**Carey Lab Reservoir Water Chemistry Metadata**

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**ABSTRACT**

All water chemistry data was collected from reservoirs in southwest Virginia (SWVA) for research projects in Dr. Cayelan Carey’s lab at Virginia Tech in the Biological Sciences department. Data collection began in 2013 with a broad survey of 15 SWVA reservoirs; thus, while many reservoirs were sampled in 2013, each was sampled only once or twice and the chemistry variables available for this year are more limited than in subsequent years. In 2014, focus was limited to 7 reservoirs but sampling was conducted more regularly and so a bi-weekly or weekly time series of the stratified period could be constructed across several chemistry parameters for most sampled reservoirs in 2014. In 2015, focus was further refined to only 5 reservoirs, 4 of which are owned and operated by the Western Virginia Water Authority (WVWA). These reservoirs were sampled at least bi-weekly throughout the stratified period, and represent the most extensive chemistry datasets the lab has collected to date.

**LOCATION**

All chemistry data from 2013-2015 are stored under the “Data” tab at <carey.biol.vt.edu>.

**ORGANIZATION AND FILE NAMES**

Data are organized by reservoir, then by year. There are data from 15 different southwest Virginia reservoirs in 2013, from 7 reservoirs in 2014, and from 5 reservoirs in 2015. All files are in .csv format.

Each reservoir has been given a three letter code. This code is followed by the year in which the water chemistry data was collected, and finally the word “Chemistry” to distinguish it from other data files for each reservoir.

Example:

CCR2013\_Chemistry.csv

Reservoir code for Carvin’s Cove Reservoir year in which data was collected

**RESERVOIR CODES**

ANN – Lake Anna

BVR – Beaverdam Reservoir

CCR – Carvin’s Cove Reservoir

CLY – Claytor Lake

DUC – Virginia Tech Duck Pond

FCR – Falling Creek Reservoir

FRY – Fairystone Lake

GWR – Gatewood Reservoir

LEE – Leesville Lake

MEG – Meg’s Pond

MOO – Lake Moomaw

MTN – Mountain Lake

PND – Lake Pandapas

POT – Philpott Lake

SHR – Spring Hollow Reservoir

SML – Smith Mountain Lake

**FILE TABLE**

Cells marked with an “x” indicate that a chemistry file exists for that reservoir in that year.

|  |  |
| --- | --- |
| **Reservoir** | **Year** |
|  | 2013 | 2014 | 2015 |
| ANN | X |  |  |
| BVR | X | X | X |
| CCR | X | X | X |
| CLY | X | X |  |
| DUC | X |  |  |
| FCR | X | X | X |
| FRY | X |  |  |
| GWR | X | X | X |
| LEE | X |  |  |
| MEG | X |  |  |
| MOO | X |  |  |
| MTN | X |  |  |
| PND | X |  |  |
| POT | X |  |  |
| SHR | X | X | X |
| SML | X | X |  |

**FILE FORMAT**

All files are in .csv format.

|  |  |
| --- | --- |
| **Column Heading** | **Column Contents & Format** |
| Reservoir | three-letter code corresponding to reservoir or lake name (ex: BVR) |
| Year | year in which data was collected (ex: 2013) |
| Date | date and time as YYYY-MM-DD HH:MM:SS (ex: 2014-03-17 15:00:00) |
| Depth\* | depth at which water sample was collected in meters (ex: 5) |
| TN\_ugL | total nitrogen in micrograms per liter |
| TP\_ugL | total phosphorus in micrograms per liter |
| SRP\_ugL | soluble reactive phosphorus in micrograms per liter |
| NH4\_ugL | ammonia in micrograms per liter |
| NO3NO2\_ugL | nitrate and nitrite in micrograms per liter |
| DOC\_mgL | dissolved organic carbon in milligrams per liter |
| DIC\_mgL | dissolved inorganic carbon in milligrams per liter |
| TOC\_mgL | total organic carbon in milligrams per liter |
| TIC\_mgL | total inorganic carbon in milligrams per liter |
| DRSI\_mgL | dissolved reactive silica in milligrams per liter |
| CO2\_ppm | carbon dioxide in parts per million |
| CH4\_ppm | methane in parts per million |
| infTPloads\_g | total phosphorus loads at the primary surface water inflow of FCR in grams |
| Notes | irregularities in sample collection, storage, or analysis or any discrepancies would be written in this column |

\* the depth 999 is a code for the primary surface water inflow stream at FCR, not a depth reading of 999 meters

**DEPTHS**

The table below describes which depths are sampled for the five most frequently sampled reservoirs.

|  |  |
| --- | --- |
| **Reservoir** | **Depth** |
| BVR | 0, 3, 6, 9, 12 |
| CCR | 0, 6, 20  |
| FCR | 0, 0.8\*, 1.6, 2.8\*, 3.8, 5, 6.2, 8, 9 |
| GWR | 0, 5, 9, 13 |
| SHR | 0, 8, 31 |

\* these depths were discontinued midway through the 2015 sampling season because it was determined that they were not adding significant information to the depth profile

**SAMPLE COLLECTION AND EQUIPMENT**

TN, TP, TOC, TIC

Unfiltered water samples were collected at specified depths for each reservoir using a Van Dorn water sampler. Samples were stored in acid-washed 125 mL polypropylene bottles and frozen within 12 hours. Samples were generally analyzed within one year of collection date.

SRP, NO3, NH4, DOC, DIC, DRSI

Water samples were collected at specified depths for each reservoir using a Van Dorn water sampler and were filtered with a 0.7 µm glass fiber filter before being stored in acid-washed 125 mL polypropylene bottles. Samples were frozen within 12 hours. Samples were generally analyzed within six months of collection date.

CO2 and CH4

Unfiltered water samples were collected at specified depths for each reservoir using a Van Dorn water sampler. Samples were stored in serum vials and were generally analyzed within 24 hours of collection.

**CHEMICAL ANALYSES AND EQUIPMENT**

TNTP

Samples were digested with alkaline persulfate (Patton and Kryskalla 2003) and then analyzed colorimetrically using flow injection analysis (APHA 2005). TN was analyzed using the cadmium reduction method (APHA 1998) and TP was analyzed using the ascorbic acid method (Murphy and Riley 1962) on a Lachat Instruments XYZ Autosampler ASX 520 Series and QuikChem Series 8500. (OTHER DETAILS ABOUT MACHINE?) For further details regarding this analysis, please refer to Virginia Tech’s Stream Team Analytical Lab Standard Operating Procedures (Stream Team SOPs). (ACCESS INFORMATION?)

SRP, NO3, NH4

Samples were analyzed colorimetrically using flow injection analysis (APHA 2005). SRP was analyzed using the ascorbic acid method (Murphy and Riley 1962), NO3 was analyzed using the cadmium reduction method (APHA 1998), and NH4 was analyzed using the Berthelot Reaction method (Solorzano 1969, APHA 2005) with a common modification as to the source of the hypochlorite ion as described in Zhang et al. 1997 on a Lachat Instruments XYZ Autosampler ASX 520 Series and QuikChem Series 8500. For further details regarding this analysis, please refer to Virginia Tech’s Stream Team Analytical Lab Standard Operating Procedures.

TOC and TIC

TOC was analyzed using the persulfate catalytic method (Brenton and Arnett 1993) and TIC was analyzed using the heated phosphoric acid method (Révész and Doctor 2014) on a Total Organic Carbon Analyzer (TOCA) 1010 from OI Analytical. For further details regarding this analysis, please refer to Virginia Tech’s Stream Team Analytical Lab Standard Operating Procedures.

DOC and DIC

DOC was analyzed using the persulfate catalytic method (Brenton and Arnett 1993) and DIC was analyzed using the heated phosphoric acid method (Révész and Doctor 2014) on a TOCA 1010 from OI Analytical. For further details regarding this analysis, please refer to Virginia Tech’s Stream Team Analytical Lab Standard Operating Procedures.

DRSI

DRSI was analyzed using the ammonium molybdate method, was reduced with sodium sulfite, and then was analyzed colorimetrically using a spectrophotometer reading at 700 nm (Wetzel and Likens 2000). For further details regarding this analysis, please refer to Virginia Tech’s Stream Team Analytical Lab Standard Operating Procedures.

CO2 and CH4

CO2 and CH4 were analyzed using a static headspace gas chromatography analysis (Hibbs et al 1998) using a Hayesep Q column. As of the date of issue of this metadata document, the Stream Team’s SOP for this analysis was still under revision, but see Bastviken 2015, Kampbell et al 1998, and USEPA 2004 as method development references. For further details regarding this analysis, please refer to the DRAFT of Virginia Tech’s Stream Team Analytical Lab Standard Operating Procedures.

**STREAM TEAM STANDARD OPERATING PROCEDURES**

CH4 and CO2 sampling and analysis: DRAFT. Accessed: 23Mar16.

Determination of soluble reactive silica in water. Issue date: 29Jul14 DRAFT.

Determination of soluble reactive phosphate in water by flow injection analysis. Issue date: 05Dec14.

Determination of nitrate and nitrite in water by flow injection analysis. Issue date: 05Dec14.

Determination of ammonia in water by flow injection analysis. Issue date: 05Dec14.

General procedures for the Lachat QuickChem 8500 flow injection analyzer. Issue date: 04Apr06.

Determination of total nitrogen and total phosphorus after manual persulfate digestion by flow injection analysis. Issue date: 20Jul15.

Determination of anions in water by ion chromatography. Issue date: 07May10.

Determination of relative sulfur hexafluoride (SF6) concentrations for calculations of reaeration by static headspace gas chromatography with electron capture detection (ECD). Issue date: 13Nov12.

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Bastviken, David. 2015. Calculation of gas concentrations in water determined by the headspace extraction method. <http://www.tema.liu.se/tema-m/iwflux/web-portal/metodhs/gas-concentrationmeasurements/copyofcopyofcopyofarkiv/copyofarchive/1.620282/Calculationsofgasconcentrationsinwaterbasedontheheadspaceextractionmethod.pdf> Retrieved 20APR2015.

Brenton R, Arnett T. 1993. Method of analysis by the U.S. Geological Survey National Water Quality Laboratory – Determination of dissolved organic carbon by UV-promoted persulfate oxidation and infrared spectrometry. Denver, CO: U.S. Geological Survey.

Hibbs D, Parkhill K, Gulliver J. 1998. Sulfur hexafluoride gas tracer studies in streams. J Environ Eng 124:8.752.

Kampbell, Don H.; Vandegrift, Steve A., 1998. Analysis of Dissolved Methane, Ethane, and Ethylene in Ground Water by Standard Gas Chromatographic Technique. Journal of Chromatographic Science 36:253-256.

Murphy J, Riley JP. 1962. A modified single solution method for the determination of phosphate in natural waters. Anal Chim Acta 27:31.6.

Patton CJ, Kryskalla JR. 2003. Methods of Analysis by the U.S. Geological Survey National Water Quality Laboratory—Evaluation of Alkaline Persulfate Digestion as an Alternative to Kjeldahl Digestion for Determination of Total and Dissolved Nitrogen and Phosphorus in Water. Denver, CO: U.S. Geological Survey.

Révész KM, Doctor DH. 2014. Automated determination of the stable carbon isotopic composition (δ13C) of total dissolved inorganic carbon (DIC) and total nonpurgeable dissolved organic carbon (DOC) in aqueous samples: RSIL lab codes 1851 and 1852: U.S. Geological Survey Techniques and Methods, book 10, chap. C20, 38 p., http:// dx.doi.org/10.3133/tm10C20.

Solorzano, L. 1969. Determination of ammonia in natural water by the phenolhypochlorite method. Limnol Oceanogr 14:799-801.

USEPA. 2004. RSKSOP-175 STANDARD OPERATING PROCEDURE Sample Preparation and Calculations for Dissolved Gas Analysis in Water Samples Using a GC Headspace Equilibration Technique, Revision No.2 <http://www.epa.gov/region1/info/testmethods/pdfs/RSKsop175v2.pdf> Retrieved 20APR2015.

The US EPA published such a procedure (Kampbell, et al. 1991) that has become known in the environmental community as “Method RSK-175.” The original publication has gone through a number of revisions with the most recent revision being RSKSOP-175 Version 5, dated October 2010. Integral to this method is US EPA RSKSOP-194, with a recent Version 4 dated April 2010. RSKSOP-194 contains the GC calibration and analysis steps, while RSKSOP-175 describes the static headspace preparation and calculations.

Wetzel RG, Likens GE. 2000. Limnological Analyses. 3rd ed. Exercise 7. Inorganic Nutrients: Nitrogen, Phosphorus, and Other Nutrients. New York: Springer.

Zhang, J.Z., Orter, P., Fisher, Ch. J. and Moore, L.D. 1997. Determination of ammonia in estuarine and coastal waters by gas segmented flow colorimetric analysis. Methods for determination of chemical substances in marine and estuarine environmental matrices. 2nd ed. EPA/7664-41-7.