

David Hanigan, PhD, PE

Associate Professor
Department of Civil and Environmental Engineering
College of Engineering
University of Nevada, Reno

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EDUCATION

Arizona State University

Ph.D. Environmental Engineering August 2015
Dissertation Title: Identification of *N*-nitrosodimethylamine Precursors to Improve Their Control
Committee Members: Paul Westerhoff, Pierre Herckes, Bruce Rittmann

University of Missouri – Columbia

M.S. Civil Engineering July 2011
Thesis Title: Removal of Disinfection By-product Precursors by Activated Carbon and MIEX®
Committee Members: Thomas Clevenger, Enos Inniss, Allen Thompson

B.S. Civil Engineering with Honors December 2009

PROFESSIONAL EXPERIENCE

University of Nevada, Reno, NV

Associate Professor July 2022 – Present
Assistant Professor July 2016 – June 2022

Arizona State University, Tempe, AZ

Postdoctoral Research Associate August 2015 – July 2016
Assessing the lifecycle impacts of engineered nanomaterials (EPA - LCNano). Development of a method to assess reactive oxygen species production of nanomaterials in environmental matrices and correlation with zebrafish embryo morphology and mortality.

Graduate Research Assistant August 2011 – August 2015
Removal and characterization of NDMA precursors at bench- (RSSCTs, bottle point) and full-scale using novel sorbents. Development of an isolation/TOF/MS method for NDMA precursor identification.

Teaching Assistant January 2013 – May 2013
Teaching assistant (full semester) and lecturer of record (4 lectures) for graduate level *Physical and Chemical Treatment of Water and Wastewater*. Greater than 10 other guest lecturers in other environmental engineering graduate level courses during PhD and post-doc.

University of Missouri, Columbia, MO

Graduate Research Assistant January 2010 – July 2011
Mitigation of disinfection by-product (trihalomethanes, haloacetic acids) formation in source waters containing elevated hydrophilic organic matter fractions.

Undergraduate Research Assistant August 2009 – December 2009
Investigated the effect of UV fluence on photoreactivation/photo repair of wastewater microorganisms.

Osage Constructors Inc. (OCCI) Fulton, MO

On-Site Engineer in Training (Matagorda, TX) May 2009 – August 2009
Site surveying, preliminary design/bid, safety officer.

On-Site Engineer in Training (Rosenberg, TX) May 2008 – August 2008

Site surveying, heavy construction.

HONORS AND AWARDS

Awards to Hanigan

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|---|-----------|
| Featured in Environmental Science: Water Research & Technology Emerging Investigator Series | 2021 |
| Nevada IDeA Network of Biomedical Research Excellence, Scientific Service Award (\$2k) | 2019 |
| American Water Works Association, Abel Wolman Fellow (\$30k/yr) | 2014-2016 |
| Water Environment Federation, Canham Graduate Studies Scholar (\$25K) | 2014 |
| ACS, Graduate Student Award in Environmental Chemistry (\$100) | 2014 |
| Arizona State Sustainable Engineering and the Built Environment, Lab Safety Award | 2014 |
| Arizona State University Engineering, Dean's Fellowship (\$30k/yr) | 2011-2013 |
| Arizona Water Association, Scholarship (\$1,000) | 2012 |
| Arizona State University, Ira A. Fulton Fellowship (\$5k) | 2011-2012 |
| University of Missouri, Paul Kufirin Memorial Scholarship (\$5k) | 2010 |

Awards to Students in Hanigan's Group

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| Kenny Hickenbottom – US Dept. of Ed. GAANN Fellowship (~32k/yr) | 2021 |
| Mingrui Song – Nevada Water Resources Association Scholarship (\$500) | 2021 |
| Mingrui Song – UNR Graduate Student's Association Travel Grant (\$500) | 2021 |
| Mingrui Song – Nevada Water Reuse Association Scholarship (\$1k) | 2021 |
| Junli Wang – Nevada Water Reuse Association Scholarship (\$1k) | 2021 |
| Elizabeth McKenna – AEESP Master's Thesis Award (\$500) | 2021 |
| Junli Wang – Nevada Water Resource Association Scholarship (\$400) | 2021 |
| Junli Wang – Air & Waste Management Association Scholarship (\$2k) | 2021 |
| Kevin Stewart – US Dept. of Ed. GAANN Fellowship (~32k/yr) | 2021 |
| Ibrahim Abusallout – NV INBRE Core Services Award (\$2k) | 2020 |
| Mingrui Song – Air & Waste Management Association Scholarship (\$2k) | 2020 |
| Priyamvada Sharma – UNR Graduate Student's Association Travel Grant (\$500) | 2020 |
| Elizabeth McKenna – Nevada Water Reuse Association Scholarship (\$1k) | 2020 |
| Ibrahim Abusallout – UNR Postdoctoral Professional Development Award (\$500) | 2019 |
| Elizabeth McKenna – First Place, AWWA WQTC Student Poster Competition | 2019 |
| Elizabeth McKenna – UNR Graduate Dean's Merit Scholarship (\$5k) | 2019 |
| Saeed Arabi – UNR College of Engineering Differential Fees Assistantship (\$13k) | 2019 |
| Elizabeth McKenna – 3 rd Place NWEA Conference Poster Competition | 2018 |
| Chelsea Cluff – NSF Graduate Research Fellowship (\$138k) | 2017 |
| Chelsea Cluff – AWWA Henry "Bud" Benjes/HDR Scholarship (\$5k) | 2017 |

SPONSORED RESEARCH

As PI

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| 1. Gas Phase PFAS and Organofluorine Release from AFFF: Measurement, Identification, and Exposure Mitigation <i>National Science Foundation CBET Environmental Engineering</i> \$330k | 2021-2024 |
| 2. Rapid Site Profiling of Organofluorine: Quantification of PFASs by Combustion Gas Analysis <i>Strategic Environmental Research and Development Program</i> \$784k | 2019-2022 |
| 3. Securing the Future of Direct and Indirect Potable Reuse – N-nitrosodimethylamine (NDMA) Formation Pathways and Precursors <i>National Science Foundation CBET Environmental Engineering</i> \$330k | 2018-2021 |
| 4. Co-Funding - Securing the Future of Direct and Indirect Potable Reuse <i>Water Research Foundation</i> \$50k | 2018-2021 |
| 5. Understanding Formation of a Critical Disinfection Byproduct: NDMA and | 2018-2020 |

Previously Unidentified NDMA Precursors in Advanced Potable Reuse Treatment Plants
Subcontracted from Orange County Water District, funding from United States Bureau of Reclamation

\$25k

6. Atmospheric CO₂ Capture Through Wastewater 2017-2018

University of Nevada, Reno New Scholarly Endeavor Grant

\$2.5k

7. Mass spectrometry to identify NDMA forming amines isolated from Orange 2017

County Advanced Water Purification Facility – Phase 2

Orange County Water District

\$15k

As Co-PI

8. Investigation of Disinfection Byproduct Formation and Mitigation in 2020-2023

Aquifer Storage and Recovery Operations

Truckee Meadows Water Authority

\$396k

9. Addressing Human Health Impacts from Emerging Contaminants in Reclaimed 2017-2020

Water to Enhance its Use for Urban and Peri-urban Agriculture

USDA AFRI Water for Agriculture

\$500k

Significant Contribution as Author

10. Identifying NDMA Forming Amines from the Orange County Water Purification 2016-2017

Facility

Orange County Water District

Co-author with Paul Westerhoff (PI)

\$18.5k

11. Understanding the Source and Fate of Polymer-Derived Nitrosamine 2016-2018

Precursors

Water Research Foundation #4622

Co-author with Paul Westerhoff (PI)

\$350k

12. Determining the Relative Importance and Contribution of Anthropogenic and 2014-2016

Natural Sources of Nitrosamine Precursors

Water Research Foundation #4499

Co-author with Paul Westerhoff (PI)

\$400k

PROFESSIONAL MEMBERSHIP AND DEVELOPMENT

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|---|--------------|
| Registered Professional Engineer in the State of Arizona | 2016-Present |
| Association of Environmental Engineering & Science Professors Member | 2015-Present |
| International Humic Substances Society Member | 2015-Present |
| American Chemical Society Member | 2013-Present |
| Water Environment Federation Member | 2013-Present |
| American Water Works Association Member | 2012-Present |
| UNR Teaching with Technology Certificate | 2019 |
| Association of College and University Educators: Effective Teaching Practices Certificate | 2017 |
| Preparing Future Faculty ASU Course Completed | 2012-2013 |
| DavidsonX EdX Course, 001X Medicinal Chemistry | 2014 |
| DelftX EdX Course, CTB3365x Introduction to Water Treatment | 2013 |
| HarvardX EdX Course, PH278x Human Health and Global Environmental Change | 2013 |
| BerkeleyX EdX Course, Stat2.1x Introduction to Statistics, Descriptive Statistics | 2013 |
| BerkeleyX EdX Course, Stat2.2x Introduction to Statistics, Probability | 2013 |
| BerkeleyX EdX course, Stat 2.3x Introduction to Statistics, Inference | 2013 |

PUBLICATIONS AND PRESENTATIONS

Refereed Journal Publications (Corresponding author underlined, **UNR students and postdocs supervised by Hanigan in blue**)

H index = 14 to 17 (Scopus, Web of Science, Google Scholar)

Times Cited = 952 to 1278

Citations per Publication = 24 to 26

1. **Abusallout, I.**, Holton, C., **Wang, J.**, Hanigan, D. Henry's Law Constants of 15 Per- and Polyfluoroalkyl Substances Determined by Static Headspace Analysis. *Environmental Science & Technology Letters*, 202X. *In Review*
2. **Wang, J.**, Lin, Z., He, X., Song, M., Westerhoff, P., Doudrick, K., Hanigan, D. Thermal Decomposition of Per- and Polyfluoroalkyl Substances: Mechanisms, Kinetics, and Implications for Thermal Treatment Processes. *Environmental Science & Technology*, 2022. 56(9): p. 5355
3. Qian, Y., Chen, Y., Hanigan, D., Shi, Y., Sun, S., Hu, Y., An, D. pH Adjustment Improves the Removal of Disinfection Byproduct Precursors from Sedimentation Sludge Water. *Resources, Conservation & Recycling*, 2022. 179: p. 106135
4. **Arabi, S. M.**, **Alicata, J.**, Hanigan, D., Hiibel, S. R. Capturing Atmospheric Carbon Dioxide by Depleting Inorganic Carbon in Municipal Wastewater. *International Journal of Greenhouse Gas Control*, 2021. 111: p. 103472
5. **Wang, J.**, **Abusallout, I.**, **Song, M.**, Marfil-Vega, R., Hanigan, D. Quantification of Per- and Polyfluoroalkyl Substances with a Modified Total Organic Carbon Analyzer and Ion Chromatography. *AWWA Water Science*, 2021. 3(4): p. e1235
6. **Sharma, P.**, Hanigan, D. Evidence of Low Levels of Trace Organic Contaminants in Terminal Lakes. *Chemosphere*, 2021. 285: p. 131408
7. **Abusallout, I.**, **Wang, J.**, Hanigan, D. Emerging investigator series: Rapid Defluorination of 22 Per- and Polyfluoroalkyl Substances in Water Using Sulfite Irradiated by Medium-Pressure UV. *Environmental Science: Water Research and Technology*, 2021. 7(9): p. 1552
8. **Thapa, U.**, **Sharma, P.**, Hanigan, D. Quantification of Pharmaceuticals in the Sealant Fluids of Actively Used Waterless Urinals. *Water Environment Research*, 2021.
9. Shahriar, A., Tan, J., **Sharma, P.**, Hanigan, D., Verburg, P., Pagilla, K., Yang, Y. Modeling the Fate and Human Health Impacts of Pharmaceuticals and Personal Care Products in Reclaimed Wastewater Irrigation for Agriculture. *Environmental Pollution*, 2021. 276: pg. 116532
10. Qian, Y., Chen, Y., Hu, Y., Hanigan, D., Westerhoff, P., An, D. Formation and Control of C- and N-DBPs during Disinfection of Filter Backwash and Sedimentation Sludge Water in Drinking Water Treatment. *Water Research*, 2021. 194: p. 116964.
11. Qian, Y., Hu, Y., Chen, Y., An, D., Westerhoff, P., Hanigan, D., Chu, W. Haloacetonitrile and Haloacetamide Precursors in Filter Backwash and Sedimentation Sludge Water during Drinking Water Treatment. *Water Research*, 2020. 186: p. 116346.
12. Rand, L., **Poustie, A.**, Bednar, A. J., Hanigan, D., Westerhoff, P., Ranville, J. F. Quantifying Temporal and Geographic Variation in Sunscreen and Mineralogic Titanium-containing Nanoparticles in Three Recreational Rivers. *Science of the Total Environment*, 2020. 743: p. 140845.
13. **Sharma, P.**, **Poustie, A.**, Verburg, P., Pagilla, K., Yang, Y., Hanigan, D. Trace Organic Contaminants in Field-scale Cultivated Alfalfa, Soil, and Pore Water after 10 Years of Irrigation with Reclaimed Wastewater. *Science of the Total Environment*, 2020. 744: p. 140698.
14. Liu, S., Liu, J., Wang, H., Yang, Y., Liu, S., Hanigan, D., Zhao, H. A New Antifouling and Antibacterial Membrane Material for Highly Selective Removal of Nitrate and Phosphate. *Industrial & Engineering Chemistry Research*, 2020. 59(26): p. 12114-12122.
15. **Poustie, A.**, Yang, Y., Verburg, P., Pagilla, P., Hanigan, D. Reclaimed Wastewater as a Viable Water Source for Agricultural Irrigation: A Review of Food Crop Growth Inhibition and Promotion in the Context of Environmental Change. *Science of the Total Environment*, 2020. 739: p. 139756.
16. **Thapa, U.**, Hanigan, D. Waterless Urinals Remove Select Pharmaceuticals from Urine by Phase Partitioning. *Environmental Science & Technology*, 2020. 54(10): p. 6344-6352.
17. Roth, J., **Abusallout, I.**, Hill, T., Holton, C., Thapa, U., Hanigan, D. Release of Volatile Per- and Polyfluoroalkyl Substances from Aqueous Film-Forming Foam. *Environmental Science & Technology Letters*, 2020. 7(3): p. 164-170. (Roth and Abusallout contributed equally).

18. **McKenna, E.**, Thompson, K., Taylor-Edmonds, L., McCurry, D., Hanigan, D. Summation of Disinfection By-product CHO Cell Relative Toxicity Indices: Sampling Bias, Uncertainty, and a Path Forward. *Environmental Science: Processes and Impacts*, 2020. 22: p. 708-718.
19. Kidd, J., Bi, Y., Hanigan, D., Herckes, P., Westerhoff, P. Yttrium Residues in MWCNT Enable Assessment of MWCNT Removal During Wastewater Treatment. *Nanomaterials*, 2019. 9(5): p. 670.
20. Saleh, N., Khalid, A., Tian, Y., Ayres, C., Sabaraya, I., Pietari, J., Hanigan, D., Chowdhury, I., Apul, O. Degradation and removal of poly- and per-fluoroalkyl substances from aqueous systems by nano-enabled water treatment strategies. *Environmental Science: Water Research and Technology*, 2019. 5(2): p. 198-208. **(Cover Article, Best Papers 2019 collection)**
21. An, D., Chen, Y., Gu, B., Westerhoff, P., Hanigan, D., Herckes, P., Fischer, N., Donovan, S., Croué, J. P., Atkinson, A. Lower Molecular Weight Fractions of PolyDADMAC Coagulants Disproportionately Contribute to *N*-nitrosodimethylamine Formation During Water Treatment. *Water Research*, 2019. 150: p. 466-472.
22. Gao, Q., Wang, C.-Z., Liu, S., Hanigan, D., Liu, S.-T., Zhao, H.-Z. Ultrafiltration Membrane Microreactor (MMR) for Simultaneous Removal of Nitrate and Phosphate from Water. *Chemical Engineering Journal*, 2019. 355: p. 238-246
23. Roback, S., Ferrer, I., Thurman, E. M., Ishida, K., Plumlee, M. H., **Poustie, A.**, Westerhoff, P., Hanigan, D. Non-Target Mass Spectroscopy Analysis of NDMA Precursors in Advanced Treatment for Potable Reuse. *Environmental Science: Water Research and Technology*, 2018. 4(12): p. 1944-1955.
24. Krasner, S. W., Westerhoff, P., Mitch, W. A., Hanigan, D., McCurry, D. L., von Gunten, U. Behavior of NDMA Precursors at 21 Full-Scale Water Treatment Facilities. *Environmental Science: Water Research & Technology*, 2018. 4(12): p. 1966-1978.
25. Hanigan, D., Truong, L., Schoepf, J., Nosaka, T., Mulchandani, A., Tanguay, R. L., Westerhoff, P. Trade-offs in Ecosystem Impacts from Nanomaterial versus Organic Chemical Ultraviolet Filters in Sunscreens. *Water Research*, 2018. 139: p. 281-290.
26. Kidd, J., Hanigan, D., Truong, L., Hristovski, K., Tanguay, R., Westerhoff, P. Developing and Interpreting Aqueous Functional Assays for Comparative Property-Risk Relationships of Different Nanoparticles. *Science of the Total Environment*, 2018. 628-629: p. 1609-1616.
27. Chen, S., Yuan, Z., Hanigan, D., Westerhoff, P., Zhao, H., Ni, J. Coagulation Behaviors of New Covalently Bound Hybrid Coagulants (CBHyC) in Surface Water Treatment. *Separation and Purification Technology*, 2018. 192(Supplement C): p. 322-328
28. Venkatesan, A. K., Reed, R. B., Lee, S., Bi, X., Hanigan, D., Yang, Y., Ranville, J. F., Herckes, P., Westerhoff, P. Detection and Sizing of Ti-containing Particles in Recreational Waters Using Single Particle ICP-MS. *Bulletin of Environmental Contamination and Toxicology*, 2018. 100(1): p. 120-126.
29. Lankone, R., Challis, K., Bi, Y., Hanigan, D., Reed, R., Zaikova, T., Hutchison, J., Westerhoff, P., Ranville, J. F., Fairbrother, F., Gilbertson, L. Methodology for Quantifying Engineered Nanomaterial Release from Diverse Product Matrices Under Outdoor Weathering Conditions and Implications for Life Cycle Assessment. *Environmental Science: Nano*, 2017. 4(9): p. 1784-1797 **(Cover article and selected by editorial team as top 10% published in ES: Nano)**
30. Hanigan, D., Truong, L., Simonich, M., Tanguay, R., Westerhoff, P. Zebrafish Embryo Toxicity of 15 Chlorinated, Brominated, and Iodinated Disinfection By-products. *Journal of Environmental Sciences*, 2017. 58: p. 302-310.
31. Hanigan, D., Ferrer, I., Thurman, E. M., Herckes, P., Westerhoff, P. LC/QTOF-MS Fragmentation of *N*-nitrosodimethylamine Precursors in Drinking Water Supplies is Predictable and Aids Their Identification. *Journal of Hazardous Materials*, 2017. 323(Part A): p. 18-25.
32. Krasner, S. W., Lee, T.F.L., Westerhoff, P., Fischer, N., Hanigan, D., Karanfil, T., Beita-Sandi, W., Taylor-Edmonds, L., Andrews, R.C. Granular Activated Carbon Treatment May Result in Higher Predicted Genotoxicity in the Presence of Bromide. *Environmental Science & Technology*, 2016. 50(17): p. 9583-9591.
33. Hicks, A. L., Reed, R., Theis, T. L., Hanigan, D., Huling, H., Zaikova, T., Hutchinson, J. E., Miller, J. Environmental Impacts of Reusable Nanoscale Silver-coated Hospital Gowns Compared to Single-use, Disposable Gowns. *Environmental Science: Nano*, 2016. 3(5): p.1124-1132.

34. [Hanigan, D.](#), Liao, X., Zhang, J., Herckes, P., Westerhoff, P. Sorption and Desorption of Organic Matter on Solid-phase Extraction Media to Isolate and Identify *N*-nitrosodimethylamine Precursors. *Journal of Separation Science*, 2016. 39(14): p. 2661-2884.
35. [Zhao, H.](#), Wang, L., Hanigan, D., Westerhoff, P., Ni, J. Novel Ion-exchange Coagulants Remove More Low Molecular Weight Organics than Traditional Coagulants. *Environmental Science & Technology*, 2016. 50(7): p. 3897-3904.
36. Zhang, J. Hanigan, D., Westerhoff, P., [Herckes, P.](#) *N*-Nitrosamine Formation Kinetics in Wastewater Effluents and Surface Waters. *Environmental Science: Water Research & Technology*, 2016. 2(2): p. 312-319. **(Editor's Choice - 2016)**
37. Liao, X., [Chen, C.](#), Xie, S., Hanigan, D., Wang, J., Zhang, X., Westerhoff, P., Krasner, S.W. Nitrosamine Precursor Removal by BAC: Adsorption versus Biotreatment Case Study. *Journal American Water Works Association*, 2015. 107(9): p. E454-E463.
38. [Hanigan, D.](#), Thurman, E. M., Ferrer, I., Zhao, Y., Andrews, S., Zhang, J., Herckes, P., and Westerhoff, P. Methadone Contributes to *N*-nitrosodimethylamine Formation in Surface Waters and Wastewaters during Chloramination. *Environmental Science & Technology Letters*, 2015. 2(6): p. 151-157. **(2nd most read article ES&TL March 2015, Highly cited article published in ES&TL, 2018)**
39. [Hanigan, D.](#), Krasner, S. W., Zhu, E., Zhang, J., Herckes, P., Westerhoff, P. Contribution and Removal of Watershed and Cationic Polymer *N*-nitrosodimethylamine Precursors. *Journal American Water Works Association*, 2015. 107(3): p. E152-E163. **(Listed under Most Read Articles consecutively from April 2015 to Jan 2016)**
40. [Krasner, S. W.](#), Mitch, W. A., McCurry, D. L., Hanigan, D., Westerhoff, P. Formation, Precursors, Control, and Occurrence of Nitrosamines in Drinking Water: A Review. *Water Research*, 2013. 47(13): p.4433-4450 **(Web of Science Highly Cited in Field)**
41. [Hanigan, D.](#), Inniss, E., Clevenger, T. E. Removal of Natural Organic Matter Fractions by MIEX® and Activated Carbon with Regard to Disinfection By-product Formation. *Journal American Water Works Association*, 2013. 105(3): p. E84-E92.
42. [Hanigan, D.](#), Zhang, J., Herckes, P., Krasner, S. W., Chen, C., and Westerhoff, P. Adsorption of *N*-Nitrosodimethylamine Precursors by Powdered and Granular Activated Carbon. *Environmental Science & Technology*, 2012. 46(22): p.12630-12639.

Refereed Book Chapters and other Refereed Publications

1. Busse, G., Hanigan, D., [Sharma, P.](#), Yang, Y., Singletary, L., Verburg, P. The Fate of Pharmaceuticals and Personal Care Products in Reclaimed Water Used for Irrigation of Agricultural Crops in Nevada. *University of Nevada Cooperative Extension Fact Sheet*, 2021. SP-21-07.
2. [Sharma, P.](#), Pagilla, K., Singletary, L., Hanigan, D. Pharmaceuticals and Personal Care Products (PPCPs) in Alfalfa Irrigated with Reclaimed Water. *University of Nevada Cooperative Extension Fact Sheet*, 2020. FS-20-05
3. Sterle, K., Ormerod, K. J., Singletary, L., Pagilla, K., Hanigan D., Verburg, P., Yang, Y. Reclaiming Water for Urban Foodsheds: State of Nevada Regulations and Permitting. *University of Nevada Cooperative Extension Fact Sheet*, 2020. FS-20-11
4. Pagilla, K., Hanigan, D., Yang, Y., Verburg, P., Sterle, L., Singletary, L. Reclaiming Water for Urban Foodsheds: Program Overview. *University of Nevada Cooperative Extension Fact Sheet*, 2020. FS-19-08
5. Chen, C., Hanigan, D., Liao, X., Wang, J., Zhang, X., Suffet, I. H., Krasner, S. W., Westerhoff, P. pH Effect on Nitrosamine Precursor Removal by Activated Carbon Adsorption, *in Recent Advances in Disinfection By-Products*, pp. 173-185, 2015, American Chemical Society.
6. Zhang, J., Hanigan, D., Shen, E., Andrews, S., Westerhoff, P., Herckes, P. Modeling NDMA Formation Kinetics During Chloramination of Model Compounds and Surface Waters Impacted by Wastewater Discharges, *in Recent Advances in Disinfection By-Products*, pp. 79-95, 2015, American Chemical Society.

Other Publications and Reports

1. [McKenna, E.](#), Sharma, P., McCurry, D., [Hanigan, D.](#) A Layman's Guide to High-resolution Mass Spectrometry. *Journal American Water Works Association*, 2020. 112(4): p. 40-49.

2. Ferrer, I., Thurman, E. M., Hanigan, D., Westerhoff, P. Finding NDMA Precursors Using Accurate Mass Tools with an Agilent 6540 Q-TOF LC/MS. *Agilent Application Note*, 2017. Agilent Technologies.
3. Westerhoff, P., Hanigan, D., Herckes, P., Thurman, E. M., Ferrer, I., Andrews, S., Zhao, V., Bukhari, Z. Relative Importance and Contribution of Anthropogenic and Natural Sources of Nitrosamine Precursors. *Water Research Foundation Final Report*, 2017. Water Research Foundation: Denver, CO.
4. Hanigan, D., Westerhoff, P. Recovery and Mass Spectrometry Aimed at Identifying NDMA Forming Amines Isolated from the Orange County Advanced Water Purification Facility. *Orange County Water District Final Report*, 2016.
5. Hanigan, D. Identification of N-nitrosodimethylamine Precursors to Improve Their Control. Arizona State University, 2015. (PhD Dissertation)
6. Krasner, S. W., Shirkhani, R., Westerhoff, P., Hanigan, D., Mitch, W. A., McCurry, D. L., Chen, C., Skadsen, J., von Gunten, U. Controlling the Formation of Nitrosamines During Water Treatment. *Water Research Foundation Final Report*, 2015. Water Research Foundation: Denver, CO.
7. Hanigan, D. Removal of Disinfection By-product Precursors by Activated Carbon and MIEX®. University of Missouri, 2011. (Masters Thesis)

Invited Presentations

1. Hanigan, D. Rapid Site Profiling of Organofluorine: Quantification of PFASs by Combustion Gas Analysis. SERDP PFAS Summer Meeting. Long Beach, CA. July 18th, 2022.
2. Hanigan, D. Anthropogenic Small Molecules in the Environment and Engineered Solutions. University of Arizona Chemical and Environmental Engineering Symposium. Tucson, AZ. March 25th, 2022
3. Hanigan, D. Anthropogenic Small Molecules in the Environment and Engineered Solutions. Washington State University. Pullman, WA. March 23rd, 2022.
4. Hanigan, D. Anthropogenic Small Molecules in the Environment and Engineered Solutions. WaterReuse Nevada Symposium. Las Vegas, NV. February 1st, 2022.
5. Hanigan, D. Tapping into the Future: Potable Reuse in Tomorrow's World. Water UCI Colloquium. May 7th, 2021.
6. Hanigan, D. Anthropogenic Small Molecules in the Environment, How They Are Measured, and Engineered Solutions. Arizona State University Environmental Engineering Seminar. April 13th, 2021
7. Hanigan, D. Rapid Site Profiling of Organofluorine: Quantification of PFASs by Combustion Gas Analysis. SERDP PFAS Summer Meeting. July 28th, 2020.
8. Hanigan, D. Advances in Engineering Impact Public Policy. Engineering Club at Davidson Academy. Reno, NV. Jan 14, 2020.
9. Hanigan, D. Past, Present, and Future of Per- and Polyfluoroalkyl Substances Analysis in the Field. SERDP Symposium. Washington D.C., November 28th, 2018.
10. Hanigan, D. Advances in Mass Spectrometry Identify a New Wave of Ultra-low Concentration Hazards. University of Nevada Geography Colloquium Series, Reno NV. Feb 15, 2017.
(selected as the semester student favorite)
11. Hanigan, D., Zhang, J., Herckes, P., Westerhoff, P. Removal and Control of Watershed and Cationic Polymer N-nitrosodimethylamine Precursors During Drinking Water Treatment. Arizona State University, School of Sustainable Engineering and the Built Environment, Tempe, AZ. 2013.
12. Hanigan, D., Clevenger, T. E., and Inniss, E. Removal of DBP Precursors by Activated Carbon and MIEX. Arizona State University, School of Sustainable Engineering and the Built Environment, Tempe, AZ. 2011.

Conference Presentations (Presenter underlined, UNR students in blue)

1. Abusallout, I. Holton, C., Hanigan, D. Are PFAS a Vapor Intrusion Threat? Association of Environmental Engineering Scientists and Professors Conference, St. Louis, MO. June 2022.
2. Hanigan, D., Song, M., Abusallout, I. Benzylidimethylamine and dimethylamine are key N-nitrosodimethylamine precursors in wastewater and potable reuse waters. 3rd International

- Water Association Disinfection and Disinfection By-products Conference, Milan, Italy. June 2022.
3. [Song, M.](#), Roback, S., Plumlee, S., Hanigan, D. Comparison of Oxidants Used in Advanced Oxidation Processes with Non-target Analysis and Bioassays. International Water Association Leading Edge Technology Conference, Reno, NV. March 2022.
 4. [He, X.](#), Hanigan, D. Adsorptive separation of fluoride and per- and polyfluoroalkyl substances (PFAS) for direct total organic fluorine (TOF) measurement. American Chemical Society National Meeting, San Diego, CA. March 2022.
 5. [Wang, J.](#), Marfil-Vega, R., Hanigan, D. Quantification of Per- and Polyfluoroalkyl Substances with a Modified Total Organic Carbon Analyzer and Ion Chromatography. American Water Works Association Water Quality Technology Conference, Tacoma, WA. November 2021.
 6. [Song, M.](#), Roback, S., Plumlee, M., Hanigan, D. Dimethylamine is an Important NDMA Precursor in Full Advanced Treated Water from Potable Reuse Facilities. American Water Works Association Water Quality Technology Conference, Tacoma, WA. November 2021.
 7. [Hanigan, D.](#), [Abusallout, I.](#), [Chan, A.](#), [Song, M.](#) Benzalkonium chloride is present in wastewater and is biotransformed to the potent *N*-nitrosodimethylamine precursor benzyldimethylamine during secondary treatment. American Chemical Society National Meeting, Atlanta, GA. August 2021.
 8. [Wang, J.](#), Marfil-Vega, R., Hanigan, D. PFAS Analysis With a Total Organic Carbon Instrument. Society of Environmental Toxicology and Chemistry North America 41st Annual Meeting. November 2020
 9. [Hanigan, D.](#), [Abusallout, I.](#), [Wang, J.](#), Marfil-Vega, R. Quantification of PFASs via total organofluorine measurements with a TOC instrument. American Chemical Society National Meeting. August 2020
 10. [Sharma, P.](#), Hanigan, D. Pharmaceutical and Personal Care Product Accumulation in Terminal Lakes Receiving Reclaimed Wastewater. American Chemical Society National Meeting, Philadelphia, PA. March 2020.
 11. [Abusallout, I.](#), Roth, J., Hill, T., Holton, C., Hanigan, D. Volatile Per- and Polyfluoroalkyl Substances Released from Aqueous Film-Forming Foam. American Chemical Society National Meeting, Philadelphia, PA. March 2020.
 12. [Abusallout, I.](#), [Wang, J.](#), Hanigan, D. Rapid Quantification of Per- and Polyfluoroalkyl Substances by Combustion Gas Analysis. National Environmental Monitoring Conference, Jacksonville, FL. August 2019.
 13. [Roth, J.](#), Holton, C., Hill, T., [Thapa, U.](#), Hanigan, D. Are Per- and Polyfluoroalkyl Substances (PFAS) a Vapor Intrusion Concern? RemTEC Summit, Denver, CO. February 2019.
 14. [Sharma, P.](#), [Poustie, A.](#), Hanigan, D. Pharmaceuticals and Personal Care Products Accumulation in Plants at the Field-scale and in Terminal Lakes. Nevada Water Environment Association Annual Conference, Sparks, NV. January 2019.
 15. [Thapa, U.](#), Hanigan, D. Using Waterless Urinal Sealant to Remove Pharmaceuticals from the Urine. Nevada Water Environment Association Annual Conference, Sparks, NV. January 2019.
 16. [Thapa, U.](#), [Cluff, C.](#), Hanigan, D. Waterless Urinal 2.0: Removing Pharmaceuticals at the Source. American Water Works Association Water Quality Technology Conference, Toronto, ON. November 13, 2018.
 17. [Hanigan, D.](#), Truong, L., Simonich, M., Tanguay, R., Westerhoff, P. Evaluating Toxicity Using Zebrafish Embryo Development: Sunscreens and Disinfection By-products. American Water Works Association Annual Conference and Exposition, Las Vegas, NV. June 13, 2018.
 18. [Hanigan, D.](#), [Poustie, A.](#), Thurman, E. M., Ferrer, I., Westerhoff, P., Roback, S. L., Ishida, K. P., Plumlee, M. H. Identifying NDMA Precursors in Advanced Treated Water for Potable Reuse. International Water Association 2nd Disinfection and Disinfection By-products Conference, Beijing, PRC. May 16, 2018.
 19. [Poustie, A.](#), Hanigan, D. Pharmaceutical Uptake in Crops Irrigated with Treated Wastewater. Nevada Water Environment Association Annual Conference, Sparks, NV. April 2018
 20. [Pagilla, K.](#), Verburg, P., Hanigan, D., Yang, Y. Water Reuse Project at University of Nevada-Reno: Addressing Human Health Impacts from Emerging Contaminants in Reclaimed Water to Enhance Its Use for Urban and Peri-Urban Agriculture. American Chemical Society National Meeting, New Orleans, LA. March 2018.

21. Lankone, R., Wang, J., Challis, K., Bi, Y., Hanigan, D., Wang, Y., Garland, M., Reed, R., Zaikova, T., Westerhoff, P. K., Gilbertson, L. M., Ranville, J. F., Fairbrother, H. Characterization of Engineered Nanomaterial Release from Nanoenabled Products Following Accelerated and Natural Weathering. American Chemical Society National Meeting, New Orleans, LA. March 2018.
22. Hanigan, D., Ferrer, I., Thurman, E. M., Roback, S., Ishida, K., Plumlee, M., Westerhoff, P. NDMA Precursor Transformation and Identification during Reverse Osmosis and UV/Peroxide Water Treatment for Indirect Potable Reuse. American Chemical Society National Meeting, San Francisco, CA. April 3, 2017.
23. Thurman, E. M., Ferrer, I., Hanigan, D., Westerhoff, P. Using Dark Matter Accurate Mass to Discover NDMA Precursors in Wastewater. American Chemical Society National Meeting, San Francisco, CA. April 3, 2017.
24. Westerhoff, P., Rice, J., Hanigan, D., Dotson, A. Reactivity Towards N-Nitrosamines of bulk and Trace Organics of Wastewater Origin. American Chemical Society National Meeting, San Francisco, CA. April 3, 2017.
25. Lee, C. F. T., Krasner, S. W., Westerhoff, P., Fischer, N. L., Hanigan, D., Karanfil, T., Beita-Sandi, W., Taylor-Edmonds, L. Unintended Consequences of GAC on Emerging DBPs. American Chemical Society National Meeting, San Diego, CA. March 2016.
26. Hanigan, D., Herckes, P., Westerhoff, P. Total Nitrosamines in Wastewaters, Surface Waters, and Foodstuffs by TONO and TONO-HPLC. AWWA Water Quality and Technology Conference, Salt Lake City, UT. Nov 15-19, 2015.
27. Hanigan, D., Herckes, P., Andrews, S., Ferrer, I., Thurman, E. M., Westerhoff, P. Identification of Nitrosamine Precursors in Waste and Surface Waters. AWWA Water Quality and Technology Conference, New Orleans, LA. Nov 17-20, 2014.
28. Hanigan, D., Krasner, S., Herckes, P., Westerhoff, P. Removal of Polymer-Derived N-nitrosamine Precursors by Activated Carbon. AWWA Water Quality and Technology Conference, Long Beach, CA. Nov 3-7, 2013.
29. Hanigan, D., Westerhoff, P., Zhang, J., Herckes, P., and Krasner, S. W. Reduction of NDMA Formation by Granular and Powdered Activated Carbon. AWWA Water Quality Technology Conference, Toronto, Canada. Nov 5, 2012.
30. Hanigan, D., Herckes, P., and Westerhoff, P. Activated Carbon for N-Nitrosodimethylamine (NDMA) Precursor Removal from Drinking Water Treatment Plant Influent. AZ Water Annual Conference, Glendale, AZ. May 3-5, 2012.

Poster Presentations (Presenter underlined, UNR students in blue)

1. Wang, J., Marfil-Vega, R., Hanigan, D. Thermal Decomposition of Gas-Phase Perfluorocarboxylic Acids: Formation of Gaseous Products and Mechanisms. International Water Association Leading Edge Technology Conference. Reno, NV. March 2022
2. Abusallout, I., Holton, C., Hanigan, D. Determination of Experimental Henry's Law Constants for 15 Poly- and Per-fluoroalkyl Substances (PFAS) Using Static Headspace Analysis. 12th International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Battelle). Palm Springs, CA. May 2022.
3. Abusallout, I., Hanigan, D. Defluorination of Per- and Polyfluoroalkyl Substances (PFASs) by Medium-pressure UV Irradiated Sulfite. SERDP & ESTCP Symposium. December 2020.
4. Wang, J., Hanigan, D. Quantification of PFASs via Total organofluorine measurements with a TOC instrument. SERDP & ESTCP Symposium. December 2020.
5. Abusallout, I., Wang, J., Schlessel, A., Marfil-Vega, R., Hanigan, D. Rapid Quantification of Per- and Polyfluoroalkyl Substances by Combustion Gas Analysis. SERDP & ESTCP Symposium, Washington D.C. December 2019.
6. McKenna, E., Thompson, K., Taylor-Edmonds, L., McCurry, D. L., Hanigan, D. Summation of Disinfection By-product Relative Toxicity Indices: Sampling Bias, Uncertainty, and a Path Forward. American Water Works Association Water Quality Technology Conference, Dallas, TX. November 3, 2019.
7. McKenna, E., Thompson, K., Taylor-Edmonds, L., McCurry, D. L., Hanigan, D. Summation of Disinfection By-product Relative Toxicity Indices: Sampling Bias, Uncertainty, and a Path

- Forward. University of Nevada, Reno Graduate Student Association Symposium, Reno, NV. October 22, 2019.
8. [Arabi, S.](#), Alicata, J., Hanigan, D., Hiibel, S.R. Capturing Atmospheric Carbon Dioxide by Depleting Wastewater Inorganic Carbon with Polymeric Membranes. UNR Global Climate Change Summit, Reno, NV. September 2019.
 9. [Wang, J.](#), [Abusallout, I.](#), [Song, M.](#), Hanigan, D. Rapid Site Profiling of Organofluorine: Quantification of PFASs by Combustion Gas Analysis (ER19-C2-1214). SERDP & ESTCP PFAS Project Meeting, San Diego, Ca. July 2019.
 10. [Hanigan, D.](#), [Poustie, A.](#), [McKenna, E.](#), Roback, S., Thurman, E. M., Ferrer, I., Plumlee, M. Identifying Nitrosamine Precursors in the Effluent of a Full Advanced Treatment Facility. Gordon Research Conference: Water Disinfection, Byproducts, and Health, South Hadley, MA. July 2019.
 11. [Roback, S.](#), Ishida, K., Plumlee, M., Mitch, W., Chuang, Y. H., Zhang, Z., Taylor-Edmonds, L., Hofmann, R., Hanigan, D., Ferrer, I., Thurman, E. M., Hoh, E. UV/monochloramine, UV/free chlorine, UV/hydrogen peroxide and UV Alone for the Removal of NDMA, NDMA Precursors, Non-target Analytes and Bioassay-indicated Toxicity. Gordon Research Conference: Water Disinfection, Byproducts, and Health, South Hadley, MA. July 2019.
 12. [Hanigan, D.](#), [Sharma, P.](#), [Thapa, U.](#) Rethinking Toilet Design to Reduce Environmental Pharmaceutical Loading. Association of Environmental Engineering Science Professors Biannual Conference, Tempe, AZ. May 2019.
 13. [McKenna, E.](#), Roback, S., Poustie, A., Thurman, E. M., Ferrer, I., Westerhoff, P., Plumlee, M., Hanigan, D. Identifying NDMA Precursors in Reuse Water Using Non-target Mass Spectrometry. Nevada Water Environment Association Annual Conference, Sparks, NV. January 2019.
 14. [Sharma, P.](#), Pagilla, K., Hanigan, D. Pharmaceuticals and Personal Care Product Accumulation in Plants at the Field Scale and in a Terminal Lake. American Water Works Association Water Quality Technology Conference, Toronto, ON. November 13, 2018.
 15. [Rand, L.](#), Bi, Y., [Poustie, A.](#), Bednar, A., Hanigan, D., Westerhoff, P., Ranville, J. Daily Cycling of Sunscreen and Mineralogic Ti-containing Nanoparticles in Three Rivers During Recreational Water Use. International Conference on the Environmental Effects of Nanoparticles and Nanomaterials, Durham, NC. September 2018
 16. [Thapa, U.](#), [Cluff, C.](#), Hanigan, D. Waterless Urinals: A Potential Extraction Media for Wastewater Pharmaceuticals. Nevada Water Environment Association Annual Conference, Sparks, NV. April 2018. **(2nd Place – Best Poster)**
 17. [Poustie, A.](#), Roback, S., Ishida, K., Thurman, E. M., Ferrer, I., Plumlee, M. H., Westerhoff, P., [Hanigan, D.](#) NDMA Precursor Transformation During RO/UV/AOP for Indirect Potable Reuse. Gordon Research Conference: Drinking Water Disinfection By-products, South Hadley, MA. July 2017.
 18. [Taylor-Edmonds, L.](#), Chih Fen Lee, T., Fischer, N., Hanigan, D., Beita-Sandi, W., Westerhoff, P., Karanfil, T., Krasner, S. W., Andrews, R. C. Genotoxicity and DBP Breakthrough Study: Granular Activated Carbon. Gordon Research Conference: Drinking Water Disinfection By-products, South Hadley, MA. 2017.
 19. [Cluff, C.](#), [Hanigan, D.](#) Taking Advantage of Waterless Urinal Design to Removal Pharmaceuticals at the Source. Association of Environmental Engineering and Science Professors Biannual Conference, Ann Arbor, MI. June 22, 2017.
 20. [Hanigan, D.](#), Truong, L., Tanguay, R., Westerhoff, P. Comparing Human- and Eco-toxicity of Nanomaterial and Organic Chemical Active Ingredients in Sunscreens. 13th International Water Association Leading Edge Conference on Water and Wastewater Technologies, Jerez de la Frontera, Spain. June 14, 2016.
 21. [Hanigan, D.](#), Reed, R., Yang, Y., Lee, S., Westerhoff, P. Measuring Nanoparticulate and Dissolved Titanium in Urban Recreational Waterways near Phoenix, AZ. Central Arizona-Phoenix Long-Term Ecological Research Project Annual Symposium, Scottsdale, AZ. Jan 15, 2016.
 22. [Hanigan, D.](#), Thurman, M., Ferrer, I., Westerhoff, P. Matlab Enabled Trawling of QqTOF Spectra for NDMA Specific Diagnostic Neutral Ion Fragments. Gordon Research Conference: Drinking Water Disinfection By-products, South Hadley, MA. 2015.

23. Hanigan, D., Thurman, M., Ferrer, I., Herckes, P., Andrews, S., Westerhoff, P. Methadone Contributes to *N*-nitrosodimethylamine Formation in Surface and Wastewater. AZ Water Annual Conference, Glendale AZ. May 6-8, 2015.
24. Hanigan, D., Herckes, P., Krasner, S. W., Westerhoff, P. Contribution and Sources of NDMA in Drinking Water. AZ Water Annual Conference, Glendale, AZ. May 7-9, 2014. **(Best Poster)**
25. Hanigan, D., Zhu, E., Herckes, P., Krasner, S. W., Westerhoff, P. Physical Removal and Control of Cationic Polymer NDMA Precursors During Drinking Water Treatment. AZ Water Annual Conference, Glendale, AZ. May 1-3, 2013.
26. Hanigan, D., Herckes, P., Krasner, S., Westerhoff, P. Adsorption of N-Nitrosodimethylamine Precursors by Powdered and Granular Activated Carbon. Gordon Research Conference: Drinking Water Disinfection By-products, South Hadley, MA. 2012.
27. Hanigan, D., Westerhoff, P. and Herckes, P. Reduction of N-Nitrosodimethylamine Formation during Chloramination by Activated Carbon Precursor Adsorption. Arizona State University Graduate Research Symposium, Tempe, AZ. Mar 15, 2012.
28. Hanigan, D. and T. E. Clevenger. Understanding MIEX® and Activated Carbon NOM Removal Mechanisms in Relation to Disinfection By-product Formation Potential. Mid America Environmental Engineering Conference, Rolla, MO. 2010.

MENTORSHIP

Post Docs at UNR

- | | |
|--|-----------|
| 1. Xuexiang He | 2021-2022 |
| 2. Ibrahim Abusallout (Now at CDM-Smith) | 2019-2021 |

Chair for UNR PhD Students

- | | |
|---|---------------|
| 1. Seth McCoy | 2022-present |
| 2. Kenny Hickenbottom | Expected 2023 |
| 3. Mingrui Song | Expected 2022 |
| 4. Junli Wang | Expected 2022 |
| 5. Priyamvada Sharma (Now with Geosyntec) | 2021 |
| 6. Utsav Thapa (Now post-doc at SUNY-Buffalo) | 2021 |

Chair for UNR MS Students

- | | |
|--|--------------|
| 1. Michael DeNicola | 2021-Present |
| 2. Kevin Stewart | 2021-Present |
| 3. Elizabeth McKenna (Now with Corona Environmental) | 2020 |
| 4. Saeed Arabi | 2020 |
| 5. Andrew Poustie (Now with Stantec) | 2018 |

Undergraduate mentees at UNR

- | | |
|------------------------------|-----------|
| 1. Jacquelyne Kittredge | 2021-2022 |
| 2. Aron Chan (Now at NV DOT) | 2019-2021 |
| 3. Jackson Alicata | 2018-2019 |
| 4. Paul Wilkerson | 2018 |
| 5. Richard Mannschreck | 2018 |
| 6. Chelsea Cluff | 2016-2017 |

Committee member at UNR

- | | |
|-------------------------------------|--------------|
| 1. Abrar Shahriar | 2022-present |
| 2. Niloufar Gharoon Dastjerdi - PhD | 2022-Present |
| 3. Zhizhen Zhang – PhD | 2021-Present |
| 4. Srinidhi Lokesh – PhD | 2020-Present |
| 5. Nicolas Silva – PhD | 2018-Present |
| 6. Laura Haak – PhD | 2018-2020 |
| 7. Grant Busse – MS | 2019-2020 |
| 8. Dinesh Adhikari – PhD | 2018 |
| 9. Nicole Furtaw – MS | 2017 |

Visiting Scholars

Richard Jacquet, France 2017

Graduate mentees while at ASU

Xiaobin Liao 2013-2014

Undergraduate mentees while at ASU and MU

2010-2015

Arthur Petit
Hanna Huling
Nora Aoudjehane
Dylan Lesan
Harsha Sharma
Lesley Le
Ted Grimes

SERVICE

American Water Works Association Organic Contaminants Research Committee
Chair 2019-Present
Vice Chair 2018 - 2019
Stead Elementary School Volunteer 2016 - Present
Water Environment Federation Awards & Recognition Committee 2015 - Present
IWA Leading Edge Technology Conference Organizing Core Committee 2021-2022
AWWA ACE Special Topics Session Chair 2021
ACS Fall Conference ENVR Symposium Co-Chair 2020
American Water Works Association Scholarship Committee 2019
NSF CBET Review Panelist 2019
Water Reuse Research Foundation Project Advisory Committee Member 2016 - 2019
American Water Works Association Organic Contaminants Control Committee 2016-2018
National Science Foundation Environmental Chemical Sciences ad hoc reviewer 2018
Nevada Regional Science Olympiad Dynamic Planet Event Supervisor 2018
Nevada State Science Olympiad Hydrogeology Event Supervisor 2017
National Science Foundation Graduate Research Fellowship Program (NSF GRFP) 2016
Civil and Environmental Engineering Review Panelist
Founder and President, Graduate Students for the Environment, 2013-2014
Arizona State University
Social Chair, Association of Graduate Civil Engineers, School of Sustainable 2013-2014
Engineering and the Built Environment, Arizona State University
Journal Reviewer - I regularly review for the following journals: Industrial & Engineering Chemistry
Research, Separation Science and Technology, Water Research, ACS Symposium Series
Book Chapter, Environmental Science and Pollution Research, Environmental Engineering
Science, Science of the Total Environment, Environmental Science & Technology, Journal of
Environmental Sciences, RSC Advances, Chemosphere, Journal American Water Works
Association, Environmental Science & Technology Letters, Journal of Cleaner Production,
Environmental Science: Water Research & Technology

TEACHING

Environmental Engineering Systems: Principles and Design (CEE 390) S18, S19, S20, S21, S22
Design of Water Treatment Systems (CEE 456/656) F17, F18, F20, F21
Physiochemical Water Treatment (CEE 752) S17, F18, S20, F21

IN PUBLIC MEDIA

1. [Environmental Science: Water Research & Technology blog – “Emerging Investigator Series – David Hanigan”](#)

2. [PBS Newshour Science Wednesday – “Scientists Trace Cancer-causing Chemical in Drinking Water back to Methadone”](#)
3. [American Chemical Society Chemical & Engineering News – “Heroin Analog May Form Carcinogen in Drinking Water”](#)
4. [Chromatography Online – “Methadone Linked to NDMA Contamination in Drinking Water”](#)
5. [Water Online – “Methadone in the Water: What’s the Real Risk?”](#)
6. [US Finance Post – “Drinking Polluted Water Could Cause Cancer?”](#)
7. [Water Online – “Chloramination May Introduce Cancer-Causing Chemicals”](#)
8. [Water Conditioning & Purification Magazine – “On Tap: Methadone Creates Harmful Byproducts in Treated Drinking Water”](#)