediment oxygen demand (SOD) on the water column, given that Fall and Widner Creeks are very shallow or dry under critical conditions, it is likely that SOD plays an increased role in the oxygen depletion. Therefore, the natural low flow during the summer months is understood to be the predominant cause of the low dissolved oxygen values. As a result, ADEM will not develop a TMDL for Mud, Fall, and Widner Creeks due to "more recent or accurate data," which is just cause for delisting a waterbody in accordance with Title 40 of the Code of Federal Regulations (CFR), Part 130.7(b)(6)(iv).

6.0 Public Participation

As part of the public participation process, this Delisting Decision (DD) will be placed on public notice and made available for review and comment. A public notice will be prepared and published in the major daily newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject DD will be made available on ADEM's Website: www.adem.state.al.us. The public can also request hard or electronic copies of the DD by contacting Ms. Kimberly Minton at 334-271-7826 or kminton@adem.state.al.us. The public will be given an opportunity to review the DD and submit comments to the Department in writing. At the end of the comment period, all written comments received during the public notice period will become part of the administrative record. ADEM will consider all comments received by the public prior to final completion of this DD and subsequent submission to EPA Region 4 for final approval.

7.0 References

ADEM Administrative Code, 2005. Water Quality Program, Chapter 335-6-10, Water Quality Criteria, and Chapter 335-6-11 Use Classifications for Interstate and Intrastate Waters.

Alabama's §303(d) Monitoring Program. ADEM.

Alabama's Ambient Water Quality Monitoring Program. ADEM.

Final 2010 Ecoregional Reference Guidelines (Summary). ADEM.

Alabama Department of Environmental Management. December 2005. Alabama's Water Quality Assessment and Listing Methodology.

Alabama Department of Environmental Management, 2014 §303(d) Lists. ADEM.

Griffith, G.E., J.M. Omernik, J.A. Comstock, S. Lawrence, G. Martin, A. Goddard, V.J. Hulcher, T. Foster. 2001. Ecoregions of Alabama and Georgia. Color poster with map, descriptive text, summary tables and photographs. U.S. Geological Survey, Reston VA.

United States Environmental Protection Agency. 1991. Guidance for Water Quality-Based Decisions: The TMDL Process, Office of Water, EPA 440/4-91-001.

Appendix A
Water Quality Data

Station ID	Activity Date	CBOD5 mgl	CBOD5 dc		Station ID	Activity Date	CBOD5 mgl	CBOD5 dc		Station ID	Activity Date	CBOD5 mgl	CBOD5 dc
MARM-1	3/30/2009	1	< MDL 1		MUDM-1	3/30/2009	1	< MDL 1		MUDM-2	3/30/2009	1	< MDL 1
MARM-1	4/15/2009	2	< MDL 2		MUDM-1	4/15/2009	2	< MDL 2		MUDM-2	4/15/2009	2	< MDL 2
MARM-1	5/7/2009	1	< MDL 1		MUDM-1	5/7/2009	1	< MDL 1		MUDM-2	5/7/2009	1	< MDL 1
MARM-1	6/11/2009	1	< MDL 1		MUDM-1	6/11/2009	1	< MDL 1		MUDM-2	6/11/2009	1	< MDL 1
MARM-1	7/9/2009	1	< MDL 1		MUDM-1	7/9/2009	1	< MDL 1		MUDM-2	8/12/2009	1	< MDL 1
MARM-1	8/12/2009	1	< MDL 1		MUDM-1	8/12/2009	1	< MDL 1		MUDM-2	10/14/2009	2	< MDL 2
MARM-1	9/10/2009	2	< MDL 2		MUDM-1	9/10/2009	2.5			MUDM-2	3/19/2013	2	< MDL 2
MARM-1	10/14/2009	2	< MDL 2		MUDM-1	10/14/2009	2	< MDL 2		MUDM-2	4/9/2013	2	< MDL 2
MARM-1	3/19/2013	2	< MDL 2		MUDM-1	3/19/2013	2	< MDL 2		MUDM-2	5/8/2013	2	< MDL 2
MARM-1	4/9/2013	2	< MDL 2		MUDM-1	4/9/2013	2	< MDL 2		MUDM-2	6/4/2013	3.1	
MARM-1	5/8/2013	2	< MDL 2		MUDM-1	5/8/2013	2	< MDL 2		MUDM-2	7/9/2013	2	< MDL 2
MARM-1	6/4/2013	2	< MDL 2		MUDM-1	6/4/2013	2	< MDL 2		MUDM-2	8/28/2013	2	< MDL 2
MARM-1	7/9/2013	2	< MDL 2		MUDM-1	7/9/2013	2	< MDL 2		MUDM-2	9/10/2013	2	< MDL 2
MARM-1	8/28/2013	2	< MDL 2		MUDM-1	8/28/2013	2	< MDL 2					
MARM-1	9/10/2013	2	< MDL 2										
MARM-1	10/17/2013	2	< MDL 2										

Figure 7:CBOD5 Grab Samples

Station ID	Activity Date	NH3 mgl			Station ID	Activity Date	NH3 mgl			Station ID	Activity Date	NH3 mgl
MARM-1	4/15/2009	0.007			MUDM-1	4/15/2009	0.007			MUDM-2	4/15/2009	0.007
MARM-1	8/12/2009	0.053			MUDM-1	8/12/2009	0.124			MUDM-2	8/12/2009	0.173
MARM-1	9/10/2009	0.003			MUDM-1	9/10/2009	0.102			MUDM-2	10/14/2009	0.081
MARM-1	10/14/2009	0.055			MUDM-1	10/14/2009	0.038			MUDM-2	3/19/2013	0.033
MARM-1	3/19/2013	0.0145			MUDM-1	3/19/2013	0.0145			MUDM-2	4/9/2013	0.058
MARM-1	4/9/2013	0.0145			MUDM-1	4/9/2013	0.088			MUDM-2	5/8/2013	0.1
MARM-1	5/8/2013	0.07			MUDM-1	5/8/2013	0.05			MUDM-2	6/4/2013	0.078
MARM-1	6/4/2013	0.099			MUDM-1	6/4/2013	0.062			MUDM-2	7/9/2013	0.04
MARM-1	7/9/2013	0.114			MUDM-1	7/9/2013	0.08			MUDM-2	8/28/2013	0.0075
MARM-1	8/28/2013	0.0075			MUDM-1	8/28/2013	0.0075			MUDM-2	9/10/2013	0.0075
MARM-1	9/10/2013	0.0075										
MARM-1	10/17/2013	0.032										

Figure 8: NH3-N Grab Samples

Station ID	Activity Date	TKN mgl			Station ID	Activity Date	TKN mgl			Station ID	Activity Date	TKN mgl
MARM-1	4/15/2009	0.47			MUDM-1	4/15/2009	0.61			MUDM-2	4/15/2009	0.8
MARM-1	8/12/2009	0.413			MUDM-1	8/12/2009	0.359			MUDM-2	8/12/2009	0.965
MARM-1	9/10/2009	0.0445			MUDM-1	9/10/2009	0.0445			MUDM-2	10/14/2009	1.318
MARM-1	10/14/2009	1.263			MUDM-1	10/14/2009	1.169			MUDM-2	3/19/2013	0.657
MARM-1	3/19/2013	0.55			MUDM-1	3/19/2013	0.524			MUDM-2	4/9/2013	0.956
MARM-1	4/9/2013	0.248			MUDM-1	4/9/2013	0.25			MUDM-2	5/8/2013	0.72
MARM-1	5/8/2013	0.57			MUDM-1	5/8/2013	0.31			MUDM-2	6/4/2013	1.41
MARM-1	6/4/2013	0.789			MUDM-1	6/4/2013	0.503			MUDM-2	7/9/2013	0.63
MARM-1	7/9/2013	0.81			MUDM-1	7/9/2013	0.62			MUDM-2	8/28/2013	1.11
MARM-1	8/28/2013	0.418			MUDM-1	8/28/2013	0.437			MUDM-2	9/10/2013	0.931
MARM-1	9/10/2013	0.493										
MARM-1	10/17/2013	0.588										

Figure 9: Total Kjeldahl Nitrogen grab samples

Station ID	Activity Date	Flow CFS	DO mgl			Station ID	Activity Date	Flow CFS	DO mgl			Station ID	Activity Date	Flow CFS	DO mgl
MARM-1	3/30/2009	13.3	10			MUDM-1	3/30/2009	80.3	10.44			MUDM-2	3/30/2009	20.9	10.15
MARM-1	4/15/2009	8.0451	9.39			MUDM-1	4/15/2009	53.0832	9.71			MUDM-2	4/15/2009	8.4443	8.53
MARM-1	5/7/2009	26.603	8.38			MUDM-1	5/7/2009		8.8			MUDM-2	5/7/2009		6.96
MARM-1	6/11/2009	1.1999	6.99			MUDM-1	6/11/2009		6.28			MUDM-2	6/11/2009		5.59
MARM-1	6/23/2009	0.592	5.8			MUDM-1	6/23/2009	2.1201	6.51			MUDM-2	6/23/2009	2.9202	6.52
MARM-1	6/24/2009	0.3428	5.88			MUDM-1	6/24/2009	2.9502	6.22			MUDM-2	6/24/2009	0.6181	5.84
MARM-1	7/8/2009	0.7971	4.84			MUDM-1	7/9/2009	0.7243	6.29			MUDM-2	7/15/2009	0.4528	4.71
MARM-1	7/9/2009	0.4355	4.36			MUDM-1	7/15/2009	3.0788	5.86			MUDM-2	7/16/2009	0.8088	4.66
MARM-1	7/9/2009	0.6333	6.92			MUDM-1	7/16/2009	2.4207	5.08			MUDM-2	7/20/2009	0	5.05
MARM-1	7/15/2009	0.6079	5.18			MUDM-1	7/20/2009	1.3526	6.73			MUDM-2	8/3/2009		6.17
MARM-1	8/3/2009		6.79			MUDM-1	8/3/2009		7.58			MUDM-2	8/11/2009	0.2969	4.46
MARM-1	8/11/2009	0.3368	3.92			MUDM-1	8/11/2009	1.54	6.02			MUDM-2	8/12/2009	0.7134	4.26
MARM-1	8/12/2009	0.3359	4.53			MUDM-1	8/12/2009	2.3681	5.62			MUDM-2	8/12/2009		4.82
MARM-1	8/24/2009	1.0387	6.98			MUDM-1	8/24/2009	3.2284	7.02			MUDM-2	8/24/2009	0.2801	5.25
MARM-1	8/25/2009	0.7507	6.6			MUDM-1	8/25/2009	2.1023	7.29			MUDM-2	8/25/2009	0.1555	5.38
MARM-1	8/26/2009	0.4289	6.25			MUDM-1	8/26/2009	1.5888	7.22			MUDM-2	8/26/2009	0.0648	4.78
MARM-1	9/10/2009	0.213	4.21			MUDM-1	9/10/2009	0.558	3.6			MUDM-2	10/14/2009		7.14
MARM-1	10/14/2009		7.93			MUDM-1	10/14/2009		8.12			MUDM-2	3/19/2013	11.03	9.47
MARM-1	3/19/2013	5.5806	11.07			MUDM-1	3/19/2013	35.3819	10.31			MUDM-2	4/9/2013	8.1304	8.37
MARM-1	4/9/2013	5.829	10.89			MUDM-1	4/9/2013	33.1731	10.49			MUDM-2	5/8/2013	31.2461	8.64
MARM-1	5/8/2013	21.5522	9.05			MUDM-1	5/8/2013	125.0805	9.35			MUDM-2	6/4/2013		6.75
MARM-1	6/4/2013		5.2			MUDM-1	6/4/2013	3.1832	6.56			MUDM-2	7/9/2013	0.6737	5.6
MARM-1	7/9/2013		4.08			MUDM-1	7/9/2013	1.3681	6.41			MUDM-2	8/20/2013	1.1907	4.89
MARM-1	8/20/2013	2.6977				MUDM-1	8/20/2013	8.4492				MUDM-2	8/21/2013	1.4118	4.67
MARM-1	8/21/2013	3.324				MUDM-1	8/21/2013	8.5107				MUDM-2	8/22/2013	1.261	4.6
MARM-1	8/22/2013	2.7971				MUDM-1	8/22/2013	7.6981				MUDM-2	8/28/2013		5.1
MARM-1	8/28/2013		6.09			MUDM-1	8/28/2013		6.36			MUDM-2	9/10/2013		6.06
MARM-1	9/10/2013		5.64												
MARM-1	10/17/2013		3.46					Number	24					Number	27
								Number of	1					Number of	9
		Number	26					violations						violations	
		Number of violations	7												

Figure 10:Dissolved Oxygen Grab Samples

Appendix B
Photographs

Figure 11: MARM-1 Beaver Dam 8-28-13

Figure 12: MARM-1 flowing area 7-9-13

Figure 13: MARM-1 Upstream 7-9-13

Figure 14: MARM-1 Upstream 8-20-13

Figure 15: MUDM-2 Area of Flow 8-28-13

Figure 16: MUDM-2 Downstream 7-9-13

Figure 17: MUDM-2 Downstream 9-10-13

Figure 18: MUDM-2 Upstream 6-4-13