

Christopher H. Hay, PhD, PE

Owner and Principal · Hay Water Solutions

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Professional Experience

<i>Hay Water Solutions, LLC</i> , Ankeny, Iowa Owner and Principal	2024–present
<i>Christopher Hay Consulting</i> , Ankeny, Iowa Owner and Principal	2024–present
<i>Iowa State University</i> , Ames, Iowa Affiliate Assistant Professor	2018–Present
<i>Iowa Soybean Association</i> , Ankeny, Iowa Conservation Design Scientist	2023–2024
Senior Research Scientist	2020–2023
Senior Manager–Production Systems Innovation	2019–2020
Senior Environmental Scientist	2015–2019
<i>South Dakota State University</i> , Brookings, S.D. Adjunct Associate Professor	2015–2018
Associate Professor and Extension Water Management Engineer	2015
Assistant Professor and Extension Water Management Engineer	2009–2015
<i>University of Nebraska-Lincoln</i> , Lincoln, Neb. Postdoctoral Research Associate	2007–2009
<i>Independent Consultant</i> , Waverly, Neb. Hydrologist	2006–2007
<i>University of Nebraska-Lincoln</i> , Lincoln, Neb. Graduate Research Fellow	2001–2006
<i>TZA Water Engineers, Inc.</i> , Littleton, Colo. Water Resources Engineer	1997–2001
<i>Carroll's Foods of Virginia, Inc.</i> , Waverly, Va. Environmental Specialist	1994–1996
<i>Virginia Department of Conservation and Recreation</i> , Suffolk, Va. Watershed Coordinator	1994
<i>USDA-ARS Water Management Research Unit</i> , Fort Collins, Colo. Engineering Aid	1991–1993

Education

University of Nebraska-Lincoln, Lincoln, Neb.

PhD, Engineering

2006

•Area of specialization: Agricultural and Biological Systems Engineering

•Minor: Statistics

Colorado State University, Fort Collins, Colo.

MS, Agricultural and Bioresource Engineering

2003

BS, Agricultural Engineering

1992

Professional Registration

Professional Engineer (Iowa, P28787)

Professional Agricultural Engineer (Nebraska, E-12426)

Honors and Awards

Outstanding Reviewer, ASABE, 2024

G. B. Gunlogson Countryside Engineering Award, ASABE, 2023

Presidential Citation, ASABE, 2023

[GroundBreakers](#) honoree, *Drainage Contractor*, 2023

Extension Education Community Award, ASA, 2021

Educational Aids Blue Ribbon Award, ASABE, 2021

Educational Aids Blue Ribbon Award, ASABE, 2018

Educational Aids Blue Ribbon Award, ASABE, 2017

Educational Aids Blue Ribbon Award, ASABE, 2016

Outstanding Reviewer, *Agronomy Journal*, 2016

Gamma Sigma Delta (SDSU Chapter) Award for Excellence in Extension, 2014

Honorable Mention Paper Award, Irrigation and Drainage Council of ASCE-EWRI, 2011

Program Excellence Award, NDSU Extension Service, 2011

USDA National Needs Graduate Research Fellow, 2001–2003

Gamma Sigma Delta—The Honor Society of Agriculture

Research Publications and Presentations

Journal Articles (Peer Reviewed)

1. Christianson, L. E., Hay, C. H., Christianson, R. D., Maxwell, B. M., & Cooke, R. (2026). Design approach tradeoffs and annual performance prediction for denitrifying bioreactors treating subsurface drainage. *Journal of Environmental Management*, 397, 128245. [doi:10.1016/j.jenvman.2025.128245](https://doi.org/10.1016/j.jenvman.2025.128245)
2. Christianson, L. E., Christianson, R. D., & Hay, C. H. (2025). Rethinking percentage-based approaches for edge-of-field practice design flow rates. *Agricultural & Environmental Letters*, 10(2), e70051. [doi:10.1002/aerl.70051](https://doi.org/10.1002/aerl.70051)

3. Christianson, L. E., Christianson, R. D., Hay, C. H., Seeman, A., Díaz-García, C., Feyereisen, G. W., Pease, L., Kjaersgaard, J., Helmers, M. J., & Soupir, M. (2025). Denitrifying bioreactor surface subsidence varies with age and cover. *Ecological Engineering*, 211, 107461. doi:10.1016/j.ecoleng.2024.107461
4. Thapa, U., Ahiablame, L., Kjaersgaard, J., & Hay, C. (2022). Field evaluation of four denitrifying woodchip bioreactors for nitrogen removal in eastern South Dakota, United States. *Science of the Total Environment*, 855: 158740. doi:10.1016/j.scitotenv.2022.158740
5. Feyereisen, G. W., Hay, C. H., Christianson, R. D., & Helmers, M. J. (2022). Frontier: Eating the metaphorical elephant: Meeting nitrogen reduction goals in Upper Mississippi River Basin states. *Journal of the ASABE* 65(3): 621-631. doi:10.13031/ja.14887.
6. Hay, C. H., Reinhart, B. D., Frankenberger, J. R., Helmers, M. J., Jia, X., Nelson, K. A., & Youssef, M. A. (2021). Frontier: Drainage water recycling in the humid regions of the U. S.: Challenges and opportunities. *Transactions of the ASABE*, 64(3), 1095-1102. doi:10.13031/trans.14207
7. Willison, R. S., Nelson, K. A., Abendroth, L. J., Chighladze, G., Hay, C. H., Jia, X.,...Wikle, C. K. (2021). Corn yield response to subsurface drainage water recycling in the Midwestern United States. *Agronomy Journal*, 113(2), 1865-1881. doi:10.1002/agj2.20579
8. Christianson, L. E., Cooke, R. A. C., Hay, C. H., Helmers, M. J., Feyereisen, G. W., Ranaivoson, A. Z.,...von Ahnen, M. (2021). Effectiveness of denitrifying bioreactors on water pollutant reduction from agricultural areas. *Transactions of the ASABE*, 64(2), 641-658. doi:10.13031/trans.14011
9. Reinhart, B. D., Frankenberger, J. R., Hay, C. H., Bowling, L. B., & Hancock, B. G. (2020). Development and sensitivity analysis of an online tool for evaluating drainage water recycling decisions. *Transactions of the ASABE*, 63(6), 1991-2002. doi:10.13031/trans.13900
10. Christianson, L., Feyereisen, G., Hay, C., Tschirner, U., Kult, K., Wickramaratne, N., Hoover, N., & Soupir, M. (2020). Denitrifying bioreactor woodchip recharge: Media properties after nine years. *Transactions of the ASABE*, 63(2), 407-416. doi:10.13031/trans.13709
11. Reinhart, B. D., Frankenberger, J. R., Hay, C. H., & Helmers, M. J. (2019). Simulated water quality and irrigation benefits from drainage water recycling at two tile-drained sites in the U.S. Midwest. *Agricultural Water Management*, 223, 105699. doi:10.1016/j.agwat.2019.105699
12. Sellner, B. M., Hua, G., Ahiablame, L. M., Trooien, T. P., Hay, C. H., & Kjaersgaard, J. (2019). Evaluation of industrial byproducts and natural minerals for phosphate adsorption from subsurface drainage. *Environmental Technology*, 40(6), 756-757. doi:10.1080/09593330.2017.1407364
13. Reyes-Gonzalez, A., Kjaersgaard, J., Trooien, T., Hay, C., & Ahiablame, L. (2018). Estimation of crop evapotranspiration using satellite remote sensing-based vegetation index. *Advances in Meteorology*, 2018, Article ID 4525021. doi:10.1155/2018/4525021
14. Strock, J. S., Hay, C. H., Helmers, M. J., Nelson, K. A., Sands, G. R., Skaggs, R. W.,

- & Douglas-Mankin, K. R. (2018). Advances in drainage: Selected works from the Tenth International Drainage Symposium. *Transactions of the ASABE*, 61(1), 161-168. [doi:10.13031/trans.12668](https://doi.org/10.13031/trans.12668)
15. Khand, K., Kjaersgaard, J., Hay, C., & Jia, X. (2017). Estimating impacts of agricultural subsurface drainage on evapotranspiration using the Landsat imagery-based METRIC model. *Hydrology*, 4(4), 49–16. [doi:10.3390/hydrology4040049](https://doi.org/10.3390/hydrology4040049)
 16. Reyes-Gonzalez, A., Kjaersgaard, J., Trooien, T., Hay, C., & Ahiablame, L. (2017). Comparative analysis of METRIC model and atmometer methods for estimating actual evapotranspiration. *International Journal of Agronomy*, 2017. [doi:10.1155/2017/3632501](https://doi.org/10.1155/2017/3632501)
 17. Hua, G., Salo, M. W., Schmit, C. G., & Hay, C. H. (2016). Nitrate and phosphate removal from agricultural subsurface drainage using laboratory woodchip bioreactors and recycled steel byproduct filters. *Water Research*, 102(C), 180–189. [doi:10.1016/j.watres.2016.06.022](https://doi.org/10.1016/j.watres.2016.06.022)
 18. Kibria, K., Ahiablame, L., Hay, C., & Djira, G. (2016). Streamflow trends and responses to climate variability and land cover change in South Dakota. *Hydrology*, 3(1), 2–20. [doi:10.3390/hydrology3010002](https://doi.org/10.3390/hydrology3010002)
 19. Hankerson, B., J. Kjaersgaard, & Hay, C. (2012). Estimation of evapotranspiration from fields with and without cover crops using remote sensing and in situ methods. *Remote Sensing*, 4, 3796-3812. [doi:10.3390/rs4123796](https://doi.org/10.3390/rs4123796)
 20. Hay, C. H., & Irmak, S. (2010). Recursive and explicit combination-based energy balance equations for calculating reference evapotranspiration in relation to Bowen ratio measurements. *Transactions of the ASABE*, 53(6), 1799–1810. [doi:10.13031/2013.35806](https://doi.org/10.13031/2013.35806)
 21. Hay, C. H., & Irmak, S. (2009). Actual and reference evaporative losses and surface coefficients of a maize field during non-growing (dormant) periods. *Journal of Irrigation and Drainage Engineering*, 135(3), 313–322. [doi:10.1061/\(ASCE\)IR.1943-4774.0000001](https://doi.org/10.1061/(ASCE)IR.1943-4774.0000001)
 22. Hay, C. H., Franti, T. G., Marx, D. B., Peters, E. J., & Hesse, L. W. (2008). Relationships between larval fish drift and abiotic factors in the Missouri River. *Journal of Freshwater Ecology*, 23(4), 589–597. [doi:10.1080/02705060.2008.9664246](https://doi.org/10.1080/02705060.2008.9664246)
 23. Hay, C. H., Franti, T. G., Marx, D. B., Peters, E. J., & Hesse, L. W. (2008). Macroinvertebrate drift density in relation to abiotic factors in the Missouri River. *Hydrobiologia*, 598, 175–189. [doi:10.1007/s10750-007-9149-3](https://doi.org/10.1007/s10750-007-9149-3)

Journal Articles (Not Peer Reviewed)

1. Hay, C. H., & Kult, K. J. (2017). Looking for agricultural water quality protection practices: Denitrifying bioreactors. *Journal of Soil and Water Conservation*, 72(6), 129A–132A. [doi:10.2489/jswc.72.6.129A](https://doi.org/10.2489/jswc.72.6.129A)

Reports

1. Environmental Defense Fund, ISG, and Hay Water Solutions. (2025). *Economic analysis of drainage water recycling: Opportunities for supporting farm resilience and water quality*. <https://library.edf.org/AssetLink/20wd5hw2gr4sn01a433trr7q3x18ei1w.pdf>

Conference Proceedings (Peer Reviewed)

1. Burckhard, S. R., Vondruska, J., Emo, K., Gent, S., Cortus, E., Hay, C., & Gutzmer, Z. (2014). Engineering the future: A workshop for high school teachers. Proceedings of the 2014 ASEE North Midwest Section Conference. Iowa City, Iowa: ASEE. [doi:10.17077/aseenmw2014.1032](https://doi.org/10.17077/aseenmw2014.1032)

Conference Proceedings and Professional Society Papers (Not Peer Reviewed)

1. Hay, C. H., & Helmers, M. J. (2017). Evaluating drainage water recycling benefits for crop production in Iowa. In C. N. Dunn & B. Van Weele (Eds.), *Proc. World Environmental and Water Resources Congress*. pp. 507–517. Reston, VA: ASCE. [doi:10.1061/9780784480601.043](https://doi.org/10.1061/9780784480601.043)
2. Hay, C. H., Kiel, A., Seeman, A., & Kyveryga, P. (2016). Monitoring tile systems in Iowa: Overview and results. 10th Int. Drainage Symp. St. Joseph, MI: ASABE. [doi:10.13031/IDS.20162490464](https://doi.org/10.13031/IDS.20162490464)
3. Reyes-Gonzalez, A., Trooien, T., Kjaersgaard, J. Hay, C., & Reta-Sanchez, D. G. (2016). Development of crop coefficients using remote sensing-based vegetation index and growing degree days. ASABE Paper No. 162462560. St. Joseph, Mich.: ASABE. [doi:10.13031/aim.20162462560](https://doi.org/10.13031/aim.20162462560)
4. Sellner, B., Hua, G., Ahiablame, L., Trooien, T., Hay, C., & Kjaersgaard J. (2016). Evaluating filter materials for phosphate adsorption from agricultural sub-surface drainage. ASABE Paper No. 162457513. St. Joseph, Mich. ASABE. [doi:10.13031/aim.20162457513](https://doi.org/10.13031/aim.20162457513)
5. Reyes-Gonzalez, A., Hay, C., Kjaersgaard, J., & Neale, C. (2015). Use of remote sensing to generate crop coefficients and estimate actual crop evapotranspiration. ASABE Paper No. 152190105. St. Joseph, Mich. ASABE. [doi:10.13031/aim.20152190105](https://doi.org/10.13031/aim.20152190105)
6. Salo, M. W., Hua, G., Schmit, C., & Hay, C. (2015). Nutrient removal from agricultural sub-surface drainage using denitrification bioreactors and phosphate adsorbents. ASABE Paper No. 152156408. St. Joseph, Mich. ASABE. [doi:10.13031/aim.20152156408](https://doi.org/10.13031/aim.20152156408)
7. Karki, G., Hay, C., Kjaersgaard, J., & Trooien, T. (2014). Design drainage intensity for eastern South Dakota. ASABE Paper No. 141914059. St. Joseph, Mich.: ASABE. [doi:10.13031/aim.20141914059](https://doi.org/10.13031/aim.20141914059)
8. Karki, G., Hay, C., Trooien, T., & Kjaersgaard, J. (2014). Calibration of DRAINMOD in South Dakota for Houdek soil series (state soil of South Dakota). ASABE Paper No. SD14-065. St. Joseph, Mich.: ASABE. [doi:10.13031/sd14065](https://doi.org/10.13031/sd14065)
9. Khand, K., Kjaersgaard, J., Hay, C., & Jia, X. (2014). Estimating evapotranspiration from drained and undrained agricultural fields using remote sensing. ASABE Paper No. 1829687. St. Joseph, Mich.: ASABE. [doi:10.13031/et.1829687](https://doi.org/10.13031/et.1829687)
10. Kjaersgaard, J., Khand, K., Hay, C., & Jia, X. (2014). Estimating evapotranspiration from fields with and without tile drainage using remote sensing. World Environmental and Water Resources Congress 2014: pp. 1745-1753. [doi:10.1061/9780784413548.173](https://doi.org/10.1061/9780784413548.173)

11. Partheeban, C., Kjaersgaard, J., Hay, C., & Trooien, T. (2014). Demonstrating the nitrogen-removal effectiveness of denitrifying bioreactors for improved drainage water management in South Dakota. ASABE Paper No. 141911325. St. Joseph, Mich.: ASABE. [doi:10.13031/aim.20141911325](https://doi.org/10.13031/aim.20141911325)
12. Partheeban, C., Kjaersgaard, J., Hay, C., & Trooien, T. (2014). A review of the factors controlling the performance of denitrifying woodchip bioreactors. ASABE Paper No. SD14-029. St. Joseph, Mich.: ASABE. [doi:10.13031/sd14029](https://doi.org/10.13031/sd14029)
13. Rasoeu, A. N., Kjaersgaard, J., Trooien, T., & Hay, C. (2014). Weather data quality control from six weather stations in South Africa surrounding Lesotho and ET mapping: The process in sustainability assessment and design criteria for irrigation for Lesotho. ASABE Paper No. SD14-015. St. Joseph, Mich.: ASABE. [doi:10.13031/sd14015](https://doi.org/10.13031/sd14015)
14. Hay, C. H., Hankerson, B., & Kjaersgaard, J. (2013). Evaluating cover crop evapotranspiration using field measurements and remote sensing techniques. ASABE Paper No. 131620977. St. Joseph, Mich.: ASABE. [doi:10.13031/aim.20131620977](https://doi.org/10.13031/aim.20131620977)
15. Trooien, T. P., Mathiowetz, A. W., Pohl, S. H., Boe, A., Gelderman, R., Todey, D. P., Hay, C. H., & Kjaersgaard, J. (2013). Performance of vegetative treatment systems for CAFOs in a northern subhumid climate. ASABE Paper No. 131619798. St. Joseph, Mich.: ASABE. [doi:10.13031/aim.20131619798](https://doi.org/10.13031/aim.20131619798)
16. Hay, C. H., Kjaersgaard, J. H., & Hankerson, B. (2012). Measurement of cover crop evapotranspiration and impacts on water management in crop production systems. ASABE Paper No. 121337007. St. Joseph, Mich.: ASABE. [doi:10.13031/2013.41727](https://doi.org/10.13031/2013.41727)
17. Hankerson, B., Hay, C., & Kjaersgaard, J. (2012). Measurement of cover crop evapotranspiration and impacts on water management in crop production systems. ASABE Section Meeting Paper No. RRV12108. St. Joseph, Mich.: ASABE. [doi:10.13031/2013.4131](https://doi.org/10.13031/2013.4131)
18. Hay, C. H., & Todey, D. P. (2011). Precipitation and evapotranspiration patterns in the northwestern Corn Belt and impacts on agricultural water management. 4th Drainage Water Management Field Day, Lamberton, Minn., Aug. 23.
19. Hay, C. H. & Todey, D. P. (2011). Precipitation and evapotranspiration patterns in the northwestern Corn Belt and impacts on agricultural water management. ASABE Paper No. 1111455. St. Joseph, Mich.: ASABE. [doi:10.13031/2013.38114](https://doi.org/10.13031/2013.38114)
20. Seagraves, B. L., Trooien, T. P., Todey, D. P., Hay, C. H., Schleicher, L. C., & Persyn, R. A. (2010). Efficacy of evapotranspiration-based landscape irrigation in eastern South Dakota. ASABE Paper No. IRR10-9995. St. Joseph, Mich.: ASABE. [doi:10.13031/2013.35894](https://doi.org/10.13031/2013.35894)
21. Hay, C. H., & Irmak, S. (2009). Bayesian model averaging for accounting for model selection uncertainty with an application for predicting net radiation. ASABE Paper No. 096630. St. Joseph, Mich.: ASABE. [doi:10.13031/2013.27199](https://doi.org/10.13031/2013.27199)
22. Hay, C. H., & Irmak, S. (2009). Recursive and explicit combination methods for calculating reference evapotranspiration. ASCE-EWRI World Environmental and Water Resources Congress, Kansas City, Mo., 17–21 May. [doi:10.1061/41036\(342\)424](https://doi.org/10.1061/41036(342)424)
23. Hay, C. H., & Irmak, S. (2008). Surface energy balance and surface coefficients of a corn field during non-growing periods. ASCE-EWRI World Environmental and Water

Resources Congress, Honolulu, Hawaii, 12–16 May. doi:10.1061/40976(316)90

24. Hay, C. H., Franti, T. G., Marx, D. B., & Hesse, L. W. (2006). Drift of fish larvae in relation to abiotic factors in the Missouri River, 8th Biennial River Management Society Symposium and 10th Annual Missouri River Natural Resources Conference, South Sioux City, Neb., 9–12 May.

Conference Presentations with Published Abstracts

1. Hay, C., Phillips, S., Helmers, M., & Archontoulis, S. (2021, Jul.). Recycling drainage water for increased resilience and improved water quality. Paper presented at the SWCS International Annual Conference, virtual. https://www.swcs.org/static/media/cms/Abstract_Book_1EE65CD438D41.pdf
2. Strock, J. S., Ghane, E., Youssef, M. A., Negm, L. S., Tian, S. S., Abendroth, L. J.,...Hay, C. H.,...Nelson, K. A. (2019, Nov.). Regional analysis of corn yield under different drainage water management systems. Paper presented at the ASA-CSSA-SSSA International Annual Meeting, San Antonio, TX. <https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/119666>
3. Sahani, A., Ahiablame, L., & Hay, C. (2017, April). Demonstration of drainage water management in eastern South Dakota. Paper presented at the 2017 Western South Dakota Hydrology Meeting, Rapid City, SD. <https://sd.water.usgs.gov/WSDconf/index.html>
4. Thapa, U., Ahiablame, L., Kjaersgaard, J., Hay, C., Hua, G., & Trooien, T. (2017, April). Using denitrification bioreactors and phosphorus adsorption media for water quality improvement in subsurface drainage systems. Paper presented at the 2017 Western South Dakota Hydrology Meeting, Rapid City, SD. <https://sd.water.usgs.gov/WSDconf/index.html>
5. Ahiablame, L., Hua, G., Hay, C., & Kjaersgaard, J. (2016, November). Nutrient removal in subsurface drainage water using denitrification bioreactors and filter materials. Paper presented at The 1st International Electronic Conference on Water Sciences. <http://sciforum.net/conference/ecws-1/ecws-a>
6. Kjaersgaard, J. H., & Hay, C. (2016, November). Estimating crop water needs and agronomic benefits of drainage water reuse and subirrigation in the Red River Valley, Minnesota. Paper presented at the ASA, CSSA, and SSSA International Annual Meeting, Phoenix, AZ. <https://scisoc.confex.com/scisoc/2015am/webprogram/Paper94856.html>
7. Sahani, A., Ahiablame, L., & Hay, C. (2016, September). Quantifying the impacts of subsurface drainage and agronomic conservation practices on hydrology and water quality. Presented at the 10th Int. Drainage Symp., Minneapolis, MN. <http://www.cce.umn.edu/documents/CPE-Conferences/IDS2016AbstractBooklet.pdf>
8. Thapa, U., Ahiablame, L., Hua, G., Trooien, T., Hay, C., & Kjaersgaard, J. (2016, September). Denitrification bioreactors to support conservation drainage in eastern South Dakota. Presented at the 10th Int. Drainage Symp., Minneapolis, MN. <http://www.cce.umn.edu/documents/CPE-Conferences/IDS2016AbstractBooklet.pdf>

9. Thapa, U., Trooien, T. P., Kjaersgaard, J. H., Hay, C., Ahiablame, L., Sellner, B. M., Hua, G., & Amiri, S. (2016, November). Combined treatment of nitrogen and phosphorus from subsurface drainage using low-cost industrial by-products and woodchip bioreactors. Presented at the ASA, CSSA, and SSSA International Annual Meeting. <https://scisoc.confex.com/scisoc/2015am/webprogram/Paper94856.html>
10. Strock, J. S., Magner, J., Garcia y Garcia, A., Dalzell, B. J., Trooien, T. P., Hay, C., & Sands, G. (2016, November). Hydrologic impacts of agricultural drainage in the Upper Midwest, USA. Presented at the ASA, CSSA, and SSSA International Annual Meeting. <https://scisoc.confex.com/scisoc/2015am/webprogram/Paper94039.html>
11. Jacobson, R. B., Galat, D. L., & Hay, C. H. (2005). Process and prospects for the designed hydrograph, lower Missouri River, Eos Trans. AGU, 86(18), Jt. Assem. Suppl., Abstract NB23C-04.

Conference Presentations without Proceedings Paper or Published Abstract

49 scientific conference presentations without proceedings paper or published abstract as author or co-author since 2005

Invited Presentations

1. Hay, C. H. (2026, Jan.). Managing water for crop production and water quality. South-West Agricultural Conference. Ontario Agricultural Conferences, Ridgetown, Ontario.
2. Hay, C. H. (2025, Jun.). Drainage water recycling for crop production and water quality. State of the Western Lake Erie Basin Conference. University of Michigan Graham Sustainability Institute, Adrian, Michigan.
3. Hay, C. H. (2025, Jan.). Managing water for crop production and water quality. CCA Conference. Ontario Certified Crop Advisor Association, London, Ontario.
4. Coleman, A., Hay, C., Clutterbuck, B., & Reinders, H. (2024, Jan.). Ag water management: Common problems & collaborative solutions. Invited panelist for panel session at the Land Improvement Contractors of Ontario and Drainage Superintendents Association of Ontario Drainage Conference, London, Ontario.
5. Hay, C. (2024, Jan.). Conservation drainage workshop. Land Improvement Contractors of Ontario Drainage Conference, London, Ontario.
6. Hay, C. H. (2023, Jul.). Conservation drainage research and industry: Transforming the edge-of-field in Iowa and beyond. Presented as part of an invited session at the American Society of Agricultural and Biological Engineers Annual International Meeting, Omaha, Neb.
7. Hay, C. H., Bowling, L. C., Helmers, M. J., & Nelson, K. A. (2021, Nov.). Recycling drainage water for crop production and water quality. Poster presented at the ASA, CSSA, SSSA International Annual Meeting, Salt Lake City, UT. <https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/132892>
8. Helmers, M. J., & Hay, C. H. (2021, Nov.). Controlled drainage for nitrate reduction and crop benefits. Poster presented at the ASA, CSSA, SSSA International Annual Meeting,

Salt Lake City, UT. <https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/132869>

9. Hay, C. (2019, Nov.). Scaling up edge-of-field denitrification practice adoption: A grand challenge. Presented as part of the ASA Environmental Quality Megaposium–Cross-Cutting Issues in Environmental Quality at the ASA-CSSA-SSSA International Annual Meeting, San Antonio, Texas. <https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/119992>
10. Hay, C. (2018, Dec.). Conservation drainage and infrastructure. Presented as part of an invited session at the North Central Region One Water Action Forum, Indianapolis, Ind.
11. Hay, C., Reinhart, B., Frankenberger, J., Bowling, L., & Helmers, M. (2018, Aug.). Yield benefits of drainage water recycling in Iowa and Indiana. Presented as part of an invited session at the American Society of Agricultural and Biological Engineers Annual International Meeting, Detroit, Mich.
12. Hay, C. (2017, Sept.). Nitrogen reduction practices: Overview, relative performance, and economic considerations. Presented at the Technical Service Provider Network Annual Meeting, Urbandale, Iowa.
13. Hay, C. (2016, Nov.). Iowa Nutrient Reduction Strategy: A coordination strategy for reducing nutrient loading and improving water quality. Presented at Iowa One Health Conference, Iowa City, Iowa.
14. Hay, C., & Wolf, R. (2016, Oct.). Iowa Nutrient Reduction Strategy: A coordination strategy for reducing nutrient loading and improving water quality. Presented at ASCE Quad Cities Section and SAME Rock Island Post Engineering Training Conference, Davenport, Iowa.
15. Hay, C., Khand, K., & Kjaersgaard, J. (2016, April). Estimating impacts of subsurface drainage on ET using remote sensing. Iowa Flood Center seminar, Iowa City, Iowa.
16. Hay, C. (2013, May). Ag. subsurface drainage: A change in the SD landscape. South Dakota Engineering Society Annual Conference. Sioux Falls, S.D.
17. Hay, C. (2013, Feb.). Agricultural water management and GISc. SDSU Geographic Information Science Center Seminar. Brookings, S.D.
18. Hay, C. H. (2011, Dec.). Agricultural subsurface drainage: History, fundamentals, benefits, and impacts. Altered Landscape Hydrology: Impacts to Rivers and Streams and Associated Biota symposium at the Midwest Fish & Wildlife Conference, Des Moines, Iowa.
19. Hay, C. H. (2010, Nov.). Regional precipitation and evapotranspiration patterns: Impacts on agricultural water management. Minnesota-Iowa Drainage Research Forum, Owatonna, Minn.
20. Hay, C. H. (2006, Oct.). Fish and invertebrate abundance in relation to abiotic factors in the Missouri River. Missouri River Natural Resources Committee Fall Meeting. Pierre, S.D.

21. Hay, C. H. (2004, July). Hydrologic variability of modeled lower Missouri River Flows and Fish and invertebrate abundances in relation to hydrology, temperature, and turbidity in the Missouri River between Ft. Randall, SD and Rulo, NE. University of Missouri-Columbia Department of Fisheries and Wildlife Sciences and USGS Columbia Environmental Research Center, Columbia, Mo.

Outreach and Extension Publications

Books Edited or Co-Edited

1. Clay, D.E., Carlson, C. G., Clay, S. A., Wagner, L., Deneke, D., & Hay C. (eds). (2013). *iGrow Soybeans: Best Management Practices for Soybean Production*. Brookings, S.D.: South Dakota State University, SDSU Extension.

Publications

1. Hay, C. H. (2025). Maintaining the edge: A quick guide to saturated buffer and bioreactor management. Ankeny, Iowa: Iowa Soybean Association.
2. Hay, C. H. & Helmers, M. (2025). Drainage water recycling increases and crop yield and improves water quality in Iowa. Ankeny, Iowa: Iowa Soybean Association.
3. Hay, C. & Helmers, M. (2024). Drainage water recycling for crop production and water quality in Iowa. Ankeny, Iowa: Iowa Soybean Association.
4. Reinhart, B., Frankenberger, J., Ghane, E., Hay, C., McMaine, J., & Abendroth, L. (2021). Tools to inform and transform drainage. Pub. ABE-164. West Lafayette, Ind.: Purdue Extension. <https://www.extension.purdue.edu/extmedia/ABE/ABE-164-W.pdf>
5. Conservation Learning Group. (2020). Whole farm conservation best practices manual. Pub. CLG105. Ames, Iowa: Iowa State University Extension and Outreach. (co-authored edge-of-field practices that work section) <https://store.extension.iastate.edu/product/15823>
6. Jaynes, D., Reinhart, B., Hay, C., Isenhardt, T., Jacquemin, S., Kjaersgaard, J., Nelson, K., & Utt, N. (2018). Questions and answers about saturated buffers for the Midwest. Pub. ABE-160. West Lafayette, Ind.: Purdue Extension. <https://www.extension.purdue.edu/extmedia/ABE/ABE-160.pdf>
7. Christianson, L.E., Frankenberger, J., Hay, C., Helmers, M. J., & Sands, G. (2018). Ten ways to reduce nitrogen loads from drained cropland in the Midwest: A summary fact-sheet. Urbana, Ill.: University of Illinois Extension. <http://draindrop.cropsci.illinois.edu/wp-content/uploads/2016/09/ten-ways-factsheet-summary-FINAL.pdf>
8. Frankenberger, J., Reinhart, B., Nelson, K., Bowling, L., Hay, C., Youssef, M., Strock, J., Jia, X., Helmers, M., & Allred, B. (2017). Questions and answers about drainage water recycling for the Midwest. Pub. ABE-156. West Lafayette, Ind.: Purdue Extension. <https://transformingdrainage.org/wp-content/uploads/2017/04/ABE-156-W.pdf>
9. Hay, C. (2016). Reducing nitrate losses from drained lands. In D. E. Clay, C. G. Carlson, S. A. Clay, & E. Byamukama (Eds). *iGrow Corn: Best Management Practices for Corn Production*

- (pp. 31-1–31-7). Brookings, S.D.: South Dakota State University. <http://igrow.org/up/resources/03-5000-2016-31.pdf>
10. Hay, C. & Trooien, T. (2016). Managing high water tables in corn production. In D. E. Clay, C. G. Carlson, S. A. Clay, & E. Byamukama (Eds). *iGrow corn: Best Management Practices for Corn Production* (pp. 30-1–30-8). Brookings, S.D.: South Dakota State University. <http://igrow.org/up/resources/03-5000-2016-30.pdf>
 11. Ostrem, D., Trooien, T., & Hay, C. (2016). Irrigating corn in South Dakota. In D. E. Clay, C. G. Carlson, S. A. Clay, & E. Byamukama (Eds). *iGrow corn: Best Management Practices for Corn Production* (pp. 33-1–33-13). Brookings, S.D.: South Dakota State University. <http://igrow.org/up/resources/03-5000-2016-33.pdf>
 12. Christianson, L.E., Frankenberger, J., Hay, C., Helmers, M. J., & Sands, G. (Eds.). (2016). Ten ways to reduce nitrogen loads from drained cropland in the Midwest. Pub. C1400. Urbana, Ill.: University of Illinois Extension. http://draindrop.cropsci.illinois.edu/wp-content/uploads/2016/09/Ten-Ways-to-Reduce-Nitrate-Loads_IL-Extension-_2016.pdf
 13. Garcia, A., Darrington, J., Cortus, E., Troelstrup, N., Thaler, B., Van der Sluis, E., Taylor, G., & Hay, C. (2015). Livestock development in South Dakota. Publication 02-2005-2015. Brookings, S.D.: SDSU Extension. <http://igrow.org/up/resources/02-2005-2015.pdf>
 14. Hay, C., & Kjaersgaard, J. (2014). Storing water for emergency use. Publication 07-2002-2014. Brookings, S.D.: SDSU Extension. <http://igrow.org/up/resources/07-2002-2014.pdf>
 15. Scherer, T., Kandel, H., Sands, G., & Hay, C. (2013). Frequently asked questions about subsurface (tile) drainage. NDSU Extension Publication AE1690. Fargo, N.D.: NDSU Extension Service. <https://www.ag.ndsu.edu/pubs/ageng/irrigate/ae1690.pdf>
 16. Sands, G. R., Hay, C., Kandel, H., & Scherer, T. (2013). Frequently asked questions about subsurface (tile) drainage in the Red River Valley. Minneapolis, Minn.: University of Minnesota Extension.
 17. Hay, C., Kjaersgaard, J., & Trooien, T. (2013). Managing high water tables and saline seeps in soybean production. In D. E. Clay, C.G. Carlson, S.A. Clay, L. Wagner, D. Deneke, and C. Hay (eds). *iGrow Soybeans: Best Management Practices for Soybean Production*. Brookings, S.D.: South Dakota State University, SDSU Extension.
 18. Hay, C., Kjaersgaard, J., & Trooien, T. (2013). Soybean irrigation. In D. E. Clay, C. G. Carlson, S. A. Clay, L. Wagner, D. Deneke, and C. Hay (eds). *iGrow Soybeans: Best Management Practices for Soybean Production*. Brookings, S.D.: South Dakota State University, SDSU Extension.
 19. Hay, C., & Trooien, T. P. (2012). Managing high water tables and saline seeps in wheat production. In D. E. Clay, C.G. Carlson, and K. Dalsted (eds). *iGrow Wheat: Best Management Practices for Wheat Production*. Brookings, S.D.: South Dakota State University, SDSU Extension.
 20. Hay, C. (2012). Agricultural drainage fact sheet. Publication 07-1001-2012. Brookings, S.D.: SDSU Extension. <http://igrow.org/up/resources/07-1001-2012.pdf>

21. Walker, J., & Hay, C. (2012). How to measure total dissolved solids using a portable conductivity meter. Publication 02-2039-2012. Brookings, S.D.: SDSU Extension. <http://igrow.org/up/resources/02-2039-2012.pdf>
22. Kjaersgaard, J., Cortus, E., & Hay, C. (2012). Nitrates in South Dakota drinking water. Publication 07-2000-2012. Brookings, S.D.: SDSU Extension. <http://igrow.org/up/resources/07-2000-2012.pdf>
23. Kjaersgaard, J., Todey, D., Hay, C., & Trooien, T. (2012). Watershed management. Publication 03-2002-2012. Brookings, S.D.: SDSU Extension. <http://igrow.org/up/resources/03-2002-2012.pdf>

Articles

1. Hay, C. (2024, February). Crop yield and water quality benefits of drainage water recycling. *Iowa Soybean Review*, 20–21.
2. Hay, C. & Seeman, A. (2020, April). Science of water monitoring: ISA lab trusted source of data. *Iowa Soybean Review*, 12–13.
3. Hay, C.. (2017, January). How much nitrogen reduction does \$125 million buy? *Iowa Soybean Review*, 22–23.
4. Hay, C. (2016, October 6). International Drainage Symposium highlights ag drainage solutions. ISA Research Advance. Ankeny, IA: Iowa Soybean Association.
5. Hay, C. (2016, September 22). 10 ways to reduce nitrogen loads from drainage — No. 6 will shock you!. ISA Research Advance. Ankeny, IA: Iowa Soybean Association.
6. Hay, C. (2016, May 5). Transforming drainage for greater resiliency. ISA Research Advance. Ankeny, IA: Iowa Soybean Association.
7. Hay, C. (2016, Feb. 11). Conservation drainage strategies for Iowa. ISA Research Advance. Ankeny, IA: Iowa Soybean Association.
8. Blachford, S., Hay, C., Burrows, R., Zdorovstov, C., & Goodman, J. (2014, Feb. 7) Water permits for local food producers. Brookings, S.D.: SDSU Extension. <http://igrow.org/community-development/local-foods/water-permits-for-local-food-producers/>
9. Sands, G. R., Hay, C., Kandel, H., & Scherer, T. (2013, July 24). Water management. In *North Dakota State University Crop & Pest Report*, No. 12. NDSU Extension.
10. Hay, C. H. (2012, May 7). Drain spacing calculations. Brookings, SD: SDSU Extension. <http://igrow.org/agronomy/corn/drain-spacing-calculations/>
11. Hay, C. H. (2012, May 21). New tile drainage research projects beginning. Brookings, SD: SDSU Extension. <http://igrow.org/agronomy/corn/new-tile-drainage-research>
12. Hay, C. H. (2012, June 10). Crop water use estimates. Brookings, SD: SDSU Extension. <http://igrow.org/agronomy/corn/crop-water-use-estimates/>
13. Hay, C. H. (2011, Nov. 28). Drainage management for production and environment. Brookings, SD: SDSU Extension. <http://igrow.org/agronomy/corn/drainage-management-for-production-environment/>

14. Hay, C. H. (2011, Dec. 21). Evaluating tile drainage—design. Brookings, SD: SDSU Extension. <http://igrow.org/agronomy/corn/evaluating-tile-drainage-design/>

Websites

1. Control Structure Stoplog Settings. <https://analytics.iasoybeans.com/cool-apps/StopLogHeight/>
2. Transforming Drainage Rate Calculators. https://analytics.iasoybeans.com/cool-apps/TD_DrainageCalculators/
3. Ten Ways to Reduce Nitrogen Loads from Drained Cropland in the Midwest. <https://erc.cals.wisc.edu/ten-ways/>
4. iGrow Drainage Calculators. <http://www.igrowdrainage.org>
5. SDSU Drain Spacing Calculator. (Superseded). Established 16 Mar. 2012. The website received 4,416 page views (3,633 unique) from 16 March 2012 to 28 Sept. 2014. Sixteen percent of site traffic was from S.D., and traffic came from 49 U.S. states and the District of Columbia, 8 Canadian provinces, and 83 countries.

Online Training Modules

1. Drainage Water Management: Level 2, Module 7—Drainage Water Management Operation and Management. Available at: <http://www.forestrywebinars.net/webinars/dwm-module-2-7>. Posted 18 Nov. 2014.
2. Drainage Water Management: Level 2, Module 2—Basic Drainage Concepts, Tools and Resources. Available at: <http://www.forestrywebinars.net/webinars/dwm-module-2-2>. Posted 17 March 2014.

Webinars

1. Economic analysis of drainage water recycling systems. Iowa Learning Farms Webinar. Available at: <https://vimeo.com/showcase/10108315?video=1138635778>. Posted 19 Nov. 2025.
2. Drainage water recycling. North Central Region Water Network The Current webinar series. Available at: https://www.youtube.com/watch?v=2QV-_RlTXic. Posted 20 Feb. 2025.
3. Edge-of-field webinar: Batch and BUILT! Helping farmers manage their edge-of-field practices. Soil and Water Conservation Society, the Agriculture Drainage Management Coalition, and Christopher Hay Consulting. Available at: [Webinar link](#). Delivered 24 Oct. 2024.
4. Conservation drainage: Combining water management and water quality. Canadian National Committee on Irrigation and Drainage webinar. Available at: <https://cwra.org/may-7-2024-12-pm-cst-cancid-agm-and-webinar-conservation-drainage/>. Posted 7 May 2024.

5. Innovations in agricultural water reuse: Successes, challenges, and funding opportunities. WaterReuse Association webcast. Available at: [Webinar link](#). Posted 22 Jun. 2023.
6. Utilizing drainage water recycling to improve water quality and manage weather risk. Iowa Learning Farms virtual field day. Available at: https://youtu.be/hl2Dn_L3N0s. Posted 8 Dec. 2022.
7. Drainage water recycling for crop production and water quality. Iowa Soybean Association Innovation to Go webinar series. Available at: <https://youtu.be/DhtU17MCbL8>. Posted 2 Aug. 2022.
8. Controlled drainage & sub-irrigation: Drainage for the control freak. Drainage Contractor drainage innovation webinar series. Available at: <https://www.drainagecontractor.com/webinars/drainage-innovation-webinar-series/>. Posted 9 Feb. 2022.
9. Combination systems: Surface drainage? Sub-surface? or both? Drainage Contractor drainage innovation webinar series. Available at: <https://www.drainagecontractor.com/webinars/drainage-innovation-webinar-series/>. Posted 7 Dec. 2021.
10. Improving bioreactor design and performance. Iowa Learning Farms virtual field day. Available at: https://youtu.be/_RZgyA6IAoo. Posted 17 Jun. 2021.
11. Recycling drainage water for multiple benefits. North Central Region Water Network The Current webinar series. Available at: <https://youtu.be/dwGhdGlXExo>. Posted 9 Dec. 2020.
12. Choosing an Edge-of-Field Practice: Decision Trees Can Help. Iowa Learning Farms webinar series. Available at: <https://vimeo.com/user42671352/review/466218437/756175c2f0>. Posted 8 Oct. 2020.
13. Drainage Water Recycling: An Emerging Conservation Drainage Practice. Iowa Learning Farms webinar series. Available at: <https://vimeo.com/user42671352/review/343282220/d85c9f5560>. Posted 19 June 2019.
14. Nitrogen Management in Tile Drained Landscapes - The Current 27. North Central Region Water Network webinar series. Available at: https://youtu.be/ks4y_vlIz7I. Posted 23 April 2017.
15. Managing Agricultural Drainage Water: The Current Webinar 8. North Central Region Water Network The Current webinar series. Available at: <https://youtu.be/VxDTd3bC8Vs>. Posted 4 June 2015.

Videos

1. Maintaining the edge: Stoplogs and control structures. Available at: https://youtu.be/eNBN_-MPGcE
2. Maintaining the edge: Control structure management. Available at: <https://youtu.be/FdvbCIRRIvE>
3. Maintaining the edge: Managing stoplog settings. Available at: <https://youtu.be/BT54h5fdcJM>

4. Maintaining the edge: Bioreactor management. Available at: https://youtu.be/TAnqhJCU6_E
5. Maintaining the edge: Saturated buffer management. Available at: <https://youtu.be/KUXOlaoFc4>
6. Maintaining the edge: Monitoring edge-of-field practices. Available at: <https://youtu.be/tQs-Nl7Q0gQ>
7. Edge of field demonstration: How to manage your water control structure. Available at: <https://vimeo.com/1023065408?share=copy>
8. Drainage water recycling: Behind the scenes. Available at: <https://youtu.be/z7mnNi61bow>
9. International Drainage Symposium tour day. Available at: <https://youtu.be/QFdOP-UrTT0>
10. Managing water for crop production, water quality, and other values. Iowa Soybean Association Innovation to Profit series. Available at: <https://youtu.be/QjY35KcK4oI>
11. Edge of Field Practices to Reduce Nutrient Losses. Iowa Soybean Association 4R's for Increased Profitability series. Available at: <https://youtu.be/vlrRXjhHdk>

Podcasts

1. Maximizing the economic benefits of drainage water. Pods of Potential podcast. Available at: <https://www.podbean.com/ep/pb-kwzzx-1781015>. Posted 23 Dec. 2024.
2. Drainage water recycling: Creating resiliency amidst dwindling resources. The Water Table podcast. Available at: <https://www.watertable.ag/podcast/drainage-water-recycling-creating-resiliency-amidst-dwindling-resources/>. Posted 29 Oct. 2024.
3. Focus on Drainage: Drainage water recycling. AgAnnex Talks podcast. Available at: <https://player.captivate.fm/episode/7ab3d269-74af-4a7b-99c4-dfc9d16df931>. Posted 12 Jul. 2024.
4. Improving water quality with saturated buffers. Pods of Potential podcast. Available at: <https://www.podbean.com/ep/pb-bi9zd-155a81a>. Posted 25 Jan. 2024.
5. GroundBreakers Episode 3 - Chris Hay. AgAnnex Talks podcast. Available at: <https://agannex-talks.captivate.fm/episode/groundbreakers-episode-3-chris-hay>. Posted 27 Jul. 2023.
6. Conservation Drainage Complexities 2. SDSU Extension Streamlines podcast. Available at: <https://extension.sdstate.edu/sites/default/files/2021-07/PC-00001-S01E002-Conservation-Drainage-P2.mp3>. Posted 21 Jul. 2021.
7. Conservation Drainage Complexities 1. SDSU Extension Streamlines podcast. Available at: <https://extension.sdstate.edu/sites/default/files/2021-07/PC-00001-S01E001-Conservation-Drainage-P1.mp3>. Posted 13 Jul. 2021.

8. What is drainage water recycling. ISA Research Spotlight. Available at: <https://www.iasoybeans.com/newsroom/audio/what-is-drainage-water-recycling>. Posted 18 May 2021.
9. Understanding Conservation Drainage. Iowa Soybean Association podcasts. Available at: <https://soundcloud.com/user-386850872/episode-14-conservation-drainage>

Outreach and Extension Activities

Outreach and Extension Meetings and Events Organized

1. 24th Annual Iowa-Minnesota-South Dakota Drainage Research Forum, 9 to 10 Sept. 2025, Brookings, SD. Coordinated with Matt Helmers (Iowa State University), Jeppe Kjaersgaard (Minnesota Department of Agriculture), Gary Sands and Lindsay Pease (University of Minnesota), and Sushant Mehan, Todd Trooien, and John Maursetter (South Dakota State University).
2. 23rd Annual Iowa-Minnesota-South Dakota Drainage Research Forum, 5 Sept. 2024, Ames, IA. Coordinated with Matt Helmers (Iowa State University), Gary Sands and Lindsay Pease (University of Minnesota), and Sushant Mehan (South Dakota State University).
3. 22nd Annual Iowa-Minnesota-South Dakota Drainage Research Forum, 20–21 Jul. 2023, Crookston, MN. Coordinated with Matt Helmers (Iowa State University), Gary Sands and Lindsay Pease (University of Minnesota), and John McMaine (South Dakota State University).
4. 21st Annual Iowa-Minnesota-South Dakota Drainage Research Forum, 23 Nov. 2021, Ames, IA and virtual. Coordinated with Matt Helmers (Iowa State University), Gary Sands and Lindsay Pease (University of Minnesota), and John McMaine (South Dakota State University).
5. Conservation Drainage Network Annual Meeting, 7–8 April 2021, virtual meeting. Served on planning committee for the meeting.
6. 20th Annual Iowa-Minnesota-South Dakota Drainage Research Forum, 1 Dec. 2020, virtual. Coordinated with Matt Helmers (Iowa State University), Gary Sands and Lindsay Pease (University of Minnesota), and John McMaine (South Dakota State University). Attendance was 286 (minimum of 1 hr.). Registrants from 18 states, 3 Canadian provinces, and 7 countries.
7. Conservation Drainage Network Annual Meeting, 3–4 June 2020, virtual meeting. Served on planning committee for the meeting. Attendance was 165 people attending from 17 states and 6 countries.
8. 19th Annual Iowa-Minnesota-South Dakota Drainage Research Forum, 26 Nov. 2019, Brookings, S. D. Coordinated with Matt Helmers (Iowa State University), Gary Sands (University of Minnesota), and John McMaine (South Dakota State University). Attendance was approximately 60 consisting of producers, contractors, and industry and agency representatives from Iowa, Minnesota, and South Dakota.

9. Watershed Applications of the Agricultural Conservation Planning Framework, 1–2 April 2019, Nashua, Iowa. Coordinated with Jamie Benning (Iowa State University), Ann Lewandowski (Minnesota Water Resources Center), Adam Kiel (Iowa Soybean Association), Joe Magner (University of Minnesota), and Andy Asell (Iowa Department of Natural Resources). Attendance was approximately 35 consisting primarily of watershed coordinators.
10. ISA Research Farmer Research Tour, 5, 7, and 9 Feb. 2019, Storm Lake, Ames, and Cedar Rapids, Iowa. Served on technical program team. Total attendance was approximately 230.
11. 18th Annual Iowa-Minnesota-South Dakota Drainage Research Forum, 13 Nov. 2018, Owatonna, Minn. Coordinated with Matt Helmers (Iowa State University), Gary Sands (University of Minnesota), and John McMaine (South Dakota State University). Attendance was approximately 75 consisting of producers, contractors, and industry and agency representatives from Iowa, Minnesota, and South Dakota.
12. ISA Farmer Research Conference, 6–7 Feb. 2018, Des Moines, Iowa. Served as program chair for the Environmental Programs and Services team on the technical program team. Attendance was approximately 460 consisting of farmers, agronomists, agency staff, academics, students, and industry representatives.
13. 17th Annual Iowa-Minnesota Drainage Research Forum, 15 Nov. 2017, Ames, Iowa. Coordinated with Matt Helmers (Iowa State University) and Gary Sands (University of Minnesota). Attendance was approximately 90 consisting of producers, contractors, and industry and agency representatives from Iowa and Minnesota.
14. Drainage Water Quality Practices Design Workshop, 15 Dec. 2016, Ft. Dodge, Iowa. Coordinated with Kapil Arora and Matt Helmers (Iowa State University) and Dan Jaynes (USDA-ARS). Attendance was 35 consisting of contractors, engineers, and watershed coordinators.
15. Conservation drainage practice tour in Boone River watershed (Iowa), 5 Sept. 2016. Coordinated with Matt Helmers (Iowa State University). Attendance was 19 people from the Danish delegation to the International Drainage Symposium.
16. Extension Subsurface Drainage Design and Water Management Workshop, 10–11 March 2015, Grand Forks, N. D. Coordinated with Tom Scherer and Hans Kandel (North Dakota State University). Attendance was 64 consisting primarily of producers and contractors. Nine industry partners provided financial support.
17. Extension Subsurface Drainage Design and Water Management Workshop, 24–25 Feb. 2015, St. Cloud, Minn. Coordinated with Brad Carlson (University of Minnesota), Matt Helmers (Iowa State University), and Tom Scherer and Hans Kandel (North Dakota State University). Attendance was 41 consisting primarily of producers and contractors. Four industry partners provided financial support.
18. Extension Subsurface Drainage Design and Water Management Workshop, 17–18 Feb. 2015, Sioux Falls, S. D. Coordinated with Brad Carlson (University of Minnesota), Matt Helmers (Iowa State University), and Tom Scherer and Hans Kandel (North Dakota State University). Attendance was 30 consisting primarily of producers and contractors. Four industry partners provided financial support.

19. 15th Annual Iowa-Minnesota-South Dakota Drainage Research Forum, 18 Nov. 2014, Ames, Ia. Coordinated with Matt Helmers (Iowa State University) and Gary Sands (University of Minnesota). Attendance was approximately 100 consisting of producers, contractors, and industry and agency representatives from Iowa, Minnesota, and South Dakota.
20. Drainage Water Management Level 2 Workshop, 28 Oct. 2014, Brookings, S.D. Coordinated with Michelle Burke (USDA NRCS) and Matt Helmers (Iowa State University). Attendance was 30 USDA NRCS staff.
21. Drainage Water Management Level 2 Workshop, 24 Sept. 2014, Jamestown, N.D. Coordinated with Christi Fisher and Erica Althoff (USDA NRCS) and Tom Scherer (North Dakota State University). Attendance was 23 USDA NRCS staff.
22. Drainage Water Management Level 2 Workshop, 23 Sept. 2014, Jamestown, N.D. Coordinated with Christi Fisher and Erica Althoff (USDA NRCS) and Tom Scherer (North Dakota State University). Attendance was 31 USDA NRCS staff.
23. Drainage Water Management Level 2 Workshop, 9 Sept. 2014, Waseca, Minn. Coordinated with Lea Holter (USDA NRCS) and Gary Sands (University of Minnesota). Attendance was 36 USDA NRCS staff.
24. Drainage Water Management Level 2 Workshop, 30 July 2014, Pocahontas, Iowa. Coordinated with Bruce Atherton (USDA NRCS) and Matt Helmers (Iowa State University). Attendance was 14 USDA NRCS staff.
25. Drainage Water Management Level 2 Workshop, 22 July 2014, Saginaw, Mich. Coordinated with Tom Bourdon and Rick Woodford (USDA NRCS) and Larry Brown (Ohio State University). Attendance was 16 USDA NRCS staff.
26. Drainage Water Management Level 2 Workshop, 29 May 2014, Portage, Wis. Coordinated with John Ramsden (USDA NRCS) and Gary Sands (University of Minnesota). Attendance was 25 USDA NRCS staff.
27. Extension Subsurface Drainage Design and Water Management Workshop, 18–19 March 2014, Owatonna, Minn. Coordinated with Gary Sands and Brad Carlson (University of Minnesota). Attendance was approximately 50 consisting primarily of producers and contractors. Seven industry partners provided financial support.
28. Extension Subsurface Drainage Design and Water Management Workshop, 5–6 March 2014, Crookston, Minn. Coordinated with Gary Sands and Brad Carlson (University of Minnesota) and Tom Scherer (North Dakota State University). Attendance was approximately 60 consisting primarily of producers and contractors. Seven industry partners provided financial support.
29. Extension Subsurface Drainage Design and Water Management Workshop, 11–12 Feb. 2014, Wahpeton, N.D. Coordinated with Gary Sands (University of Minnesota) and Tom Scherer (North Dakota State University). Attendance was approximately 50 consisting primarily of producers and contractors. Eight industry partners provided financial support.
30. Extension Subsurface Drainage Design and Water Management Workshop, 29–30 Jan. 2014, Sioux Falls, S.D. Coordinated with Gary Sands (University of Minnesota)

and Tom Scherer (North Dakota State University). Attendance was approximately 45 consisting primarily of producers and contractors. Four industry partners provided financial support.

31. 14th Annual Iowa-Minnesota-South Dakota Drainage Research Forum, 14 November 2013, Sioux Falls, S.D. Coordinated with Matt Helmers (Iowa State University) and Gary Sands (University of Minnesota). Attendance was approximately 70 consisting of producers, contractors, and industry and agency representatives from Iowa, Minnesota, and South Dakota.
32. 14th Annual Iowa-Minnesota-South Dakota Drainage Research Forum, 14 Nov. 2013, Sioux Falls, S.D. Coordinated with Matt Helmers (Iowa State University) and Gary Sands (University of Minnesota). Attendance was approximately 70 consisting of producers, contractors, and industry and agency representatives from Iowa, Minnesota, and South Dakota.
33. Big Sioux Water Festival, 7 May 2013, Brookings, S.D. Served as facilities chair on the festival organizing committee. Attended by over 1000 fourth graders.
34. NCERA 217 (Drainage design and management practices to improve water quality) and Agricultural Drainage Management Systems Task Force joint meeting, 9–11 April 2013, Sioux Falls, S.D. Coordinated with Jeppe Kjaersgaard (SDSU), Jane Frankenberger (Purdue University) and Paul Sweeney (USDA-NRCS). Attendance was 47 consisting of academics, industry and agricultural group representatives, government officials and agency personnel.
35. SD-MN-ND Extension Subsurface Drainage Design and Water Management Workshop, 27–28 Feb. 2013, Aberdeen, SD. Coordinated with Gary Sands (University of Minnesota) and Tom Scherer (North Dakota State University). Attendance was 75 consisting primarily of producers and contractors.
36. MN-ND-SD Extension Subsurface Drainage Design and Water Management Workshop, Moorhead, MN. 12–13 Feb. 2013. Coordinated with Gary Sands (University of Minnesota) and Tom Scherer and Hans Kandel (North Dakota State University). Attendance was 80 consisting primarily of producers and contractors.
37. 13th Annual IA-MN-SD Drainage Research Forum, 20 Nov. 2012, Waseca, MN. Coordinated with Gary Sands (University of Minnesota) and Matt Helmers (Iowa State University). Attendance was 60 consisting of producers, contractors, and industry and agency representatives from Iowa, Minnesota, and South Dakota.
38. MN-SD Extension Subsurface Drainage Design Workshop, 13–14 March 2012, Mankato, MN. Coordinated with Gary Sands and Brad Carlson (University of Minnesota). Attendance was 50 consisting primarily of producers and contractors.
39. MN-ND-SD Extension Subsurface Drainage Design Workshop, 23–24 Feb. 2012, Wahpeton, ND. Coordinated with Gary Sands (University of Minnesota) and Tom Scherer and Hans Kandel (North Dakota State University). Attendance was 50 consisting primarily of producers and contractors.
40. MN-ND-SD Extension Subsurface Drainage Design Workshop, 21–22 Feb. 2012, Wahpeton, ND. Coordinated with Gary Sands (University of Minnesota) and Tom Scherer

and Hans Kandel (North Dakota State University). Attendance was 50 consisting primarily of producers and contractors.

41. SD-MN-ND Extension Drainage and Water Management Design Workshop, 2–3 Feb. 2012, Sioux Falls, SD. Coordinated with Gary Sands (University of Minnesota) and Tom Scherer (North Dakota State University). Attendance was 50 consisting primarily of producers and contractors.
42. SD-MN-ND Extension Drainage and Water Management Design Workshop, 31 Jan.–1 Feb. 2012, Sioux Falls, SD. Coordinated with Gary Sands (University of Minnesota) and Tom Scherer (North Dakota State University). Attendance was 50 consisting primarily of producers and contractors.
43. 12th Annual IA-MN-SD Drainage Research Forum, 22 Nov. 2011, Okoboji, IA. Coordinated with Matt Helmers (Iowa State University) and Gary Sands (University of Minnesota). Attendance was 95 consisting of producers, contractors, and industry and agency representatives from Iowa, Minnesota, and South Dakota.
44. SD-MN Subsurface Drainage Design Workshop, 23 March 2011, Sioux Falls, SD. Coordinated with Gary Sands (University of Minnesota). Attendance was 50 consisting primarily of producers and contractors. 96% of evaluation respondents rated the Sioux Falls workshop as useful or very useful (63% very useful). 71% of respondents rated my soil principles and tools presentation as useful or very useful. Received industry sponsorship from five vendors.
45. MN-ND-SD Subsurface Drainage Design Workshop, 1–2 March 2011, Wahpeton, ND. Coordinated with Gary Sands (University of Minnesota) and Tom Scherer and Hans Kandel (North Dakota State University). Attendance was 50 consisting primarily of producers and contractors.
46. MN-ND-SD Subsurface Drainage Design Workshop, 23–24 Feb. 2011, Wahpeton, ND. Coordinated with Gary Sands (University of Minnesota) and Tom Scherer and Hans Kandel (North Dakota State University). Attendance was 50 consisting primarily of producers and contractors.
47. Tri-State (SD, ND, MN) Agricultural Drainage Forum, 26 Jan. 2011, Brookings, SD. Coordinated with Gary Sands (University of Minnesota) and Tom Scherer (North Dakota State University). Attendance was 180 consisting of producers, contractors, county officials, general public, and industry, conservation group, and agency representatives from South Dakota and Minnesota. 95% of evaluation respondents rated the overall program as good or excellent. 86% rated my drainage fundamentals presentation as useful or very useful.
48. 11th Annual IA-MN Drainage Research Forum, 23 Nov. 2010, Owatonna, MN. Coordinated with Gary Sands (University of Minnesota) and Matt Helmers (Iowa State University). Attendance was 85 participants consisting of producers, contractors, and industry and agency representatives from Iowa, Minnesota, and South Dakota.
49. South Dakota Agricultural Drainage Forum, 16 Sept. 2010, Huron, SD. Coordinated with a team of educators. Attended by over 100 participants consisting of producers, government officials, consultants, and contractors. A majority (56%) of evaluation respondents rated the presentation as excellent. 92% of participants indicated that

they had a better understanding of drainage fundamentals as a result of the forum, which would impact over 38,000 acres. Presentations were recorded and made available via the web. A needs assessment was conducted as part of the program to help guide future drainage programming efforts.

Outreach and Extension Presentations

159 outreach and extension presentations since 2010

Outreach and Extension Service Activities

1. Invited member of the Natural Solutions to Ecological and Economic Problems Caused by Extreme Precipitation Events in the Upper Mississippi River Basin workshop convened by the USGS Midwest Climate Adaptation Science Center. 2023.
2. Invited member of a Blue Ribbon Panel on Irrigation Technologies and Water Use Efficiency to make recommendations to USDA NRCS about irrigation water management practices convened by SWCS. 2022.
3. Invited member of an Edge-of-Field Blue Ribbon Panel to make recommendations to USDA NRCS about how to increase adoption of edge-of-field practices convened by SWCS. 2021.
4. Invited partner for development of an Edge-of-Field Roadmap to scale edge-of-field practice adoption more broadly led by The Nature Conservancy, Soil and Water Conservation Society, and Meridian Institute. 2020.
5. Serve as the nongovernmental organization representative to the Conservation Drainage Network Organizing Committee, 2019 to present.
6. Participated in convening events by the WaterReuse Association to develop Joint Water Sector Comments on the development of the EPA/Federal Agency National Water Reuse Action Plan, 2019.
7. Co-lead, Conservation Drainage Working Group, Conservation Infrastructure Initiative, 2018 to present. The Conservation Infrastructure Initiative, co-led by the Iowa Agriculture Water Alliance and Iowa Department of Agriculture and Land Stewardship, seeks to increase the investment and engagement from both public and private sectors in implementing the Iowa Nutrient Reduction Strategy.
8. Served as the South Dakota representative to the Leadership Team for the North Central Region Water Network—a 12-state collaboration between Extension water resource professionals and university, federal, state, NGO and industry partners, 2013 to 2015.
9. Served on the organizing committee for the annual Big Sioux Water Festival at South Dakota State University that is attended by over 1,000 fourth graders each year, 2010, 2011, 2012, 2013, 2014, and 2015.
10. Member of the Steering Committee for the Eastern South Dakota Water Conference, 2009, 2010, 2011, 2012, 2013, and 2014 (Chair in 2009 and 2010, Vice-Chair in 2011–2014).

Teaching and Advising

Undergraduate Courses Taught

Natural Resources Engineering (ABE 434, SDSU, 2009, 2014)
Independent Study Courses in Natural Resources Engineering (ABE 491, SDSU, 2011)
Special Topics—Natural Resources Engineering (ABE 492, SDSU, 2010)

Graduate Courses Taught

Advanced Hydrology in Agriculture (ABE 732, SDSU 25%, 2014)
Groundwater Engineering in Agriculture (ABE 733, SDSU, 25%, 2010, 2012)
Advanced Irrigation Engineering (ABE 734, SDSU, 25%, 2013)
Theoretical Microclimatology (ABE 752, SDSU, 25%, 2009, 2011, 2013)
Special Topics—Advanced Irrigation Engineering (ABE 792, SDSU, 25%, 2011)
GIS Applications in Watershed Modeling (BSEN 998, UNL, 25%, 2006)

Graduate Student Advising (Major Advisor)

Arturo Reyes-Gonzalez, SDSU (PhD, 2017)
Ashik Sahani, SDSU (MS, 2017)
Govinda Karki, SDSU (PhD, 2017)
Shailendra Singh, SDSU (MS, 2016)
Erick Koech, SDSU (MS, 2015)
Kul Khand, SDSU (MS, 2014)
Brett Hankerson, SDSU (MS, 2013)

Graduate Student Advising (Committee Member)

Eric Henning, ISU (PhD, in progress)
Gabriel Johnson, ISU (PhD, 2025)
Tyler Meyer, ISU (MS, 2023)
Sam Phillips, ISU (MS, 2021)
Benjamin Reinhart, Purdue (MS, 2019)
Philip Schumacher, SDSU (PhD, ABD)
Manashi Paul, SDSU (MS, 2016)
Ferouz Ayadi, SDSU (PhD, 2015)
Karishma Kibria, SDSU (MS, 2015)
Sihan Sun, SDSU (MS, 2015)
Cynthuja Partheeban, SDSU (MS, 2014)
Angelinah Rasoeu, SDSU (MS, 2014)
Gibril Vandy, SDSU (MS, 2014)
Md Rajibul Al Mamun, SDSU (MS, 2012)
Adam Mathiowetz, SDSU (MS, 2011)

Other Contributions to Teaching

1. Filling the Pipeline: Agricultural Drainage Education to Meet 21st Century Water Management Needs. 2023. Developed Module 8: Controlled Drainage available at: <https://transformingdrainage.org/drainage-course/module-8/>. Developed video “Edge of field practice decision trees” as part of Module 12: Conservation Drainage Practice Comparison and Costs available at: <https://transformingdrainage.org/drainage-course/module-12/>.
2. Engineering the Future Workshop. 2015. Co-lead the Agricultural and Biosystems Engineering day of this week-long workshop to help high school science and math teachers incorporate the Next Generation Science Standards engineering principles and standards into their courses. 20 participants.
3. Engineering the Future Workshop. 2014. Co-lead the Agricultural and Biosystems Engineering day of this week-long workshop to help high school science and math teachers incorporate the Next Generation Science Standards engineering principles and standards into their courses. 20 participants.
4. Engineering the Future Workshop. 2012. Co-lead the Agricultural and Biosystems Engineering day of this week-long workshop to help high school science and math teachers incorporate the Next Generation Science Standards engineering principles and standards into their courses. 18 participants.

Professional Society Membership and Service

American Society of Agricultural and Biological Engineers

Meetings Council, NRES Representative (2018–2020)

Led an ad hoc subcommittee to look at improvements to poster sessions

NRES-01 NRES Community Executive Committee, Chair (2017–2018), Vice-Chair (2016–2017), Secretary (2015–2016), Member (2018–2020)

NRES-02 NRES Community Steering Committee, Chair (2017–2018), Vice-Chair (2016–2017), Secretary (2015–2016), Member (2011–2022)

NRES-04 NRES Program Committee, Chair (2016–2017), Vice-Chair (2015–2016), Member (2013–2015)

NRES-09 NRES Forward Planning, Chair (2018–2019), Member (2018–2022)

NRES-23 Drainage Group, Chair (2013–2015), Vice-Chair (2011–2013), Member

EOPD-208 Extension Committee, Chair (2013–2014), Vice-Chair (2012–2013), Secretary (2011–2012)

M-155 Gunlogson Countryside Engineering, Chair (2025–Present), Member

M-152 ADS/Hancor Soil & Water Engineering Award, Member (2017–2020)

M-102 Awards Coordinating, Member

NRES-21 Hydrology Group, Member

NRES-244 Irrigation Management Committee, Member

Professional Engineering Institute, Member

American Society of Agronomy

Managing Denitrification in Agronomic Systems Community, Member

American Society of Civil Engineers

EWRI Drainage and Water Quality Committee, Member

EWRI Evapotranspiration in Irrigation and Hydrology Committee, Member

Gamma Sigma Delta, The Honor Society of Agriculture

SDSU Chapter Secretary 2013–2015

Soil and Water Conservation Society

Professional Conferences or Symposia

Co-chair of the 11th International Drainage Symposium. 30 Aug.–2 Sept. 2022. Des Moines, IA. Attendance was approximately 200 from 22 states and 12 countries.

Program Chair of the 10th International Drainage Symposium. 6–9 Sept. 2016. Minneapolis, Minn. The program featured 134 technical presentations and posters from 10 countries.

Transportation Co-chair for the 2015 NACAA AM/PIC. 12–16 July 2015. Sioux Falls, S. Dak.

Editing and Reviewing

Journal Editor

Guest Associate Editor for the Advances in Drainage: Selected Works from the Tenth International Drainage Symposium special collection in *Transactions of the American Society of Agricultural and Biological Engineers* and *Applied Engineering in Agriculture*.

Journal Reviewer (number of reviews)

Agricultural Water Management (6)

Agronomy Journal (2)

Applied Engineering in Agriculture (6)

Biosystems Engineering (1)

Environmental Monitoring and Assessment (1)

Environmental Technology & Innovation (1)

Field Crops Research (1)

Irrigation Science (1)

Journal of the ASABE (8)

Journal of Environmental Quality (6)

Journal of Hydrology (2)

Journal of Irrigation and Drainage Engineering (1)

Journal of Natural Resources and Agricultural Ecosystems (2)

Journal of Soil and Water Conservation (1)

Proceedings of the South Dakota Academy of Sciences (1)

Transactions of the American Society of Agricultural and Biological Engineers (15)

Others

Review of an Extension publication for Purdue University, 2023
Review of an Extension publication for Iowa State University, 2023
Review of three Extension publications for Michigan State University, 2021
Review of Extension publication for Purdue University, 2021
Review of Extension publication for Michigan State University, 2020
Reviewer of manuscripts for the American Society of Agricultural and Biological Engineers National Decennial Irrigation Symposium, 2020
Review of 4R Plus continuing education course for CCAs, 2018
Review of Extension publication for North Carolina State University, 2018
Review of Extension publication for SDSU Extension, 2017
Reviewer of manuscripts for ASABE Soil and Water Division paper awards, 2012 and 2013
Reviewer of educational aids for the ASABE Educational Aids Competition for Blue Ribbon Awards, 2010 and 2014, and Assistant Judging Coordinator for the medium publication category, 2014 and 2015
Reviewer of manuscripts for the American Society of Agricultural and Biological Engineers National Decennial Irrigation Symposium, 2010
Reviewed a regional Extension publication on energy conservation in irrigation, 2010

Proposal Reviews

Ohio State University College of Food, Agriculture and Environmental Science Internal Grants Program (1)
South Dakota Nutrient Research and Education Council (1)
Iowa Nutrient Research Center (5 primary, 5 secondary, 40 total)
International Arid Lands Consortium (1)
NIWR/USGS 104g program (1)

External Reviews

External review of workplan for a USDA-ARS unit
External review of a promotion packet for University of Minnesota Extension
External review of a promotion and tenure packet for North Dakota State University

University Service (SDSU)

University

University Library Committee 2010–2015
Graduate Faculty Representative (5 Masters, 3 PhD)
Member of the Graduate Faculty 2009–2015
Proposal reviewer for Research and Scholarship Support Fund, 2012

College

Member of five-year administrative review committee for department head, 2015

SDSU representative to the North Central Extension and Research Activity (NCERA) 217: Drainage design and management practices to improve water quality, 2010–2015 (Chair 2013–2014, Secretary 2012–2013)
Departmental faculty representative to the Engineering Phonathon committee, 2009, 2010, 2011

Department

Member of the program committee for the department's hosting of the 2014 North Central ASABE/CSBE meeting
Department representative at Spring Majors Fair, 2012
Spoke to GE 109 class about Agricultural and Biosystems Engineering, 2012 and 2013
Helped develop text and design for ABE recruiting banner, 2012
Edited ABE recruiting fact sheet, 2012
Assisted with departmental Hobo Day alumni luncheon, 2010, 2011, 2012, and 2013
Department representative at Senior Day, 2011
Department holiday party planning committee, 2011
Assisted with the development of new Program Educational Objectives as part of the department's ABET accreditation process, 2009
Assisted with marketing efforts and session scheduling for the department's hosting of the North Central ASABE/CSBE meeting, 2009
Search committee chair for departmental hiring (1 position)
Search committee member for departmental hiring (5 positions)