

Appendix C to rule 3745-4-05 of the Administrative Code.  
 Appendix 3745-4-05  
 Some examples of acceptable analytical methods for level 1 and level 2 credible data.

Parameter	Technique	Level	(complete reference citations provided at end of table)				
			Credible Data	Volunteer Manual	Hach Company	USEPA Methods	Standard Methods
			Chapter	Method	Method	Method	--
<b>Chemical and physical parameters and methods</b>							
Acidity	Digital titrator	1, 2		8200 8233			
	Acidity as CaCO <sub>3</sub> , Electrometric endpoint or phenolphthalein endpoint	2			305.1	2310 B	
Alkalinity	Digital titrator method (Phenolphthalein and Methylorange endpoints)	1, 2	5.10	8203			
	Alkalinity as CaCO <sub>3</sub> , Electrometric endpoint of Colorimetric manual titration to pH 4.5	2			310.1	2320 B	
	Alkalinity as CaCO <sub>3</sub> , Electrometric endpoint of Colorimetric automatic titration to pH 4.5	2			310.2		
Ammonia (as N)	Nesslerization	2			350.2	18 <sup>th</sup> edition 4500-NH3C	
	Titration	2			350.2	20 <sup>th</sup> edition 4500-NH3C	
	Electrode	2			350.3	20 <sup>th</sup> edition 4500-NH3D or E	
	Colorimetric, automated phenate	2			350.1	20 <sup>th</sup> edition 4500-NH3G	
Conductivity	Handheld meter	1					See endnote <sup>1</sup>

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Parameter	Technique	Level	(complete reference citations provided at end of table)				
			Chapter	Method	Method	Method	--
	Field meter with probe	1, 2	5.9				See endnote <sup>1</sup>
	Wheatstone bridge- type meter	2			120.1	2510 B	
Dissolved Oxygen	Electrometric method	1, 2			360.1	4500-O G	
	Azide modification (Winkler) method	1, 2			360.2	4500-O C	
	Azide modification of Winkler method buret titration	1, 2		8229			
	High range dissolved oxygen method	1, 2		8166			
	Field meter with galvanic, polarographic or luminescent probe	1, 2	5.2				See endnote <sup>1</sup>
	Handheld meter	1, 2					See endnote <sup>1</sup>
Nitrate or Nitrate-nitrite minus nitrite	Manual Cadmium reduction method with portable colorimeter or color wheel	1, 2	5.7				
	Electrode Method	2				4500-NO <sub>3</sub> C	
	Colorimetric (Brucine sulfate)	2			352.1		
	Colorimetric, manual Cadmium reduction with laboratory or portable colorimeter	2			353.3	4500-NO <sub>3</sub> E	
Phosphorus total or dissolved (0.45 micron filtered sampled)	Colorimetric, manual ascorbic acid single reagent	1, 2	5.6		365.2	4500-P E	
	Colorimetric, manual ascorbic acid two reagent	2	5.6		365.3		

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			Chapter	Method	Method	Method	--
	Colorimetric, automated ascorbic acid	2	5.6		365.1	4500-P F	
pH	Field meter with probe	1, 2	5.4				See endnote <sup>1</sup>
	Digital pocket meters	1, 2	5.4				See endnote <sup>1</sup>
	Color comparison systems	1, 2	5.4				See endnote <sup>1</sup>
Temperature	Liquid-in-glass thermometer	1, 2				2550 B	
	Thermistor thermometer	1, 2				2550 B	
	Field meter with probe	1, 2	5.3				See endnote <sup>1</sup>
	Digital thermometer	1, 2					See endnote <sup>1</sup>
	Handheld meter	1, 2					See endnote <sup>1</sup>
Turbidity	Portable/pocket turbidity meter	1, 2	5.5				See endnote <sup>1</sup>
	Nephelometric	2			180.1	2130 B	
Total suspended residue or total suspended solids (TSS)	Transparency tube	1, 2	5.5				See endnote <sup>2</sup>
	Gravimetric method	2	5.8		160.2	2540 D	

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			Chapter	Method	Method	Method	--
<b>Other parameters and methods</b>							
Bacteria	E. coli membrane filtration plating on mTEC agar	2	5.11			9213 D	
	Fecal coliform membrane filtration plating on mFC agar	2	5.11			9222 D	
Benthic insects (statewide for level 1, outside of mine affected streams in WAP for level 2)	Stream Quality Monitoring (SQM)	1					See endnote <sup>3</sup>
	Validation study necessary	2					See endnote <sup>4</sup>
Benthic insects (limited to mine affected streams in WAP)	Macroinvertebrate Aggregated Index for Streams (MAIS)	2					See endnote <sup>5</sup>
Stream flow	Travel-time method	1	5.1				
	Vertical-axis velocity meter	2					See endnote <sup>6</sup>
	Electromagnetic flow meter	2					See endnote <sup>6</sup>
Water transparency	Secchi disk	1, 2	5.5				
	Transparency tube	1	5.5				See endnote <sup>2</sup>

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			Chapter	Method	Method	Method	--
Reference citations	<p><b>Volunteer Manual</b> - USEPA. 1997. Volunteer Stream Monitoring: A Methods Manual. EPA 841-B-97-003. United States Environmental Protection Agency, Office of Water. Washington D.C. 210 p. (This document is available through libraries and on the web at <a href="http://www.epa.gov/owow/monitoring/volunteer/">www.epa.gov/owow/monitoring/volunteer/</a>.)</p> <p><b>Hach Company</b>. 2005. Water analysis methods published by Hach Company, Loveland, CO. (These methods are available on the web at <a href="http://www.hach.com">www.hach.com</a>.)</p> <p><b>USEPA</b>. 1983. Methods for Chemical Analysis of Water and Wastes. U.S. Environmental Protection Agency. EPA 600/4-79-020. United States Environmental Protection Agency, Office of Research and Development, Environmental Monitoring and Support Laboratory. Cincinnati, Ohio. 552 p. (This document is available through libraries and on the web at <a href="http://www.epa.gov/waterscience/methods/method/">www.epa.gov/waterscience/methods/method/</a>.)</p> <p><b>“Standard Methods”</b> (These methods are available through libraries; the latest edition of the methods is also available on the web at <a href="http://www.standardmethods.org">www.standardmethods.org</a>.)</p> <p>Eaton, A.D., L.S. Clesceri, E.W. Rice, A.E. Greenberg, M.A.H. Franson, (editors). 2005. Standard Methods for the Examination of Water and Wastewater: Centennial Edition. 21st Edition. ISBN: 0875530478. American Public Health Association. Washington, D.C. 1368 p.</p> <p>Clesceri, L.S., A.E. Greenberg, and A.D.Eaton, (editors). 1998. Standard Methods for the Examination of Water and Wastewater. 20th Edition. ISBN: 0875532357. American Public Health Association. Washington, D.C. 1325 p.</p> <p>APHA. 1995. Standard Methods for the Examination of Water and Wastewater. American Public Health Association. 19th Edition. American Public Health Association. Washington, D.C.</p> <p>APHA. 1992. Standard Methods for the Examination of Water and Wastewater. American Public Health Association. 18th Edition. American Public Health Association. Washington, D.C.</p>						

Table endnotes:

1. Follow instructions provided by manufacturer of instrumentation.
2. Methods are described in: Anderson, P. and R. D. Davic. 2004. Use of transparency tubes for rapid assessment of total suspended solids and turbidity in streams. *Lake and Reservoir Management*. 20(2): 110-120. This document describes studies that found a highly predictive correlation between these assessment tools and NTU turbidity in streams. (This document is available on the web at [www.epa.ohio.gov/dsw/credibledata/index.aspx](http://www.epa.ohio.gov/dsw/credibledata/index.aspx).)
3. Methods are described in: Kopec J. and S. Lewis. 1983. Stream quality monitoring. Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Scenic Rivers Programs. Columbus, Ohio. 20 p.; and Ohio DNR. A guide to volunteer stream monitoring. Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Scenic Rivers Section. Columbus, Ohio. 40 p. (Both documents can be obtained by contacting Ohio Department of Natural Resources, Division of Natural Areas & Preserves, 2045 Morse Road, Bldg. F-1, Columbus OH 43229 (614) 265-6453.)
4. Ohio EPA is interested in cooperating with investigators to develop and test suitable methods. Contact Jeff DeShon, Ohio EPA, Division of Surface Water ([jeff.deshon@epa.state.oh.us](mailto:jeff.deshon@epa.state.oh.us)) for more information. "Western Allegheny Plateau Ecoregion (WAP)" means the relatively homogenous ecoregion in eastern and southeastern Ohio and delineated in the publication "Omernik, J.M. 1987. Ecoregions of the conterminous United States. *Ann. Assoc. Amer. Geogr.* 77(1):118-125." (This document is available through libraries and the map is available on the web at [www.epa.gov/wed/pages/ecoregions/level\\_iii.htm](http://www.epa.gov/wed/pages/ecoregions/level_iii.htm).)
5. For mine affected streams contained fully or partially within the Western Allegheny Plateau ecoregion of Ohio, macroinvertebrate sampling shall be conducted using a combination of the kick-net riffle sampling and dip-net sweeps as described in Barbour et al. (1999). In areas of, or samples with, high organism density, subsampling of the composited final sample shall be performed in accordance with Section 7.3.2 of Barbour et al. (1999). Raw collated benthic macroinvertebrate data shall be collapsed and categorized through the MAIS (Smith and Voshell 1997), yielding an index value correspondent with levels of environmental quality. Johnson, K. S. 2007. Field and Laboratory Methods for using the MAIS (Macroinvertebrate Aggregated Index for Streams) in Rapid Bioassessment of Ohio Streams. Ohio University Department of Biological Sciences. Athens, OH. 18 pp.

Barbour M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadable rivers: periphyton, benthic macroinvertebrates and fish. Second edition. EPA 841/B-99-002. U.S. Environmental Protection Agency, Office of Water. Washington D.C. (This document is available through libraries and on the web at [www.epa.gov/owow/monitoring/rbp/](http://www.epa.gov/owow/monitoring/rbp/).)

Johnson, K.J. 2007. Field and Laboratory Methods for using the MAIS (Macroinvertebrate Aggregated Index for Streams) in Rapid Bioassessment of Ohio Streams. Ohio University Department of Biological Sciences. Athens, OH. 18 pp.

Smith, E.P. and J.R. Voshell. 1997. Studies of benthic macroinvertebrates and fish in streams within EPA Region 3 for the development of biological indicators of ecological condition. Part 1, benthic macroinvertebrates. Report to U.S. EPA.. Cooperative Agreement CF821462010. U.S. Environmental Protection Agency. Washington D.C. (This document is available on the web at

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[www.epa.ohio.gov/dsw/credibledata/references.aspx](http://www.epa.ohio.gov/dsw/credibledata/references.aspx).)

6. Rantz, Saul Edward et al. 1982. Measurement and computation of streamflow -- v. 1, Measurement of stage and discharge: U.S. Geological Survey Water-Supply Paper 2175. United States Department of Interior, U.S. Geological Survey. Washington D.C. 284 p. (This document is available through libraries and on the web at <http://pubs.usgs.gov/wsp/wsp2175/>.)

