

Martin W. Doyle, Ph.D.

Professor of River Science and Policy, Nicholas School of Environment
Director of Water Policy, Nicholas Institute for Environmental Policy Solutions
Duke University
(919) 360-6458 (cell), martin.doyle@duke.edu, www.martindoyle.net

Martin Doyle is a Professor at Duke University, and (since 2013), a co-organizer for water programming at the Aspen Institute. Dr. Doyle's research and expertise are at the interface of science, finance, and policy of U.S. water governance. His training is in the hydraulics and sediment transport of rivers, but he also works on infrastructure finance, environmental restoration, impact investing, and the impacts of climate change on the nation's infrastructure. He holds degrees from Purdue (PhD), Mississippi (MS/Engineering), and Harding University (BS).

His basic science research has resulted in several awards: he is a Guggenheim Fellow, a National Academy of Sciences Kavli Fellow, and recipient of the National Science Foundation's Early Career Award. He has twice won the Boggess Award for the most influential paper published in the *Journal of the American Water Resources Association*. For his work bridging environmental science and policy, he was named a Leopold Leadership Fellow, a GlaxoSmithKline Faculty Fellow for Public Policy, a Walton Family Foundation Fellow, and selected by the US National Academy of Sciences to deliver the 2021 Gilbert White Memorial Lecture.

As an educator and mentor, Dr. Doyle has taught hundreds of students in the classroom. As a mentor, he has advised 14 PhD students, 4 post-docs, 7 master of science students, and dozens of professional masters students (Environmental Management, Public Policy, or Business Administration). In 2018, he received the Excellence in Graduate Student Mentoring Award from Duke University.

Dr. Doyle has also worked within the federal government on US water and infrastructure policy, including his appointment to the US Army Science Board. In 2016 he helped initiate the Department of Interior's Natural Resource Investment Center where he helped push forward the Obama Administration's strategies for innovative infrastructure finance, and the department's strategies for managing water in the west. Prior to that, in 2009 he was the Frederick J Clarke Scholar at the US Army Corps of Engineers and worked at their Institute for Water Resources on regulatory policy. He has also advised several state-level agencies in NC, OR, and CA.

In 2017, Doyle and Lauren Patterson co-founded the Internet of Water, a major initiative to modernize America's water data infrastructure. To implement this vision, Doyle and Patterson raised > \$10M from philanthropic foundations and government agencies, created a business and implementation plan, hired the initial startup team, and launched the organization. The Internet of Water approach developed by Doyle and Patterson has been formally adopted by several states through legislation or practice (NM, TX, CA, OR), and was explicitly authorized by the US Congress in the 2021 Infrastructure Investment and Jobs Act (Section 50213).

Beyond his work with government and academia, Dr. Doyle has been engaged in private activities including advising multi-national corporations on water sustainability and water risk, working with private investment firms in their development of novel water-related investment funds, and in development and financing of infrastructure projects. In 2022, he co-founded a water data analytics firm which develops and leverages proprietary software and data (co-licensed by Duke University) for evaluating financial risks, strategies, and opportunities in water-related fixed income.

Doyle has published ~150 peer-reviewed journal articles, law reviews, and book chapters, as well as *The Source* (WW Norton) – an environmental and political history of America's Rivers – chosen by Amazon as "one of the best history books of 2018." His second book – *Streams of Revenue* – was published by MIT Press in 2021, and explores how the use of markets have affected the practice of environmental conservation. He is currently completing *Water, Wall Street, and the Future of America's Cities*.

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RESEARCH AND TEACHING INTERESTS

River System Science: river hydrology, hydraulics, ecology, biogeochemistry

Environmental Finance and Policy: water policy, infrastructure finance, ESG

River History: political economy of river use, politics and technology in US from colonial era – present

EDUCATION

Ph.D. 2002, Purdue University, Earth Science.

M.S. 1997, University of Mississippi, Environmental Engineering.

B.S. 1995, Harding University, Physics, Mathematics.

PRIMARY PROFESSIONAL POSITIONS AND AFFILIATIONS

Duke University – Durham, NC

Professor of River Science and Policy, Nicholas School of Environment (2011-present)

Senior Associate Dean (Jan 2019-June 2020)

Program Chair, Water Resources Mgmt MEM (2011-2015; 2020-2023)

Director for Water Policy, Nicholas Institute for Environmental Policy Solutions (2013-present)

Internet of Water, Co-founder (2017), Director (2017-2018), Chair of Board (2018-2021)

University of North Carolina – Chapel Hill, NC

Associate Professor, Department of Geography (2006-2011)

Joint appointment in Department of Environmental Science & Engineering

Assistant Professor, Department of Geography (2002 – 2006)

Purdue University, West Lafayette, IN

USDA Research Fellow, Environmental Sciences and Engineering Institute (1999-2001)

Graduate Research Assistant, Department of Earth and Atmospheric Sciences (2001-2002)

Inter-Fluve, Inc., Bozeman, MT and Hood River, OR

Hydraulic Engineer (EI) (1997-1999)

National Sedimentation Laboratory, Oxford, MS

Research Assistant Hydraulic Engineer (1995-1997)

Mt. Rainier National Park, Longmire, WA

Hydrologist (1994)

LEAVE, SABBATICAL, AND DETAIL POSITIONS AND AFFILIATIONS

U.S. Department of Interior, Washington, DC

Natural Resource Investment Center, Senior Conservation Finance Fellow (Jan 2016 – Jan 2017)

U.S. Army Corps of Engineers – Institute for Water Resources, Ft Belvoir, VA

Frederick J Clarke Visiting Scholar (2009 – 2010)

Bren School of Environmental Science and Management

Visiting Professor (summer, 2018, 2020)

Cary Institute of Ecosystem Studies, Millbrook, NY

Visiting Scientist (Fall 2004)

PROFESSIONAL DISTINCTIONS

National and International Recognition

Guggenheim Fellow, 2009-2010

Gilbert White Memorial Lecturer, National Academy of Sciences, 2021

Kavli Fellow, National Academy of Sciences, 2009
Walton Fellow, Walton Family Foundation, 2021
Elected Fellow, American Associations of Geographers, 2023

Distinguished Alumni Award, Purdue University College of Science, 2023
US Army Science Board, 2020-2021
Meridian Book Award, Association of American Geographers, 2019
G.K. Gilbert Award for Research in Geomorphology, Association of American Geographers, 2018
Outstanding Alumni, Purdue University – Department of Earth, Atmospheric & Planetary Science, 2016
William R. Boggess Award, American Water Resources Association, 2013
William R. Boggess Award, American Water Resources Association, 2010
Julian Simon Fellow, Property and Environment Research Center, 2009-2010
Aldo Leopold Leadership Fellow, Stanford Univ – Woods Institute of Environment, 2008
Frederick J Clarke Fellow, US Army Corps of Engineers-Institute for Water Resources, 2009-2010
GlaxoSmithKline Faculty Fellow for Public Policy, Institute for Emerging Issues, 2008
Editor's Award for Excellence in Reviewing, Amer. Geophysical Union (*Water Resources Res*), 2006
Early Career Award, National Science Foundation, 2005

Distinguished Lectures or Seminars

Georgia Water Resources Association, Annual Meeting Keynote, 2023
Ed and Elizabeth Hammond Distinguished Lecture, University of Tennessee, 2018
UDI Distinguished Seminar, Oak Ridge National Laboratory, 2018
Distinguished Speaker Series (Center for Water in West), University of Colorado-Boulder, 2018
Donald Harleman Memorial Lecture in Water Resources Engineering, Penn State University, 2016
Presidential Plenary Speaker, Association of American Geographers, 2015
Borland Distinguished Lecture in Hydraulics, Colorado State University, 2014
Rieth Distinguished Lecture, Purdue University Department of Civil Engineering, 2010
John Treacy Memorial Lecture, University of Wisconsin, 2006

University Recognition

Excellence in Graduate Student Mentoring, Dean of the Graduate School, Duke University, 2018

Recognition of Dissertation and Graduate Research

Horton Grant, American Geophysical Union, 2000
Fahnestock Award, Geological Society of America, 2001
Chorafas Prize, Chorafas Foundation-Switzerland, 2002
Nystrom Award, Association of American Geographers, 2004
Wolman Award, Association of American Geographers, 2002
National Academy of Sciences – Sigma Xi, Dissertation Research Award, 2000
USDA GAANN Dissertation Fellowship, 1999-2001

SCIENCE AND POLICY COMMITTEES AND PANELS

International Joint Commission (US-Canada)/Great Lakes Adaptive Management Committee
US Representative, Independent Review Group (2021-present)
US Army Science Board (2020-2021)
Oregon's Water in 2100 – Convener and Leader (Oregon Business Council; Oregon Governor Office)
September – December 2019
Aldo Leopold Leadership Program – Advisory Committee
June 2015 – June 2017
US Army Corps of Engineers, Missouri River Recovery Program – Independent Science Advisory Panel
(Lead author for first report from panel)
Dec 2010 – 2015
NC Ecosystem Enhancement Program – Science Advisory Committee
2010-2012

National Ecological Observatory Network
Hydroecology sub-committee
Heinz Center for Policy, Economics and the Environment
Dam Removal Science and Policy Panel
Coalition of Universities for the Advancement of Hydrologic Sciences (CUAHSI)
Floodplain Processes Working Group
National Center for Earth-Surface Dynamics
Morphodynamics following Dam Removal
American Society of Civil Engineers Task Committees
Unstable Channel Processes Task Committee (Secretary)
Dam Decommissioning Task Committee
River Restoration Task Committee

KEY/REPRESENTATIVE PUBLICATIONS

[Complete list of publications provided at end of document]

Books

Doyle (2018). *The Source: How Rivers Made America, and America Remade Its Rivers*. WW Norton.
Best of 2018 (Top 10 Books in History), Amazon.
Meridian Book Award (American Association of Geographers)
Tucson Book Festival
[Reviewed in *Wall Street Journal*, *NY Times Book Review*, *Nature*, *Outside Magazine*, *The New Republic*, among others]

Lave and Doyle (2021). *Streams of Revenue: The Restoration Economy and the Ecosystems it Creates*. MIT Press.
Reviewed in *Nature*.
Featured in *The New Yorker*
Nominated for Globe Award.

Doyle (In prep). *Tapped Out: Water Finance and Equity in America's Cities*.

Aspen Institute-Nicholas Institute Water Forum

[Doyle was primary co-organizer, co-convenor, and author/co-author of the annual forum and report series]

Water Affordability and Equity, 2020/2021 Aspen-Nicholas Water Forum, in press.

Ensuring Water Quality: The Future of the Clean Water Act and the Safe Drinking Water in the 21st Century, 2019 Aspen-Nicholas Water Forum.

Regional Integration: Cooperation and Integration for Water Management, 2018 Aspen-Nicholas Water Forum.

The Future of Groundwater, 2017 Aspen-Nicholas Water Forum. 68 pgs.

Internet of Water: Sharing and Integrating Water Data for Sustainability, 2017 Aspen Institute Dialogue Series on Water Data, 33 pgs.

Conservation Finance & Impact Investing for US Water, 2016 Aspen-Nicholas Water Forum. 68 pgs.

Data Intelligence for 21st Century Water Management, 2015 Aspen-Nicholas Water Forum, 67 pgs.

Innovating for a Sustainable and Resilient Water Future, 2014 Aspen-Nicholas Water Forum, 35 pgs.

Key Representative Journal Publications (full list at end of document)

Doyle et al. (2020). Growing options for shrinking cities. *Journal of the American Water Works Association* 112(12): 56-66.

Doyle and Patterson (2019). Federal decentralization and adaptive management of water resources: reservoir reallocation by the US Army Corps of Engineers. *Journal of the American Water Resources Association* 55(5): 1248-1267.

- Doyle (2018). Addressing the declining appropriations for Bureau of Reclamation infrastructure: policies needed for enabling private finance. *Journal of the American Water Resources Association* 54: 993-1000.
- Doyle et al. (2015). Morphology of streams restored for market and non-market purposes: Insights from a mixed natural-social science approach. *Water Resources Research* 51(7); 5603-5622.
- Doyle and VonWindheim (2015). Environmental management strategy: Four forces analysis. *Environmental Management* 55: 6-18.
- Doyle et al. (2014). The optimal scale of markets for water quality trading. *Water Resources Research* 50(9): 7231-7244.
- Doyle (2012). America's rivers and the American experiment. *Journal of the American Water Resources Association* 48(4): 820-837.
- Doyle and Ensign (2009). Alternative reference frames in river systems science. *BioScience* 59: 499-510.
- Doyle et al. (2008). Aging infrastructure and ecosystem restoration. *Science* 319(5861): 286-287.
- Doyle et al. (2005). Effective discharge analysis of ecological processes in streams. *Water Resources Research*, 41, W1141, doi: 10.1029/2005WR004222.
- Doyle et al. (2003). Channel adjustments following two dam removals in Wisconsin. *Water Resources Research*. 39(1), 1011, doi: 10.1029/2002WR001714.

FOUNDATION/PHILANTHROPY-SUPPORTED INITIATIVES

Internet of Water (total to date: > \$10M secured)

BHP Foundation.
 George and Cynthia Mitchell Foundation.
 Gordon and Betty Moore Foundation.
 Pisces Foundation.
 S.D. Bechtel Jr Foundation.
 Kingfisher Foundation.
 Walton Family Foundation – Innovation Fund.
 Windward Fund.

Natural Resources Finance/Infrastructure Finance (total to date: \$250,000)

TomKat Charitable Trust.
 Walton Family Foundation.

RESEARCH GRANTS

> \$6M Funded

Oregon Department of Environmental Quality.
 World Wildlife Fund
 USDOE/ORNL
 US Army Corps of Engineers.
 Spring Point Partners.
 US Bureau of Reclamation.
 USDA-Office of Environmental Markets.
 Freeport MacMoRan.
 National Science Foundation.
 U.S. Forest Service
 National Science Foundation. CAREER.
 Water Resources Research Institute.
 National Geographic Society – Committee on Research and Exploration.
 Smithsonian Institution-Research Fellowship Program.
 Showalter Fund.
 Bradley Fund for the Environment.
 NASA Space Grant Consortium.

KEYNOTE OR PLENARY PRESENTATIONS

Keynote or Plenary Presentations

2021 US National Academy of Science, Gilbert White Distinguished Lecture.
2015 Association of American Geographers Presidential Plenary Speaker, Chicago, IL
2013 International Society of River Science Biennial Symposium, Keynote, Beijing, China
2013 River Restoration Northwest, Hood River, OR
2012 Board Meeting of American Rivers, Fall Meeting
2011 International Society for River Science (ISRS) Biennial Symposium, Opening Keynote, Berlin, Germany
2011 Elwha River Science Symposium, Commemorating the initiation of removal of Elwha dams, Keynote on Science and Policy of Dam removal, Port Angeles, WA

Invited Academic Seminars

2021 University of British Columbia, Department of Geography
2020 Utah State University, Department of Watershed Sciences
2020 University of Washington, Department of Civil Engineering
2018 Distinguished Seminar, Oak Ridge National Laboratory
2018 Hammond Distinguished Lecture, Univ of Tennessee (Dept of Geography)
2018 Boise State University, Department of Geoscience
2017 Distinguished Speaker Series, Western Water Series, CU-Boulder
2017 Distinguished Speaker, Ecole Normale Supérieure (Paris)
2016 Penn State University, Civil Engineering, Harleman Memorial Lecture in Water Resources
2014 Colorado State University, Hydrology Days, Borland Hydraulics Lecture
2012 Oregon State University, Water and Society Seminar Series
2012 University of Oregon, Department of Geography
2012 University of South Carolina, Department of Geography and Department of Geology
2010 Purdue University, Public Lecture Series on the Environment and Department of Earth Science and School of Engineering
2009 University of Pennsylvania, School of Law-Program on Law, Economy and the Environment
2009 Georgetown University, Walsh School of Foreign Affairs-Program on Science, Technology and International Affairs (invited 2009)
2009 University of North Carolina – Greensboro, Department of Geography
2008 Oak Ridge National Laboratory, Division of Computational Science and Mathematics
2008 Penn State University, University-wide and general public lecture series for “EarthTalks”
2008 Johns Hopkins University, Department of Geography and Environmental Engineering
2007 University of Maryland – Baltimore County, IGERT Water in Urban Program
2007 Chesapeake Biological Laboratory – University of Maryland
2007 Appalachian Laboratory – University of Maryland
2007 Duke University, Nicholas School of Environment and Earth Science
2006 University of Virginia, Department of Civil and Environmental Engineering
2006 University of Wisconsin, Department of Geography
2005 Virginia Tech University, Department of Civil and Environmental Engineering
2005 Cornell University, Department of Biological and Environmental Engineering
2004 Dartmouth College, Department of Geography and Department of Earth Science
2004 Institute of Ecosystem Studies
2004 University of Connecticut, Department of Geography
2004 University at Buffalo, SUNY, Department of Geography
2004 USGS Columbia Environmental Research Center / University of Missouri
2004 Duke University, Program in Ecology
2004 Furman University, Department of Environmental and Earth Science
2003 Smithsonian Environmental Research Center
2003 Colgate University, Department of Environmental Science

2002 University of North Carolina, Department of Geography
2002 University of Tennessee, Department of Civil and Environmental Engineering
1998 University of Nottingham (UK), Department of Geography

TEACHING AND ADVISING

Current Graduate Students and Post-doctoral Fellows Advised

Erik Patton (PhD, Environment, 2022 – present); water, climate change, and national security
Major, US Army
US Army Goodpaster Scholar
Jonny Behrens (PhD, Ecology, 2019-present; Emily Bernhardt primary advisor); ecotoxicology

PhD Students, MS Students, and Post-docs Advised:

Erika Smull (PhD, Environment, 2022); municipal bond market dynamics; Breckinridge Capital
Nicholas Bruns (PhD, Duke, Ecology, 2017-2022); remote sensing in large rivers
University Scholar
Olivia August (MS, Civil Engineering, 2022); infrastructure and financial risk assessment
Katy Hansen (PhD, Duke, 2021; M. Mullin primary advisor); Envir. Policy Innovation Center
Rhodes Scholar
Doris Duke Fellow
John Gardner (PhD, Duke, Environment, 2014-2018); Assistant Professor, Univ of Pittsburgh
NSF-EAR Post-Doctoral Fellowship
NSF IGERT Sensor Networks Fellowship
Matt Fuller (PhD, Duke, Environment, 2012-2017); Scientist, EPA
Koehane Fellow
HydroResearch Foundation Fellow
Matt Ross (PhD, Duke, Ecology, 2016-; co-advised with E. Bernhardt); Assist Prof, Colorado State U
NSF Graduate Fellowship
Chuck Podolak (post-doc, 2012-2014); Dir. for Environ. Policy, Office of Gov. Doug Ducey (AZ).
AAAS Congressional Science Fellow (Senator Jeff Flake, R-AZ)
Autumn Thoyre (PhD, UNC, Geography, 2014), Assoc. Prof, San Francisco State Univ.
Jeff Muehlbauer (PhD, UNC, Ecology, 2013), Assis. Prof, Univ. of Alaska
Brian Lutz (post-doc, 2011-2013), Chief Scientist, Climate Corp/Bayer Crop Science.
Kimberly Meitzen (post-doc joint with TNC, 2013), Assist. Prof, Texas State Univ. (Geography).
Lauren Patterson (MS and PhD, Geography, 2012), Sr. Policy Associate, Nicholas Institute
Udall Fellowship
William R Boggess Award for best paper published in JAWRA, 2010
NSF Graduate Research Fellowship
AAG Kasperson Award for Hazards Research 2007
UNC Impact Award 2007
Goldwater Scholar
Tim Baird (PhD, Geography, 2012), Associate Professor, Virginia Tech (Geography)
Fulbright-Hays Fellowship
Chris Sandt (MS, Env Sci & Engin, 2011), Environmental Engineer, DC Water
ASCE Dames and Moore Fellowship
Scott Ensign (PhD, Ecology, 2011), Assistant Director, Stroud Water Research Center.
USGS Mendenhall Post-doctoral fellowship
EPA STAR Graduate Fellowship
Ecological Society of America – Best Biogeosciences Paper Award 2007
JR Rigby (post-doc, 2010-2011); Research Hydrologist, Natl Sedimentation Laboratory
Marshall Scholar
NSF Graduate Fellowship

Erich Hester (PhD, Ecology, 2008); Assoc Prof, Virginia Tech Univ (Civil Engineering)
EPA STAR Graduate Fellowship
Jason Julian (PhD, Geography, 2007); Associate Chair, Prof, Texas State Univ (Geography)
Nystrom Award Finalist
Adam Riggsbee (PhD, Env Sci and Engin. 2006, UNC): Principal/Owner: Riverbank Ecosystems
Cailin Orr (Post-doc, 2005-2006, UNC): Carleton College
Joel Sholtes (MS, Geography, 2009), Hydraulic engineer, Bureau of Reclamation
Melanie Small (MA, Geography, 2007, UNC); Lecturer Connecticut College
Rebecca Manners (MA, Geography, 2006, UNC): Owner, Bed & Breakfast, Vermont
PhD Utah State University
Reds Wolman Award 2005;
Stirling Hydroecology Award 2006

UNIVERSITY, PROFESSIONAL, AND COMMUNITY SERVICE

International Service

Lifewater International. Volunteer hydrologist for water resources development projects in developing nations

Editorial Boards

Ecology
Water Resources Research
Annals of the Association of American Geographers

Proposal Reviews

NSF-Hydrologic Sciences
NSF-Geomorphology and Land Use Change
NSF-Geography and Regional Science
NSF Ecology
NSF-Ecosystems
National Oceanic and Atmospheric Administration
CALFED Delta-Bay Program
National Geographic – Council on Research and Exploration

Manuscript Reviews (ad hoc – not included editing duties, > 500 total):

American Philosophical Society, Annals of the Association of American Geographers, Biogeochemistry, BioScience, Canadian Journal of Fisheries and Aquatic Sciences, Earth-Science Reviews, Earth Surface Processes and Landforms, Ecological Applications, Ecological Economics, Ecological Monographs, Ecology, Ecology and Society, Ecology Letters, Environmental Management, Geological Society of America Bulletin, Geomorphology, Geophysical Research Letters, Gravel-bed Rivers, Hydrological Processes, Journal of the American Water Resources Association, Journal of Geophysical Research – Biogeoscience, Journal of Geophysical Research – Earth Surface, Journal of Hydraulic Engineering, Journal of Hydrologic Engineering, Limnology and Oceanography, Nature, Physical Geography, Proceedings of the National Academy of Sciences, Professional Geographer, Remote Sensing of Environment, Science, Water Resources Research, Water Research

PUBLICATIONS

[RSS]: River system science (geomorphology, ecology, biogeochemistry, hydrology)
[EEP]: Environmental economics and policy (ecosystem service markets, infrastructure, floodplain management, legal jurisdictions)
[FINC]: Infrastructure finance; Environmental/conservation finance and impact investing
[HIST]: History or archaeology (political economy of rivers; geo-archaeology)

Major Works

Doyle, M.W. (2018). *The Source: How Rivers Made America and America Remade its Rivers*. W.W. Norton & Co., New York.

R. Lave and M.W. Doyle. (2021). *Streams of Revenue: The Restoration Economy and the Ecosystems it Creates*. MIT Press.

Doyle, M.W., L. Patterson and E. Smull (In revision). *Water, Wall Street, and the Future of America's Cities*.

Peer-reviewed Journal Publications (including in press):

127. Bruns, N.E., J. Gardner, and M.W. Doyle (2022, in review). Flow dependent patches of river color. *Limnology & Oceanography*. [RSS]

126. August, O., M.W. Doyle, L. Patterson and E. Smull (2023). Financial capability and performance: assessing trends among North Carolina utilities. *Journal of the American Water Works Association* 115: 1-16 [FINC]

125. Patterson, L., S. Bryson and M.W. Doyle (2022, in review). The affordability of water services for households in United States cities. *PLoS Water*. [FINC]

124. Smull, E., E. Kodra, A. Stern, A. Teras, M. Bonanno, and M.W. Doyle (2022, in review). Climate, race, and the cost of capital in the municipal bond market. *PLoS ONE*. [FINC]

123. Smull, E., L. Eastman, L. Patterson and M.W. Doyle (2021). Water consumption and utility revenues at the start of a pandemic: insights from 11 utilities. *Journal of the American Water Works Association* doi: 10.1002/awwa.1804. [FINC]

122. Bruns, N., J. Heffernan, M. Ross, and M.W. Doyle (2022). A simple metric for predicting the timing of river phytoplankton blooms. *Ecosphere*, doi: 10.1002/ecs2.4348. [RSS]

121. Smull, E. and M.W. Doyle (2021, in review). Accounting for residential nonpayment risk in water utility financial planning. *Water Economics and Policy*. [FINC]

120. Smull, E., L. Patterson and M.W. Doyle (2022). Rising market risk exposure of municipal water service providers in distressed cities. *ASCE Journal of Water Resources Planning & Management* 148(2): 05021032: 1-11 [FINC].

119. Patterson, L. and M.W. Doyle (2021). Measuring water affordability and the financial capability of utilities. *Water Science* doi: 10.1002/aws2.1260. [EEP/FINC].
[winner of Best Paper award from American Water Works Association]

118. Doyle et al. (2020). Growing options for shrinking cities. *Journal of the American Water Works Association* 112(12): 56-66. [EEP/FINC].

117. Robertson, M.M., R. Lave, and M.W. Doyle (2020, accepted). Watershed moments: scalar fixes in neoliberal environmental governance. *Environment and Planning E: Nature and Space*. [EEP]

116. Manning, A.P., J.P. Julian and M.W. Doyle (2020). Riparian vegetation as an indicator of stream channel presence and connectivity in arid environments. *Journal of Arid Environments* 178: 104167 [RSS].

115. Gardner, J.R., T. Pavelsky, and M.W. Doyle (2019). The abundance, size, and spacing of lakes within river networks. *Geophysical Research Letters* 46: 2592-2601. [RSS].

114. M.W. Doyle and L. Patterson (2019). Federal decentralization and adaptive management: Reservoir reallocation by the US Army Corps of Engineers. *Journal of the American Water Resources Association* 55(5): 1248-1267. [EEP]

113. L. Patterson, M. Tchamkina, and M.W. Doyle (2019). Managing rivers under changing natural and societal boundary conditions, part 2: Expected compared with experienced conditions at U.S. Army Corps of Engineers reservoirs. *River Research & Applications* 35: 341-352. [RSS].

112. L. Patterson and M.W. Doyle (2019). Managing rivers under changing natural and societal boundary conditions, part 1: National trends and U.S. Army Corps of Engineers reservoirs. *River Research & Applications* 35: 327-340. [RSS].

111. M. Fuller and M.W. Doyle (2018). Gene flow simulations demonstrate resistance of long-lived species to genetic erosion of habitat fragmentation. *Conservation Genetics* 19: 1439-1448. [RSS].

110. Messer, T., M. Montano, P.L. Ferguson and M.W. Doyle (2020, in review). Impact of dissolved organic matter on Imidacloprid photodegradation rates in natural waters. *Environmental Science: Processes and Impacts*. [RSS].
109. Robertson, M.M., R. Lave and M.W. Doyle (2020, in press). Streams of value: defining rivers and streams as environmental commodities in three US states. *Environment and Planning E*. [EEP]
108. Blaszczyk, J., D.L. Urban, M.W. Doyle and E.S. Bernhardt (2019). Scoured or suffocated: urban stream ecosystems oscillate between hydrologic and dissolved oxygen extremes. *Limnology and Oceanography* 64: 877-894. [RSS].
107. Doyle, M.W. (2018). Addressing the declining appropriations for Bureau of Reclamation infrastructure: policies needed for enabling private finance. *Journal of the American Water Resources Association* 54(5): 993-1000. [FINC]
106. Gardner, J.R., S. Ensign, J. Houser, and M.W. Doyle (2020). Light exposure along particle flowpaths in large rivers. *Limnology & Oceanography* 65: 128-142. [RSS].
105. Gardner, J.R., and M.W. Doyle (2018). Sediment-water surface area along rivers: water column vs. benthic. *Ecosystems* 21: 1505-1520. [RSS].
104. Fuller, R.L., J. Dennison, G. Swarr, K. Weichert, C. Griego and M.W. Doyle (2018). Impacts of recreational flow releases on macroinvertebrate drift at different distances from Abanakee Dam, New York, USA. *Northeastern Naturalist* 25: 222-235. [RSS].
103. Patterson, L.A. and M.W. Doyle (2018). A nationwide analysis of U.S. Army Corps of Engineers reservoir performance in meeting operational targets. *Journal of the American Water Resources Association* 54: 543-564. [EEP].
102. Ensign, S.H., M.W. Doyle and J.R. Gardner (2017). New strategies for measuring rates of environmental processes in rivers, lakes, and estuaries. *Freshwater Science* 36: 453-465. [RSS].
101. Fuller, M.R., M.W. Doyle, and D.L. Strayer (2015). Causes and consequences of habitat fragmentation in river networks. *Annals of the NY Academy of Sciences (The Year in Ecology and Conservation Biology)* 1355: 31-51. [RSS].
100. Doyle, M.W., J. Singh, R. Lave and M.M. Robertson (2015). Morphology of streams restored for market and non-market purposes: Insights from a mixed natural-social science approach. *Water Resources Research* 51(7): 5603-5622. [EEP/RSS].
99. Ross, M.R.V., E.S. Bernhardt, M.W. Doyle and J.B. Heffernan (2015). Designer ecosystems: incorporating design into applied ecology. *Annual Review of Environment and Resources* 40: 419-443. [EEP]
98. Podolak, C., and M.W. Doyle (2015). Reservoir sedimentation and storage capacity in the United States: Management needs for the 21st century. *Journal of Hydraulic Engineering* 141(4): 1-8. [EEP]
97. Doyle, M.W. and J. VonWindheim (2015). Environmental management strategy: Four forces analysis. *Environmental Management* 55: 6-18. [EEP]
96. Doyle, M.W., L. Patterson, Y. Chen, K. Schnier, and A.J. Yates (2014). The optimal scale of markets for water quality trading. *Water Resources Research* 50(9): 7231-7244 [EEP].
95. Clay, P., J.D. Muehlbauer and M.W. Doyle (in press, 2014). Effect of tributary and braided confluences on aquatic macroinvertebrate communities and geomorphology in an alpine river watershed. *Freshwater Science* 34(3): 845-856. [RSS]
94. Podolak, C., and M.W. Doyle (2014). Conditional water rights in the western United States: introducing uncertainty in prior appropriation. *Journal of the American Water Resources Association* 51(1): 14-32. [EEP].
93. Miller, B.W. and M.W. Doyle (2014). Rangeland management and fluvial geomorphology in the Simanjiro Plains, Tanzania. *Geomorphology* 214: 366-377. [RSS]
92. Fuller, R.L., J. Dennison, S. Doyle, L. Levy, J. Owen, E. Shope, G. Swarr, L. Vo, K. Weichert, E. DiCesare and M.W. Doyle (2013). Influence of flood history and hydrology on transport of organic matter in a frequently flooded river. *Journal of Freshwater Ecology* 29(1): 37-51. [RSS]
91. Ensign, S.H., M.W. Doyle and M.F. Piehler (2013). The effect of tide on the hydrology and morphology of a freshwater river. *Earth Surface Processes and Landforms* 38: 655-660. [RSS]
90. Muehlbauer, J.D., S.F. Collins, M.W. Doyle and K. Tockner (2014). Spatial extent of the potential “stream signature” in terrestrial food webs using meta-analysis. *Ecology* 95: 44-55. [RSS]

89. Sandt, C.J., and M.W. Doyle (2013). The hydrologic and economic feasibility of micro hydropower upfitting and integration of existing low-head dams in the United States. *Energy Policy* 63: 261-271. [EEP].
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