TOWN OF CASTLE ROCK SERVICES AGREEMENT TO PROVIDE ON-CALL WATER QUALITY CONSULTING SERVICES

DATE: ______, 2019

PARTIES: TOWN OF CASTLE ROCK, a Colorado municipal corporation, 100 N. Wilcox Street, Castle Rock, Colorado 80104 ("Town").

CDM SMITH, INC., a Massachusetts corporation, 555 17th Street, Suite 500, Denver, Colorado 80202 ("Consultant").

RECITALS:

- A. The Town issued a request for proposal seeking qualified professionals with expertise in water quality consulting services ("RFP #2019-04").
 - B. Consultant timely submitted its proposal.
- C. Town wishes to retain Consultant on an on-call basis to provide planning, design engineering and construction administration services as needed.

TERMS:

- **Section 1.** Scope of Services. Consultant shall provide the scope of services as set forth in RFP #2019-04 and as further described in Consultant's proposal attached as *Exhibit 1* ("Services").
- **Section 2.** Request for Services. Town shall issue a request for Services to Consultant for specific projects on an as-needed basis. Consultant, at its option can accept or decline any request. Upon confirming Consultant's availability to undertake the requested Services, the parties shall develop and agree to a scope of work through the form of a task order, attached as *Exhibit 2* ("Task Order").

Nothing in this Agreement shall obligate the Town to use Consultant for any specific project or task. Town, in its sole discretion, shall have the right to utilize other companies or firms for similar services, or in the event Consultant fails to respond to a request for Services, or declines to submit its proposal for a specific task.

Section 3. Term / Renewal. The term of this Agreement shall commence upon its execution and expire December 31, 2019. Provided, this Agreement may be renewed by the parties under the same terms and conditions for up to 2 additional one-year terms. The renewal shall be effected upon the execution of the Renewal Agreement in the form attached as *Exhibit 3*, which shall update the fee/rate schedule, if applicable. The Renewal Agreement must be fully executed prior to the December 31 expiration.

The Town shall have the right to terminate this Agreement at any time with 10 days written notice to Consultant by providing written notice to Consultant of termination. The Town's only obligation in the event of termination shall be payment of fees and expenses incurred up to and including the effective date of termination.

Projects initiated before the expiration of this Agreement shall survive expiration of this Agreement and shall be completed pursuant to the terms of this Agreement unless Town gives Consultant notice of termination of the project.

- Section 4. <u>Payment</u>. Consultant shall invoice Town for the Services rendered under a Task Order at the rates designated in the attached *Exhibit 1*. Consultant shall submit invoices to Town on a monthly basis and Town shall pay such invoices within 30 days of receipt. In no event shall the cumulative payment to Consultant exceed \$50,000 during any term of this Agreement, unless approved in writing by the Town.
- Section 5. <u>Performance of Services</u>. Consultant shall complete the Services for each task in accordance with the agreed upon timeframe set forth in the Task Order. Consultant shall devote adequate resources to assure timely completion of the Services. Consultant shall perform the Services under this Agreement using a standard of care, skill and diligence ordinarily used by reputable professionals performing under circumstances similar to those required by this Agreement.
- **Section 6.** <u>Subcontractors.</u> Consultant may utilize subcontractors to assist with non-specialized work as necessary to complete Task Orders. Consultant will submit any proposed subcontractor and the description of their services to the Town for approval prior to the execution of the Task Order. Consultant shall be solely responsible for payment to such approved subcontractor.
- Section 7. <u>Assignment.</u> This Agreement shall not be assigned by Consultant without the written consent of the Town.
- **Section 8.** Notice. Any notice required or permitted by this Agreement shall be in writing and shall be deemed to have been sufficiently given for all purposes if sent by certified mail or registered mail, postage and fees prepaid, addressed to the party to whom such notice is to be given at the address set forth on the first page of this Agreement, or at such other address as has been previously furnished in writing to the other party or parties. Such notice shall be deemed given when deposited in the United States mail.
- **Section 9.** Prohibition Against Employing Illegal Aliens. Consultant shall not knowingly employ or contract with an illegal alien to perform work under this contract. Consultant shall not enter into a contract with a subcontractor that fails to certify to the Consultant that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this contract.

Consultant has confirmed the employment eligibility of all employees who are newly hired for employment to perform work under the public contract for services through participation in either the E-verify program or the Department program, as defined in C.R.S. §§ 8-17.5-101(3.3) and 8-17.5-101(3.7), respectively. Consultant is prohibited from using the E-verify program or Department program procedures to undertake pre-employment screening of job applicants while this contract is being performed.

If Consultant obtains actual knowledge that a subcontractor performing work under this Agreement for services knowingly employs or contracts with an illegal alien, Consultant shall:

- A. Notify the subcontractor and the Town within three days that the Consultant has actual knowledge that the subcontractor is employing or contracting with an illegal alien; and
- B. Terminate the subcontract with the subcontractor if within three days of receiving notice required pursuant to this paragraph the subcontractor does not stop employee or contracting with the illegal alien; except that the Consultant shall not terminate the contract with the subcontractor if during such three days the subcontractor provides information to establish that the subcontractor has not knowingly employed or contracted with an illegal alien.

Consultant shall comply with any reasonable request by the Department of Labor and Employment made in the course of an investigation that the Department is undertaking pursuant to the authority established in C.R.S. §8-17.5-102(5).

If Consultant violates a provision of this contract required pursuant to C.R.S. §8-17.5-102, Town may terminate the contract for breach of contract. If the contract is so terminated, the Consultant shall be liable for actual and consequential damages to the Town.

- **Section 10.** <u>Insurance.</u> Consultant agrees to procure and maintain, at its own cost, the following policy or policies of insurance. Consultant shall not be relieved of any liability, claims, demands or other obligations assumed pursuant to this Agreement by reason of its failure to procure or maintain insurance, or by reason of its failure to procure or maintain insurance in sufficient amounts, durations, or types.
- A. Consultant shall procure and maintain, and shall cause each subcontractor of the Consultant to procure and maintain, a policy with the minimum insurance coverage listed below. Such coverage shall be procured and maintained with forms and insurers acceptable to the Town. All coverage shall be continuously maintained from the date of commencement of services hereunder. In the case of any claims-made policy, the necessary retroactive dates and extended reporting periods shall be procured to maintain such continuous coverage.
 - 1. Workers Compensation insurance to cover obligations imposed by the Workers Compensation Act of Colorado and any other applicable laws for any employee engaged in the performance of Work under this contract, and Employer's Liability insurance with minimum limits of FIVE HUNDRED THOUSAND

DOLLARS (\$500,000) each accident, FIVE HUNDRED THOUSAND DOLLARS (\$500,000) disease-policy limit, and FIVE HUNDRED THOUSAND DOLLARS (\$500,000) disease-each employee.

- 2. Comprehensive General Liability insurance with minimum combined single limits of ONE MILLION DOLLARS (\$1,000,000) each occurrence and ONE MILLION DOLLARS (\$1,000,000) aggregate. The policy shall be applicable to all premises and operations. The policy shall include coverage for bodily injury, broad form property damage (including for contractual and employee acts), blanket contractual, independent contractors, products, and completed operations. The policy shall contain a severability of interests provision.
- 3. Comprehensive Automobile Liability Insurance with minimum combined single limits for bodily injury and property damage of not less than ONE MILLION DOLLARS (\$1,000,000) each occurrence and ONE MILLION DOLLARS (\$1,000,000) aggregate with respect to each of Contractor's owned, hired and/or non-owned vehicles assigned to or used in performance of the services. The policy shall contain a severability of interests provision.
- 4. Professional Liability insurance with minimum limits of ONE MILLION DOLLARS (\$1,000,000) per claim and ONE MILLION DOLLARS (\$1,000,000) aggregate.
- B. The policies required above, except Workers' Compensation insurance, Employers' Liability insurance and Professional Liability insurance shall be endorsed to include the Town, its officers and employees, as additional insureds. Every policy required above, excluding Workers Compensation and Professional Liability, if applicable, shall be primary insurance, and any insurance carried by the Town, its officers, or its employees, shall be excess and not contributory insurance to that provided by Contractor. The additional insured endorsement for the Comprehensive General Liability insurance required above shall not contain any exclusion for bodily injury or property damage arising from completed operations. The Consultant shall be solely responsible for any deductible losses under each of the policies required above.
- C. Certificates of insurance shall be completed by Contractor's insurance agent as evidence that policies providing the required coverage, conditions and minimum limits are in full force and effect, and shall be subject to review and approval by the Town. Each certificate shall identify the Project and shall provide that coverage afforded under the policies shall not be cancelled, terminated or materially changed until at least 30 days prior written notice has been give to the Town. If the words "endeavor to" appear in the portion of the certificate addressing cancellation, those words shall be stricken from the certificate by the agent(s) completing the certificate. The Town reserves the right to request and receive a certified copy of any policy and any endorsement thereto.
- D. Failure on the part of Consultant to procure or maintain policies providing the required coverage, conditions, and minimum limits shall constitute a material breach of

contract upon which at the Town's discretion may procure or renew any such policy or any extended connection therewith, and all monies so paid by the Town shall be repaid by Consultant to the Town upon demand, or the Town may offset the cost of the premiums against any monies due to Consultant from the Town.

- E. The parties understand and agree that the Town is relying on, and does not waive or intend to waive by any provision of this contract, the monetary limitations (presently \$350,000 per person, \$990,000 per occurrence) or any other rights, immunities, and protections provided by the Colorado Governmental Immunity Act, §24-10-101, et seq., C.R.S., as from time to time amended, or otherwise available to Town, its officers, or its employees.
- **Section 11.** <u>Indemnification.</u> Consultant expressly agrees to indemnify and hold harmless Town or any of its officers or employees from any and all claims, damages, liability, or court awards including attorney's fees that are or may be awarded as a result of any loss, injury or damage sustained or claimed to have been sustained by anyone, including, but not limited to, any person, firm, partnership, or corporation, to the extent caused by the negligent acts, errors or omissions of Consultant or any of their employees or agents in performing work pursuant to this Agreement. In the event that any such suit or action is brought against Town, Town will give notice within ten (10) days thereof to Contractor.
- Section 12. <u>Delays.</u> Any delays in or failure of performance by any party of his or its obligations under this Agreement shall be excused if such delays or failure are a result of acts of God, fires, floods, strikes, labor disputes, accidents, regulations or orders of civil or military authorities, shortages of labor or materials, or other causes, similar or dissimilar, which are beyond the control of such party.
- **Section 13.** Additional Documents. The parties agree to execute any additional documents or take any additional action that is necessary to carry out this Agreement.
- Section 14. Entire Agreement. This Agreement represents the entire agreement between the parties and there are no oral or collateral agreements or understandings. This Agreement may be amended only by an instrument in writing signed by the parties. If any other provision of this Agreement is held invalid or unenforceable, no other provision shall be affected by such holding, and all of the remaining provisions of this Agreement shall continue in full force and effect.
- Section 15. <u>Default and Remedies</u>. In the event either party should default in performance of its obligations under this agreement, and such default shall remain uncured for more than 10 days after notice of default is given to the defaulting party, the non-defaulting party shall be entitled to pursue any and all legal remedies. In addition, no Party will be entitled to lost profits, economic damages, or actual, direct, incidental, consequential, punitive or exemplary damages in the event of a default.
- Section 16. <u>Waiver</u>. A waiver by any party to this Agreement of the breach of any term or provision of this Agreement shall not operate or be construed as a waiver of any subsequent breach by either party.

Section 17. Governing Law. This Agreement shall be governed by the laws of the State of Colorado.

Section 18. <u>Independent Contractor.</u> Consultant and Town hereby represent that Consultant is an independent contractor for all purposes hereunder. As such, Consultant is not covered by any worker's compensation insurance or any other insurance maintained by Town except as would apply to members of the general public. Consultant shall not create any indebtedness on behalf of the Town.

Section 19. No Third Party Beneficiaries. It is expressly understood and agreed that enforcement of the terms and conditions of this Agreement, and all rights of action relating to such enforcement, shall be strictly reserved to Town and Contractor, and nothing contained in this Agreement shall give or allow any such claim or right of action by any other third party on such Agreement. It is the express intention of the parties that any person other than Town or Consultant receiving services or benefits under this Agreement shall be deemed to be an incidental beneficiary only.

ATTEST:

TOWN OF CASTLE ROCK

isa Anderson, Town Clerk

avid L. Corliss, Town Manager

Approved as to form:

Approved as to content:

Robert J. Slentz, Town Attorney

Mark Marlowe, Director of Castle Rock Water



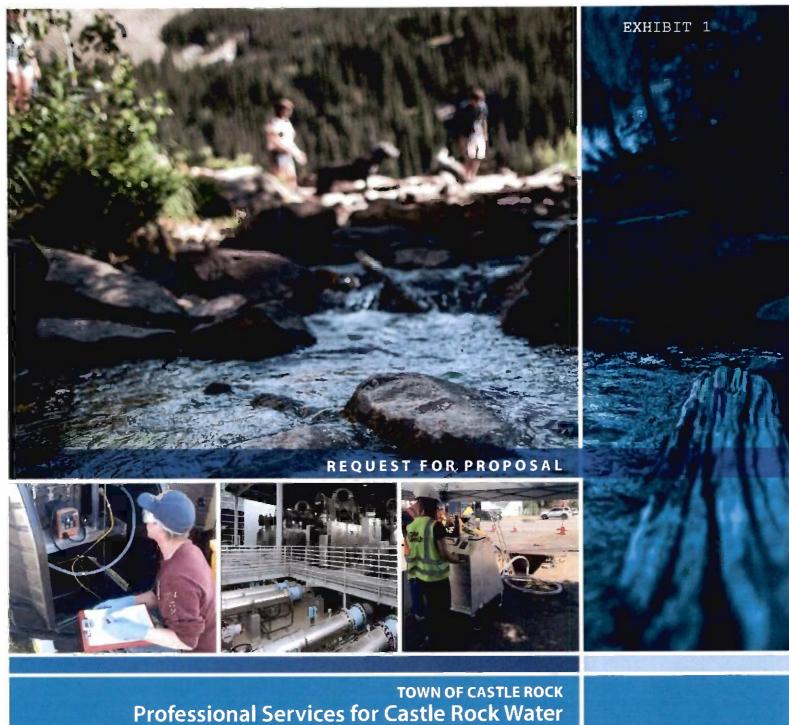
CONTRACTOR:

CDM SMITH, INC.

Ву:

Solomon Abel
Officer In Charge

11/2018 On-Call - Modified



Professional Services for Castle Rock Water
Water Quality Consulting
RFP No. 2019-04

April 1, 2019





Castle Rock Water Attention: Mr. Tim Friday, Assistant Director 175 Kellogg Ct. Castle Rock, CO 80109

RE: RFP No. 2019-04, Proposal for Professional Services for Caste Rock Water Water Quality Consulting

Dear Mr. Friday and Members of the Selection Committee,

As Castle Rock Water (CR Water) expands their renewable water supply by incorporating reusable wastewater effluent into their source portfolio, it will be critical those efforts are coordinated with and accepted by state authorities and the local community; and the treatment meets water quality requirements and goals. The CDM Smith Team offers peace-of-mind through our support as your water quality consultant, providing oversight through local and nationally known experts with specific emphasis on reuse water, contaminants of emerging concern (CECs), mixing of different water supplies (imported, surface water, reuse water, groundwater, etc.), and the resulting impacts on corrosion control, regulatory limits, and aesthetics.

With this proposal, CDM Smith presents a truly comprehensive team and water partnership to support CR Water in achieving your goals—providing a more sustainable supply of safe, high quality water for the community through:

- » Comprehensive review of the existing water quality monitoring plan and recommendations for improvement based on wastewater effluent contributions, future regulations, etc.
- » Identification and characterization of CECs, along with guidance on treatment/ public engagement.
- » Development of a process for establishing health-based water quality goals—a multi-year progression that will incorporate industry recommendations for present and future, and latest water quality science along with operating experience for the process improvements at Plum Creek Water Purification Facility.
- >> Technical support for CR Water's community engagement program.

Through a responsive local leadership team, local and national discipline experts, and the support of an all-star technical advisory panel, CDM Smith has crafted a full-service water quality consulting team that can support CR Water covering all aspects of your water program. You have met several of these individuals already, including Principal in Charge Solomon Abel, Technical Director (and our National Water Practice Lead) Chris Schulz, Water Treatment expert Doug Brown, and our rising water reuse star, Jill Vandegrift—who, along with Technical Advisory Panel Lead Greg Wetterau, recently supported the USEPA in developing the 2017 Potable Reuse Compendium, a supplemental document to its Guidelines for Water Reuse that surveys the state of potable reuse across the US.

Jill, along with potable reuse expert Jennifer Hooper, and Technical Advisory Panel member Channah Rock, worked extensively on Water Research Foundation (WRF) Project 4508 to assess appropriate monitoring and process validation approaches to manage risks in potable reuse facilities through early identification of failures using indicator and surrogate monitoring, while providing accurate and cost-effective monitoring strategies. Solomon, Chris, Jill, proposed Project Manager Greg Dye, and other members of this team are also currently working together in support of Westminster's Water 2025 Process Selection and Pilot Plant project, supporting that community in developing water treatment resiliency while addressing varying water quality conditions, adapting to changing regulatory standards, and improving water supply flexibility. With the support of our Technical Advisory Panel expert in CECs, Dr. Eric Dickinson—who serves on the National Water Research Institute (NWRI)

independent advisory panel to provide guidance to the Colorado Department of Public Health and Environment (CDPHE) in developing regulations for direct potable reuse of recycled wastewater (2018-2019)—the CDM Smith Team is *already* leading and guiding the industry in direct potable reuse (DPR) in Colorado and nationally, and we are excited to have the opportunity to help guide CR Water as it works to permit and gain public approval of its reuse system!

Working with our local communities on ground-breaking, state of the industry water quality consulting and support is the reason all of our water experts love to come to work each day. We are excited to introduce our full team to you in the following pages, and look forward to supporting CR Water on your path to enhanced water quality and resiliency.

The CDM Smith Team will stay actively engaged in the selection process and will not change the staff pool proposed unless approved in advance in writing by the Town.

Thank you for your time in reviewing our qualifications, and please don't hesitate to call me at (303) 383-2300 if you have any questions.

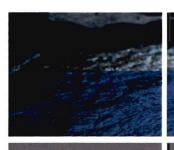
Sincerely,

Solomon Abel, PE Principal-in-Charge

Shull

CDM Smith Inc.

Greg Dye, PE, PMP Project Manager CDM Smith Inc.







SECTION 1

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A. Company Overview and History

With 160 personnel based in our Denver office, CDM Smith offers the Town of Castle Rock diverse resources spanning planning, design, permitting, and construction capabilities.

CDM Smith is an employee-owned consulting, engineering, construction, and operations firm providing integrated solutions in water, environment, transportation, energy, and facilities. Firmly rooted in the local community for more than 40 years, our Denver office is comprised of employees supporting planning, design and construction projects locally, and throughout the United States. We work together—in teams and in partnership with our clients—to solve complex environmental and water supply challenges.



Stability Through Employee-Ownership

The stability of our workforce, and company control we exercise through our employee ownership, has allowed CDM Smith to build strong, long-term relationships with our clients and attract great people. Our history as a successful, privately-owned firm has also provided additional stability for our staff and clients at a time when many other firms are experiencing significant turmoil due to heavy merger and acquisition activity. Our year-over-year growth—with annual revenues of more than one billion dollars since 2008—attests to our commitment to both our client and employee relationships, while supporting a strong balance sheet and healthy backlog.



Providing **lasting and integrated** solutions in water, environment, transportation, energy, and facilities

Celebrating 70 years of innovative solutions.

EMPLOYEE-OWNED firm, founded in 1947 and serving *Colorado*

since 1972

OUR STAFF

Drawing on the expertise of

5,000EMPLOYEES



OUR DENVER OFFICE



All engineering and construction services under ONE roof.



160 engineering, specialty, and support staff spanning planning, design, and implementation.

OUR INDUSTRY LEADERSHIP



\$1.2 BILLION in annual revenue.



ONE firm providing lasting and integrated solutions.



B. Description of Relevant Experience

The following pages present a brief overview of the CDM Smith Team's experience related to the services requested in the CR Water's Water Quality Consulting Request for Proposal.



The CDM Smith Team will provide the credible, national expertise to support CR Water's drinking water program, giving you guidance and peace of mind that you are doing the right thing for now and in the future.

Our Commitment—



Provide holistic expertise in water quality consulting to support the Town's drinking water program.



Provide options and solutions for a more sustainable water supply in support of CR Water's near and long term goals.



Incorporate a thorough understanding of the Town's surrounding water environment into recommendations for improvement.



Assist CR Water in identifying and characterizing contaminants of emerging concern and establishing health-based water quality goals specific to the Town's water supply.



Be CR Water's advocate, supporting the success of CR Water's community engagement program throughout development and implementation of water quality improvements.

Backed up by Experience that Drives Results

We have assembled and presented a comprehensive team with local and national expertise to support CR Water in the successful completion of every aspect of your Water Quality Consulting scope of services, as presented in the RFP:

- » Reuse water
- » Contaminants of emerging concern
- » Managing portfolio of multiple water sources
- » Resulting impacts on corrosion control, regulatory limits, and aesthetics

Currently, CR Water provides approximately 29% renewable water, with a goal to reach 75% by 2050. The CDM Smith team, through our expert resources across water supply planning (Sue Morea), drinking water (Doug Brown) and water quality (Tim Rynders), potable reuse (Jen Hooper and Jill Vandegrift), and corrosion control (Amrou Atassi), will present ideas to best support the integration of reuse water with water supplies to help CR Water get the most out of your water sources.

The CDM Smith team will review and present recommendations and options for improvement for CR Water's water treatment, based on discussions with Tim Friday and other Town staff and stakeholders, and a thorough review of:

- The Town's goals for current and future water quality and treatment processes for the Plum Creek Water Purification Facility.
- » The Town's water quality concerns, including TDS (due to salt runoff from roads).
- >> WISE water quality, treatment, and distribution practices for the water supply.
- Denver Basin groundwater quality and current treatment and distribution practices for the non-renewable supply.

CDM Smith is a leader in the identification and characterization of contaminants of emerging concern (CECs), bringing valuable lessons learned from our related work on both active water programs and related WRF studies, highlighted in the following pages. Led by Jen Hooper and supported by Technical Advisory Panel members Dr. Dora Chiang and Dr. Eric Dickinson, we will assist CR Water in furthering development of their on-going program. Additionally, with the support of internationally known Technical Advisory Panel member Dr. Joe Cotruvo, we will begin to integrate our findings within a cohesive process of establishing health-based water quality goals for the Town—a multi-year progression that will incorporate the latest water quality science along with operating experience for the process improvements at PCWPF.

Along with support from CDM Smith's local leadership team, presented on pages 11 and 12, Dr. Melissa Harclerode brings national expertise to support CR Water in the successful application of your community engagement program for this contract. Dr. Harclerode is CDM Smith's expert in risk communication and stakeholder engagement, specializing in the development and application of assessment approaches to evaluate environmental, social, and economic impacts of environmental infrastructure and restoration projects, as well as on the development of effective communication tools to support clients and communities throughout these programs. Her recent experience has focused on addressing the issue of contaminants of emerging concern, both through project and national level support in preparation of risk communication for the development of Best Suggested Practices (BSP) guidance.



CDM Smith is just beginning the WATER2025
Process Selection and Pilot for the City of
Westminster, part of a visionary program for
the development of a new plant to improve
water treatment resiliency and address varying
water quality conditions, adapt to changing
regulatory standards, improve water supply
flexibility, and embrace environmental
sustainability and resource stewardship.

CDM Smith just received the 2018
WateReuse Award for Excellence
in Transformational Innovation,
and the 2018 American Academy
of Environmental Engineers and
Scientists Grand Prize for Research for
our work on the Biofiltration-Direct
Potable Reuse Pilot Testing for a Water
Research Foundation project with
Gwinnett County, Georgia. The work
included side-by-side piloting facilities
to compare DPR against the County's
existing practice of defacto indirect
potable reuse.

Our Local Water Practice

CDM Smith's water practice helps our clients solve treatment problems, protect the environment, and improve water quality. We have designed more than 140 new or expanded water treatment facilities across Colorado and the western US—covering every aspect of water quality investigations, treatment improvements, and related facilities (treatment plants, pumping, transmission, and storage).

With in-house capabilities in the disciplines of process design, site/civil, mechanical, electrical, HVAC, architectural, plumbing, cost estimating, and instrumentation engineering, CDM Smith offers our clients a unique breadth and continuity of service, which ultimately benefits project budgets, schedules, and overall quality.

Water Treatment

CDM Smith specializes in water supply, water and wastewater treatment, hydraulic modeling, comprehensive facility planning, and water quality assessment. We are continually innovating and developing new treatment approaches to improve efficiencies

and operations, which includes researching biological filtration methods, leveraging computational fluid dynamics modeling to optimize plant operations, and many other areas impacting today's ongoing water facility operations and maintenance for municipalities.

Locally, our teams provide a full spectrum of services from studies, planning, and design through cost estimating, construction administration, and management services.

Along the Front Range, we have delivered a variety of water treatment-related projects, such as:

- » Currently serving as a prime member of the Owner's Representative Team for Denver Water's greenfield Northwater Treatment Plant (NTP)—a state-of-the-art WTP in Jefferson County that will be capable of treating up to 75 million gallons of water a day.
- » Englewood Allen Water Treatment Plant (WTP) UV Disinfection System
- Sanitation District Reverse Osmosis WTP

Potable Reuse

Reuse is the future of water supply. CDM Smith has completed more than 190 reuse projects worldwide, and can help you conquer the regulatory, operational, and communications challenges that may arise along the way.

CDM Smith has been a pioneer in the implementation of potable reuse; from design of the world-renowned Orange County Groundwater Replenishment System, to the support of potable reuse programs in Singapore, Australia, and Kuwait. We understand the unique challenges of developing a potable reuse program that is safe, reliable, and supported by both regulators and the community as a whole.

CDM Smith experts (including local Denver team member Jill Vandegrift) supported the USEPA in developing a supplemental document to their Guidelines for Water Reuse that surveys the state of potable water reuse in the United States. The document focuses on summarizing federal laws impacting potable reuse and state regulatory frameworks for potable reuse; highlighting opportunities, challenges, and trends in potable reuse; and potable reuse applications, treatment technologies, research results, and case studies.





CDM Smith Denver staff brew masters worked with Ratio Beerworks to celebrate the water life-cycle by converting reuse water into beer—with our 12-log Lager winning the WEFTEC 2017 Pure Water Brewing Alliance Smackdown!

Our Denver office personnel have been heavily involved in cutting edge, award winning reuse (both indirect and potable) programs and R&D efforts, including:

- » Doug Brown (Treatment Process Engineer), and Chris Schulz' (Technical Review) support of both Orange County, CA's Groundwater Replenishment System Indirect Potable Reuse Plant—one of the largest, most successful potable reuse projects in the world, and the Leo J. Vander Lans Water **Treatment Facility Expansion** For Indirect Potable Reuse (IPR)— achieving overall plant recovery of 92%, the system is the highest recovery for an indirect potable reuse MF/RO/UV plant in the world.
- Jill Vandegrift (Project Engineer) and Dr. Josh Goldman-Torres' (Project Engineer) support of WRF 4508, Assessing Techniques to Evaluate and Demonstrate the Safety of DPR, to ultimately develop guidance on surrogate and indicator compounds appropriate for assessing performance of chemical and pathogen

- removal on various DPR treatment trains.
- Providing guidance on appropriate indicator and surrogate monitoring techniques to ensure the safety of direct potable reuse water through a Water Research Foundation Project.
- Supporting an award-winning Biofiltration-Direct Potable Reuse pilot testing program for Georgia's Gwinnett County that included side-by-side piloting facilities to compare direct potable reuse against the County's existing practice of planned indirect potable reuse.
- » Transforming Long Beach wastewater into Denver beer for WEFTEC's 2017 Pure Water Brewing Alliance Smackdown.

Denver's Jill Vandegrift was also awarded the Water Reuse Association's 2016 Young Professional of the Year.





CDM Smith literally wrote the book(s) on water reuse. We have led the development of five editions of the EPA reuse guidelines, beginning with the completion of the first Guidelines for Water Reuse in 1980 and including Greg Wetterau and Jill Vandegrift's support in the development of the 2017 Potable Reuse Compendium—a supplemental document to its Guidelines for Water Reuse. The Compendium surveys the state of potable reuse across the US. outlines existing state regulations and guidelines; discusses opportunities, challenges and trend; evaluates potable water reuse applications, treatment technologies, and research results; and provides an overview of potable reuse case studies.



CDM Smith's piloting expert Dr. Josh Goldman in action.



CDM Smith operates several Environmental Technologies Laboratories across the US—including in Denver and Bellevue—partnering with clients, non-profit research foundations, universities, and vendors to perform more than \$4 million of research each year.

Piloting and Innovative R&D

We maintain a robust Research and Development (R&D) program that fosters development of cutting edge research and creative solutions for our clients.

CDM Smith is regularly involved in R&D efforts—teaming and collaborating with our clients to advance research that is of importance to us all. Recent work our Denver team has been involved with includes our work on the WRF 4508 project (Assessing Techniques to Evaluate and Demonstrate the Safety of DPR); the development of innovative options for effluent heat recovery for Metro Wastewater Reclamation District; and collaborating with a local brewery to convert reuse water into beer!

To support our R&D program, CDM Smith also owns and operates pilot testing equipment and environmental treatability laboratories to assist our teams in conducting bench-scale and pilot testing activities, and successfully executing system modification via engineering design and construction administration.

Our pilot and bench scale testing experts allow our clients to eliminate the need for costly downtime for

their plants, and deliver results that more thoughtfully and efficiently support their current and future facility needs.

CDM Smith's current R&D program includes playing a leadership role in more than 35 groundbreaking water, wastewater, water reuse, environmental, energy, and transportation projects each year. Our ground-breaking research is focused in the areas of water filtration, alternative disinfection, indirect and direct potable water reuse, waste-to-energy conversion, biosolids management, traffic tolling, climate resiliency, emerging contaminants, asset management, and more. We believe in a collaborative approach and are proud to partner with our clients, non-profit research foundations, universities, and vendors to perform over \$4 million of research each year.

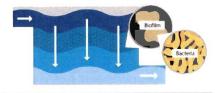
A Sample of CDM Smith's Related, Recently Completed and Ongoing Research

- » Direct Potable Reuse using multi-stage ozone-biological filtration. Client: Confidential; Status: Ongoing
- » Assessing Techniques to Evaluate and Demonstrate the Safety of DPR (WRF 4508). Client: Gwinnett County; Status: Complete

- Somparing the Human Health Risks of DPR to IPR. A CDM Smith-funded R&D project; Status: Complete
- » Chemically Enhanced Biological Filtration (WRF 4429). This project evaluated the treatment efficacy of eight chemical pre-oxidants, biofiltration and GAC for removal of personal care products and pharmaceuticals (PPCPs) and disinfection byproduct precursors for a de facto IPR facility, Greater Cincinnati Water Works. This project used batch oxidation endpoint, kinetics, and sorption isotherm tests to evaluate removal of PPCPs and DBP precursors at the CDM Smith **Environmental Technologies** Laboratory. Subsequent pilot testing at Greater Cincinnati Water Works involved optimization of preoxidant dose, biological filtration and GAC sorption design. This study focused on a holistic solution for management of NOM and PPCPs to provide high quality potable water and decrease overall operating costs. Client: Greater Cincinnati Water Works, who operates as de facto IPR; Status: Complete
- Treating Contaminants of Emerging Concern: Vannatta St Well Station -Alternatives Analysis for Treatment of 1,4-Dioxane. Client: New Jersey American Water (This project will compare three treatment technologies for removal of 1-4 dioxane: biosparging, advanced electrochemical oxidation and







CDM Smith led WRF project 4429 with Greater Cincinnati Water Works where we evaluated multiple pre-oxidants in conjunction with biofiltraiton and GAC for removal of CECs and organic carbon. This involved bench and pilot testing.

advanced oxidation (UV+H2O2). 1-4 dioxane is one of several emerging contaminates that NJDEP and other state regulatory authorities have adopted more stringent drinking water standards.); Status: Ongoing

- » PFAS Treatment with GAC and IX. Client: Town of Ayer; Status: Ongoing
- » PerfluorAd Technology Demonstration for the Removal of PFAS from Water. Status: Ongoing
- » Practical Monitoring Tools for Biological Processes in Biofiltration. Multiple clients, including Denver Water; Status: Ongoing
- » Development of an Integrated Water Systems Model. Client: multiple; Status: Ongoing

Contaminants of Emerging Concern

Our industry is continually searching for the most appropriate technologies to protect our water supply and water quality. Based on the ever evolving drivers of pharmaceuticals, emerging contaminants, organic compounds, taste and odor constituents, a new set of technologies have recently emerged in our industry and

revolutionary changes are once again on the horizon for our industry.

CDM Smith's emerging contaminants practice includes the evaluation of CECs for DPR as in our work for the WRF 4508 project, as well as Orange County's reuse system, and Brunswick County Surface Water Treatment Plant Planning and Design Services.

One example of some of our recent piloting and design work regarding emerging contaminants includes Denver's Chris Schulz' contributions as part of Cincinnnati, Ohio's UV Disinfection and ultraviolet (UV)/ advanced oxidation process (AOP) Pilot Study and Design, and our involvement leading the WRF 4429 project for Greater Cincinnati Water Works (GCWW), where we evaluated multiple pre-oxidants in conjunction with biofiltraiton and GAC for removal of CECs and organic carbon. This involved bench and pilot testing.

Chris provided provide engineering services for the design and construction of GCWW's 240-million-gallon-per-day (mgd), potable water UV disinfection facility with capability to be converted to a UV-chlorine AOP in the future, should it become necessary for advanced treatment of emerging contaminants in the Ohio River. AOP was evaluated to meet the following treatment objectives: seasonal taste and odor control, specifically MIB (2-methylisoborneol)

reduction, and year-round destruction of emerging contaminants such as pharmaceuticals and personal care products (PPCPs), endocrine disrupting compounds (EDCs), pesticides (e.g., atrazine) and other chemical contaminants that may be present in the Ohio River watershed.

CDM Smith experts also collaborate with the DoD Environmental Security Technology Certification Program (ESTCP) and our federal and private clients to research, develop, and demonstrate innovative, insitu processes to remediate contaminants in groundwater and soil. We have also won ESTCP projects for wastewater treatment (anerobic membrane bioreactor) and energy production from wastewater (microbial fuel cells).

CDM Smith's Bellevue Research & Testing Laboratory is capable of customized treatability studies for evaluating innovative solutions to remediation challenges, with eight full-time laboratory staff with the in-depth experience and cutting edge tools to perform evaluations of advanced water treatment processes including ozonation and ultraviolet radiation combined with the advanced oxidation process (UV-AOP).



CDM Smith's Denver team members participated in a unique opportunity to provide community outreach in support of reuse by converting reuse water into beer—their 12-log Lager—to participate in WEFTEC 2017's Pure Water Brewing Alliance Smackdown and their panel question and answer session.



CDM Smith has completed more than 70 integrated water resources plans—including a statewide reuse planning study—and the most comprehensive analysis of water supply and resource needs in the state of Colorado's history.

Community Engagement

Our responsibility and ability to add value within the communities we serve extends far beyond our projects.

CDM Smith participates in community engagement at a variety of levels within the projects and programs we support, from attending public meetings and open houses with the communities we serve, to national level communications and outreach activities regarding specific areas of concern such as CECs, to involvement in organizations like WEFTEC, Water for People, and Engineers Without Borders, as well as through CDM Smith Cares, our own internal volunteer outreach program to benefit the environment, children, communities, and charities.

In addition to our local team members' experience supporting community engagement efforts for projects, we have included additional national-level support—specifically with respect to CECs—Dr. Melissa Harclerode, to support CR Water in the successful application of their community engagement program for this contract. Dr. Harclerode is an environmental sustainability scientist and CDM Smith's expert in risk communication and stakeholder engagement, specializing in the development and application

of assessment approaches to evaluate environmental, social, and economic impacts of environmental infrastructure and restoration projects, as well as on the development of effective communication tools to support clients and communities throughout these programs.

Related to Dr. Harclerode's work on a recent PFAS project, CDM Smith recently developed a video in-house designed to simply and easily communicate the complex issues presented by CECs—specificaly PFAS— to both the local client community and any community concerned about this issue. The video presentation (https://www. cdmsmith.com/en/Client-Solutions/ Focus-Areas/Environment/Emerging-Contaminants), which featured Dr. Harclerode and other members of our proposed team, was lauded in a tweet by David La France, CEO of the American Water Works Association, as "a really great example of how to communicate a complicated issue in an easy to understand way."

Water Resources and Supply

Our focused expertise regarding water resources and water supply will support CR Water in the integration of reuse water with water supplies to get the most out of your water sources.

CDM Smith also brings extensive statewide water resources planning and design experience. We have prepared more than 70 integrated resources plans and state and regional water plans, and our Denver office offers full-service water resources capabilities with staff focusing on water supply modeling, water demand forecasting/management, reuse, integrated solutions, as well as stormwater management, floodplain resiliency, river engineering.

We bring working knowledge of state-wide water resources and strategies, gained through our work on the Colorado Water Conservation Board State Water Supply Initiative (10-yr program including SWSI 1, SWSI 2, SWSI 2010, and Basin Needs Assessment), which is the most comprehensive analysis of water supplies and resource needs in the state's history. We also bring a thorough understanding of the South Platte Basin, Arkansas Basin, and Colorado River Basin water rights, opportunities, and constraints through our local and regional planning work.









ALL

STAR

The CDM Smith Team



Principal in Charge Solomon Abel, PE

Project Manager Greg Dye, PE, PMP

Technical Director Chris Schulz, PE, BCEE

Delivery Team

Potable Reuse Jen Hooper, PE Jill Vandegrift, PE

Water Quality Tim Rynders, PE

Water Reclamation and Membrane Treatment Jaeho Ho, PhD, PE

Drinking Water Doug Brown, PE, BCEE

Piloting and Data Analysis Josh Goldman-Torres, PhD, PE Carl Lundin, PE

Contaminants of Emerging Concern Jen Hooper, PE

Corrosion Control Amrou Atassi, PE, BCEE

Water Supply Planning Sue Morea

Public Outreach Melissa Harcierode, PhD, BCES, **ENV SP**

> Cost Estimation Todd Stalnaker

Legend

- ▲ Joseph Cotruvo & Associates L.L.C.
- Southern Nevada Water Authority; Colorado School of Mines
- Arizona State University
- CDM Smith Independent Consultant

Bold names denote project leadership Colorado-based team member

Technical Advisory Panel

Greg Wetterau, PE, BCEE

Contaminants of Emerging Concern Sheau-Yun (Dora) Chiang,

PhD, PE A Eric Dickenson, PE, PhD

Disinfection By-Products

A Phil Singer, PhD, BCEE

Public Health

Joe Cotruvo, PhD, BCES

Pathogen Removal

Channah Rock, PhD

The CDM Smith Team will support CR Water with lessons learned from the most comprehensive resume of local and national experts, leading the reuse industry in real-world implementation, research, and publications. We will leverage our expertise in water reuse, contaminants of emerging concern, innovative treatment technologies, and mixing of various water supplies and the resulting impacts on corrosion, regulatory compliance, and water aesthetics.

A. Team Organizational Chart, Staff Roles, and Structure

Our organization chart above presents our one-stop shop of discipline experts and water quality technical advisors to support CR Water throughout your treatment train expansion and as you move towards DPR.

Our Water Quality Consulting team will be led by local Project Manager Greg Dye, who will serve as Castle Rock's primary point of contact. Greg will manage the consulting contract and coordinate the efforts of the Delivery Team discipline task leads noted in the grey box above, supported by the technical direction and leadership of Chris Schulz (also located in our Denver office). Chris and

our local and national Delivery Team members will offer the leadership and expertise to drive CR Water's water quality efforts forward, along with the further support and oversight of our Technical Advisory Panel. The Technical Advisory Panel brings CR Water further peace of mind through world-wide water supply, treatment, facility, and operations knowledge, integrated with a critical understanding of local water quality.

As Principal in Charge, Solomon Abel will work to confirm that the team is meeting CR Water expectations at all times, and are supported by the necessary resources to deliver high quality service and water quality success for the Castle Rock community.



B. Staff/Subconsultant Roles and Resumes

A brief overview of our Water Quality Consulting team members, their roles and relevant experience/expertise is provided beginning on the following page. Resumes for all team members have been included in the Appendix at the end of this proposal.

Note: The CDM Smith Team will stay actively engaged in the selection process and will not change the staff pool proposed unless approved in advance in writing by the Town.

Subconsultants

We have included a few key subconsultants as members of this team's Technical Advisory Panel. These are:

- » Eric Dickenson, PhD, PE Contaminants of Emerging Concern
 - Southern Nevada Water Authority; Colorado School of Mines
- » Phil Singer, PhD, BCEE Disinfection By-Products CDM Smith Exclusive Independent Consultant
- » Joe Cotruvo, PhD, BCES Public Health Joseph Cotruvo & Associates L.L.C.
- » Channah Rock, PhD Pathogen Removal Arizona State University

These individuals are noted in the organization chart and included in the team overview table beginning on the following page, along with details regarding our previous work with each. A resume for each is also included in the Appendix at the end of this proposal.

C. Current and Projected Workloads

We manage our work flow, backlog, and staffing to address delivery need. The CDM Smith Team's current and projected workload is such that all personnel assigned and presented in this RFP are available for completion of this contract to support CR Water's needs. Our depth and breadth of local (160+ personnel), and national/global resources (5,000+ personnel)—along with the resources of our subconsultants—means that we can add resources as necessary across every discipline represented here and more to meet any need of CR Water. Additionally, we continue to grow—we added 24 staff to the Denver office in 2018 alone—allowing us to shift resources and project support as needed to meet each client's needs.

We have included estimated average percentages in the team table that we assume will be required to deliver CR Water's needs throughout the lifetime of this Water Quality Consulting Contract, though every team-member is 100% committed to this project and will dedicate the time necessary for its successful execution.

D. Number of Employees / Work Performance

CDM Smith's nearby Denver location, local contract leadership, and mix of local and national staff allows CR Water the benefit of a highly responsive and accessible team.

As noted, CDM Smith provides the resources of more than 160 personnel in our Denver office, supported by more than 5,000 personnel across the globe. The CDM Smith Team will provide the majority of our service delivery through our Denver office (555 17th Street, Suite 500, Denver, CO 80202) and Denver-based project leadership, with support of local and national multi-disciplinary personnel covering every aspect of CR Water's requested services.

CDM Smith is licensed to do work in the State of Colorado (Secretary of State of Colorado entity identification number 19871498616) and our Denver production office noted above is located approximately 30 miles from the Town of Castle Rock.

OFFICE OF THE SECRETARY OF STATE OF THE STATE OF COLORADO

CERTIFICATE OF FACT OF GOOD STANDING

I. Wayne W. Williams, as the Secretary of State of the State of Colorado, hereby certify that, according to the records of this office.

CDM Smith law.

is an entity formed or registered under the Isw of Massachusetts. has complied with all applicable requirements of this office, and is in good standing with this office. This entity has been assigned entity identification number. 1987;1498-16

This certificate reflects facts established or disclosed by documents delivered to this office on paper through matti/2018 that have been posted, and by documents delivered to this office electronically through 10M4/2018 to 13:16:22

Haive affixed hervto the Great Seal of the State of Colorado and duly generated, executed, and issued this official certificate at Deriver. Colorado on 10:004/2018; § 137:6-22 in accordance with applicable faw. This certificate is assigned Confirmation Number 1111-4010.



Way WWW. Williams.

CDM Smith Team Overview/ Brief Resumes

The availability percentages shown in the far right column below indicate estimated average throughout the lifetime of the project; however, It should be underscored that each key team member is 100% committed to this project and will dedicate the time necessary for its successful execution.

Team Member/Role

Responsibilities

Related Experience/Expertise

Avail. %*



Greg Dye, PE, PMP Project Manager

Chris Schulz.

PE. BCEE

Technical

Director

Project management / primary point of contact for CR Water throughout contract delivery

Review existing

Monitoring Plan,

Become familiar

with Plum Creek

Water Purification

and communicate

Plum Creek Water

improvements

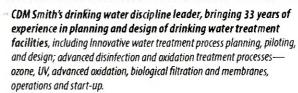
Purification Facility

operating experience

now and after process

Facility, understand

- Certified Project Management Professional with 20+ years of experience in workforce planning, project staffing and supervision, and mentoring.
- Extensive experience in water project, program, and business management focused on planning, design, and construction phase services for water infrastructure, including membrane treatment and advanced water treatment processes, and reuse facility upgrades.
- Served as deputy project manager for the State of Utah Division of Water Resources Lake Powell Water Supply System, preparing the environmental reports for an environmental impact statement and the conceptual design of a \$1.38 water supply project for southern Utah.



- Brings CR Water the benefits of his decades-long history leading successful
 pilot plant and treatment projects, including serving as technical or process
 lead for 20 pilot plant and treatability studies across the US and averseas.
- Currently leading Westminster's WATER2025 Process Selection efforts for piloting of treatment processes addressing varying water quality conditions for a new water treatment facility for the City.
- Holds 11 US patents on water treatment technology, has published more than 70 papers and two books on water treatment process and design topics, and has served as a mentor to several members of this CDM Smith team.



COM Smith Denver Staff

Solomon Abel, PE Principal in Charge

Confirm that the team is meeting CR Water expectations at all times, and are supported by the necessary resouces CDM Smith's Regional Manager for the Rocky Mountain area, bringing Castle Rock a proven record of solving client challenges across the development and delivery of permitting, design, construction supervision, and start-up of integrated water planning, treatment works, reuse and conveyance systems throughout the US and across the globe.



10%

 Drinking water experience spanning piloting, design and construction supervision of conventional treatment, slow sand filtration, and various membrane treatment technologies.



Greg Wetterau, PE, BCEE Technical Advisory Panel Lead

Lead Panel, keep team apprised of latest water quality science; review deliverables and decisions, provide recommendations; provide monitoring recommendations for advanced treatment/ potable reuse, regulatory review and health-based goals assessment

- CDM Smith Technical Strategy Leader for Reuse and Desalination with 25 years of advanced water treatment experience, including more than 20 potable reuse projects around the world.
- Trusted expert to regulatory agencies, serving as program manager for EPA's 2017 Potable Reuse Compendium, lead author of Hawaii's 2019 Membrane Filtration Guidance document, and permitting lead for California's first two potable reuse projects approved under the state groundwater recharge reuse regulations.
- Recognized industry leader in potable reuse and advanced water treatment, serving on Boards of Directors for the American Membrane Technology Association and the International Desalination Association with more than 100 published papers and presentations.





Team Me	mber/Role	Responsibilities	Related Experience/Expertise	Avail. %*
	Sheau-Yun (Dora) Chiang, PhD, PE Technical Advisory Panel: Contaminants of Emerging Concern	Keep team apprised of latest water quality science; review deliverables and decisions, provide recommendations; CR Water supply CEC review and characterization	 A senior environmental engineer and CDM Smith's Technical Strategy Leader for the emerging contaminants market, develaping the cammunity of practice for emerging contaminants, contributing to technology transfer on emerging contaminants, and leading technology development through the Department of Defense' (DoD) research funding programs. A remediation consultant with more than 20 years of experience on charocterizing and remediating contaminated sites impacted by CECs (1,4-dioxane, nano materials, 1,2,3-Trichlarapropane (TCP), PFAS etc.). 	5%
Part-time Colorado Resident	▲ Eric Dickenson, PE Technical Advisory Panel: Contaminants of Emerging Concern	Keep team apprised of latest water quality science; review deliverables and decisions, provide recommendations; CR Water supply CEC review and characterization	 A Research and Development Project Manager for Water Quality Research and Development for Southern Nevada Water Authority, and a Research Professor/Affiliate Faculty for Colorado School of Mines with focused expertise regarding CECs and DPR. Involved in groundbreaking DPR and CEC research with the Water Research Foundation (WRF) and EPA, including Co-PI of "Blending Requirements for Water from Direct Potable Reuse Treatment Facilities" (WRF 4536), and member af the "Framework for Quantifying Microbial Risk and Sustainability of Potable Reuse Systems in the United States" team for U.S. EPA, examining microbial/chemical risks associated with potable reuse trains. Nominated for a National Water Research Institute (NWRI) independent advisory panel to provide guidance to the CDPHE in developing regulations for direct potable reuse of recycled wastewater (2018-2019). 	5%
	A Phil Singer, PhD, BCEE Technical Advisory Panel: Disinfection By-Products	Keep team apprised of latest water quality science; review deliverables and decisions, provide recommendations; CR Water DBP potential evaluation	 Nationally recagnized expert in water quality and advanced drinking water treatment, and an exclusive independent consultant to CDM Smith. Brings more than 45 years of experience in drinking water research and development projects, with a strong focus on treatment for control of disinfection by-products, disinfection processes, and the removal of natural organic material, iron and manganese, and micro-constituents. Recently worked with CDM Smith's Jen Hooper and Chris Schulz in a similar role on WRF 4620, Practical Monitoring Tools for Biological Processes in Biofiltration. 	5%
	▲ Joe Cotruvo, PhD, BCES Technical Advisory Panel: Public Health	Keep team apprised of latest water quality science; review deliverables and decisions, provide recommendations; begin establishing health-based water quality goals	 President of Joseph Cotruvo & Associates, LLC, Water, Environment and Public Health Consultants, and has served many years on the World Health Organization's (WHO) Guidelines for Drinking Water Quality Committee, was an initiator of the WHO Guidelines for Potable Reuse, and the Guidelines for reuse in beverage production. Serves on numerous expert advisory panels for the Notional Water Research Institute on drinking water quality. Has completed several potable water resuse projects with CDM 5mith, including the innovative Groundwater Replenishment System Indirect Potable Reuse Plant for Orange County Water District—one of the the largest, most successful potable reuse prajects in the world. 	5%
	▲ Channah Rock, PhD Technical Advisory Panel: Pathogen Removal	Keep team apprised of latest water quality science; review deliverables and decisions, provide recommendations; CR Water Microbial Constituent evaluation for potable reuse	 An Associate Professor and Woter Quality Specialist at the University of Arizona. Has played a leadership role in evaluating reclaimed water quality and promoting water reuse as a safe and practical resource for the southwest. Possesses a wide variety of experience in traditional microbiological and viral methods for pathogen detection using culture and molecular techniques. Worked extensively with CDM Smith's Jill Vandegrift and Jen Hooper on WRF Project 4508 to assess appropriate monitoring and process validation approaches to manage risks in potable reuse facilities through early identification of failures using indicator and surrogate monitoring, while providing accurate and cost-effective monitoring strategies. 	5%

Team Member/Role

Responsibilities

Related Experience/Expertise

Avail. %*



Jen Hooper, Potable Reuse / Contaminants of Emerging Concern

Review existing Monitoring Plan, provide monitoring recommendations for advanced treatment/ potable reuse, CR Water supply CEC review

Review existing

potable reuse

Monitoring Plan,

provide monitoring

recommendations for

advanced treatment/

- Specialist in evaluating innovative chemical and biological treatment technologies through bench and pilot testing, ozone and biological filtration for drinking water and reuse applications and assessing the environmental fate and transport and degradation of CECs.
- Leads water and wastewater projects at CDM Smith's Environmental Research and Technologies Laboratory in Bellevue, WA.
- CDM Smith's technical lead on 6 WRF projects as a Principal Investigator or co-Principal Investigator, including WRF 4508, Assessing Techniques to Evaluate and Demonstrate the Safety of DPR; and WRF Reuse 15-11, Ozone Biofiltration Direct Potable Reuse Testing at Gwinnett County.
- Has been involved in over a dozen Water Research Foundation, Water Reuse Research Foundation and Department of Defense Environmental Security Technology Certification Program (ESTCP) research projects.
- Process design engineer for drinking water treatment projects from piloting to full-scale design and construction.
- Expertise in engineering services, technical reviews, and regulatory assignments for water supply projects and water reuse feasibility studies—primarily regarding potable reuse applications.
- Supported the USEPA in developing the 2017 Potable Reuse Compendium, a supplemental document to its Guidelines for Water Reuse that surveys the state of potable reuse across the US.
- Serves as Research and Development Coordinator for CDM Smith's Water Group including internally-funded and externally-funded pursuits on innovative and industry-changing topics.





Vandegrift, Potable Reuse

Tim Rynders,

Water Quality

Become familiar with Plum Creek Water Purification Facility, understand and communicate Plum Creek Water **Purification Facility** operating experience

now and after process improvements Become familiar with Plum Creek

Water Purification

and communicate

Plum Creek Water

improvements

Purification Facility

operating experience

now and after process

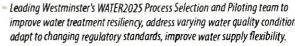
Facility, understand

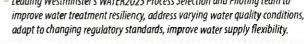
= 15 years of experience in planning, design, construction, and startup of water treatment facilities.

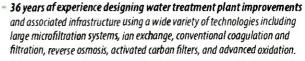
Extensive experience leading, designing, and operating water pilot plant treatability studies for process selection and optimization, as well as subsequent involvement in full-scale plant construction activities for local clients including Denver Water, Englewood, ECCV Water & Sanitation District.



10%

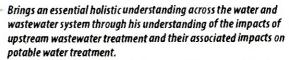








- Cxpertise spanning averall process design and chemistry, hydraulics and piping, and aperatians and control philosophy for water treatment facilities.
- Design manager an more than \$500M in design-build and fast-track water infrastructure prajects.



- 15 years of experience in regulatory, research & development, and process engineering of wastewater treatment, with Process design and modeling af biological wastewater treatment systems.
- Technical expertise in advanced water/wastewater treatment systems including MF/UF/MBR for water reuse.



COM Smith Denver Staff

Doug Brown, PE, BCEE **Drinking Water**

Jaeho Ho, PhD, PE Water Reclamation and Membrane

Treatment

Review wastewater effluent & other renewable sources data





Team Memb	per/Role	Responsibilities	Related Experience/Expertise	Avai %*
To PE	oldman- rres, PhD,	Review imported water data, review nonrenewable supply data, review wastewater effluent & other renewable sources data	 An expert in piloting innovative technologies, such as electrical chemical treatment of graywater for non-potable reuse, piloting UV and peracetic acid systems for WW, and monitoring tools for reuse treatment trains. Adept in analysis of pilot data and presentation of data to dients through user friendly tools and dashboards to enable clear decision-making. Expertise in membrane-based water treatment technology, water chemistry, membrane distillation, ian exchange, reverse osmosis. Currently serving as a pilot operator and data analysis engineer for Westminster's innovative WATER2025 Process Selection and Pilating ta improve water treatment resiliency, address varying water quality conditions, adapt to regulatory standards, improve water supply flexibility. 	25%
PE Pil	orl Lundin, e oting and ata Analysis	Review imported water data, review nonrenewable supply data, review wastewater effluent & other renewable sources data	 Experienced in conventional water/wastewater design and construction, including advanced water treatment processes, design, piloting, and construction, and management of diverse water projects. Experience in both high and low pressure membrane processes for drinking water treatment, and novel applications of osmotic membrane technology. Is currently serving as a pilot designer and supporting procurement and installation for Westminster's innovative WATER2025 project. 	25%
Ar PE	nrou Atassi, , BCEE rrosion ntrol	Provide corrosion control expertise	 A senior project manager and senior project engineer with 19 years of experience specializing in drinking water treatment and distribution and energy efficiency/system optimization. A specialist in corrosion control, water distribution, and treatment. Has led several Water Research Foundation projects related to corrosion control and distribution system water quality. 	5%
We We	e Morea ater Supply anning	Provide water supply planning support	 More than 30 years of experience leading integrated water resources planning projects, with focused expertise in the integration of reuse water with water supplies to get the most out of the water sources. Adept at effectively integrating advance treatment systems into water supply programs. CDM Smith's project director/program manager for the Colorado Water Conservation Board's SWSI program for 14+ years; involved conducting a statewide water supply investigation. CDM Smith's project director for several state water plans such as CO, AR, MO, OK, and GA; guiding state water agricultural and environmental technical roundtables to assess risks; identify gaps between available and future water resource needs; and implement strategies to meet water supply needs. 	5%
He PH EN	elissa nrclerode, nD, BCES, IV SP blic ntreach	Technical support for community engagement	 CDM Smith's expert in risk communication and stakeholder engagement. Specializes in the development and application of assessment approaches to evaluate environmental, social, and economic impacts of environmental infrastructure and restoration projects, as well as in the development of effective communication tools to support clients and communities. Focused experience addressing the issue of CECs with affected communities. Prepared the risk communication chapter of the National Groundwater Association's PFAS Best Suggested Practices (BSP) guidance titled Groundwater and PFAS: State of Knowledge and Practice (December 2017). 	10%
St.	dd alnaker ost timation	Cost estimation support	 A chief CDM Smith estimator with 2S years of experience in water and wastewater infrastructure planning, design, piloting, and construction. Expert in the preparation of conceptual, preliminary design, and final design estimates, detailed bid estimates, and change order pricing. 	5%







Groundwater Replenishment System Indirect Potable Reuse Plant, Orange County, CA

The Groundwater Replenishment System (GWRS) is one of the largest potable reuse projects in the world, providing a reliable, high-quality source of water to recharge the Orange County Groundwater Basin. CDM Smith led the project development phase, final design, bidding, construction, and operations and maintenance for this world class facility, which is providing a new water source for about 500,000 people living in the area.

Faced with extended droughts and continued population growth, the Orange County Water District and Orange County Sanitation District embarked on the landmark GWRS project—a true model of sustainability. Producing potable water for indirect reuse from highly treated wastewater, the system conserves and recovers limited water resources, reduces energy consumption and supports economic vitality.

This first phase of the GWRS program reclaimed and recycled up to 70 mgd of secondary effluent with a future capacity of 130 mgd. The secondary effluent undergoes three additional levels of treatment, including microfiltration (MF), reverse osmosis, and ultraviolet disinfection with advanced oxidation to ensure that all bacteria, emerging contaminants and viruses are removed. The highly-treated water is used to prevent seawater intrusion through a series of strategically placed injection wells and is also distributed to inland basins to recharge the groundwater supply with near-distilled water quality - the highest quality water available for recharge.

All of the facilities were constructed inside a building for climate and noise control. GWRS was the first large scale advanced water treatment plant using MF/RO/UV-AOP processes, which is the standard for potable reuse. The project received several awards, including:

- » AAEE Excellence in Environmental Engineering Awards Grand Prize for Design 2008
- ASCE Outstanding Civil Engineering Achievement Award & Ramesh M. Khona Award 2009
- » ACEC Grand Conceptor Award & Engineering Excellence Award Communication of Engineering 2009
- >> Stockholm Industry Water Award (OCWD/OCSD) 2008
- » IDA Global Water Award Water Project of the Year (honorable mention) 2008
- >> IWA Innovation Project Award

CDM Smith has received follow-on work at the plant via an Effluent Reuse

Study finished just last year, including analysis of new processes at GWRS. This joint project between the Sanitation District and the OCWD identified modifications needed to support the GWRS Final Expansion. The primary goal of the study was to identify how the Sanitation District's treatment systems can be modified to deliver 170-mgd of secondary effluent to OCWD to enable the GWRS Final Expansion to 130 mgd. CDM Smith is also currently completing ongoing work at the Plant implementing recommendations from the study.





Relevance/Key Tasks:

- CDM Smith led the design through completion of one of the largest, most successful potable reuse projects in the world.
- ✓ Features large scale advanced water treatment plant using MF/RO/UV-AOP processes to ensure removal of emerging contaminants.

Reference: Orange County Water District (OCWD), Mehul Patel, (714) 378-3200

Year Completed: 2018 (most current plant work)

Key Team Members/Roles: Doug Brown / Treatment Process Engineer, Chris Schulz / Technical Review, Greg Wetterau / Technical Review, Joe Cotruvo / Public Health Advisor

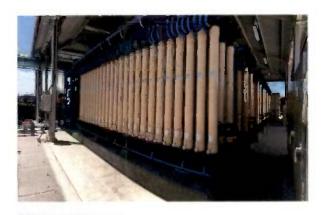


Leo J. Vander Lans Water Treatment Facility Expansion For Indirect Potable Reuse, Los Angeles, CA

To replace the need for imported water, the Water Replenishment District of Southern California decided to expand their MF/RO/UV system from 3 to 8 mgd. Ultimately achieving overall plant recovery of 92%, the system is the highest recovery for an indirect potable reuse MF/RO/UV plant in the world and provides 100% recycled water (its entire supply of water) to the Alamitos groundwater barrier. It is also the first reuse plant in the world to use UV for destruction of contaminants of emerging concern.

The Leo J. Vander Lans Water Treatment Facility creates recycled water for an engineered freshwater pressure ridge and seawater trough designed to protect groundwater in the Central Basin of Los Angeles County from seawater intrusion. Fresh water for injection at the facility was imported from the State Project Water and Colorado River. With the expansion complete, this project now replaces up to 92% percent of the potable water previously used for the barrier, conserving about three billion gallons of fresh water annually. The total use of recycled water at the facility represents a significant step forward in using a local water source to protect the groundwater basin while conserving California's precious water resources.

CDM Smith's 18-year history with this facility began with the original feasibility studies in 1994. CDM Smith designed the initial 3 mgd Phase 1 project, leading the design of the MF and RO facilities, sitework, chemical systems, product water pump station, buildings, pipelines, and control systems. The expansion also involved seamlessly integrating modifications to the existing plant with minimal impacts to the current operations.



Relevance/Key Tasks:

- ✓ Designed both the initial and expansion of the LVLWTF, including testing and implementation of high recovery RO and full-scale demonstration testing of UV/chlorine for advanced oxidation.
- ✓ The first reuse plant in the world to use UV for destruction of contaminants of emerging concern
- ✓ The first facility permitted under California's Final 2014 Groundwater Replenishment Reuse Regulations.

Reference: Tom Knoell, Water Replenishment District of Southern California, (562) 275-4266

Year Completed: 2014

Key Team Members/Roles: Doug Brown /Treatment Process Engineer, Greg Wetterau /Process Lead, Chris Schulz/Technical Review

CDM Smith designed and permitted the facility expansion to 8 mgd to replace all imported water injection to the barrier, utilizing microfiltration, reverse osmosis, and advanced oxidation to allow the Water Replenishment District of Southern California to recharge 100 percent recycled water without dilution. *This innovative design utilizes a dissolved air-flotation system, secondary microfiltration system, and secondary reverse osmosis (RO) system to achieve an overall increase plant recovery to 92.5 percent, providing UV-AOP to meet the advanced oxidation requirement.* The increase in recovery eliminated MF backwash discharge entirely and reduced the daily RO brine flow in half, significantly reducing the waste discharge costs.

This was the first facility to be permitted under California's Final 2014 Groundwater Replenishment Reuse Regulations.

Assessing Techniques to Evaluate and Demonstrate the Safety of DPR (WRF 4508)

CDM Smith collaborated with Shane Snyder and Channah Rock from the University of Arizona in this groundbreaking work to evaluate monitoring strategies pertinent to direct potable reuse. The project developed guidance on surrogate and indicator compounds appropriate for assessing performance of chemical and pathogen removal on various DPR treatment trains. Final publication of these findings is expected in late Spring 2019.

Since DPR has the potential to encounter a wider range of contaminants, higher initial contaminant concentrations than traditional sources of drinking water, and shorter response times to system upsets, demonstrating the safety of DPR water requires monitoring beyond current approaches for indirect potable reuse or conventional drinking water treatment. This project evaluated known techniques/methodologies for the assessment of DPR water quality to demonstrate the use of selected techniques at evaluating the effectiveness of currently accepted and alternative treatment trains for the production of DPR water.

Project Outcomes and Benefits

The project outcomes include a DPR guidance that water utilities and regulators can use to evaluate water quality of existing or potential future DPR scenarios and help facilitate a proactive monitoring process that is protective of public health. Key benefits include:

- >> Development of adequate monitoring strategies—critically important for the protection of public health in potable reuse scenarios.
- » Development of assurances—needed to confirm the quality of water produced and the safety of consumers—as potable reuse becomes a reality for many communities.
- » Research providing recommendations towards the use on non-traditional monitoring strategies (tools), coupled with standard bulk parameters used by industry, to aid in the evaluation of DPR treatment performance and the protection of public health.
- » Recommendation of the use of advanced tools (e.g. molecular techniques, bioassays, alternative indicators), to be completed by any DPR project as part of their sampling program as a key way to supplement the standard bulk data to aid in understanding of treatment performance, instill public confidence, and to elevate the safety of purified water from potable reuse facilities.

The report and utility guidance are expected to be published in late Spring 2019.

2 Floorescence (Raman Units) 350 1 5 one (Raman Units) 300 250 300 400 500 Emission Wavelength (nm)

Fluorescence EEM as an indicator of chemical constituents in advanced treated water





Microbiological culture methods such as Clostridium sp. (left) and rapid assays like IDEXX Colilert (right) were analyzed to provide guidance on simple but robust pathogen monitoring

Relevance/Key Tasks:

- ✓ Evaluation and demonstration of DPR
- ✓ Available literature review
- ✓ Historical data review
- ✓ 1-year full-scale sampling to identify appropriate indicator and surrogate compounds for monitoring on DPR treatment trains

Reference: Grace (Hyunyoung) Jang (303) 347-6112, HJang@waterrf.org

Year Completed: On-going

Key Team Members/Roles: Channah Rock / Principal Investigator, Jen Hooper / Co-Principal Investigator, Jill Vandegrift / Project Engineer, Josh Goldman-Torres / Project Engineer, and Greg Wetterau / Technical Advisor



Water samples collected from a full advanced treatment train (MF/RO/UV-AOP, right to left)



Ozone Biofiltration DPR Testing at Gwinnett County (WRF Reuse 15-11)

In another groundbreaking DPR project for WRF, CDM Smith collaborated with Denise Funk of Gwinnett County to pilot test several blending ratios of advanced treated water using ozone/biofiltration without RO. The project demonstrated that non-RO ozone/biofiltration treatment provided potable water quality at less than half the capital and operational costs of full advanced treatment (MF/RO/UV-AOP). The project received the 2018 American Academy of Environmental Engineers and Scientists Grand Prize award in Research and the 2018 WateReuse Association Engineering Excellence award in Transformational Innovation.

The primary objectives of this research were to demonstrate that ozone-biofiltration can be used to achieve potable quality water in a DPR scenario and evaluate which blending ratios could be used to meet primary and secondary drinking water standards. An additional objective was to evaluate the potential of the FWH WRC blended water to stabilize water quality and operations during challenges with Lake Sidney Lanier raw water quality.

CDM Smith supported Gwinnett County's principal investigator by assisting with the development of the piloting facility design, testing protocol, literature review, a piloting operations plan and the analytical sampling plan to test a variety of advanced treatment technologies as the County considered the potential of direct potable reuse within their system, compared against the County's existing practice of defacto indirect potable reuse.

Jen Hooper lead the design of the two 6 GPM pilot plants, operated in parallel to compare direct potable reuse against the County's existing practice of defacto indirect potable reuse. One pilot unit was operated as Gwinnett County's current planned IPR scenario, and the other train was dedicated to the investigation of DPR, receiving blended water from the advanced water reclamation facility. CDM Smith provided the design specifications and reviewed the project plans and drawings, while Intuitech built the plant.

For utilities facing scarcity of water supplies, this research demonstrated that alternative ozone/biofiltration-based treatment provided an economical alternative for diversifying water supply sources through DPR compared to RO. In particular, RO-based treatment for inland facilities is not economically viable, due to the high cost of RO brine disposal. Thus, this project demonstrated that this alternative treatment train achieved high treated water quality at a significantly lower cost. The findings from this research will help various water utilities across the country who are looking to evaluate and implement DPR at their facilities.



Relevance/Key Tasks:

- Preparation of pilot testing plan including design criteria, pilot plant design, specifications required for pilot facility procurement, sampling and operational SOPs
- ✓ Coordination of third-party laboratories, performing analytical testing services, data monitoring and analysis, as well as preparation of regular reporting
- ✓ Providing operational services to aid with system commissioning and start-up and operational support for continuous operation of the piloting facilities.
- ✓ Concurrent operation of two, independent side-by-side piloting facilities to compare direct potable reuse against the County's existing practice of defacto indirect potable reuse.
- ✓ Testing of a variety of advanced treatment technologies.

Reference: Denise Funk, PE, BCEE, Division Director, Research and Development, (678) 376-6908

Year Completed: 2018

Key Team Members/Roles: Jennifer Hooper / Co-Principal Investigator and Design Lead, Chris Schulz / Co-Principal Investigator, Josh Goldman-Torres / Data Manager

CDM Smith has enjoyed a long and successful working relationship with Gwinnett County. In addition to WRF 15-11, we are currently completing full-scale work at each of their drinking water treatment plants (SCFP and LFP)—that we designed and were built in the 1990s—helping them with their ozone and filtration systems.

Upper Occoquan Service Authority (UOSA) Advanced Treatment Pilot and Feasibility Study for Ozone Biofiltration (OBF) System, Fairfax, VA

CDM Smith has completed the pilot and is currently completing full-scale design work to determine the impact of ozone to extend the life of granular activated carbon contactors for an indirect potable reuse treatment plant. The pilot also studied options for the removal of CECs. The pilot results demonstrated that the ozone-biofiltration process can meet UOSA's organic reduction targets, eliminating the need to regenerate carbon.

UOSA owns and operates a 54-mgd Regional Water Reclamation Facility (RWRF) with preliminary, primary, secondary, tertiary, and advanced treatment facilities. The advanced treatment facilities include multi-media filtration and granular-activated carbon (GAC) adsorption. CDM Smith was selected to provide professional engineering services for the feasibility evaluation of installing an OBF system among UOSA's advanced treatment facilities at the RWRF, including establishing water quality criteria and comparing water treatment processes. The project is funded in part by the WateReuse Research Foundation in support of IPR and DPR water treatment technology research.

As part of this procurement and the multi-phase professional services contract, CDM Smith is providing support for the design and installation of OBF, which includes a bench and pilot study as part of Phase I of the project. Phases 2 through 5 include design and services during construction related to the implementation of the Phase I recommendations. These phases include additional engineering services, including: predesign, schematic and final design, bid and award services, services during construction, commissioning, and closeout and follow-up operations support for the full-scale facility.



Relevance/Key Tasks:

- ✓ Optimization of indirect potable reuse treatment
- ✓ Pilot and full-scale facility design and construction
- ✓ Bench and pilot studies, including bench-scale testing on ozone feed water (UOSA filter effluent) samples
- ✓ On-site pilot scale testing to facilitate detailed design of an ozone biologically activated carbon (BAC) system
- ✓ Pilot-scale testing to determine the effectiveness of an ozone BAC process for removing pharmaceuticals and personal care products (PPCPs) and microconstituents for indirect potable reuse
- ✓ Providing PERs, pre-design and design services and documentation as-required for permitting and construction activities

Reference: Bob Angelotti, Upper Occoquan Service Authority, (703) 830-2200

Year Completed: Ongoing

Key Team Members/Roles: Greg-Wetterau/Technical Review, Chris Schulz /Technical Advisor, Josh Goldman-Torres / Project Engineer

Indirect & Direct Potable Reuse Feasibility Study; Reclaimed Water Permitting; & River Road WWTP Improvements, Wichita Falls, TX

CDM Smith evaluated the use of wastewater treatment plant effluent from their River Road WWTP for use as a water source for either indirect potable reuse or direct potable reuse. The selected alternative was a sustainable and innovative water resources planning solution - an indirect potable reuse alternative.

CDM Smith worked closely with Texas Commission on Environmental Quality (TCEQ) to work through permitting challenges and received the TPDES Major Amendment of Permit to implement the indirect potable reuse project in December 2014. CDM Smith's work has involved much more than just completing the permit application – we educated the City and the TCEQ regarding the impact of the reclaimed water discharge on lake water quality and developed tools for use in the evaluation to demonstrate that the discharge can meet the required standards for Lake Arrowhead. The City also selected CDM Smith to perform all design and construction services.



Relevance/Key Tasks:

- ✓ Obtained TCEQ approval to operate an IPR plant
- ✓ Water quality modeling to evaluate impact of flows on the source water

Reference: City of Wichita Falls, Russell Schreiber, (940) 761-7477

Year Completed: 2018

Key Team Members/Roles: Doug Brown/

Technical Review

UV Disinfection Design, and UV/AOP Pilot Study, Cincinnati, OH

CDM Smith worked with the Greater Cincinnati Water Works (GCWW) to design and implement a 240-mgd, potable water UV disinfection facility with provisions to convert to a UV-chlorine advanced oxidation process in the future, for advanced treatment of emerging contaminants in the Ohio River.

The new UV facility is located at the Richard Miller Treatment Plant (RMTP), a surface water plant that employs conventional surface water filtration, along with post-filtration granular activated carbon (GAC) adsorption for organics removal. The UV disinfection process was installed between the GAC effluent and the finished water clearwells prior to addition of chlorine and corrosion control chemicals. UV plus chlorine provides a multiple-disinfection barrier for inactivating a variety of microbes, significantly improving public health protection. The UV system was designed to provide 4-log Cryptosporidium inactivation and 1- to 3-log inactivation of emerging chlorine-resistant bacterial pathogens with ultraviolet transmittance (UVT) ranging from 93 to 99 percent. In addition, a chlorine solution and mixing system was provided in the common inlet channel of the UV facility for converting from UV disinfection to UV-AOP operation in the future.



CDM Smith and GCWW's Water Quality and Research Division collaborated on two WRF studies to assess advanced treatment technologies being considered by the City of Castle Rock for potable reuse-UV-AOP and Biologic Filtration. Specifically, our team developed UV AOP models and process control algorithms for GCWW's UV system that accounts for UV dose, hydroxyl scavengers (including TOC and alkalinity) and reaction constants for target compounds (e.g., MIB, Geosmin, atrazine). We also developed analytical approaches to relate collimated beam and pilot UV-chlorine AOP studies to predict full-scale performance.

The Chemically Enhanced Biological Filtration project (WRF 4429) evaluated the treatment efficacy of eight chemical pre-oxidants, biofiltration and GAC for removal of personal care products and pharmaceuticals (PPCPs) and disinfection byproduct precursors from the Ohio River, a de facto IPR supply. This project used batch oxidation endpoint, kinetics, and sorption isotherm tests to evaluate removal of PPCPs and DBP precursors at the CDM Smith Environmental Technologies Laboratory. Subsequent pilot testing at Greater Cincinnati Water Works involved optimization of pre-oxidant dose, biological filtration and GAC sorption design. This applied research focused on optimizing solutions for management of NOM and PPCPs to provide high quality potable water and decrease overall operating costs—consistent with the challenges and water quality objectives for Castle Rock's water reuse program.



Relevance/Key Tasks:

- Design and implementation services for potable water UV disinfection facility.
- Assessed advanced treatment technologies being considered by the City of Castle Rock for potable reuse-UV-AOP and Biologic Filtration.
- Designed with capabilities for advanced treatment of emerging contaminants.
- ✓ A UV implementation coupled with the advanced treatment pilot plant system allow GCWW to pilot test multiple scenarios for future advanced treatment options.

Reference: Ramesh Kashinkunti, (513) 591-7710

Year Completed: 2014

Key Team Members/Roles: Chris Schulz / **Technical** Director, Jen Hooper / Project

Engineer

Project Success

As evidence of the successful collaborative relationship between CDM Smith and GCWW, the team was awarded the 2014 Grand Prize in Operations and Management by American Academy of Environmental Engineers and Scientists (AAEE).

Brunswick County Surface Water Treatment Plant Planning and Design Services to Expand Capacity and Treat Emerging Contaminants, Brunswick County, NC

Industrial and municipal discharges, and agricultural runoff in North Carolina's Cape Fear River watershed present water quality challenges more commonly observed at advanced treatment reuse facilities than at drinking water facilities. The Northwest Water treatment plant operated by Brunswick County has one source of supply, the Cape Fear River, must increase the plant's production from 24-mgd to meet increasing demands, and must implement advanced treatment to remove a variety of regulated and unregulated CECs. CDM Smith evaluated conventional and innovative treatment techniques, and is working with the County to accelerate the design and implementation of a cost-effective solution to resolve health concerns, and meet the expectations of the public and regulators on a first of its kind project.

The Cape Fear River contains a variety of contaminants of public health concern, including per- and polyfluoroalkylcompounds (PFAS), 1,4-dioxane, hexavalent chromium, N-Nitrosodimethylamine (NDMA), endocrine disruptors (EDCs), pesticides, and Pharmaceuticals and Personal Care Products (PPCPs), among others. These regulated and unregulated contaminants accumulate in the rivers and are resistant to removal by conventional surface water treatment processes.

The County selected CDM Smith to complete the Water Treatment Evaluation, which involved these major tasks:

- » Evaluation of Source Water Quality and Emerging Contaminants.
- » Desktop Alternatives Analysis for Advanced Treatment Options.
- » Evaluation of Treatment Plant Process Improvements for Expansion to 36-mgd.
- » Pilot Study to Remove 1, 4 Dioxane, PFAS, and other Contaminants
- » Permitting and Modeling Services
- » Draft and Final Report, that outlines a plan to expand and improve treatment
- » Presented to report findings to the Board of Commissioners

CDM Smith's proposed approach included evaluating existing data sets to determine which contaminants were the most concerning, develop draft treatment goals, implementing a fast-tracked and effective pilot study, and determining which treatment alternative best meets the County's goals. Ultimately, RO was selected over UV/AOP, O3-BAF, O3-H2O2, or GAC.

The project approach was tailored to the specific distinctions of the Northwest WTP and its contaminants, all while adhering to the County's target dates for sharing information with the public in March and April 2018. The report was completed in 3 months, along with initial rounds of pilot results. Subsequent to the completion of the treatment evaluation, the County's Board of Commissioners approved the recommendation to expand the WTP to 45 mgd and include advanced treatment. The project is currently in design.







Relevance/Key Tasks:

- ✓ Evaluated the presence of emerging contaminants in the Cape Fear River and which advanced treatment options would be best suited to efficiently remove them.
- ✓ Tested the advanced treatment technologies of Reverse Osmosis; Ozone with Biofiltration and Post-Filter GAC; and Post-Filter GAC with IX and UV-AOP.

Reference: John Nichols, Director of Public Utilities, (910) 253-2653

Year Completed: On-going

Key Team Members/Roles: Doug Brown / Technical Review, Greg Wetterau / Technical Review, Jennifer Hooper, Jaeho Ho / Process Engineer

Northeast Water Purification Plant Expansion (NEWPP), Houston, TX

CDM Smith is partnering with the City of Houston to deliver the nation's largest progressive design-build water treatment project. The City is expanding its Northeast water purification plant from 80 mgd to 400 mgd, dramatically increasing its ability to support steady residential and commercial growth while reducing dependency on groundwater.

As part of the expansion, the Houston Waterworks Team is designing and constructing a new raw water facility, including intake, pumping and conveyance to withdraw raw water from Lake Houston and deliver it about 1.5 miles away to the expanded NEWPP. The raw water from Lake Houston is challenging to treat because it is "flashy," meaning the water quality characteristics vary widely due in part to the lake's shallowness. During rain events, the turbidity, organics and alkalinity of the water change drastically. These changes make the water difficult to treat with a single treatment process alone. To address these challenges while meeting the city's goals, the team is delivering significant water supply innovation, including:

- » Innovative treatment strategies like chlorine dioxide, ozonation, and biological filtration to preserve high-quality finished water
- The largest installation of 40-inch diameter dual purpose centrifuges at a water treatment plant in the US.
- » The second largest installation of granular media single cell filtration units in the US.



Relevance/Key Tasks:

✓ Design solutions focused on nimbly adapting to highly variable water quality conditions with multiple treatment strategies such as chlorine dioxide, ozonation, and biological filtration.

Reference: Ravi Kaleyatodi, City of Houston Engineering Director, (281) 455-5872

Year Completed: On-going

Key Team Members/Role: Chris Schultz / Design Manager

"To help the city nimbly adapt to the variable raw water conditions, we are bringing to bear innovative treatment strategies like chlorine dioxide, ozonation and biological filtration, which have been proven to be very beneficial at other Texas facilities using similar source waters, but will be a first for Houston. We are helping the city to deliver much larger production rates for its customers, and even given a broad range of raw water qualities, preserving high-quality finished water." —Randy Rogers, Chief Engineer

The NEWPP expansion is required to comply with subsidence district rules for conversion from groundwater to surface water supply. Features of the project include the design, construction and commissioning of an intake pump station, twin 108-inch transmission mains, pre- and post-treatment chemical addition, flocculation and sedimentation basins, ozone treatment, filtration, finished water storage tanks, and a high service pumping station.

Design-Build Collaboration is Driving Success

The project will be implemented in phases, with the first phase increasing the capacity of the NEWPP from the present 80 mgd to 160 mgd by 2021, and the second phase increasing the overall facility production capacity to 400 mgd by 2024. The NEWPP expansion will more than quadruple the city's ability to deliver water to its customers. Through progressive design-build delivery, groundbreaking occurred in January 2018, and construction activities are now underway with the project reaching the 30% design milestone.

Achieving the city's goals for rapid water supply growth with an ambitious schedule will require extensive collaboration between all players involved in the project, which made this project ideal for a progressive design-build approach. "We're working together to make this effort successful," says project manager Randy Rogers. "In our Collaboration Center, we have members of the Houston Waterworks Team, staff from the city of Houston and their advisors, representatives of the regional authorities and their advisors—all together under one roof. Every time we modify or progress the design, our constructors provide input and give us feedback on the cost and schedule impacts. Our experts are constantly trading ideas and finding ways to improve the design. Working with each other and with the city, we can deliver all the benefits of design-build and make the city's vision a reality."

Loudoun Water Ozone Biofiltration WTP Design and Construction, Loudoun, VA

CDM Smith provided preliminary engineering, final design, bid, engineering services during construction, and construction management for a new 20-mgd (expandable to 40 mgd) ozone biofiltration water treatment plant in Northern Virginia. CDM Smith's design also integrated the potential for future regulatory changes that could impact the plant, with space reserved for future advanced treatment for regulatory compliance.

Several members of our Denver staff supported the delivery of the new Loudoun Water Treatment Plant (LWTP), performing preliminary engineering, final design, and construction administration services for the new 20 mgd WTP (expandable to 40 mgd). During the preliminary design phase of this project, CDM Smith performed water quality testing, engineering evaluations, calculations and design development to analyze conditions of the water in the Potomac River, determine treatment goals for the new plant, and select process trains for the new plant. In addition, we performed targeted bench-scale and full-scale confirmation testing to support development of design criteria for preoxidation and ozone disinfection treatment processes.

The LWTP was delivered as a conventional treatment process train in a consolidated treatment complex layout for the water treatment facility and a campus layout for the residuals facility, post-filter clearwells, and finished water pumping station. The design provides a cost-exective, operator friendly facility that meets plant site and hydraulic constraints, as well as improved system reliability and enhanced operational flexibility with no 'single point of failure'. The overall water treatment facility layout and basis of design for unit processes include preoxidation, rapid mixing, flocculation, sedimentation, intermediate ozone, biological filtration, and UV disinfection, as well as clearwells and a high service pumping station.





Relevance/Key Tasks:

- ✓ Included extensive water quality testing
- ✓ Designed with options for advanced treatment to address changes in regulatory requirements related to emerging contaminants.

Reference: Nicolle Boulay, PE, Program Manager, Loudoun Water, (571) 291-7745

Year Completed: 2017

Key Team Members/Roles: Chris Schulz /Technical Director, Josh-Goldman-Torres / Data Analysis, Jen Hooper/Technical Support, Jill Vandegrift / Submittals Review









CDM Smith Hourly Rate Schedule

Valid through December 31, 2019

Role	Hourly Rate
Technical Advisory Spec	\$275
Technical Spec.	\$265
Estimator	\$220
Sr. Engineer	\$210
Project Manager	\$200
Reg Spec	\$180
Construction Spec.	\$180
Sr. Designer	\$165
Staff Engineer I	\$150
Designer	\$140
Task Manager	\$130
Staff Engineer II	\$125
Drafter	\$100
Administrative	\$90

Additional Rate Information:

- The rate sheet above shall be valid through December 31, 2019.
- » Project related services shall be billed monthly.
- » Vehicle mileage shall be at current IRS audit rate at time of service performance.
- » Communications/computer time charges are incorporated into the hourly rates and not billed separately.
- » Office related consumable supplies shall be billed at cost with no additional mark-up.
- » Travel related items such as car rental, hotel, and per diem shall be billed at cost with no additional mark-up.
- » Project related printing and reproduction services shall be billed at cost with no additional mark-up.
- » Subconsultant shall be billed at cost with 5% mark-up.
- Any overtime for non-salaried/non-exempt personnel that has been approved in advance by CR Water shall be billed at 1.5 times the standard hourly rate with no additional mark-up. Overtime for exempt salaried personnel shall be billed at the standard hourly rate identified in the above noted fully burdened rate structure.



Agreement (Response to Terms and Conditions)

CDM Smith has read, understands, accepts each section of the RFP, and would like to request the following minor modifications and/or have further discussion with UTILITIES regarding the following:

- Clause 15 The use of "time is of the essence" is not appropriate for professional services. This language is more appropriate for construction. If this provision cannot be removed, we would request that it apply equally to both parties and not only to CDM Smith's performance.
- Clause 16 Recommend deleting "and recover its reasonable attorney's fees and costs in such legal action." We believe this creates an incentive for both parties to spend as much as possible to win, which only increases the costs of litigation. CDM Smith prefers to follow the American Rule whereby each party remains responsible for its own costs of litigation.



APPENDIX Team Member Resumes



Greg Dye, PE, PMP Project Manager



Education

MS - Environmental

Engineering, Montana State

University

BS - Civil Engineering, Montana State University

Registration/Certifications

Professional Engineer: Colorado (1997), Montana Sanitary Engineer: Arizona

Civil Engineer: Arizona, California

Certified Project Management Professional (PMP)®

Affiliations

Member, American Water Works Association Member, Water Environment Federation Mr. Dye is a Certified Project Management Professional with 20+ years of experience in project, program, and business management, including large engineering projects utilizing multiple disciplines, subconsultants, and globally-dispersed teams. His project experience is focused on the planning, design, and construction phase services for water infrastructure, including membrane treatment and advanced water treatment processes, and reuse facility upgrades. He has worked on projects located throughout Colorado and the western US, including Utah, California, Arizona, Montana, and Texas.

Project Manager, Denver Water Recycling Plant PON System and Valve Upgrades, Denver, Colorado. Mr. Dye managed the design and construction phase services for replacement of polymer blending and feed system, PLC for polymer system, and miscellaneous valves.

Project Manager, Northern Colorado Water Conservancy District, Eastern Pump Station; Berthoud, Colorado. Mr. Dye Managed the design of a new booster pump station for the Southern Water Supply Project. The pump station has a firm capacity of 15,000 gpm and has six 700 horsepower pumps.

Project Engineer, Colorado Springs Utilities J.D. Philips Water Reclamation Facility; Colorado Springs, Colorado. Mr. Dye completed preliminary and final design of a new 10 mgd plant. For the preliminary design, evaluated alternatives for both the secondary and tertiary treatment processes. As part of the evaluations, prepared life-cycle cost estimates, evaluated non-economic criteria, and performed power cost sensitivity analyses of the alternatives. Served as the process lead for the final design of the sodium hypochlorite disinfection and tertiary filtration systems.

Project Manager, City of Great FallsWater Treatment Plant Facility Upgrades, Great Falls, Montana. Mr. Dye managed the preparation of a Preliminary Engineering Report for \$55M in upgrades to the existing 50 mgd water treatment plant. To meet financial constraints, the project was broken down into several phases. For the first phase, managed the detailed design of a \$25M construction project consisting of an administration building addition; a replacement of existing medium voltage switchgear and large-diameter yard piping; modifications to an existing 15 kV substation; a new 15 kV substation, Chemical Feed and UV Disinfection Building, clearwell, supplemental chlorination system, and emergency power generation system; and expansion and upgrade of l&C controls and SCADA system. He is currently managing the construction phase services.

Project Manager, City of Central Water Facilities Master Plan, Central, Colorado. Mr. Dye prepared a master plan for the raw water collection and transmission system, water treatment facilities, and the treated water storage and distribution system. New stream diversion facilities, and rehabilitation of infiltration galleries, and repairs to transmission piping were evaluated for the raw water collection and transmission system. The improvements to the water treatment plant evaluated included facilities for controlling the raw water pH, stabilizing the treated water with soda ash, and thickening and drying of residuals. A new reservoir, rehabilitation of pressure-reducing stations, and piping modifications were planned for the distribution system.

Project Manager, Pinery Water and Wastewater District, Pinery Wastewater Treatment Facility Phases 1 and 2, Parker, Colorado. Mr. Dye managed the predesign, design, and services during construction for two projects for the existing



treatment plant, the Phase 1 process upgrade and the Phase 2 capacity expansion. The process upgrade included facilities for biological and chemical phosphorous removal, nitrification, denitrification, and ultraviolet disinfection. In addition, the capacity of the tertiary filters, solids handling and biosolids composting facilities were expanded.

Project Manager, City of Broomfield, Wastewater Collection System Master Plan Revision, Broomfield, Colorado. Mr. Dye managed the evaluation of alternative modifications to the existing wastewater collection system.

Project Manager, City of Boulder, Boulder Reservoir Water Treatment Plant, Boulder, Colorado. Mr. Dye served as project manager for the services during construction of process modifications to the existing plant. The modifications included a conversion to a dissolved air floatation treatment facility, addition of new sludge lagoons and expansion of the high service pumping station.

Project Manager, North Davis Sewer District,
Wastewater Treatment Plant, Layton, Utah. Mr. Dye
managed this design-build (CM-at-Risk) project for a
process change and capacity expansion to an existing
wastewater treatment plant. This \$89M project featured a
change to a trickling filter solids contact process; addition
of gravity belt thickeners for waste solids and belt filter
presses for dewatering biosolids; expansion of a water
quality testing laboratory, influent pump station, and
chlorine contact basins; and upgrades to the plant power
system and influent screening.

Project Manager, North Davis Sewer District,
Wastewater Treatment Plant, Layton, Utah. Mr. Dye was
the project manager for an odor emissions control study.
The study is to predict odor emissions from the existing
wastewater treatment facilities and biosolids processing
areas through atmospheric modeling, evaluate alternative
technologies for reducing the odor emissions, and
evaluate alternatives for disposing of the biosolids. As part
of the study, two pilot tests were performed to evaluate
the addition of ferric chloride to the influent flow stream
and the addition of an odor counteractant to the drying
biosolids to reduce odor emissions.

Project Manager, City of Englewood, Allen Water Treatment Plant Upgrade, Englewood, Colorado. Mr. Dye managed the preliminary design, design and services during construction of an \$11M upgrade to the Allen Water Treatment Plant. The project included new raw water flow diversion facilities; new rapid mix, flocculation, and sedimentation basins; modification to the existing chemical feed facilities; filter rehabilitation; and new sludge dewatering and drying facilities.

Project Manager, City of Longmont, WTP Odor Emissions Study, Longmont, Colorado. Mr. Dye managed the preparation of an odor emissions study. The study predicted odor emissions from the existing wastewater treatment facilities through atmospheric modeling and included an evaluation of alternative technologies for reducing the odor emissions.

Project Manager, Denver Water, Marston WTP Filter Complex, Denver, Colorado. Mr. Dye was responsible for the preliminary and final design of a new 125 mgd filter complex for Denver Water's Marston WTP. The preliminary design included an assessment of the condition of the original filter plant and evaluated alternatives for rehabilitation and replacement the filters. The \$36M project included a new filter complex, administration building, power generation facility, backwash water supply pumping station, filter air scour facility, and chemical storage and feed system.

Project Engineer, Denver Water, Moffat Collection System, Denver, Colorado. Mr. Dye was responsible for the development and evaluation of the transmission mains and pump stations for the project alternatives. This work included an assessment of the condition of the existing Moffat Water Treatment Plant and its capability to treat a variety of source water qualities. Also included was a review of regulations, industry standards and trends; an assessment of the quality of the different source waters; and a determination of treatment needs and the processes to meet the needs of the project alternatives. Life-cycle costs were estimated and non-economic criteria were evaluated for each of the project alternatives.

Project Manager, City of Brighton Reverse Osmosis Treatment Facility, Brighton, Colorado. Mr. Dye managed the design and engineering services during construction for the expansion of the treatment facility to 13 mgd. The expansion included the addition of a treatment train consisting of cartridge filters, a membrane feed pump, a reverse osmosis membrane filtration module, and a degassifier.

Deputy Project Manager, State of Utah Division of Water Resources Lake Powell Water Supply System, Salt Lake City, Utah. Mr. Dye prepared the environmental reports for an environmental impact statement and the conceptual design of a \$1.3B water supply project for southern Utah. He was also directly in charge of preparing the conceptual design of two water treatment facilities, three pump stations, and 55 miles of pipeline for the project. The project is to provide 100 mgd of water for several cities and consists of two water treatment plants, 160 miles of 69- and 36-inch diameter pipeline, eight pumping stations and seven hydropower generation facilities.

Chris Schulz, PE, BCEE Technical Director



Education

MS – Environmental Engineering, University of North Carolina, 1982 BS – Civil Engineering,

University of Detroit, 1980

Registration/Certifications

Professional Engineer: Colorado (2001)

Affiliations

Member, American Water Works Association, International Ozone Association, International Ultraviolet Light Association Member, AWWA UV Disinfection Standards Committee

Member, Board of Directors, International Ozone Association

Honors/Awards

Grand Award in Operations and Management, American Academy of Environmental Engineers, Cincinnati UV Disinfection Project, 2014 (on behalf of CDM Smith) Mr. Schulz is a water treatment process specialist and has 33 years' experience in planning and design of drinking water treatment facilities in the United States and overseas. He is a specialist in advanced disinfection and oxidation treatment processes. He holds 11 U.S. patents (plus three pending) on water treatment technologies. He has published seven articles in peer-reviewed journals, presented more than 70 papers at professional engineering conferences and is co-author of two books on UV disinfection in drinking water and surface water treatment for communities in developing countries. He has served as technical director, project manager, project engineer or process design advisor on dozens of water treatment plant designs and studies involving advanced processes (UV, ozone, advanced oxidation, biological filtration and membranes) in the United States and overseas.

Mr. Schulz has been active in water treatment process research, which has led to development of new technologies for ozone dissolution, ozone residual monitoring, ozone disinfection of water mains, hydraulic flocculation, field calibration of particle counters, field calibration of ultraviolet (UV) intensity sensors and point-of-entry water treatment systems. He has also directed several pilot plant studies for municipal water supplies for treatment process selection and optimization.

Ozone Design Lead, Ozone Disinfection Facility, Houston, Texas. Mr. Schulz is currently serving as the ozone design lead for a new 320-mgd WTP for the city of Houston, Texas. The ozone facility will include six ozone generators with a capacity of 17,400 ppd, a chilled cooling water system and four settled water ozone contactors with fine-bubble diffusers and a contact time of 10 minutes at design flow. A new hybrid constant concentration control strategy will be designed for the ozone system to rapidly respond to changing plant flow and water quality conditions.

Technical Director, Ozone-Biofiltration System Upgrade Project, Arlington,

Texas. Mr. Schulz is providing study, design and construction services for the phased upgrading of two ozone-biofiltration process trains for the John Kubala and Pierce Burch water treatment plants. The plants have design capacities of 97.5 and 75 mgd, respectively and include two stages of ozonation (preozone and intermediate ozone) followed by biological filtration. The project includes upgrades or replacement of existing ozone generation equipment, replacement of offgas destruct units, replacement of fine-bubble diffuser grids, and modifications to the automatic control system to improve treatment performance under rapidly changing flow and water quality conditions.

Technical Director, New Ozone-Biofiltration Water Treatment Plant, Loudoun County, Virginia. Mr. Schulz is serving as technical director and process lead for a new 20-mgd (expandable to 40 mgd) ozone-biofiltration water treatment plant in Northern Virginia. The plant process train includes two ozone treatment stages—preozone for taste and odor control and settled water ozone for primary disinfection and ozone-enhanced biological filtration for removing turbidity and biodegradable organic carbon. The ozone system uses a pumped sidestream injection system in conjunction with a pipeline flash reactor for preozone and nozzle manifold for settled water ozone to improve ozone treatment performance.

Design Manager, UV Disinfection Facility, Houston, Texas. Mr. Schulz provided design services for a 200-mgd UV disinfection facility for the city of Houston, Texas. The project included an assessment of conventional treatment processes (including



enhanced coagulation with ferric chloride) to improve UVT water quality prior to UV disinfection.

Senior Process Advisor, WTP Design, Picqua, Ohio. Mr. Schulz is serving as the senior process advisor for a new 6-mgd (expandable to 9 mgd) WTP. The process train will include conventional mixing, floculation and clarification processes for softening, followed by biological filtration for particle removal and carbon contactors for seasonal control of chlorinated disinfection byproducts and atrazine řemoval.

Ozone Process Designer, Ozone Facility Design, Gwinnett County, Georgia. Mr. Schulz provided design and construction services for 150-mgd preozone facility with an installed ozone generation capacity of 1,500 pounds per day. The ozone design included high-concentration, oxygen-fed ozone generation system and sidestream venturi injection-downflow tube (SVIDT) ozone contacting system, developed by Mr. Schulz.

Process Selection Lead, WATER2025 Process Selection and Pilot, City of Westminster, Colorado. Mr. Schulz is currently leading the process selection efforts, and supporting the desk top evaluation for a visionary program for Westminster, focusing on providing high-quality water to its customers and transitioning from the Semper Water Treatment Plant to a new water treatment plant. The new plant will ultimately be designed to improve treatment resiliency to address varying water quality conditions, adapt to changing regulatory standards, improve water supply flexibility and water quality, and embrace environmental sustainability and resource stewardship. The team will also be providing expertise and counsel regarding the design and construction of a new WTP.

Senior Process Advisor, UV Disinfection Facility, Englewood, Colorado. Mr. Schulz provided design services for a new 30-mgd UV disinfection facility for the City of Englewood Colorado. The UV facility was constructed inside an existing finished water clearwell, which was also refurbished under the project. The UV system includes three medium-pressure UV reactors, supplied by Trojan Technologies, A specially designed bypass piping system around the clearwell allowed the plant to continue to operate throughout the construction period.

Project Manager and Technical Director, UV-Advanced Oxidation Process Master Plan and Design, Cincinnati, Ohio. Mr. Schulz provided study services for this UV process master plan and led design services for the subsequent 240-mgd disinfection facility. The study objective was to determine if an advanced oxidation process (AOP) should be considered as a future process upgrade for the new UV disinfection facility to be constructed at GCWW's Richard Miller Treatment Plant. AOP was evaluated to meet the following treatment

objectives: seasonal taste and odor control, specifically MIB (2-methylisoborneol) reduction, and year-round destruction of emerging contaminants such as pharmaceuticals and personal care products (PPCPs), endocrine disrupting compounds (EDCs), pesticides (e.g., atrazine) and other chemical contaminants that may be present in the Ohio River watershed.

The master plan evaluated 14 UV disinfection and UV/ peroxide design alternatives involving pumped and gravityfeed delivery systems, five plant/process train locations and construction phasing of disinfection and AOP capability. An ozone/peroxide "benchmark" AOP was also developed for comparing cost and performance against UV-based treatment processes. The UV system was designed for 3-log Cryptosporidium inactivation and 1- to 3-log inactivation of emerging chlorine-resistant bacterial pathogens. The UV disinfection process, now under construction, will be located downstream of an existing post-filter granular activated carbon (GAC) adsorption process, which allows for costeffective design and operation of the UV system with UVTs ranging from 93 to 99 percent. A new computer-based tool and guidance document, recently published by AwwaRF, was used to accurately predict daily UV system performance and operating costs based on historical flow and water quality data to establish the optimal number of parallel operating UV trains, and associated head loss, equipment redundancy and turndown requirements.

Senior Process Advisor, CAT/DEL Pilot Study, Department of Environmental Protection, New York. Mr. Schulz provided study and design services for a 2,200-mgd UV disinfection facility for the unfiltered Catskill-Delaware supply for the city of New York. The work has included performing the filtration study of the CAT/DEL water supply including an evaluation of alternative treatment schemes; design, acquisition and operation of pilot plants for alternative processes; conceptual design; environmental review; and preliminary design of the recommended facilities.

Process and Equipment Lead, Denver Water, North Treatment Plant Owner's Representative Services, Denver, Colorado. Mr. Schulz leads the process design for the Owner's Representative team, providing guidance regarding early procurement of equipment for the new state-of-the-art NTP.

Senior Process Advisor, UV Disinfection Facility, East Cherry Creek, Colorado. For the East Cherry Creek Valley Water Authority, Mr. Schulz provided design services for a new 15-mgd groundwater supply determined to be under the influence of surface water. The process train includes UV disinfection, followed by low-pressure reverse osmosis membranes to meet both disinfection and TDS reduction goals for the project. The UV system will be the first system in Colorado to meet Giardia-based disinfection requirements of the Surface Water Treatment Rule without conventional filters.

Solomon Abel, PE Principal in Charge



Education

MS – Civil/ Environmental Engineering, Iowa State University, 1999

BS – Civil Engineering, Iowa State University, 1997

Registration

Professional Engineer: Kansas

Affiliations

Member, American Water Works Association Member, Water Environment Federation Mr. Abel is a Denver-based environmental engineer with 21 years of experience successfully guiding some of CDM Smith's most critical water infrastructure projects to bring value to clients worldwide—across the US, the Middle East, Europe, Latin America, and the Caribbean. He now oversees operations in the Denver, Colorado area, providing guidance and support for the development and delivery water and wastewater treatment works, reuse and conveyance systems, pump stations, solid waste, industrial, and drainage improvement projects. Through his leadership role, he brings the authority to ensure that any project or task undertaken will have the necessary resources – both financial and personnel – to efficiently complete the project without impacting budget, schedule, or quality. He will also support the identification of any value-added opportunities or project cost savings, and is able to assist in reviewing documents for quality control.

Principal/Client Service Leader, Aquifer Pilot Study, South Metro Water Supply Authority (SMWSA), Greenwood Village, Colorado. Mr. Abel supported the SMWSA team to obtain a Water Supply Reserve Account Grant to evaluate the feasibility of aquifer storage and recovery (ASR) to manage the delivery and use of additional water supplies in their respective systems. The team's work has provided guidance and assistance to SMWSA and its members in their evaluation of using ASR as a viable option to effectively manage their renewable water supplies.

Principal-in-Charge, WATER2025 Process Selection and Pilot, City of Westminster, Colorado. Mr. Abel is providing leadership and resource support for this visionary program for Westminster, focusing on providing high-quality water to its customers and transitioning from the Semper Water Treatment Plant to a new water treatment plant. The new plant will ultimately be designed to improve treatment resiliency to address varying water quality conditions, adapt to changing regulatory standards, improve water supply flexibility and water quality, and embrace environmental sustainability and resource stewardship. The team will also be providing expertise and counsel regarding the design and construction of a new WTP.

Client Service Leader, Denver Water Owner's Representative Services for the Northwater Treatment Plant, Denver, Colorado. Mr. Abel is supporting the Owner's Representative Team for Denver Water's greenfield North Treatment Plant—a new, state-of-the-art WTP in Jefferson County that will ultimately be capable of treating up to 75 million gallons of water a day, and will be equipped with disinfection technology that will provide more flexibility to react to changes in water quality.

Principal/Client Service Leader, Denver Water On-Call Engineering Services, Denver, Colorado. Mr. Abel is supporting CDM Smith's On-Call services teams in completion of task orders for Denver Water, including treatment and hydraulics improvements as needed.

Client Service Leader, East Cherry Creek Valley (ECCV) Water & Sanitation District North System Phase 3 Expansion, Aurora, Colorado. Mr. Abel is supporting the team providing engineering services for an additional project phase following a successful expansion of a 10-MGD brackish water reverse osmosis (RO) system to reduce water hardness and total dissolved solids. The Phase 3 Expansion will increase the District's renewable water supply up to 20 MGD and will include a new standalone



chemical facility, additional treated water pumping capacity, and administrative space for the District's operations team. The process is anticipated to be a high-recovery RO process that recovers approximately 94% of the brackish groundwater supply.

Client Service Leader, East Cherry Creek Valley (ECCV) Water & Sanitation District On-Call Engineering Support, Aurora, Colorado. Mr. Abel is supporting the team providing engineering on-call support to ECCV supporting design modifications, improvements, and recommendations related to the RO WTP's chemical storage areas, programming and instrumentation modifications, and equipment.

Client Service Leader, Metro Wastewater Reclamation District, PAR 1323 In-Stream Temperature Habitat Improvements, Denver, Colorado. Based on CDM Smith's lessons learned from more than 25 years of hands-on experience completing similar habitat improvements for the District and along more than 20 miles of the SPR, we were awarded PAR 1323 to engage in the evaluation, preliminary design, final design, bidding, and construction phase services for river enhancements—ultimately to reduce in-stream water temperatures, improve and stabilize the aquatic habitat, and achieve regulatory compliance.

Client Service Leader, Metro Wastewater Reclamation District PAR 1279 South Platte River Segment 15 Temperature Mitigation Alternatives Analysis and Feasibility Study, Denver, Colorado. Mr. Abel provided resource and team support for completion of this study, focused on developing viable projects for phased implementation to reduce effluent temperatures and achieve compliance with stream standards, including instream habitat projects to improve instream mixing and heat recovery projects within the influent system or at the treatment facility.

Project Director/Project Manager, Various Projects, Fort Myers, Florida. Mr. Abel led the development of innovative energy reduction and energy savings ideas at existing facilities, assisted city government in completing grant applications, and the initiation of a city-wide energy audit. Mr. Abel worked closely with city staff on annual environmental permitting monitoring reports, and permit renewals, and managed the completion of construction of a reuse production facility to supply reclaimed water throughout the city.

Colombia Country Manager; Water and Wastewater Director – Latin Ámerica and the Caribbean; Project Manager – Canoas WWTP; Client Service Leader – South America and the Caribbean. Mr. Abel was CDM Smith's Colombia Country Manager where he

managed the Colombia operations. This role included sales, sales planning and sales management; HR/ hiring/training oversight, including leading the growth of two offices from 10 people to over 80 people; and operations and cost control. Key projects in which he has led, participated in, and delivered include the Canoas WWTP; Central Bogota Aqueduct, Sewer, and Stormwater modeling and network expansion for the City of nine million people; San Andres Integrated Water Management Plan, an emergency medium term desalination plant and water supply, and long term vision of the Island with a capital expenditure (CAPEX) of over \$40 Million. Mr. Abel served as the Project Manager on the design of the US\$1.6 Billion Canoas WWTP, which will serve 7.3 million people in Bogota. This greenfield plant is being designed for 365 mgd average flow and a peak flow of 640 mgd.

Project Manager, Puerto Rico Aqueduct and Sewer Authority Program Management Consortium, San Juan, Puerto Rico. Mr. Abel served as the startup and hardware lead on the Puerto Rico Aqueduct and Sewer Authority's (PRASA's) Automation Program, with the ultimate goal of automating all 120 water treatment plants (WTPs) in Puerto Rico and transforming PRASA from a plant-focused model to a cluster-based organizational model. Mr. Abel managed a team of over 30 engineers from both the United States and Puerto Rico in the programming, integration, and startup of the plants. He coordinated with regional and island- wide operations and maintenance personnel, from regional directors to plant operators, on startup activities, training, and troubleshooting.

Project Director, Various Projects, Lee County, Florida. Mr. Abel worked closely with many levels of Lee County staff to lead many projects, including a multi-year engineer-of-record contract that includes evaluation and inspection of all county water, wastewater, wellfield, and pumping facilities and a financial and asset management review of the county organization; an integrated water resource master plan for the entire county evaluating all water supply sources, including reuse, brackish and sea water desalination, surface and groundwater use, including aquifer storage and recovery, etc.

Project Manager, Operations and Technical Support Contract, Collier County, Florida. Mr. Abel managed CDM Smith's operations and technical support contract with Collier County. This contract was used by the county at any time to assist with improving their general operations throughout their drinking water supply system. This contract included developing an operations protocol for the North County Regional WTP utilizing reverse osmosis (RO) membranes; a wellfield operations and maintenance manual; and investigation of a 10-km medium voltage cable failure.

Gregory D. Wetterau, PE, BCEE Technical Advisory Panel: Panel Lead



Education

MS – Environmental Engineering, University of Illinois, Urbana, Illinois, 1994

BS – Civil Englneering, University of Illinois, Urbana, Illinois, 1992

BA – Liberal Arts, Wheaton College, Wheaton, Illinois, 1992

Registration/ Certifications

Professional Engineer: Washington (1998), Oregon, and California

Honors/Awards

Board Certified Environmental Engineer (BCEE), American Academy of Environmental Engineers and Scientists

Affiliations

Member, International Water Association

> Member, International Desalination Association

Mr. Wetterau serves as CDM Smith Technical Strategy Leader for Reuse and Desalination and is an environmental engineer with more than 25 years of experience in engineering and project management for planning, design, and construction phases of water and wastewater projects. His primary expertise includes process and system design for membrane filtration, desalination, and advanced wastewater treatment facilities, having been involved with piloting, design, or facility start-up for more than sixty membrane treatment facilities throughout the world. Mr. Wetterau is a recognized international expert in the implementation of membrane treatment technologies, and has supported projects on six continents. He currently sits on the Boards of Directors for the American Membrane Technology Association (AMTA) and the International Desalination Association (IDA), serves on Project Advisory Committees for the WaterReuse Research Foundation, and is a peer reviewer for the Journal of the American Waterworks Association (AWWA).

Project Manager, EPA Reuse Guidelines Potable Reuse Compendium. Mr. Wetterau led the completion of the 2017 Potable Reuse Compendium, supplementing the 2012 Guidelines for Water Reuse, addressing the current status of potable reuse in the United States, the regulatory framework, current treatment approaches, and relative risks compared with more traditional drinking water supplies.

Process Lead, Leo J. Vander Lans Water Treatment Facility Expansion, Long Beach, California. For the Water Replenishment District of Southern California, Mr. Wetterau served as lead process engineer during design and construction for expansion of the 3 mgd indirect potable reuse facility to 8 mgd, without increasing waste flows to the sewer. A dissolved air flotation (DAF), secondary MF system, and third stage RO will produce an overall plant recovery of 91 percent. The design also includes the addition of advanced oxidation to comply with pending indirect potable reuse regulations in California. Mr. Wetterau has been heavily involved with permitting of the facility, the first to be approved under current draft Groundwater Recharge Reuse Regulations.

Process Lead, Water Purification Technology Evaluation Project, JEA, Florida. For JEA, Mr. Wetterau served as the lead process engineer during pilot testing of advanced treatment technologies for potable reuse. The project included pilot testing of two alternative process trains at both the Southwest Wastewater Treatment Plant and the Buckman Wastewater Treatment Plant. The treatment processes include: coagulation, flocculation, sedimentation, ozone, biological filtration, and advanced oxidation; and ultrafiltration, reverse osmosis, and advanced oxidation. Mr. Wetterau was responsible for selection of the overall treatment processes, development of design criteria, review and approval of the testing and monitoring protocol, weekly review of operating data, and remote troubleshooting of plant operations.

Process Expert, Demonstration of High Quality Drinking Water Production Using Multi-Stage Ozone-Biological Filtration: A Comparison of DPR With Existing IPR Practice, Gwinnett County Department of Water Resources, Gwinnett County, Georgia. CDM Smith is supporting Gwinnett County in performing pilot-scale tests in this side-by-side study of IPR and DPR to evaluate the efficacy of ozone-BAF. The DPR pilot will evaluate various ratios of blended F. Wayne Hills WRC effluent in combination with Lake Lanier as a raw water source. CDM Smith is also providing professional consulting services to support DWR with the design and procurement of pilot testing facilities, design of the experimental approach, operations plan development and operations support, data analysis, and recommendations for full-scale implementation requirements related to the



two pilot studies at the Shoal Creek Filter Plant. Mr. Wetterau is responsible for review of project deliverables, such as the pilot design and testing and monitoring plan, as well as site inspection and operational support.

Technical Reviewer, Groundwater Replenishment System (GWRS), Orange County, California. Mr. Wetterau provided technical review of membrane design for the world-class groundwater replenishment system project, which will provide up to 200,000 Orange County families with a new source of drinking water. The GWR System will reclaim and recycle up to 95 mgd of secondary effluent from the Orange County Sanitation District's Plant No. 1. The secondary effluent will undergo three additional levels of treatment, including microfiltration, 100-percent reverse osmosis treatment, and ultraviolet disinfection.

Third Party Reviewer, Advanced Treatment Plant Design-Build, Perth, Australia. Mr. Wetterau served as third party reviewer for the Water Corporation of Western Australia during the alliance development, final design, construction, and start-up phases of the 10 mgd Beenyup Advanced Water Treatment Facility. In this role, he was responsible for technical review of the two competing proposals submitted on Australia's first wastewater reuse groundwater replenishment project, technical review of process equipment.

Technical Reviewer, Indirect Potable Reuse Preliminary Program Assessment, Santa Clara Valley Water District.

Mr. Wetterau is serving as senior technical reviewer on the South Bay Water Recycling Strategic Master Plan to identify a recommended mix of potable reuse and non-potable reuse projects to achieve 40,000 AFY of recycled water use by 2025 and 50,000 AFY by 2035. Mr. Wetterau is providing recommendations on treatment technologies, permitting impacts, and siting alternatives for a 5-mgd potable reuse satellite facility and a 30-mgd centralized facility.

Task Leader, Reclaimed Water Master Plan, Los Angeles, California. Mr. Wetterau served as task leader on the groundwater replenishment treatment pilot study for the Los Angeles Department of Water and Power utilizing microfiltration, reverse osmosis, and two alternative forms of advanced oxidation, to produce potable quality water from both a tertiary and secondary effluent source. Mr. Wetterau led several workshops and participated in public outreach meetings and tours of the treatment facility. He also served as lead technical advisor for potable reuse aspects.

Technical Lead, Water Purification Demonstration Project, San Diego, California. Mr. Wetterau provided senior technical oversight for design, construction, and operation for this component in the city's planned indirect potable reuse facility which will employ reservoir augmentation to supplement the raw water supply from the San Vicente reservoir. The demonstration project included two independent process trains including microfiltration,

ultrafiltration, reverse osmosis, and advanced oxidation with ultraviolet light and hydrogen peroxide. Mr. Wetterau worked closely throughout the project with the Department of Public Health to support the development of future reservoir augmentation regulations and has led technical presentations to multiple regulatory agencies, public interest groups, and City Council.

Task Leader, Effluent Reuse Study, Orange County
Sanitation District (OCSD) and Orange County Water
District (OCWD). Mr. Wetterau is serving as Task Leader for the
Effluent Reuse Study to identify the modifications needed to
OCSD's treatment systems to deliver 179-mgd of secondary
effluent to the Groundwater Replenishment System (GWRS)
to enable OCWD to complete the Final Expansion to 130 mgd.
Mr. Wetterau is leading the development of two of the project
tasks, including an evaluation of separate treatment for nonreclaimable flows and an evaluation of high recovery RO as a
means of reducing influent flow demands for GWRS.

Technical Specialist, Reuse Water System Master Plan Update, City of Raleigh Public Utilities Department (CORPUD), Raleigh, North Carolina. CORPUD is examining water reuse as an alternative to reduce pressures on the city's water resources. Mr. Wetterau served as a technical specialist for the study to characterize the water quality of the Neuse River, which is the receiving water for effluent from the City's Neuse River WWTP and serves as the source water for downstream users. The study will include a baseline water quality assessment to define the environmental fate and transport of contaminants from point and non-point sources in the river basin. Water quality parameters with respect to public health are being investigated.

Task Leader, Metropolitan Water District of Southern California (MWD) Regional Purified Water Reuse Study, Los Angeles, California. Mr. Wetterau served as task leader for the process treatment evaluation and development of water quality goals for a future advanced treatment facility utilizing treated wastewater from the Los Angeles County Sanitation Department to supplement the MWD raw water supply through either reservoir augmentation or groundwater replenishment.

Selected Presentations and Publications

- Wetterau, G.D., Chalmers, R.B., and Schulz, C. "Full-Scale Testing of UV/Chlorine for Potable Reuse" IUVA News, v20n3, 2018
- Wetterau, G.D. and Kiefer, C. "Cost of Treatment." AWW M62 Membrane Applications for Water Reuse, 2018
- Wetterau, G.D., R.B. Chalmers, P. Liu, W. Pearce, "Advancing Indirect Potable Reuse in California." Water Practice & Technology, September 2013
- Wetterau, G.D. "Impact of Source Water Selection on Indirect Potable Reuse." Presented at the AWWA Annual Conference and Exposition, Chicago, Illinois, June 2010.

Sheau-Yun (Dora) Chiang, PhD, PE Technical Advisory Panel: Contaminants of Emerging Concern



Education

PhD – Environmental Engineering, Georgia Institute of Technology, Atlanta, Georgia, 1994-1999

MS – Environmental Engineering, Illinois Institute of Technology, Chicago, Illinois, 1992-1994

MS – Chemistry, Chung Yuan Christian University, Taiwan, 1988-1990

BS – Chemistry, Chung Yuan Christian University, 1984-1988

Registration/Certifications

Professional Engineer: Georgia (2004)

Affiliations / Activities

Interstate Technology & Regulatory Council (ITRC) PFAS Team Member, 2017-present

Interstate Technology & Regulatory Council (ITRC) PFAS Team Training Subgroup Leader, 2018-Present

Battelle Conference, Steering Committee, 2018

PFAS Special Issue, Remediation Journal, Co-Editor, Spring 2018 (under preparation)

1,4-Dioxane Special Issue, Remediation Journal, Co-Editor, Winter 2016 Dr. Chiang is a senior environmental engineer and CDM Smith's Technical Strategy Leader for the emerging contaminants market. She is a remediation consultant with more than 20 years of experience on characterizing and remediating contaminated sites. She has worked on sites impacted by emerging contaminants (1,4-dioxane, nano materials, 1,2,3-Trichloropropane (TCP), PFAS etc.) since 2001. She works closely with CDM Smith's leadership team to develop the community of practice for emerging contaminants, contributes to technology transfer on emerging contaminants, and also leads technology development through DoD's research funding programs. She has also collaborated with universities and clients to develop innovative remediation technologies and to transfer the developed technologies from laboratory to field applications and commercialization.

Principal Investigator, US Department of Defense (DoD) Strategic Environmental Research and Development Program (SERDP), "An Electrocoagulation and Electrooxidation Treatment Train to Degrade PFAS and Other Persistent Organic Contaminants in Ground Water". Dr. Chiang directs the project team at AECOM (contract holder) and university research team at University of Georgia to prove the concept and evaluate the approach of using electrocoagulation to remove PFAS following with a destruction technology (i.e., electrochemical oxidation) to destroy PFAS concentrated on the flocs. Dr. Chiang leads the communications with DoD SERDP program manager and the University, and provides project oversight and data evaluation to ensure the overall success of the project.

Principal Investigator, US Air Force Base Broad Agency Announcement (BAA) Program, "Coupling Ion-Exchange Resin with Electrochemical Treafment For Complete Separation and Destruction of PFOS and PFOA in Groundwater". Dr. Chiang directs the project team at AECOM (contract holder), technology vendors and university research team at University of Georgia to test, evaluate, design and demonstrate a pilot-scale innovative PFAS treatment system at two selected US Air Force Bases. The project proposed to remove PFAS in the extracted groundwater using regenerable ion exchange resin following with destruction of PFAS in the concentrated regeneration waste using electrochemical oxidation process. Dr. Chiang leads the communications with US Air Force Center for Engineering and the Environment (AFCEE) BAA project manager and technical advisors, US Air Force RPM and university, and provides project oversights and data evaluation to ensure the overall success of the project.

Prior to CDM Smith

Technical Advisor, PFAS Site Inspection, Air National Guard, Multiple Locations,

Dr. Chiang provided senior review and advices on site inspections (SIs) at sites with known aqueous film-forming foam (AFFF) releases located nationally. Data obtained from these investigations are used to identify potential sources at each installation. She also developed and directed corporate PFAS sampling guidance including training ANG PFAS sampling teams to perform PFAS field sampling and characterization.

Technical Advisor, PFAS Preliminary Assessment, Site Inspection and Site Investigation, US Navy, Multiple Locations. Dr. Chiang provided senior review and advices on multiple project work plans, project deliverables (PA/SI, site investigation, feasibility studies, IDW waste management) for Marine Corps Base Hawaii, Oahu,



Hawaii, Former Naval Air Station South Weymouth, and Naval Air Station Joint Reserve Base Willow Grove. She was responsible for deliverable qualities and technology transfer, and provided inputs on PFAS fate and transport mechanisms.

Technical Advisor, PFOS/PFOA CERCLA Site Inspection at Joint Base Lewis McChord, Washington, US Army Corps of Engineers, Seattle District. Dr. Chiang built the company PFAS team in the State of Washington in order to perform this project, and directed the project team on PFAS source identifications, site characterizations, sampling, exposure pathway evaluation and client communications. She served as subject matter expert to provide PFAS technology transfer to multiple agencies (State of Washington, JBLM RPM, Army Corp Seattle District and Region 10) involved in the project.

Technical Advisor/Subject Matter Expert, PFAS Site Investigation, Australia Department of Defence, RAAF Base Williamtown and Oakey Army Aviation, Australia.

Dr. Chiang served as project advisor and subject matter expert to evaluate PFAS conceptual site model, develop protocols and evaluate data on PFAS fate and transport. She supported the laboratory column study to verify PFAS precursor biotransformation and supported the plant uptake study to evaluate the PFAS uptakes by different edible plants. Dr. Chiang used total oxidizable precursor (TOP) assay as a screening tool to verify the accumulation of wide ranges of PFAS compounds in unsaturated soil, sediment, groundwater and surface water. She led the technology development for the project team to develop effective destruction technologies to destroy PFAS in groundwater and liquid waste streams. The study results have been presented in national and global remediation conferences and published in Remedial Journal, PFAS Special Issue. This is also the first field study that confirms the mass storage of PFAS in the unsaturated soil that serves as a long-term source of PFAS dissolved plumes.

Co-Pl, US Air Force - Broad Agency Announcement Research Funding on "Bioaugmentation to Enhance Biodegradation of 1,4-Dioxane," AFCEC, Texas (2013-2018). Serving as co-Pl of the project as senior technical advisor on developing field demonstration protocol to deliver 1,4-dioxane degrader CB1190 into subsurface and monitor for CB1190 distribution, abundance and activity. This was the first field demonstration to verify CB1190 distribution and its in-situ biodegradation potential of 1,4-dioxane. CB1190 was delivered into subsurface through injection well, DPT injection points and in-situ bioreactor baited with CB1190. Dr. Chiang was responsible for project progress, data quality, senior reviewer of major

deliverables and point of contact with Dr. Shaily Mahendra at UCLA.

Senior Engineer, Feasibility Study, Avon Park Air Force Range, US Army Corps of Engineers - Omaha District, Florida. Dr. Chiang conducted fate and transport analyses of groundwater and soil contaminants (arsenic, iron, manganese, fluoride, nitrate, cyanide, PAHs, herbicide and pesticides) for eight Avon Park AFR sites.

Technical Advisor, SWMU 17, Charleston Weapon Sites, Performance-Based Groundwater Remediation, US Army Corps of Engineers- Omaha District, South Carolina. Dr. Chiang provided site cleanup strategy support and managed the design of a full-scale groundwater bioremediation system with injection of pH buffered emulsified vegetable oil and dechlorinating bacteria.

Quality Control Manager, Soil and Groundwater Remediation Technology Evaluation and Selection, South Jersey Clothing Company Superfund Site, US Army Corps of Engineers, Kansas City District, New Jersey. Dr. Chiang provided senior review on technology selection, design and implementation of a groundwater remediation system for treatment of chlorinated solvents in soil and groundwater.

Publications

» Chiang, Dora Sheau-Yun, and Rebecca Mora. "Technical Review of 1,4-Dioxane: Occurrence, Characterization, and Aerobic Biodegradation in Groundwater," Journal of Soil and Groundwater Remediation, Vol. 1, No. 2, Nov. 2014, pp. 1-30, doi:10.6499/JSGR.2014.0102.006.

Presentations

- » Lead trainer, AFCEC Technology Transfer Training on "Alternative Solutions on Managing Emerging Contaminants – 1,4-Dioxane and PFAS", San Antonio, TX, March 2018
- » Emerging Contaminants and Treatment Technologies(invited). 2015 New Hampshire Waste Management Seminar, November 2015.
- Occurrence, Characterization and Treatment technologies for Emerging Contaminants in Soil and Groundwater (invited speaker), Bureau of Water Protection and Land Reuse, Connecticut Department of Energy and Environmental Protection, November 2015.

Eric Dickenson, PE Technical Advisory Panel: Contaminants of Emerging Concern and DPR



Education

PhD– Civil Engineering, University of Colorado at Boulder, 2005

MS – Civil Engineering, University of Colorado at Boulder, 2000

BS – Chemical Engineering, University of California at Davis, 1995

Honors/Awards

Dr. Dickenson was nominated for a National Water Research Institute (NWRI) independent advisory panel to provide guidance to the Colorado Department of Public Health and Environment (CDPHE) in developing regulations for direct potable reuse of recycled wastewater (2018-2019).

Dr. Dickinson is a subconsultant, currently serving as a Research and Development Project Manager for Water Quality Research and Development for Southern Nevada Water Authority, and 1/2 time as a Research Professor/Affiliate Faculty for Colorado School of Mines. Dr. Dickenson is a Research and Development Project Manager for Water Quality Research and Development for Southern Nevada Water Authority, as well as a Research Professor/Affiliate Faculty for Colorado School of Mines, with focused expertise regarding a broad range contaminants of emerging concern, and specifically regarding DPR.

Closely Related Grants

Co-PI – "Blending Requirements for Water from Direct Potable Reuse Treatment Facilities", The Water Research Foundation (4536). This project examined how reclaimed water quality, blend ratio, location, and water quality impact treatment, distribution systems (using premise plumbing rigs) and water quality.

Team – "Framework for Quantifying Microbial Risk and Sustainability of Potable Reuse Systems in the United States", U.S. EPA. This project examined the microbial/chemical risks associated with various potable reuse trains.

Co-PI – "Building Community Confidence in Potable Reuse Through Stronger Risk Analysis", The Water Research Foundation (14-16). This project examined the impact of both on-spec and off-spec treatment performance on microbial risk to the potable reuse water consumer. Demonstrated emerging contaminants can be removed by a pilot-scale ozone/biofiltration/granular activated carbon potable reuse system.

Team – "Potable Reuse Demonstration Pilot", City of Altamonte Springs, Florida. This project demonstrated the removal of biological and chemical contaminants by a demonstration ozone/biofiltration/GAC-based potable reuse system.

Co-PI – "Investigation of Treatment Alternatives for Short-Chain Poly- and Perfluoroalkyl Substances", The Water Research Foundation (4913). This new project will investigate various treatment options for the removal of short-chain PFAS from contaminated potable waters.

Co-PI – "Controlling Nitrosamines and Other Trace Organic Contaminants
Using Advanced Oxidation Processes and Biofiltration as an Alternative, NonFAT Technology for Indirect Potable Water Reuse", Water Environment Reuse
Foundation (13-10). Demonstrated some CECs/TorCs can be removed by pilot-scale
ozone/biofiltration (evaluated differing media types) potable reuse systems.

PI – "Simultaneous Removal of Multiple Chemical Contaminants Using Biofiltration", The Water Research Foundation (4559). Demonstrated some CECs/TOrCs/DBP precursors can be removed by pilot-scale ozone/biofiltration (evaluated differing media types and EBCT) in drinking water and potable reuse systems.

PI – "Formation of Nitrosamines and Perfluorochemicals during Ozonation in Water Reuse Applications", WateReuse Research Foundation (11-08). Discovered that NDMA can be formed during oxidation by ozone and removed by biofiltration in potable reuse systems.

Closely Related Publications

Sarner, E., Inyang, M., Garvey, E., Parks, J., Glover, C., Grimaldi, A., Dickenson, E., Sutherland, J., Salveson, A., Edwards, M.A., Pruden, A., Impact of blending for direct potable reuse on premise plumbing microbial ecology and regrowth of



- opportunistic pathogens and antibiotic resistant bacteria, *Water Research*, 2019, https://doi.org/10.1016/j.watres.2018.12.003.
- » Neyestani, M., Dickenson, E., Mclain, J., Obergh, V., Quinones, O., Rock, C. and Gerrity, D. Solids retention time, influent antibiotic concentrations, and temperature as selective pressures for antibiotic resistance in activated sludge systems. Environmental Science: Water Research & Technology, 3, 883, 2017.
- » Glover, C., Quiñones, O., Dickenson, E. Fate of perfluoroalkyl acids and their precursors in pilotand full-scale potable reuse facilities, Water Research, 144, 454-461, 2018.
- Solover, C., Trenholm, R., Verdugo, E., Dickenson, E. N-nitrosomorpholine: A persistent trace organic contaminant in potable reuse water, *Water Research*. 148: 306-313, 2018.
- » Stanford, B. and Dickenson, E. Control of trace organic compounds in potable reuse without membranes, World Water: Water Reuse & Desalination, 8:2, 30-31,2017.
- » Arnold, M., Batista, J., Dickenson, E., Gerrity D. Use of ozone-biofiltration for bulk organic removal and disinfection byproduct mitigation in potable reuse applications, Chemosphere, 202, 228-237, 2018.
- » Inyang, M., and Dickenson, E. The use of carbon adsorbents for the removal of perfluoroalkyl acids from potable reuse systems, *Chemosphere*, 184, 168-175, 2017.
- Serrity, D., Pisarenko, A., Marti, E., Trenholm, R., Gerringer, F., Reungoat, J., Dickenson E. Nitrosamines in pilot- and full-scale wastewater treatment plants with ozonation, Water Research, 72, 251-261, 2015.
- Dickenson, E., Drewes, J.E., Sedlak, D.L., Wert, E.C., Snyder, S.A., Applying surrogates and indicators to assess removal efficiency of trace organic chemicals during chemical oxidation of wastewaters. Environmental Science and Technology, 43, 6242-6247, 2009.
- Dickenson, E., Snyder, S., Sedlak, D. and Drewes, J. Indicator compounds for assessment of wastewater effluent contributions to flow and water quality, Water Research, 45, 1199-1212, 2011.
- » Li, D., Stanford, B., Dickenson, E., Khunjar, W., Homme, C., Rosenfeldt, E., Sharp, J. Effect of advanced oxidation on N-nitrosodimethylamine (NDMA) formation and microbial ecology during

- pilot-scale biological activated carbon filtration, *Water Research*, 113:160-170, 2017.
- » Inyang, M., Flowers, R., McAvoy, D., and Dickenson, E. Biotransformation of trace organic compounds by activated sludge from a biological nutrient treatment system. *Bioresource Technology*. 216, 778-784, 2016.
- » Dickenson, E. and Verdugo, E. Treatment of poly- and perfluoroalkyl substances. Chapter in *Perfluoroalkyl Substances in the Environment: Theory, Practice, and Innovation*, CRC Press, 2018.

Synergistic Activities

- » Nominated participant for a National Water Research Institute independent advisory panel to provide guidance to the Colorado Department of Public Health and Environment and other stakeholders to aid in developing regulations for direct potable reuse of recycled wastewater (2018-2019).
- » WateReuse Nevada Section committee member (2014 – present).

Phil Singer, PhD, BCEE Technical Advisory Panel: Disinfection By-Products



Education

PhD – Harvard University, 1969 MS – Northwestern University, Sanitary Engineering, 1964; BSCE – The Cooper Union, Civil Engineering, 1963

Registration/Certifications

Board Certified Environmental Engineer (BCEE), American Academy of Environmental Engineers and Scientists

Affiliations/Activities

University of North Carolina faculty member (1973 - 2011)

Dr. Singer is an exclusive sub-consultant to CDM Smith.

Dr. Singer is a nationally recognized expert in water quality and advanced drinking water treatment, and an exclusive consultant to CDM Smith. He brings more than 45 years of experience in drinking water research and development projects, with a strong focus on treatment for control of disinfection by-products, disinfection processes, and the removal of natural organic material, iron and manganese, and micro-constituents.

Principal Investigator, Ozonation and Enhanced Coagulation for Control of DBPs, US Environmental Protection Agency. Dr. Singer and his group evaluated the effectiveness of ozonation, coagulation, and biofiltration in controlling halogenated disinfection by-products in drinking water. Ozonation preceding coagulation and clarification and ozonation following coagulation and clarification were investigated. Biofiltration following coagulation and ozonation was also examined. Both bench and pilot-scale studies were employed. Variables examined included ozone and coagulant dose, pH, type of organic material, bromide concentration, and type of biologically-active filter media. Performance was assessed based on the measurement of TOC, DOC, UV absorbance, THM formation potential, HAA formation potential, bromate, and biodegradable organic carbon. All nine bromine- and chlorine-containing HAAs were measured. The study was performed in two distinct phases: one involving both bench-scale and pilot-plant investigations, and one involving only bench-scale Investigations.

Principal Investigator, Enhanced Coagulation and Enhanced Softening for the Removal of Disinfection By-Product Precursors: An Evaluation, AWWA Water Utility Council. Dr. Singer and his group completed a comprehensive jartest evaluation of the proposed enhanced coagulation TOC removal requirements. Aluminum sulfate jar-testing was performed on 31 raw waters of various chemical characteristics from across the U.S. Included within the waters studied were at least three representative waters from each of the nine elements in the 3x3 TOC-alkalinity matrix. The objectives were to assess the achievability of the enhanced coagulation TOC removal requirements in the proposed D/DBP Rule; evaluate the suitability of the point of diminishing returns alternative performance criterion on the TOC removal requirements; and demonstrate and interpret the effects of specific raw water characteristics on the removal of TOC by coagulation.

Principal Investigator, Application of ICR Data to Analyze DBP Occurrence in the Context of Water Quality, Treatment, and Distribution System Characteristics, US Environmental Protection Agency. Dr. Singer's group explored the ICR database to determine the impact of water quality characteristics on DBP occurrence, the impact of water treatment practices on DBP occurrence, factors influencing changes in DBP concentrations in distribution systems, and relationships among different DBP classes and species. The ICR data capture the variability in source water and treatment conditions across the entire United States, on a scale that is at least one order of magnitude larger than any prior monitoring study, and with an enormous degree of detail in respect to water quality and treatment conditions. The data are highly structured and were acquired using uniform methodologies and stringent quality assurance.

Co-Principal Investigator, Evaluation of MIEX Process Impacts on Treated Water Quality for a Range of Raw Water Supplies, AWWA Research Foundation. Dr. inger and his group evaluated the effectiveness of the magnetized anion exchange



process and demonstrated its applicability under different raw water quality conditions. Core objectives for bench and pilot testing were to determine: (1) NOM removals as measured by UV 254 and DOC; (2) effect on molecular weight size fractions of DOC and on hydrophilic/hydrophobic organic carbon distribution; (3) capability to reduce formation of THMs and HAAs; (4) effect on coagulant demand; (5) effect on the removal of bromide and the formation of brominated organics; (6) effect on chlorine demand; (7) retention of resin capacity through multiple cycles of regeneration. Bench-scale testing and pilot-plant studies were conducted at four locations across the U.S.

Co-Principal Investigator, Formation and Decay of Disinfection By-Products in the Distribution System, AWWA Research Foundation. Dr. Singer and his team examined the formation and decay of selected DBPs in distribution systems focusing on the four THMs and the nine HAAs as well as individual THM and HAA species. The project objectives included evaluation of the critical factors that affect THM and HAA behavior in distribution systems, examination of the effect of storage reservoirs/ tanks and booster chlorination stations on THM and HAA concentration and speciation, evaluation of the changes in DBP concentrations and speciation during seasonal changes from chloramines to free chlorine to avoid potential nitrification episodes, and determination of methods of identifying the distribution system locations and times of maximum THM and HAA concentrations in order to address Stage 2 DBPR requirements.

Principal Investigator, Occurrence of Selected Pharmaceutically-Active Compounds and Personal Care Products in Gwinnett County Wastewater and Drinking Water, Gwinnett County (GA) Department of Public Utilities. The presence of 18 pharmaceutically active compounds (PhACs) and personal care products (PCPs) and one endocrine disrupting compound (EDC) was followed monthly after various stages of treatment in an advanced wastewater treatment plant in the US. Twenty-four hour composite samples were collected after primary clarification, biological treatment and membrane filtration, granular activated carbon (GAC) adsorption, and ozonation. Compounds were identified using high performance liquid chromatography/tandem mass spectrometry (LC-MS/MS) and gas chromatography/ mass spectrometry (GC-MS) after solid-phase extraction. Standard addition methods were applied to overcome matrix effects. The extent of PPCP removal by the various processes was related to the physical-chemical properties of the compounds.

Co-Principal Investigator, Practical Monitoring Tools for Biological Processes in Biofiltration Water Research Foundation (WRF) 4620, Various Locations. As part of a joint Water Research Foundation study, Twenty-three participating utilities, CDM Smith (as lead research organization) and HDR embarked on a research and development project to evaluate methods for robust bioprocess monitoring for biofiltration based on the need for practical monitoring tools for operators that provide rapid feedback, as well as to provide guidance on how to interpret bioprocess monitoring data and relate results into a process control strategy. The team built upon the screening of biofiltration monitoring and control tools that CDM Smith led for Water Research Foundation (WRF) Project 4231, and addressing the need for practical and quantitative guidance on when and how to use the tools, how to interpret data, and how bioprocess monitoring can be integrated into a process control strategy to enhance performance. The research will ultimately This research will benefit the drinking water community by providing a clear framework on how to monitor and control the biological processes being utilized by a growing number of facilities in filters to realize the benefits of biofiltration as an engineered and controlled process.

Project Advisor, Cary/Apex Water Treatment Facility, Cary, NC. The Town of Cary retained CDM Smith to provide engineering services to expand the Cary/Apex Water Treatment Facility (CAWTF) from 16 mgd capacity to 40 mgd. Mr. Singer served as a project advisor on the technical review committee for this project.

Related Research Grants/Contracts

- "Ozonation and Enhanced Coagulation for Control of DBPs," US Environmental Protection Agency, 3/31/98-3/30/01, \$300,000
- "Enhanced Coagulation and Enhanced Softening for the Removal of Disinfection By-Product Precursors: An Evaluation," American Water Works Association Water Utility Council, 5/1/94-4/30/95, \$79,000
- "Application of ICR Data to Analyze DBP Occurrence in the Context of Water Quality, Treatment, and Distribution System Characteristics, "US Environmental Protection Agency, 10/15/01-10/14/04, \$100,003

Joe Cotruvo, PhD, BCES Technical Advisory Panel: Public Health



Education

PhD – Physical Organic Chemistry, Ohio State University

B5 - Chemistry, University of Toledo

Registration/Certifications

Board Certified, American Academy of Environmental Engineers and Scientists (AAEES)

Affiliations

University of Toledo Research Professor in Chemistry and of Environmental Sciences, and a member of their Green Chemistry and Engineering Science Advisory Board

Former Chairman of the Water Quality Committee of the Board of Directors of the DC Water and Sewer Authority for 8 years

Awards

AAEES Science Award, 2019

Dr. Cotruvo is a subconsultant, currently serving as President of Joseph Cotruvo & Associates, LLC, Water, Environment and Public Health Consultants. Dr. Joseph Cotruvo is President of Joseph Cotruvo & Associates, LLC, Water, Environment and Public Health Consultants. Dr. Cotruvo has served many years on the World Health Organization's Guidelines for Drinking Water Quality Committee, and was an initiator of the WHO Guidelines for Potable Reuse, and the Guidelines for reuse in beverage production. He is on numerous expert advisory panels for the National Water Research Institute on drinking water quality, desalination, and water reuse, as well as Singapore's National Environment Agency Water Standards Advisory Committee. He has completed wastewater and potable water reuse projects for Orange County, San Diego, and Los Angeles, CA. He was also chairman of the water quality committee of the Board of Directors of the DC Water and Sewer Authority for 8 years.

At USEPA he was first director of the Drinking Water Standards Division, and director of the Risk Assessment Division in Pollution Prevention and Toxics. The former developed comprehensive national drinking water regulations and risk assessments for mlcrobials, organic and inorganic chemicals and radionuclides, the original regulations for THM disinfection by-products, surface water filtration rules, and proposed corrosion control lead and copper rules. He also initiated EPA's Drinking Water Health Advisory Program providing health risk guidance for unregulated contaminants and emergencies.

His work includes: quality specifications and health protection policy for potable water wastewater reclamation and reuse; legionella and other biofilm contaminants in distribution systems; comprehensive microbial DNA-based microbial analysis applications in water and wastewater and biofilms; point-of-use water treatment technologies; nutritional minerals in drinking water; disinfection by-products; safe drinking water for emergencies; Safe Drinking Water Act regulatory policy. His team has completed research studies that he initiated on pre-systemic metabolism and the low dose toxicology and mode of action of bromate; additional mode of action and bromate formation study is in progress.

He has produced numerous WHO monographs on water and health risk topics. He was a technical editor for the Journal of the American Water Works Association and an associate editor for the Water Science Journal. He has more than 300 publications, presentations and articles on health risk, water quality and regulation. Recipient of the American Academy of Environmental Engineers and Scientists (AAEES), Science Award for 2019.

Selected Consultations and Advisory Functions

- » National Water Research Institute, Independent Scientific Advisory Panel for Metropolitan Water District of Southern California, and the Sanitation District of Los Angeles, California Advanced Purification Demonstration Project. 2018-2021.
- » National Water Research Institute, Advisory Panel for Water Reuse in Sokel, California, 2017.
- American Academy of Environ. Engineers and Scientists Board Certification Sustainability Committee Water Sustainability Products, Standard 375, Joint Committee. NSF International -2016



- » School of Green Chemistry and Engineering Science Advisory Board. Univ. of Toledo, 2015-WHO Water Quality and Health Technical Advisory Group (WQTAG), 2015-2019.
- » World Health Organization committee to develop guidelines for potable water reuse, 2015-2017
- » Christopher Columbus Awards Selection Committee, National Science Foundation, April 2014
- » National Water Reuse Institute/WateReuse Association/AWWA/WEF Framework for Direct Potable Reuse Guidelines, 2014-2015.
- » Nanyang University Environment and Water Research Institute Advisory Board, Singapore, 2014-2015
- » World Health Organization Committee on Water Reuse Guidelines Development, 2014-
- » National Water Reuse Institute Potable Water Reuse Guidelines Advisory Panel for the State of New Mexico, May 2014-2016
- Water Quality Regulations for Potable Reuse in Arizona. Expert Workshop invited panel member, November 6, 2013.
- » Direct Potable Reuse status and recommended strategies for guidelines development. USEPA Office of Groundwater and Drinking Water. October 29, 2013.
- Water Quality Association. Emerging Technologies Task Force, 2013.
- » Advisory Board, College of Agriculture, Urban Sustainability and Environmental Sciences (CAUSES) of the University of the District of Columbia, Washington, DC. 2013-2017.
- World Health Organization expert panel consultation on Regulation of Mixtures in Drinking Water, 2013
- » WateReuse Association, Guidelines for Direct and Indirect Potable Reuse Committee, Chairman, 2013.
- » Joint Committee on Standards for Sustainability for Water Products. NSF International. 2013.
- » Direct Potable Reuse National Expert Panel, Ohio Department of Health, 2013-2015.
- Water Technology and Water/Waste Processing Technical Advisory Board, Technical Editor, 2013-
- The Ohio State University, Chemistry and Biochemistry Department Dev. Committee, 2012-

- » Water/Waste Processing Magazine. Editorial column author. 2013
- » National Regulatory Committee of the WateReuse Association, Chairman, 2012-2014.
- » Health Research Peer Review Technical Editor: Editorial Board, Journal American Water Works Association, 6/2011-current.
- International Life Sciences Institute Guidelines for Water Reuse in Beverage and Food Processing, Committee Chairman. 2011-2013
- » District of Columbia Water and Sewer Authority, Chairman of the Water Quality and Water Services Committee, Board of Directors, 2011-2013.
- Water Technology On-line, Expert Group. Author of articles examining water contaminants issues. 2011 2016.
- World Health Organization Expert Panel on Pharmaceuticals and Personal Care Products in Water-2009-2010.

Channah Rock, PhD Technical Advisory Panel: Pathogen Removal



Education

PhD – Civil and Environmental Engineering, Arizona State University

MS – Civil and Environmental Engineering, Arizona State University

BS – Microbiology, New Mexico State University

Appointments

Nancy Roma Paech Distinguished Professor, Institute of Agriculture, The University of Sydney (2017)

Associate Professor and Specialist - Water Quality; Department of Soil, Water and Environmental Science, The University of Arizona (2013 – present)

Assistant Professor and Specialist - Water Quality, Department of Soil, Water and Environmental Science, The University of Arizona (2007-2013)

Laboratory Technician/Postdoctoral Researcher, USDA-ARS (2006-2007)

Graduate Research/Teaching Assistant, Arizona State University (2003-2007)

Dr. Rock is a subconsultant, currently serving as an Associate Professor and Water Quality Specialist at the University of Arizona. Dr. Channah Rock is an Associate Professor and Water Quality Specialist at the University of Arizona, serving as Co-Project Director for the Department of Soil, Water, and Environmental Science. Dr. Rock has played a leadership role in evaluating reclaimed water quality and promoting water reuse as a safe and practical resource for the southwest. Additionally, Dr. Rock works with stakeholder engagement to facilitate awareness and drive water quality improvements in surface waters of Arizona. She also possesses a wide variety of experience in traditional microbiological and viral methods for pathogen detection using culture and molecular techniques.

Experience Highlights

- She provided significant regulatory support in Arizona in 2017/2018 when she co-led two ADEQ technical work groups to revise recycled water regulations with a focus on potable reuse. She provided significant efforts to support the content within the Guidance Framework for Direct Potable Reuse in Arizona, published in 2017. These efforts led ADEQ to rescind the prohibition on potable reuse in the State of Arizona.
- She served as the President of Arizona WateReuse Association (2015-2017) and Past-President of Arizona WateReuse Association (2018-current). She is also a member of the Arizona Water Association (2010-current), American Water Works Association (2010-current American Society for Microbiology (2005-current), National WateReuse Association (2012-current), International Association of Food Protection (2017-current), and on multiple state panels on emerging contaminants/food safety (2014-current).
- She is an ad-hoc reviewer for Journal of Water Supply: Research and Technology-AQUA IQA, Journal of Environmental Management, Journal of Natural Resources and Life Sciences Education, Pathogens, CHEMOSPHERE, University of Arizona Water Resource Research Center, New Mexico Water Resources Research Institute, University of Arizona Cooperative Extension, and University of Nevada Cooperative Extension (2007-current) Proposal reviewer for Center for Disease Control Graduate Program Grants (2010), Water Environment & Reuse Foundation (2014-current), National Science Foundation (2012, 2015), and USDA (2015, 2017, 2018)
- Additionally, she supports educational outreach activities include adult education on public perception and scientific literacy related to water quality issues, including potable reuse, across the southwest; stakeholder (watershed groups/partnerships, Master Watershed Stewards, growers, and local municipalities) engagement to facilitate awareness and drive water quality improvements; extension focused on water quality interface between research and the public to better drive behavior change.



Select Publications

- » Rock, C.M., D. Gerrity, and F. Solop (2012). Survey of statewide public perceptions regarding water reuse in Arizona. *Journal of Water Supply: Research and Technology-AQUA IWA*, 61: 506–517.
- » Rock, C., and C.P. Gerba (2014). Water quality. In: Produce Contamination Problem: Causes and Solutions, 2nd Ed. (pp. 123-138). Elsevier.
- » McLain, J.E.T., C.M. Rock, and C.P. Gerba. (2017) Environmental Antibiotic Resistance Associated with Land Application of Biosolids In: Antimicrobial Resistance in Wastewater Treatment Processes, (p.p. 241 - 251) John Wiley & Sons.
- » Neyestani M, Dickenson E, McLain J, Robleto E, Rock C, Gerrity D. (2017) Impacts of solids retention time on trace organic compound attenuation and bacterial resistance to trimethoprim and sulfamethoxazole. Chemosphere. 182:149–158.
- » Rock CM, Gerba CP, Walter B, Masaaki K. (2018) Reducing uncertainty in estimating virus reduction by advanced water treatment processes. Water Research; 282 – 288.
- » Dery, J. L., Rock, C. M., Goldstein, R. R., Onumajuru, C., Brassill, N., Zozaya, S., & Suri, M. R. (2019). Understanding grower perceptions and attitudes on the use of nontraditional water sources, including reclaimed or recycled water, in the semi-arid Southwest United States. *Environmental Research*, 500-509.
- » Suri, M. R., Dery, J. L., Pérodin, J., Brassill, N., He, X., Ammons, S., ... Goldstein, R. E. R. (2019). U.S. farmers' opinions on the use of nontraditional water sources for agricultural activities. *Environmental Research*, 172, 345-357.
- Schannah M. Rock, Natalie Brassill, Jessica L. Dery, Dametreea Carr, Jean E. McLain, Kelly R. Bright, Charles P. Gerba (2019) Review of water quality criteria for water reuse and risk-based implications for irrigated produce under the FDA Food Safety Modernization Act, produce safety rule, Environmental Research, 172, 616-629.
- » Rock, C.M., D. Carr, R. Brevington, K. Nolte, and N. Brassill (2015). *Microbiology online food safety training modules*. UA CALS.

- Section 2015 Se
- » Rivadeneira, P.K., C.M. Rock, J.E.T. McLain, N. Brassill, R. Urzua, & J. Dery (2018) E. coli Prevention and Control in Fresh Produce from Farm-to-Fork. *Arizona Cooperative Extension*, #AZ1767.
- » Rock, C.M., J.E.T. McLain, N. Brassill, J. Dery, & P. Rivadeneira (2018) E. coli, Water Quality, Food Safety, and Human Health. *Arizona Cooperative Extension*, #AZ1763.
- » Dery, J., C.M. Rock, J.E.T. McLain, & D. Gerrity (2018) Common Terms in Water Recycling and Agricultural Irrigation. *Arizona Cooperative Extension*, #AZ1762.

Jennifer Hooper, PE Potable Reuse / Contaminants of Emerging Concern



Education

MS – Environmental Engineering, Cornell University, 2006

> BS – Biological Systems Engineering, University of Idaho, 2004

Registration

Professional Engineer: Washington (2010)

Awards

AAEES Grand Prize Award for Engineering Excellence in Research, 2018

WateReuse Association Award for Excellence in Technical Innovation, 2018

> CDM Smith Best Technical Paper Award, 2014

National Water Research Institute Fellowship

National Science Foundation Fellowship

Tau Beta Pi and Alpha Epsilon Honor Societies Ms. Hooper is a senior environmental engineer with 13 years of professional experience specializing in evaluating innovative chemical and biological treatment technologies through bench and pilot testing; ozone/biological filtration for drinking water and reuse applications; bioremediation; and assessing the environmental fate and transport and degradation of emerging contaminants. Ms. Hooper also serves as the technical lead for water and wastewater projects at CDM Smith's Environmental Research and Technologies Laboratory. In this capacity, she manages and performs technical review of bench-scale experiments. Laboratory bench testing has focused on ultraviolet (UV) disinfection, ozone, advanced oxidation processes (AOP), granular activated carbon (GAC), biofiltration, and anion exchange (IX) treatment for conventional and emerging contaminants including personal care products and pharmaceuticals (PPCPs), perfluorinated compounds (PFCs), and algal toxins. She has been involved in a leadership role in over a dozen Water Research Foundation (WRF) and Department of Defense Environmental Security Technology Certification Program (ESTCP) projects.

Co-Principal Investigator, WRF Reuse 15-11, Demonstration of High Quality Drinking Water Production Using Multi-Stage Ozone-Biological Filtration: A Comparison of **DPR with Existing IPR Practice.** This Tailored Collaboration project is a joint research project between CDM Smith, Gwinnett County Department of Water Resources and WRF. The project evaluated alternative treatment trains to the full advanced treatment (FAT) model for IRP and DPR which includes microfiltration/ultrafiltration (MF/UF), reverse osmosis (RO), and advanced oxidation (AOP). Implementation of FAT has been difficult due to high energy, capital, and operations and maintenance costs, and use is particularly difficult for inland facilities where RO concentrate disposal is not practical. This pilot-scale demonstration study of ozone-biofiltration as an alternative and more economical treatment train for DPR. Two side-by-side pilots as either IPR or DPR were evaluated to assess treatment efficacy when F. Wayne Hill WRC advanced treated water was blended at various ratios and used alone as a raw water source. Performance data will incorporate results from a Hazard Analysis and Critical Control Points (HACCP) evaluation including primary and secondary drinking water standards as well as unregulated microbial contaminants and chemical compounds. Over 300 analytes were included to evaluate treatment efficacy, including compounds with primary and secondary maximum contaminant levels (MCLs) and microbials, fluorescence emission excitation matrices (EEM), PPCPs, nitrogenous disinfection byproducts, 1,4 dioxane, PFCs, and a suite of trace chemical constituents. This research demonstrated that ozone-BAF can provide water of equal or higher quality than current drinking water supplies without the use of RO. Ms. Hooper lead design of the pilot treatment facilities, the experimental design, and development of the final report. This project was awarded the American Academy of Environmental Engineers and Scientists (AAEES) Grand Prize for Engineering Excellence in the research category and the WateReuse Association Award for Excellence in Technical Innovation in 2018.

Co-Principal Investigator, WRF 4508/Reuse13-14, Assessment of Techniques to Evaluate & Demonstrate the Safety of Water from DPR Treatment Facilities. This project evaluated tools and metrics appropriate and acceptable for assessing the safety of direct potable water reuse (DPR) facilities. Ms. Hooper oversaw compilation of the literature review, presented at an expert panel workshop to develop the monitoring framework, compiled historical monitoring data, evaluated surrogate and indicator compounds for their usefulness in process monitoring during a 9-month long detailed



sampling campaign at two facilities, and led development of the Draft and Final Report.

Principal Investigator, WRF 4620, Practical Monitoring Tools for Biological Processes in Biofiltration.

CDM Smith is collaborated with 21 utilities on this project to advance the way we manage biological filtration for drinking water treatment. Many utilities are moving from conventional filtration to biological filtration to increase treated water quality in terms of removal of organics, trace chemical constituents such as personal care products and pharmaceuticals, disinfection byproduct formation potential, iron and manganese, and taste and odor compounds. The challenge is a lack of integration on how to monitor, control, and operate biofilters to enhance hydraulic performance and treated water quality. This project provided an in-depth evaluation of tools used to monitor biological processes, including pilot and full-scale sampling over the duration of one year from a diverse range of utilities. Results have been compiled into a Guidance Manual targeted to utility managers and operators for immediate use.

Co-Principal Investigator, WRF 4719, A Biofiltration Guidance Manual for Rapid-Rate Filtration Facilities.

This project is developing a central reference, a Biofiltration Handbook, for the design, operations, monitoring, conversion, and optimization of biofiltration. The Biofiltration Handbook will facilitate the implementation of biological filtration as an effective engineered process rather than an incidental process. Ms. Hooper is leading the monitoring chapter of the Biofiltration Handbook.

Co-Principal Investigator, WRF 4555, Optimizing Biofiltration for Various Source Water Quality Conditions.

This project to evaluated optimization strategies for enhancing performance of biological filters. Guidance was provided on how to implement optimization strategies under various source water qualities and upstream treatment processes. Results from pilot testing at 15 facilities was distilled into key guidance for biofilter optimization and distilled into a decision-tree/decision-support framework for determining which optimization methods to focus on under different situations.

Project Manager and Project Engineer, WRF 4429, Chemically-Enhanced Biological Filtration to Enhance Water Quality and Minimize Cost. This project evaluated use of chemically-enhanced biological filtration for destruction of natural organic matter (NOM) and CECs. The objective was to enhance performance of biofiltration while minimizing disinfection byproduct (DBP) formation, distribution system regrowth, and cost. Jar tests were used to evaluate a variety of chemical enhancements for oxidation of organic matter and CECs at the CDM Smith Environmental Technologies Laboratory.

Project Engineer, WRF 4312, An Operational Definition of Biological Stability. The objective of this project was to develop a decision framework for assessing water quality in distribution systems for risk of bacterial growth. Multiple factors influence the likelihood for growth including concentrations of various fractions of organic compounds, nutrients and disinfectant residuals, temperatures, hydraulic retention times, and distribution system pipe characteristics. Ms. Hooper statistically evaluated historical data from 26 water treatment facilities and distribution systems to determine significant factors that influenced biological stability. These findings were validated during an 18-month study at six utilities. The key controlling variables were included in a Guidance Manual targeted for utility managers and operators.

Project Engineer, WRF 4231, A Monitoring and Control Toolbox for Biological Filtration. This project benchmarked biological filtration in drinking water treatment and evaluated over 40 monitoring and control tools for enhancing biological processes. Tools most applicable for process monitoring and control were field validated over a one-year during at four utilities. Findings from this project were used to develop a Guidance Document for biofiltration monitoring and control for utility managers and operators.

Project Engineer, Department of Defense (DoD) Environmental Security Technology Certification Program (ESTCP), Membrane Biofilm Reactor Pilot Plant for Potable Water Treatment. This technology demonstration project for ESTCP was for a ten gallon per minute (gpm) pilot-scale.

for ESTCP was for a ten gallon per minute (gpm) pilot-scale drinking water treatment system utilizing a membrane biofilm reactor (MBfR) technology for treatment of perchlorate- and nitrate-contaminated groundwater. Anaerobic autotrophic biodegradation was used for the complete destruction of perchlorate and nitrate. The demonstration included start-up, process optimization, steady-state, and a challenge phase.

Ms. Hooper was responsible for management of field staff and subcontractors, data analysis and interpretation, budget tracking, and the final research report. CDM Smith won the 2014 American Academy of Environmental Engineers and Scientists Grand Prize in Research for this project.

Publications

- » Vandegrift, Jillian, Jennifer Hooper, Allegra da Silva, Kati Bell, Channah Rock and Shane Snyder. 2019. Techniques to evaluate water quality at direct potable reuse (DPR) treatment facilities. JAWWA, Accepted.
- Funk, Denise, Kati Bell and Jennifer Hooper. 2018. Ozone-biofiltration direct potable reuse: a promising alternative for meeting future water supply needs. IUVA News. 20(3), 24-28.
- » Bell, Kati, Abigail Antolovich, Denise Funk, Jennifer Hooper, Julie Minton, and Larry Schimmoller. 2016. Ozone-biologically active filtration – an alternative treatment for potable reuse. World Water, 7 (1), 27-30.

Jill Vandegrift, PE Potable Reuse



Education

MS – Civil and Environmental Engineering, Colorado State University, 2014

BS – Environmental Engineering, Rensselaer Polytechnic Institute, 2012

Registration/Certifications

Professional Engineer: Colorado (2018)

Honors/Awards

WateReuse Association's Young Professional of the Year Member of CDM Smith's Winning Team for WEFTEC's 2017 Pure Water Brewing Alliance Smackdown Ms. Vandegrift is an environmental engineer with experience spanning engineering services, technical reviews, and regulatory assignments for several water supply projects and water reuse feasibility studies—primarily regarding potable reuse applications. A leading light in our R&D Program, she is constantly advancing the science and practice of potable reuse treatment and operations. Ms. Vandegrift also has experience assessing the applicability of water availability models for water resources supply and planning purposes, and design experience on water treatment plant and lift station upgrade projects.

Project Engineer and Author, Potable Reuse Supplement Document to the Environmental Protection Agency (EPA) 2012 Guidelines for Water Reuse, Washington, DC. CDM Smith produced a potable reuse document to serve as a supplement to the 2012 Guidelines for Water Reuse to address best practices and approaches in DPR, utilizing the established technical and policy knowledge base. Establishing the current state of the science and practice in DPR to inform future projects is a critical need in supporting future DPR practices which are gaining in use as part of many water supply plans across the nation. Ms. Vandegrift was a technical author on this publication.

Project Engineer, Assessment of Techniques to Evaluate and Demonstrate the Safety of Water from Direct Potable Reuse Treatment Facilities, Water Research Foundation Project 4508. The University of Arizona is leading Water Research Foundation Project #4508 to produce a DPR guidance framework that water utilities and regulators can use to evaluate the safety of existing or potential future DPR scenarios and help facilitate a proactive DPR monitoring process that is protective of public health. CDM Smith is acting as co-Principal Investigator on the project. Ms. Vandegrift was a technical author for the literature review involved with this project, which included an in-depth discussion on potable reuse monitoring methods and chemical indicators and surrogates for potable reuse monitoring. Ms. Vandegrift is a project engineer on subsequent phases of the project which include an evaluation of historical monitoring data from participating water and wastewater utilities, and a full-scale sampling phase incorporating monitoring of identified water quality monitoring parameters.

Project Engineer, Denver Water Ozone Gas Disinfection of Pipelines Research, Denver, Colorado. Ms. Vandegrift recently collaborated with Denver Water on an award-winning ozone pipeline disinfection R&D project—discovering a safe and effective way to drastically reduce the time needed to complete most pipeline disinfection tasks, while at the same time uncovering a more effective treatment that can kill even the most persistent bacteria.

Pilot Operation and Data Analysis Engineer, WATER2025 Process Selection and Pilot, City of Westminster, Colorado. Ms. Vandegrift is supporting the pilot operations and data analysis for this visionary program for Westminster, focusing on providing high-quality water to its customers and transitioning from the Semper Water Treatment Plant to a new water treatment plant. The new plant will ultimately be designed to improve treatment resiliency to address varying water quality conditions, adapt to changing regulatory standards, improve water supply flexibility and water quality, and embrace environmental sustainability and resource stewardship. The team will also be providing expertise and counsel regarding the design and construction of a new WTP.



Project Engineer, West Portal Industrial Water Treatment Plant Ultrafiltration Pilot Plant & Full-Scale Facility, Winter Park, Colorado. Ms. Vandegrift provided project engineering services for the design/build, startup, commissioning and operation of a new treatment plant for tunnel discharge water at the Moffat Tunnel near Winter Park.

Project Engineer, Northern Water Supply Pump Station Expansion Feasibility Study, Northern Transmission System Expansion, Evaluation and Predesign, East Cherry Creek Valley. CDM Smith provided an evaluation of improvements needed for a Phase 2 increase in capacity of 10 mgd for the East Chery Creek Valley Water and Sanitation District Northern Water Supply treatment and transmission system. A prior pump station upgrade evaluation focused on limiting capital costs and expansion to meet 15 mgd in the NWS. Ms. Vandegrift developed a detailed cost comparison tool in order to compare costs for pursuing medium voltage or low voltage pumps/drives for future expansion and for predicting pumping costs on a selected future date.

Project Engineer, Potomac Water Supply Program, Trap Rock Water Treatment Facility Construction Services, Loudoun County, Virginia. CDM Smith was providing construction services on this Trap Rock Water Treatment Facility in Loudon County, Virginia, including submittal and RFI review. Ms. Vandegrift provided engineering services during construction including helping coordinate major ozone and mechanical submittal reviews.

Project Engineer, Comprehensive Water Resources Management Plan, Suffolk County, New York. The project team used state-of-the-art tools, including three-dimensional groundwater flow and contaminant transport models GIS databases and decision support tools, which supported the development and evaluation of water resource protection alternatives that considered both groundwater and surface water resources. This project also involved a document identifying early actions that the county should implement to protect ground and surface water resources. Ms. Vandegrift was a technical author for the literature review on contaminants of emerging concern in septic systems for this project.

Project Engineer, Evaluation and Documentation of the State of Texas Water Availability Model (WAM) and Water Rights Analysis Package (WRAP), Fort Worth,

Texas. Ms. Vandegrift served as project engineer for an ongoing evaluation of the State of Texas WAM and WRAP. She helped perform an evaluation of WAM's ability to simulate water rights and the assessment of accuracy of hydrological outputs from WAM for Regulatory permitting

needs of the USACE Fort Worth District. This evaluation included the assessment of applicability to scenario management, optimization of operations to minimize and avoid hydrological modifications, system demands, individual and/or aggregated system operations, reservoir operations (storage and releases), river reach flow modifications, and applicability to support resource assessments required by NEPA.

Prior to CDM Smith

Graduate Research Assistant, Colorado State University, Fort Collins, Colorado. Ms. Vandegrift provided research assistance to Dr. Sybil Sharvelle on the Graywater Reuse Pilot System and Model City Ordinance for Graywater Legislation in Fort Collins study.

Lab Analyst, Colorado State University and Symbios Technologies. Ms. Vandegrift was a lab analyst for produced water samples at Colorado State University.

Tim Rynders, PE Water Quality



Education

BS - Environmental
Engineering, University of
Nevada Reno, 2002

Professional Engineer:

Registration/Certifications

Colorado, Nevada, North Carolina (2007) 40-hour OSHA Training, 2003 OSHA 8-Hour Update - current through 2012

> FEMA Incident Command System 100 and 200, 2006

Affiliations

Civil Engineers

Member, Engineers Without Borders Member, American Water Works, Association Member, Master Brewer's

Association of America

Member, American Society of

Mr. Rynders brings 15 years of experience in the leadership, design, and operation of water pilot plant treatability studies for process selection and optimization, as well as subsequent involvement in full-scale plant construction activities. Mr. Rynders brings strong relationships with piloting vendors, such as Intuitech, to leverage the most beneficial use of piloting technology for each client, and support pilot construction and operations. Locally, his involvement has included successful piloting for Denver Water, Englewood, East Cherry Creek Valley Water & Sanitation District, and for the West Portal Industrial Water Treatment Plant Ultrafiltration Pilot Plant and Full-Scale Facility in Winter Park. His project responsibilities have also focused on owner's representation during construction.

Project Manager, WATER202S Process Selection and Pilot, City of Westminster, Colorado. Mr. Rynders is currently leading the process selection and piloting team for this visionary program for Westminster, focusing on providing high-quality water to its customers and transitioning from the Semper Water Treatment Plant to a new water treatment plant. The new plant will ultimately be designed to improve treatment resiliency to address varying water quality conditions, adapt to changing regulatory standards, improve water supply flexibility and water quality, and embrace environmental sustainability and resource stewardship. The team will also be providing expertise and counsel regarding the design and construction of a new WTP.

Process Engineer, 10-mgd Reverse Osmosis Water Treatment Plant Design, East Cherry Creek Valley Water & Sanitation District, Colorado. Mr. Rynders completed the final design of a brackish water RO facility for ECCV. He was task leader for the process design of the facility that included two 3.35-mgd low pressure RO skids, two 410-gpm brine minimization RO skids, and a 5-mgd ultra-violet (UV) bypass loop, and three 300-HP vertical turbine pumps.

Process Engineer, East Cherry Creek Valley Water and Sanitation District Zero Liquid Discharge Pilot Study, Aurora, Colorado. Mr. Rynders was the project engineer for a pilot study evaluating two unique RO membrane processes for treating concentrate from a primary RO facility in Colorado. He was responsible for the final layout, equipment procurement and performed installation, operation, and data collection activities for the duration of the project. The study demonstrated that it was feasible to eliminate and reduce liquid discharge to inland receiving waters from inland RO treatment processes. The study also demonstrated that the technologies piloted were compatible with traditional municipal operations.

Process Engineer, City of Fernley WTP Final Design and Bid Services and Construction Management, Fernley, Nevada. Mr. Rynders completed the final design of a proposed \$40M, 20-mgd groundwater treatment facility for the City of Fernley, Nevada, which utilized microfiltration membranes to remove arsenic from the groundwater. The project was completed on an accelerated schedule to be on-line before an EPA mandated deadline. He was task leader for process design of the solids/ residuals handling and recycle flows, on-site storm water retention, and granular activated carbon filtration. His design responsibilities also included liquid and solids process hydraulic profiles, geotechnical site investigation, and numerous other elements of the civil design from pump selection to developing technical specifications for bidding. Mr. Rynders also provided construction services by reviewing submittals, equipment and O&M submittals through startup. The project received the 2011 ACEC of Nevada Honor Award.



Project Engineer, Manganese Removal Pre-Treatment Evaluation and Process Modification at the Allen WTP, Englewood, Colorado. CDM Smith developed an emergency plan and design to get the filters back on-line after the regenerated GAC was re-installed in the filters. He also performed a cost/benefit comparison memorandum investigating the usage of new vs. reactivated GAC in the filters.

Project Manager, Allen WTP UV Disinfection & Electrical Upgrades, City of Englewood, Colorado. Mr. Rynders designed and operated a 0.75 mgd UV fouling pilot evaluation of available UV disinfection technology. The project converted a portion of the existing clearwell into a dry well containing three trains of UV disinfection providing a 3-log cryptosporidium removal with a peak capacity of 28 mgd. The plant upgrade was completed before the deadline for facilities with Bin 2 classifications per the LT2ESWTR regulations.

Project Manager and Lead Process Engineer,
Confidential Brewery Client, Process Water Treatment
Plant, Asheville, North Carolina. Mr. Rynders was
responsible for designing the new process water
treatment plant for a proposed new 500,000 bpd brewery.
The facilities included a lift station, a 120,000 gallon
buried equalization tank including mixing and chemical
neutralization facilities prior to discharge to either the
sewer or a future anaerobic digester for biogas recovery.
The project included piloting anaerobic UF membranes
to determine compatibility with typically brewery
wastes. The project was expected to reduce BOD and TSS
concentration levels below industrial surcharge limits
and have a five year payback period based upon biogas
production value estimates.

Project Engineer, UV Disinfection and UV-AOP Feasibility Study, Central Filtration WTP, Israel. Mr.

Rynders performed a feasibility study for upgrading the 476 mgd conventional filtration plant to include UV disinfection. The project consisted of comparing European and United States guidelines for UV and UV/AOP disinfection, preparing preliminary facility layouts, cost estimates, UV procurement guidelines, and providing facilitated tours of the world's largest UV installations for Mekorot staff.

Project Manager & Engineer, West Portał Industrial Water Treatment Plant Ultrafiltration Pilot Plant & Full-Scale Facility, Winter Park, Colorado. Mr. Rynders was the project manager and engineer for a pilot study and plant design. The study evaluated treatment options for the railroad tunnel discharge water at the Moffat Tunnel near Rollinsville, CO. The pilot objectives were to evaluate the effectiveness of microfiltration and conventional

media filtration systems to remove dissolved metals to meet the CDPHE discharge requirements into both the Fraser and South Boulder Creeks. In coordination with the CDPHE, CDM Smith performed both a pilot study and produced a top-quality water treatment system to meet existing NPDES permit requirements. Ultimately, 200-gpm membrane treatment system was designed to include automated solids dewatering using dissolved air flotation, and a centrifuge. Membrane testing and backwash recovery and solids reclamation pilot testing was performed with respect to coagulant and polymer dosing.

Project Engineer, Ozone System Upgrading Project, Orlando, Florida. Mr. Rynders provided study services for the phased upgrading of seven operational ozone systems for hydrogen sulfide oxidation, with a combined production capacity of 15,000 ppd. The upgrades included a conversion from an air-fed to oxygen-fed ozone system at the Southwest plant, replacement of ozone generation equipment at all plants, and conversion from fine-bubble diffusion to sidestream injection at selected plants. During the study phase, the ozone process at each plant was evaluated to achieve multiple water quality objectives including: hydrogen sulfide oxidation, disinfection for 4-log virus inactivation and reduction in disinfection by-product formation.

Process Engineer, 0.5-mgd Microfiltration/Ultrafiltration Reverse Osmosis Wastewater Effluent Reuse Demonstration Facility, Gallup, New Mexico. Mr. Rynders prepared design documents and technical specifications for the procurement, construction, and testing of three parallel MF/UF Pretreatment trains feeding three parallel RO trains. The study seeks to demonstrate the ability to treat wastewater effluent to meet all drinking water standards and potentially reduce the City of Gallup's reliance increasingly

Project Engineer, Heat Recovery Project, Avon, Colorado.

scarce low quality groundwater.

Mr. Rynders prepared construction documents, startup assistance and evaluated the economic benefits for the design of a heat recovery project which extracts useful waste heat from treated wastewater effluent from the Eagle River Water and Sanitation District Avon WWTP. The project included a 3.5-MMBH capacity heat pump designed with expansion capability to 7.0 MMBH heat recovery. The extracted heat has been used for supplying the Town useful heat for the Town Aquatic Recreation Center, and are currently looking at options to expand the system for future snowmelt and downtown redevelopment. The project reduces the effluent temperature discharged to the Eagle River in the critical low flow fall spawning season. Preliminary work on the project also included feasibility for using extracted heat to improve digester processes in the WWTP.

Doug Brown, PE, BCEE Drinking Water



Education

MS – Civil Engineering,
University of Illinois, 1979

BS – Civil Engineering,
Oklahoma State University,
1978

Registration/Certifications

Professional Engineer: Colorado (1983), California, Utah

Honors/Awards

Board Certified Environmental Engineer (BCEE) American Academy of Environmental Engineers and Scientists Mr. Brown has 36 years of experience designing treatment plants and associated infrastructure using a wide variety of technologies including large microfiltration systems, ion exchange, conventional coagulation and filtration, reverse osmosis, activated carbon filters, and advanced oxidation. He is a nationally recognized researcher in high recovery reverse osmosis systems, with responsibilities including the preparation of evaluation reports, construction plans and specifications, and operational procedures. His responsibilities have included preparation of evaluation reports, construction plans and specifications, and operational procedures. Primary technical responsibilities include the overall process design and chemistry, hydraulics and piping, and control philosophy associated with the water treatment facilities. In addition, Mr. Brown has served as design manager on more than \$500M of design-build and fast-track water infrastructure projects.

Lead Practitioner, Allen WTP UV Disinfection & Electrical Upgrades, City of Englewood, Colorado. Mr. Brown served as project manager for the preliminary design and pilot testing of a 28-mgd UV disinfection system for a surface water treatment plant. The project included pilot testing both medium-pressure and low-pressure highoutput UV systems to provide additional inactivation of cryptosporidium. The project includes demolition of a deteriorating chlorine contact basin, new piping, electrical system, and UV equipment building.

Water Treatment Process Engineer, Groundwater Replenishment System (GWRS), Pilot Testing and Design of Advanced Recycled Water Treatment Plant, Fountain Valley, California. Mr. Brown provided process expertise for the MF pretreatment and the RO processes used for the secondary wastewater reclamation process. The technical reviews included evaluation of the equipment configuration for the submerged membrane system, applicable flux rates to achieve the minimum specified cleaning, and operational implications of the backwashing and cleaning processes.

Water Treatment Process Engineer, Leo J. Vander Lans IPR Water Treatment Facility (LJVLWTF), Pilot Testing and Full Scale Implementation, Long Beach, California. Mr. Brown provided process expertise for the Phase 2 expansion of the LJVLWTF, which increased the capacity from 3-mgd to 8-mgd. The project included pilot testing, the preliminary design for a 6-mile pipeline from the Los Coyotes Water Reclamation Plant to the LJVLWTF site, as well as the final design and construction services for the treatment plant expansion. Major issues such as increasing the capacity without increasing the waste flow are being solved by treating and reusing the MF backwash waste and adding an additional RO stage to raise the plant recovery rate to approximately 92 percent.

Design Oversight Manager, North System Renewal Water Treatment Plant Owner's Representative Services, Denver Water, Colorado. Mr. Brown is currently serving as Design Oversight Manager for the new NSRWTP Design RFP Development and Selection Support. He will provide DW with overall coordination of design packages, including technical oversight, budgeting, and standards. He will also assist in development and implementation of Design Package RFPs and selection scoring for the of multiple phased project packages.

Project Manager, Water Treatment Plant Ultraviolet System Design, East Cherry Creek Valley Water & Sanitation District, Colorado. Mr. Brown served as project



manager for the preliminary design and pilot testing of a 28-mgd UV disinfection system for a surface water treatment plant. The project included pilot testing both medium-pressure and low-pressure high-output UV systems to provide additional inactivation of Cryptosporidium. The project includes demolition of a deteriorating chlorine contact basin, new piping, electrical system, and UV equipment building.

Project Manager, East Cherry Creek Valley Water and Sanitation District, Reverse Osmosis Groundwater Treatment System, Denver, Colorado. Mr. Brown was responsible for the mechanical process design for a 10-mgd brackish water RO system design. The system incorporated two large capacity compact RO arrays using through port pressure vessels. The design utilized low pressure RO membranes and interstage energy recovery turbo-boosters to achieve high productivity at low feedwater pressures. A UV treatment system was included to inactivate any giardia and cryptosporidium in the bypass blending water.

Process Engineer, Water Treatment Plant, City of Piqua, Ohio. Mr. Brown was responsible for the process design of a new 7-mgd conventional lime softening plant including chemical feed systems, gravity filters, GAC polishing filters and pumping systems. He evaluated the plant hydraulics and developed preliminary designs for the new unit processes, and coordinated the activities of the discipline design teams for this \$34 million construction project. One critical element of the project was identifying value engineering alternatives to meet the owner's construction budget.

Water Treatment Process Engineer, Edward C. Little Water Reclamation Facility (Phase III Expansion Project), West Basin Municipal Water District, El Segundo, California. Mr. Brown provided process expertise for the design of West Basin's Phase IV expansion of the Water Reclamation Facility, which included a 5-mgd expansion to the AWT facility and addition of an UV system for advanced oxidation of emerging contaminants and disinfection for the Barrier Water. The final design and construction of the Phase IV expansion was completed using a design-build delivery.

Water Treatment Process Engineer, Navajo-Gallup Water Supply Project – Pilot Study, Bureau of Reclamation – DO – Acquisition Operations Group, Denver, Colorado. The Navajo-Gallup Water Supply Project features the withdrawal of up to 40 mgd from the San Juan River for treatment and distribution to downstream users on the western half of the project. Prior to the construction of a full-scale WTP, there was a need

to perform pilot testing to identify and optimize the water treatment processes due to the variable source water quality. Mr. Brown provided review of the preliminary design for the 0.5-mgd MF/RO reclaimed water demonstration system.

Design Build Manager, Fort Irwin Brackish Groundwater Treatment System, California. Mr. Brown served as design manager for development of layouts, process design and equipment selection for a \$100 million 6-mgd brackish water treatment and brine minimization system design-build project. The facility included high efficiency operations building, treated water pump station, pre-engineered metal process buildings, chemical systems and thermal mechanical equipment to achieve 99 percent overall recovery.

Project Manager, Water Treatment Plant Upgrade,
City of Monroe, Louisiana. Mr. Brown was responsible
for the design of new sludge blanket clarifiers, filters and
chemical feed system to upgrade and expand a 40 year
old conventional water treatment to 24-mgd peak day
capacity. Mr. Brown evaluated the plant hydraulics and
developed preliminary designs for the new unit processes,
and coordinated the activities of the discipline design teams
for this \$34 million construction project. Critical elements of
the project was developing a construction sequence to bring
the new facilities on-line, so the existing systems could be
replaced and upgraded without extensive shutdown of the
water treatment plant.

Process Engineer, Indirect Potable Reuse/Reservoir Augmentation Demonstration Project Advanced Water Purification Facility, City of San Diego, California.

CDM Smith designed, constructed, operated, and tested a 1 mgd demonstration scale AWT Plant at the North City Water Reclamation Plant (NCWRP). This demonstration phase was used to evaluate the feasibility of using advanced treatment technology to produce water that can be sent to a local reservoir and later distributed as potable water and to determine if the Demonstration Project meets regulatory requirements and provides evidence of viability of a full-scale reservoir augmentation project. Mr. Brown provided preliminary design services for the 1 mgd demonstration system.

Project Manager, Camp Pendleton Pump Station and Forcemain Replacement, Marine Corps Base, Camp Pendleton, California. Mr. Brown was project manager for a project to replace or upgrade three sewage lift stations at the Camp Pendleton Marine Corp Base to reduce the potential for sewage spills. New pumping equipment, overflow structures and forcemain are being provided using a design-build procurement process. Mr. Brown was responsible for managing the design and interfacing with the government reviews team and the contractor to complete the project in less than 20 months.

Jaeho Ho, PhD, PE Water Reclamation and Membrane Treatment



Education

PhD – Civil Engineering (Major: Environmental Engineering; Co-major: Biorenewable Resources and Technology), Iowa State University, Ames, Iowa, May 2007

MS – Civil Engineering (Major: Environmental Engineering), Korea University, Seoul, Korea, February 2000

BS – Civil Engineering, Korea University, Seoul, Korea, February 1998

Registration/Certifications

Professional Engineer: Iowa (2012)

Training

Optimal Design & Operation of RO Systems seminar, David H. Paul, Inc., April 2012, Aurora, Illinois

NPDES Permit Writers' Training Course, US EPA, September 2008, Montgomery, Alabama Dr. Ho is an environmental engineer working in CDM Smith's Bellevue Lab with more than 16 years of experience in R&D and process engineering for water and wastewater treatment systems, including biorenewable technologies, water reuse, membrane (RO/MF/UF/MBR) technologies, mining/flue gas desulfurization (FGD) wastewater treatment, and desalination technologies. He has tested and evaluated several different membranes (polymeric and ceramic membrane) for various MBR projects. A leader in the industry, Dr. Ho has four patents, countless published papers, and over two dozen conference presentations.

Prior to CDM Smith

Principal Investigator, Low Energy Consumption MBR System Development, Doosan Heavy Industry, Tampa, Florida. Dr. Ho led a three-year R&D project to develop a highly energy efficient water reuse process with MBR focusing on operational cost reduction through development of an energy efficient MBR system. He evaluated multiple membranes and methods to replace air scouring which is currently used for submerged MF/UF system. A new membrane scouring mechanism was designed and tested at the laboratory scale. The bench results were then used to design the pilot for membrane performance evaluation. Energy consumption was evaluated and used to optimize pilot performance. The design, operation and maintenance protocols for LENA MBR membrane system using mechanical motion were developed to reduce energy consumption compared to other MBR processes through the elimination or further reduction in air scouring energy consumption.

NPDES Permit Writer, South Carolina Department of Health and Environmental Control, Columbia, South Carolina. Dr. Ho reviewed and evaluated engineering plans and specifications for domestic wastewater treatment systems, wastewater reclamation and reuse systems, and land application systems to ensure compliance with regulations and design guidelines.

Patents

- 1. Submerged membrane filtration system using reciprocating membrane, US 9,833,741 B2 (Granted December 2017)
- **2.** Membrane Bioreactor System Using Reciprocating Membrane, US 9,884,295 B2 (Granted February 2018)
- **3.** Sewage/wastewater treatment system using granular activated sludge and membrane bio-reactor and sewage/wastewater treatment method using the same, US 20170203984 A1 (Filed June 2016)
- **4.** Biological process to remove nitrogen from high strength wastewater, Korea Patent #0315874 (Granted November 2001)

Publications

- J. Ho, S. Smith, J. Patamasank, P. Tontcheva, G. Kim and H. Roh (2015) Pilot demonstration of energy efficient membrane bioreactor using reciprocating submerged membrane, Water Environment Research, 87, 266-273.
- J. Ho, S. Smith and H. Roh (2014) Alternative energy efficient membrane bioreactor (MBR) using reciprocating submerged membrane, Water Science and Technology, 70, 1998-2003.



Conference/Workshop Presentations

- » J. Liberzon, J. Chen, T. Lung Lin, A. Hanra, J. Ho, C. Lee, A Scale-Resistant, Membrane-Based Solution for the Treatment of FGD Wastewater to Meet EPA Guidelines, International Water Conference, November 4-8, 2018, Scottsdale, AZ
- J. Ho, C. Claessen, C. Lee, Submerged ultra-filtration applications for mine-impacted water treatment, Water Congress 2018, May 9-11, 2018, Santiago, Chile
- » J. Ho, C. Lee, H. Poth, B. Shoar, Effective Removal of Arsenic with Precipitation and Ceramic Filtration (Cer@Senic process), 2018 AMTA/AWWA Membrane Technology Conference, March 12 – 16, 2018, West Palm Beach, FL
- W. Lee, J. Ho, G. Lee, H. Roh, Long term demonstration test of Low Energy No Aeration (LENA) MBR in water reclamation plant, 8th IWA Specialist Conference on Membrane Technology for Water and Wastewater Treatment, September 5-9, 2017, Singapore
- J. Ho, LENA MBR Demonstration at Ulu Pandan Water Reclamation Plant, AMTA/SEDA Joint Technology Transfer Workshop "MBR and Reuse in the Southeast", April 4-6, 2017, Atlanta, GA
- » J. Ho, R. Broglio, G. Lee, H. K. Roh, Selenium Removal from Coal Impacted Water Using a Novel LENA UF System, Energy, Utility & Environment Conference, February 8-10, 2017, San Diego, CA
- » J. Ho, G. Lee, H. K. Roh, 0.5 MGD Full Scale Demonstration of Low Energy No Aeration (LENA) MBR Using Reciprocating Submerged Membrane, Water Convention, Singapore International Water Week 2016, July 10–14, 2016, Singapore
- » H. Roh, G. Lee and J. Ho, A Half MGD Scale Demonstration of an Innovative Energy Efficient Submerged MF/UF Membrane System, Water in Mining 2016, May 18-20, 2016, Santiago, Chile
- J. Ho, C. Claessen, G. Lee and H. Roh, Case Studies of Reciprocating Submerged UF for Selenium Removal, AWWA/AMTA 2016 Membrane Technology Conference & Exposition, February 1-4, 2016, San Antonio, TX
- » J. Ho, H. Roh and G. Lee, Energy effective LENA (Low Energy No Aeration) MBR technology for wastewater reuse, Global Energy Technology Summit 2015, November 7-9, 2015, New Delhi, India
- » J. Ho, Low energy no aeration MBR for mining wastewater treatment, AMTA Technology Transfer Workshop, December 8-11, 2014, Keystone, CO

- » J. Ho, S. Smith, G. Kim and H. Roh, Evaluation of membrane performance and power consumption in pilot-scale anaerobic membrane bioreactor (AnMBR) treating domestic wastewater at ambient temperature, IWA Regional Conference on Water Reuse & Energy 2014, October 21-24, Daegu, Korea
- J. Ho, S. Smith, J. Patamasank, P. Tontcheva, G. Kim and H. Roh, Energy efficient reciprocation MBR (rMBR) for nutrient removal from wastewater, IWA World Water Congress & Exhibition 2014, September 21-26, 2014, Lisbon, Portugal
- J. Ho, S. Smith, G. Kim and H. Roh, Energy efficient submerged UF/MF system utilizing reciprocating inertia for wastewater treatment, 4th International Congress on Water Management in Mining, May 28-30, 2014, Vina del Mar, Chile
- J. Ho, S. Smith, J. Patamasank, P. Tontcheva, G. D. Kim and H. K. Roh, Alternative Energy Efficient Membrane Bioreactor (MBR) Using Reciprocating Submerged Membrane, 11th IWA Leading Edge Conference on Water and Wastewater Technologies, May 26-29, 2014, Abu Dhabi, United Arab Emirates
- J. Ho, S. Smith, J. Patamasank, P. Tontcheva, G. Kim, H. Roh, Development of Alternative Energy Saving MBR Using Reciprocating Vibration in Place of Membrane Air Scouring, WEFTEC 2013, Oct. 5- 9, 2013, Chicago, IL
- S. Smith, G. Kim, L. Doan, J. Ho, P. Tontcheva, J. Patamasank, H. Roh, On-Site Pilot Demonstration of Biological Phosphorus Removal in MBR for Water Reuse, 27th Annual WaterReuse Symposium, Sep. 9-12, 2012, Hollywood, FL
- » J. Ho, Decentralized wastewater systems permit requirements and procedures, Southeast RCAP and EPA Wastewater Alternatives Workshop, July 30, 2009, Greenville, SC
- » J. Ho, S. Sung, Performance evaluation of anaerobic membrane bioreactor using non-woven cloth membrane treating low strength wastewater, 4th International Workshop on Innovative Anaerobic Technology, Feb. 23-24, 2007, Daejeon, Korea.
- J. Ho, Anaerobic membrane bioreactor (AMBR) Application to low strength wastewater at ambient temperature, S1th Annual Great Plains Waste Management Conference, Mar. 21-22, 2007, Council Bluffs, IA.

Josh Goldman-Torres, PhD, PE Piloting and Data Analysis



Education

PhD – Civil Engineering, University of New Mexico, 2012

MS – Environmental Science & Policy, University of South Florida, 2007

BA – Anthropology, The State University of New York at Stony Brook, 2000

Registration/Certifications

Professional Engineer: Colorado (2016)

Honors/Awards

Rocky Mountain Water Treatment Competition, Winning Team, 2008 US Patent No: 8,557,119

High water recovery from desalination systems using ion exchange technology

Dr. Goldman-Torres brings expertise in the areas of water and wastewater disinfection, membrane based water treatment technology, desalination, water chemistry, membrane distillation, ion exchange, reverse osmosis, salt recovery, and electrodialysis. His doctoral research, which resulted in a provisional patent, focused on salt recovery from reverse osmosis concentrate using ion exchange. Along with piloting, Dr. Goldman-Torres is especially adept in the analysis of pilot data, and the presentation of that data to clients through user friendly tools and dashboards to enable clear decision-making based on piloting results.

Recently, Dr. Goldman-Torres has focused on the development, operations, and analysis associated with piloting UV and peracetic acid systems for wastewater treatment, with project work that has been instrumental in the area of wastewater disinfection. He has developed expertise in the use of peracetic acid (PAA) and ultraviolet (UV) technology, and has designed, operated, and analyzed data from several large-scale pilot studies across the United States and Canada. Currently, Dr. Goldman-Torres is involved in cutting edge research to investigate the combined use of UV and PAA for wastewater disinfection. He is also involved in 3D modeling using Trimble Sketch-up for various projects at CDM Smith.

Project Engineer, West Portal Industrial Water Treatment Plant Ultrafiltration Pilot Plant & Full-Scale Facility, Winter Park, Colorado. Dr. Goldman-Torres assisted in the design and modeling of a water treatment plant for removal of heavy metals contained in discharge from a railroad tunnel. He supported all aspects of design including coordination with subcontractors, utilities, and town personnel, process mechanical design of all unit processes, and will be involved in construction related engineering support.

Project Engineer, UOSA Ozone Biofiltration Pilot, Fairfax, Virginia. Dr. Goldman-Torres assisted in the design of a pilot scale ozone biofiltration test. He composed the pilot test plan to determine the extent of granular activated carbon life extension.

Project Engineer, High Salinity – Direct Osmosis (HS-DO) R&D, Colorado. Along with two other process engineers at CDM Smith, Dr. Goldman-Torres developed, installed, and evaluated a pilot system at East Cherry Creek Valley's North Water Treatment Plant to test a novel reverse osmosis cleaning system. The HS-DO cleaning system was licensed by Membrane Recovery, Ltd, and involved sending a plug of high salinity water down the feed channel to act as a driving force to pull permeate back into the feed channel, lifting foulants and dissolving scale from the membrane surface. This process was done for a brief period during operations, so no down time was required.

Pilot Operation and Data Analysis Engineer, WATER2025 Process Selection and Pilot, City of Westminster, Colorado. Dr. Goldman-Torres is supporting the pilot operations and data analysis for this visionary program for Westminster, focusing on providing high-quality water to its customers and transitioning from the Semper Water Treatment Plant to a new water treatment plant. The new plant will ultimately be designed to improve treatment resiliency to address varying water quality conditions, adapt to changing regulatory standards, improve water supply flexibility and water quality, and embrace environmental sustainability and resource stewardship. The team



will also be providing expertise and counsel regarding the design and construction of a new WTP.

Project Engineer, Anardarko Reverse Osmosis Pilot Project, Rawlins, Wyoming. For the Anadarko Pilot
Project, Dr. Goldman-Torres assisted in startup and
operations of the pilot plant. He was responsible for
operations, data storage and collections.

Project Engineer, East Water Purification Plant, Houston, Texas. Dr. Goldman-Torres analyzed data from a pilot test to determine the effect of chemical feed location on mixing and settling performance.

Project Engineer, High Sierra C-4 Expansion Project, Greeley, Colorado. For the C-4 Expansion Project, Dr. Goldman-Torres worked with a team of process engineers to design and implement a treatment process for production and flowback water from hydraulic fracturing operation. The design goals included oil recovery, solids removal, and deep well injection.

Project Engineer, High Sierra C-6 Solids Processing Facility, Greeley, Colorado. For the C-6 Solids Processing Facility, Dr. Goldman-Torres designed a treatment process and facility for solids produced as a byproduct of production and flowback water treatment. The process was focused on oil recovery and generation of solids for disposal in a non-hazardous landfill.

Project Engineer, High Sierra C-8 Expansion Project, Greeley, Colorado. For the C-8 Expansion Project, Dr. Goldman-Torres worked with a team of process engineers to design and implement a treatment process for production and flowback water from hydraulic fracturing operation. The design goals included oil recovery, solids removal, and deep well injection. Dr. Goldman-Torres prepared much of the design package using Trimble Sketch-up and Trimble Layout.

Project Engineer, High Sierra, Greeley, Colorado. Dr. Goldman-Torres performed a geochemical analysis to determine the composition of salts removed in a clarifier and determine whether the salts would re-dissolve when mixed with water from another process.

Project Engineer, Narragansett Bay Commission, Rumford, Rhode Island. Dr. Goldman-Torres compared the feasibility of upgrading an existing UV disinfection system from medium pressure to low pressure, high output. He performed a 15 year cost analysis to compare several different UV systems and determine the best fit.

Project Engineer, EnCana Hydraulic Fracture Water Management for Piceance Basin Project, Denver,

Colorado. For the Fracture Water Management Project, Dr. Goldman-Torres analyzed flow patterns and water quality parameters recorded over a three month period at two hydraulic fracturing sites. Results were presented to EnCana in a formal report which was used to inform treatment options.

Project Engineer, Johnson County Wastewater, Kansas City, Kansas. Dr. Goldman-Torres conducted bench scale studies with different coagulants and disinfectants to determine optimal treatment for secondary effluent, to meet permit requirements. He was responsible for study design, lab operations, data analysis, and reporting.

Project Engineer, Peracetic Acid Disinfection Pilot, Vancouver, Canada. Dr. Goldman-Torres analyzed data from a peracetic acid disinfection pilot in a wastewater treatment plant. He used data from the pilot to model disinfection results at several peracetic residual concentrations and contact times.

Project Engineer, TRA Central Regional Wastewater System UV Pilot, Dallas, Texas. Dr. Goldman-Torres assisted in the design, operations, and data analysis of a large scale UV pilot disinfection system for a wastewater treatment plant to compare and field verify four different UV systems and peracetic acid reactor. Dr. Goldman-Torres was responsible for day to day pilot operations, data collection, lab analyses, and data analysis.

Project Engineer, Memphis Wastewater Disinfection Pilot, Memphis, Tennessee. Dr. Goldman-Torres assisted in the design and construction of pilot scale disinfection systems at two wastewater treatment plants in Memphis to compare the effects of three disinfectants.

Project Engineer, PeroxyChem Portable Peracetic Acid Reactor Design. Dr. Goldman-Torres designed a portable peracetic acid reactor which was built by PeroxyChem for mobile field testing of peracetic acid.

Prior to CDM Smith

Graduate Research Assistant, University of New Mexico, Albuquerque, New Mexico. Dr. Goldman-Torres designed and executed a research study of salt recovery from reverse osmosis concentrate funded by the WateReuse Foundation. He used and maintained analytical equipment including Atomic Adsorption Spectrometer and Ion Chromotography System. Dr. Goldman-Torres designed, built, and operated pilot scale inter-stage ion exchange treatment process.

Carl Lundin, PE Piloting and Data Analysis



Education

MS – Environmental Science and Engineering, Colorado School of Mines, 2009 BS – Civil Engineering, Colorado School of Mines, 2007

Registration/Certifications

Professional Engineer: Washington (2007)

Affiliations

Member, American Water Works Association Member, American Membrane Technology Association Mr. Lundin has a background in advanced water treatment processes, design, piloting, and construction, and management of diverse types of projects. He has specific experience in both high and low pressure membrane processes for drinking water and wastewater treatment, as well as novel applications of osmotic membrane technology. He also has experience with conventional water/wastewater design and construction, both domestically and internationally.

Pilot Design, Procurement, and Installation, WATER2025 Process Selection and Pilot, City of Westminster, Colorado. Mr. Lundin is supporting the pilot design, procurement, and installation for this visionary program for Westminster, focusing on providing high-quality water to its customers and transitioning from the Semper Water Treatment Plant to a new water treatment plant. The new plant will ultimately be designed to improve treatment resiliency to address varying water quality conditions, adapt to changing regulatory standards, improve water supply flexibility and water quality, and embrace environmental sustainability and resource stewardship. The team will also be providing expertise and counsel regarding the design and construction of a new WTP.

Technical Lead, FO/RO Pilot System, Porifera, Inc. Mr. Lundin was the main participant assisting Porifera, Inc. with the development of a pilot system to test the performance of novel forward osmosis (FO) and carbon nanotube reverse osmosis (RO) membranes that Porifera has developed. Mr. Lundin developed a software model of the pilot system, collaborated with Porifera engineers on the process and mechanical design, developed control descriptions, and assisted with construction and operation in several phases. This work helped Porifera secure a partnership with a Tier 1 membrane manufacturer.

Deputy Project Manager, Comprehensive Water Master Plan, Honolulu, Hawaii. CDM Smith was selected by the Honolulu Board of Water Supply to complete their first Water Master Plan. This \$14 million project included building hydraulic models of the entire island- wide system, condition assessment of hundreds of reservoirs, piloting of condition assessment technologies for over 2,100 miles of transmission and distribution mains, statistical analysis of the pipe network, capital and financial planning, future demand projection, source quantity and quality evaluation, communications support, and coordination with several other consultants, subconsultants, and vendors. Mr. Lundin assisted the PM in all aspects of the management of the project and was specifically responsible for contracting, budgeting, invoicing, scheduling, client management and support, as well as managing the condition assessment and capital improvement program tasks.

Membrane Filtration/Civil Task Lead, Delta Water Supply Project D-B, Stockton, California. CDM Smith designed and built a 30mgd surface water ultrafiltration drinking water treatment plant for the City of Stockton which enabled the city to utilize a recently acquired water right. Mr. Lundin lead civil design tasks, finalized the design of the membrane filtration sub-system, and had a large role in other process mechanical systems. Mr. Lundin worked as part of a large multi-disciplinary design team on process design, site civil design, drawing review and drafting coordination, and specification writing. Mr. Lundin also provided engineering services during construction, working closely with the contractor, and assisted with start-up and acceptance testing.



Screenings Improvements Project, King County, Washington. CDM Smith assisted King County with the design of a headworks retrofit at the 110mgd AAF West Point Wastewater Treatment Plant in Seattle, WA. The project included replacement of climber bar screens with fine multi-rake bar screens, addition of belt and screw solids handling, and new screenings processing equipment housed in a new building. The design was completed utilizing a 3D/4D approach. Mr. Lundin led the civil design and assisted with process design from

pre-design through final design, as well as engineering

5 year project of data collected by Harris County Flood

Control District, and estimated losses avoided in Harris

services during construction. Mr. Lundin also coordinated

and managed the dispersed design team throughout the

County by applying FEMA's Loss Avoidance methodology.

Civil Task Lead/Process Designer/ESDC Task Lead,

Startup Lead, Food Waste Digestion Pilot, USAF Academy, Colorado Mr. Lundin led pilot and site improvement design, coordinated engineering services during construction, and led initial startup of a pilot scale food waste anaerobic digestion system at a DoD site.

Project Engineer, Desalination Pretreatment, Orange County, California. Mr. Lundin provided pilot and experiment design, day to day consultation with the operator, and wrote the piloting report for a system targeting iron and manganese removal from a beach well before desalination. Tested processes included oxidation (air, chlorine, and permanganate), conventional dual media filtration, greensand filtration, and membrane ultrafiltration.

Lead Field Engineer, ASR/Groundwater Monitoring Program, Sammamish Plateau, Washington. CDM Smith has been providing monitoring services for ASR and groundwater for the Sammamish Plateau Water and Sewer District for over 25 years. Mr. Lundin led the field work for this monitoring for several years, and was responsible for recording and maintaining dozens of dataloggers, making manual measurements, reducing large amounts of data, and troubleshooting various technical problems as they arose. Mr. Lundin also trained District staff to take over some aspects of the monitoring program.

Staff Engineer, Cascade Water Alliance 2010 Transmission and Supply Plan, Bellevue, Washington.

Cascade Water Alliance, a coalition of eight water districts in the central Puget Sound region, worked with CDM Smith to update the transmission and supply plan for 2010. As a staff engineer, Mr. Lundin completed cost estimates and fact sheets for various water supply options, and participated in workshops with the consultant team and

Cascade throughout the definition, scoring, and selection process.

Staff Engineer, Covington Water District Supply Option Analysis, Covington, Washington. To better define and plan for future demand, Covington Water District retained CDM Smith to forecast demand and assist with the development of a long range water supply plan. Mr. Lundin completed cost estimates and fact sheets for various water supply options, and participated in scoring workshops with the client.

Research Assistant, Advanced Water Technology Center (AQWATEC) - Colorado School of Mines, Golden, Colorado. Working under Drs. Jorg Drewes and Tzahi Cath, Mr. Lundin completed research on a novel osmotically-driven hybrid membrane system. The system utilized forward osmosis and reverse osmosis processes to augment drinking water production and reduce energy demand associated with seawater desalination and water reuse. As part of this work, Mr. Lundin completed computer modeling of the system, and conducted significant bench- and pilot-scale experiments to demonstrate process feasibility. Mr. Lundin also upgraded/rebuilt a conventional granular filtration pilot to membrane filtration. The purpose of the pilot was to optimize iron and manganese removal. Mr. Lundin also worked closely with other researchers in the Center to develop and test novel processes for concentrate minimization, membrane distillation, and trace organic rejection by membranes. Several reports and papers were published pertaining to this work.

Amrou Atassi, PE, BCEE Corrosion Control



Education

MS – Environmental
Engineering, Purdue University,
2001

BS – Civil Engineering, Valparaiso University, 2000

Registration/Certifications Professional Engineer: Illinois (2004)

Mr. Atassi is a senior project manager and senior project engineer specializing in drinking water treatment and distribution and energy efficiency/system optimization. With 19 years of experience, he has worked on all phases of water treatment projects, including pilot testing, distribution system modeling, corrosion control, master planning, water quality compliance issues, energy efficiency analysis/planning, design, and construction phase services. He has worked on a wide range of projects from \$5,000 studies to over \$250 million construction projects. Mr. Atassi brings specialized expertise in the fields of corrosion control, water distribution, and treatment, leading several Water Research Foundation Projects related to corrosion control and distribution system water quality.

Corrosion Specialist, Highland Park WTP Improvements, Highland Park, Illinois. Mr. Atassi developed testing protocols for the evaluation of the impact of treatment process changes on corrosion variables. He worked with Virginia Tech University on bench scale testing to evaluate the impact on changes from conventional treatment to membranes and from chloramines to sodium hypochlorite. He provided the city with key recommendations to maintain compliance with the Lead and Copper Rule.

Project Manager/Co-Principal Investigator, WaterRF 4317, Non-Intrusive Methodology for Assessing Lead and Copper Corrosion (Teamed with Marc Edwards & Jeff Parks at Virginia Tech University). Mr. Atassi is serving as project manager and co-principal Investigator on WaterRF 4317 to develop and evaluate corrosion control evaluation methods, such as pipe loops, for lead and copper corrosion. Pipe loop systems are currently being design to evaluate corrosion control in the distribution system for five participating utilities.

Project Manager/Co-Principal Investigator, WaterRF 4033, Impact of Phosphate Corrosion Inhibitors on Cement-Based Pipes and Linings (Teamed with Marc Edwards & Jeff Parks at Virginia Tech University). Mr. Atassi served as project manager and co-principal Investigator on WaterRF 4033 to understand the impact of water quality and phosphate products on cement-based pipes. The research project includes 20 utilities using different phosphate corrosion inhibitors.

Co-Principal Investigator, WaterRF 4014, Comparison of Zinc Versus Non-Zinc Corrosion Control for Lead and Copper (Teamed with American Water Service Company and Marc Edwards at Virginia Tech University). Mr. Atassi served as coprincipal Investigator on WaterRF 4014 to evaluate zinc-phosphate products and their effectiveness with lead and copper corrosion control.

Project Manager/Lead Project Engineer, JWPP Pipe Loops Pilot Testing, Chicago Illinois. For Chicago DWM, Mr. Atassi served as lead project engineer on the pipe loops pilot testing program, which involves collecting and analyzing weekly samples to analyze chemical interactions within the water distribution system, specifically aluminum phosphate formation. This study also involves the optimization of corrosion control strategies.

Project Manager/Lead Project Engineer, Pipe Loop Testing, DuPage Pumping Station, DuPage, Illinois. For the DuPage Water Commission, Mr. Atassi served as project manager and lead project engineer on the pipe loops pilot testing program at the DuPage Water Commission. Testing involves different strategies for corrosion



control and minimizing deposition formation in the distribution system.

Lead Project Engineer/Corrosion Control Specialist, Water System Assessment and Red Water Control Study, US Navy, NAVFAC, Segionella Navy Base,

Italy. Mr. Atassi served as the lead project engineer for the evaluation of Segionella Navy base's water facilities (reverse osmosis or RO system) and investigation of red water sources in the distribution system. Mr. Atassi led field reconnaissance efforts including field sampling at different sites on Base to evaluate water quality (two-week comprehensive site assessment and field sampling). He developed treatment alternatives to reduce the corrosivity of the water and address red water concerns on base, including modifications to the RO system as well as the addition of a calcite contactor.

Technical Reviewer, Distribution System Water Quality, Savannah, Georgia. Mr. Atassi served as the technical reviewer/advisor for the Savannah distribution water quality study, including included bench scale testing to evaluate the impact of harbor dredging and increased chloride levels on disinfection by-product (DBP) formation and corrosion control.

Project Manager, Kankakee and Danville Water Plant Buildings Assessments and Risk Prioritization, Kankakee and Danville, Illinois. Mr. Atassi led a multi-discipline team (process, structural, electrical, plumbing, fire protection, HVAC, architectural, civil and instrumentation) for the comprehensive assessment of the building facilities at Aqua Illinois' Danville and Kankakee water plants. This included over six buildings at both facilities. Mr. Atassi also worked with the team on risk analysis and development of a comprehensive capital and maintenance improvement plan for the next 20 years.

Project Director, Water System Expansion North Group, Lake County, Illinois. Mr. Atassi oversaw CDM Smith's evaluation for potential for developing a complete water system for 13 communities in northern Lake County, including a new 55-mgd WTP and more than 55 miles of transmission system piping and pumping stations with an estimated capital cost estimate of \$280 million. CDM Smith performed route selection, preliminary hydraulics, design criteria development, and capital cost estimating. This project would have doubled the size of CLCJAWA's water system and provided multiple benefits to its redundancy, reliability, and economies of scale. CDM Smith was also asked to conduct an investigation focused on system-wide improvements required to increase capacity based on the capacity assessment results.

Project Manager, Water Treatment Plant Improvements, f Highland Park, Illinois. Mr. Atassi served as the project manager for the construction of the \$38 million Highland Park's WTP Improvements project (30 mgd). This retrofit project was completed within schedule and budget. In addition to a new filtration facility retrofitted within the existing plant, the project also included new raw water pumps, chemical feed facilities, and clearwell improvements.

Project Manager and Senior Process Engineer, JWPP Condition Assessment, Chicago, Illinois. For the Chicago DWM, Mr. Atassi led a multi-discipline team (process, structural, electrical, plumbing, fire protection, HVAC, architectural, civil and instrumentation) for the comprehensive assessment of the world's largest water purification plant at 1.2 billion gallons per day. He was also in charge of the process/mechanical assessment, including low lift pumping, pretreatment facilities, filters, and other process equipment. He then led the recommendations development as part of the second phase of this project.

Publications and Presentations

- » Water Research Foundation 4033, Impact of Phosphate Corrosion Inhibitors on Cement-based Pipes and Linings. June 2010. WaterRF. Denver, Colorado.
- Water Research Foundation 4014, Comparison of Zinc Versus Non-Zinc Corrosion Control for Lead and Copper. June 2011. WaterRF, Denver, Colorado.
- » Distribution System Corrosion Control and Unintended Consequences. September 20, 2007. Presented at the Fall Meeting of the West Shore Water Producers Association. Hammond, Indiana.
- Sorrosion Control Optimization Using Lead Pipe Loops. February 2006. Presented at the Indiana Section AWWA Conference. Indianapolis, Indiana.

Sue Morea Water Supply Planning



Education

MS – Environmental
Engineering, Colorado State
University, 1986

BA – Biology, University of
Colorado, 1980)

Ms. Morea has 27 years of water supply planning and water quality experience and has led numerous analysis and planning projects for federal, state, municipal, and private sectors. As CDM Smith's Project Director for the Colorado Statewide Water Supply Initiative, she has been responsible for helping guide the technical roundtables of state water, agriculture, and environmental interests toward developing solutions for meeting Colorado's water supply needs.

Technical Director, Arkansas Basin Implementation Plan, Colorado Water Conservation Board, Colorado. Ms. Morea served as technical director to develop the Basin Implementation Plan (Arkansas BIP) for the Arkansas Basin Roundtable to identify both supply constraints and opportunities, as well as projects and methods for a regional planning model. Key project responsibilities included developing a regional water allocation model and implementation strategy and planning tool to evaluate potential benefits/impacts. Ultimately delivering a "master needs" database for the Arkansas Basin allowing the Basin Roundtable to prioritize projects for implementation and identify potential opportunities for multi-purpose projects. CDM Smith was also tasked with stakeholder outreach and public presentations at several public and stakeholder events.

Technical Director & Quality Review, Northern Integrated Supply Plan, United States Army Corps of Engineers (CO). CDM Smith is part of the third-party consultant team supporting the U.S. Army Corps of Engineers (USACE) to develop and prepare the Draft and Final Environmental Statements for the Northern Integrated Supply Project (NISP). In addition to general project support, CDM Smith is the Team Lead on hydrology modeling, water resources, and operations reports. CDM Smith has also been a key team member providing water quality analysis, aquatic species evaluation and geomorphology studies assessing the potential effects the new reservoir may have on nearby waterbodies.

Project Director, South Metro Water Supply Authority Aquifer Storage Recovery Feasibility Study (SMWSA), Denver, Colorado. Ms. Morea is currently working with SMWSA in Denver to evaluate options for aquifer storage and recovery for the area.

Project Director, Interbasin Compact Roundtable Technical Support, Colorado. For the Colorado Department of Natural Resources, Ms. Morea provided support to the Interbasin Compact Roundtable process. This work involves providing technical assistance to the Basin Roundtables and the Interbasin Compact Committee in completing consumptive and nonconsumptive needs assessments.

Program Manager, Statewide Water Supply Initiative, Colorado. Ms. Morea is serving as program manager for landmark Statewide Water Supply Initiative (SWSI) for the Colorado Water Conservation Board. The project involves conducting a statewide water supply investigation for use in identifying solutions to persistent drought and growth problems. CDM Smith's role is to investigate supply and demand in eight river basins across the state and develop a comprehensive water supply plan that includes financing and regulatory compliance strategies.

Project Director, Colorado Statewide Water Supply Initiative, Phase 2. The Colorado legislature authorized and funded a second phase of the Colorado SWSI in order to develop greater understanding and consensus on key water supply issues. Ms. Morea is directing and facilitating CDM Smith in its effort to lead technical roundtables



of water leaders from every basin and interest group to discuss water efficiency, environmental and recreational priorities, alternatives to permanent agricultural dry up, and develop solutions for meeting Colorado's water supply gap. The Colorado Statewide Water Supply Initiative project won an Engineering Excellence Award from the American Consulting Engineer's Council of Colorado (ACEC/CO).

Officer-in-Charge, Groundwater and Surface Water Components of South Platte Decision Support System (SPDSS) Feasibility Studies, Colorado. CDM Smith was selected by Colorado Water Conservation Board to conduct a feasibility study for the ground water and surface water components of the SPDSS. Ms. Morea served as the officer-in-charge on this project, overseeing both studies and all of their various components.

Officer-in-Charge, Integrated Water Resources Plan, Castle Pines North Metropolitan District, Colorado. Ms. Morea is leading the development of an Integrated Water Resources Plan (IWRP) and long-range water supply for this district, which is currently 100 percent dependent upon non-renewable Denver basin groundwater sources.

Officer-in-Charge, Halligan-Seaman Reservoir Water Management Project, Cities of Greeley and Fort Collins, Colorado. Ms. Morea is serving as CDM Smith's officer-in-charge for the preparation of an EIS for the enlargement of Halligan and Seaman Reservoirs. The project is sponsored by the cities of Fort Collins and Greeley, three water districts, and two irrigation companies, and involved the. As a Third Party Consultant team member to the U.S. Army Corps of Engineers, CDM Smith is leading the hydrology, water allocation modeling, reservoir yield, water demand, water quality, water treatment and alternatives analyses.

Principal-in-Charge, Colorado Drought Planning Survey, Colorado. CDM Smith participated in a study for the CWCB to assess the state's drought preparedness. The results of the study helped the CWCB clarify which water providers are in need of the State's assistance and which are candidates for the state's construction fund loan program. CDM Smith provided technical expertise and guidance on issues dealing with hydrology, water rights, drought evaluations and general water resources.

Technical Advisor for Water Resources and Stakeholder Decision Science, City of Austin, Austin Water Integrated Water Resource Plan (IWRP). Ms. Morea is currently providing team leadership, direction, and technical strategy support in the development of this IWRP to provide a plan for water supply and demand management options for the City of Austin in a regional water supply context. Through public outreach and coordination of efforts between City departments

and the Austin Integrated Water Resource Planning Community Task Force, the IWRP will deliver a holistic and inclusive approach to water resource planning involving advanced water conservation strategies, water reuse and reclamation, sustainable water resource planning, financial modeling, climate adaptation, and scenario planning. The innovative and integrated water management plan is being delivered to ensure a diversified, sustainable, and resilient water future for Austin.

Project Director, Missouri Water Plan. Ms. Morea served as project director to develop an overall work plan for the State of Missouri Water Plan update. Elements of the work plan included supply, demand, water quality, and infrastructure evaluations.

Technical Director, Georgia Statewide Water Resources Plan, Georgia Environmental Protection Division

(EPD), Georgia. Ms. Morea provided technical direction to the Georgia EPD and Regional Water Planning Councils for the development of water resource plans for three of Georgia's Regional Water Planning Councils. This high profile, \$1.8 million project involved developing comprehensive and sustainable water supply, wastewater, and stormwater plans and management strategies for the Regional Councils. The development of sustainable and implementable regional water plans involved quantifying and forecasting current and future (through the year 2050) municipal, commercial, and industrial water needs; assessing current resources within the regions; identifying "gaps" between available water resources and future water resource needs; and developing and evaluating diverse water supply and demand management strategies that could be implemented to meet future needs while protecting water quality and natural systems.

Technical Director, Arkansas State Water Plan, Arkansas Natural Resources Commission, Little Rock, Arkansas.

Ms. Morea served as technical director to develop the 2014 update of the Arkansas Water Plan. This comprehensive update included water demand projections, surface water and groundwater availability assessments, and analysis of water supply gaps and development of alternatives to alleviate the projected water supply deficits. The 2014 Update was completed with unprecedented stakeholder outreach and involvement and with public support of the implementation plans.

Project Director, Oklahoma Water Plan. Ms. Morea served the Oklahoma Water Resources Development Board to update their state water plan. This was a \$2.5 million effort with the Army Corps of Engineers. The effort included evaluation of supply, demand, gap analysis, and water supply alternatives.

Melissa Harclerode, PhD, BCES, ENV SP Public Outreach



Education

PhD – Environmental Management, Montclair State University, 2016

MS – Environmental Science, Rutgers University/New Jersey Institute of Technology, 2010

BS – Environmental Science and Biology, Muhlenberg College, 2005

Certifications

American Academy of Environmental Engineers & Scientist, Board Certified Environmental Scientist, Sustainability Specialty, 2017

Institute of Sustainable Infrastructure's EnvisionTM Sustainability Professional Credential, 2013

Affiliations / Activities

At-Large Board Member, Sustainable Remediation Forum (SURF), 2014 and 2015

Social Aspect TI Lead, Sustainable Remediation Forum (SURF), 2013 through present

Technical Reviewer for Journal of Environmental Management, 2016 through present

Awards

28th Annual APEX Awards for Publication Excellence; The winning article, Integrating the Social Dimension in Remediation Decision-Making: State of the Practice and Way Forward, published in the Winter 2015 issue of Remediation Journal Dr. Harclerode brings 13 years of experience as an environmental sustainability scientist and expert in risk communication and stakeholder engagement across a variety of markets, including remediation, water resources, and transportation. She specializes in the development and application of integrated assessment approaches to comprehensively define sustainability objectives and evaluate environmental, social, and economic impacts of environmental infrastructure and restoration projects. She regularly provides related technical support and modeling for environmental footprint analysis, life cycle assessment, community impact evaluations, risk communication, stakeholder engagement techniques, climate change vulnerability assessments, and development of sustainable best management practices. Recently, Dr. Harclerode was responsible for preparing the risk communication chapter of the National Groundwater Association's PFAS Best Suggested Practices (BSP) guidance titled Groundwater and PFAS: State of Knowledge and Practice (December 2017). She is also the section lead for the risk communication chapter, focused on developing PFAS communication tools for the Interstate Technology & Regulatory Council's PFAS Guidance document currently in development.

Project Manager and Stakeholder Outreach Lead, Passaic River Basin Resilience Plan, North Jersey Transportation Planning Authority (NJTPA). Dr. Harclerode is responsible for managing a multi-discipline team comprised of water resources, global information systems (GIS), transportation, sustainability, and resiliency experts to assess the vulnerability of transportation assets to climate change impacts within the Passaic River watershed.

Exxon Mobil EMES Green and Sustainable Remediation Guide. Dr. Harclerode assisted ExxonMobil develop and enhance their green and sustainable remediation (GSR) tools for retail facility and related remediation. In addition, she assisted with review and refinement of the EMES GSR best management practices (BMPs) and implementation guide.

Sustainability Lead, Department of Defense (DOD) Strategic Environmental Research and Development Program (SERDP), Life Cycle Assessment of Water Re-Use. Dr. Harclerode conducted a technical and quality control review of a life cycle impact assessment performed for water supply and re-use scenarios for a military base.

Sustainability Lead, DOD Environmental Security Technology Certification Program (ESTCP), Sustainable Wastewater Treatment. Dr. Harclerode is currently leading a life cycle assessment to evaluate sustainable impacts of wastewater treatment scenarios including conventional treatment approach and two pilot-scale anaerobic membrane bioreactor (AnMBR) treatment systems comprised of granulated active carbon (GAC)-fluidized and gas-spared.

Workshop Leadership

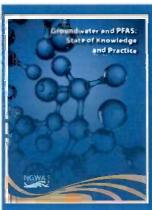
» Introduction to Stakeholder Engagement: Using Social Methodology to Strengthen Your Relationships with the Public. Eleventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds, April 8-12, 2018, Palm Springs, CA. Platform Presentation.



- The Role of Stakeholder Collaboration in Sustainable Remediation: Its Purpose, Benefit, and Process.
 - 9th International Conference on Remediation and Management of Contaminated Sediments, January 9, 2017, New Orleans, Louisiana. Professional Development Workshop. Co-Lead.
 - 4th International Conference on Sustainable Remediation (SustRem), April 26, 2016, Montreal, Canada. Professional Development Workshop. Co-Lead.
- » Risk vs. Risk Perception in Remediation. Washington Department of Ecology, Corrective Action Network Meeting, September 22, 2016, Bellevue, Washington. Led training.

Research and Development (R&D) Projects

- Sustainable Risk Management Framework. Dr. Harclerode was Technical Lead for the development of an early decision framework designed to facilitate the identification of metrics and tools to confidently evaluate performance of sustainable risk management strategies in alignment with stakeholder needs and overcome barriers associated with risk perception, uncertainty, and lack of transparency. The framework was published in the 2016 Journal of Environmental Management Special Issue on Sustainable Remediation.
- » National Groundwater Association (NGWA) PFAS Guidance. NGWA prepared a guidance on per- and polyfluoroalkyl substances (PFAS), an emerging contaminant that has impacted site-specific drinking water supplies. Dr. Harclerode was responsible for preparing the risk communication chapter.
- » Interstate Technology & Regulatory Council (ITRC) PFA5 Guidance. Dr. Harclerode is the section lead for the risk communication chapter for the ITRC PFAS Guidance currently in development.



Dr. Harclerode's recent experience has focused on addressing the issue of CECs—most recently regarding PFAS. In addition to this work, she was responsible for preparing the risk communication chapter of the National Groundwater Association's PFAS Best Suggested Practices (BSP) guidance titled Groundwater and PFAS: State of Knowledge and Practice (December 2017).

Presentations/Trainings

- Harclerode, M.A., E. Emmett, and L. Hall. Risk Communication in Emerging Contaminants: NGWA PFAS Guidance. Eleventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds, April 8-12, 2018, Palm Springs, CA. Platform Presentation.
- Harclerode, M.A., Macbeth, T., and Gurr, C. Implementing Successful Risk-Based Cleanups: Drivers and Benchmarking Strategies. Battelle Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 22-26, 2016, Palm Springs, CA. Platform Presentation.
- » Harclerode, M., Ridsdale, D. R., Darmendrail, D., Bardos, P., Alexandrescu, F., Nathanail, P., Pizzol, L., and Rizzo, E. 2015. Integrating the Social Element in Remedial Decision-Making: State of the Practice and Way Forward (A SURF Technical Initiative). Battelle Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 22-26, 2016, Palm Springs, CA. Platform Presentation.
- » Harclerode, M.A., Lal, P., Vedwan, N., Wolde, B., and Miller, M. E. Role of Risk Perception in Non-Point Metals Source Pollution Cleanup. Battelle Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 22-26, 2016, Palm Springs, CA. Poster.
- Warclerode, M.A. and Risdale, D. R. The Role of Stakeholder Collaboration in Sustainable Remediation: Its Purpose, Benefit, and Process. 4th International Conference on Sustainable Remediation (SustRem), April 25-27, Montreal, Canada. Professional Development Workshop.
- » Harclerode, M.A., P. Lal, and M. E. Miller. Quantifying Global Impacts to Society from the Consumption of Natural Resources during Environmental Remediation Activities. 4th International Conference on Sustainable Remediation (SustRem), April 25-27, Montreal, Canada. Platform Presentation.
- Harclerode, M. A., Lal, P., Vedwan, N., Wolde, B., and Miller, M. E. Role of Risk Perception in Management and Stakeholder Engagement of Widespread Metals Source Pollution Cleanup. 4th International Conference on Sustainable Remediation (SustRem), April 25-27, Montreal, Canada. Platform Presentation.
- Harclerode, M., Ridsdale, D. R., Darmendrail, D., Bardos, P., Alexandrescu, F., Nathanail, P., Pizzol, L., and Rizzo, E. 2015. The Social Aspect of Remediation: A SURF Initiative. 31st Annual International Conference on Soils, Sediments, Water, and Energy, October 19-22, 2015, Amherst, MA, Platform Presentation.

Todd Stalnaker Cost Estimator



EducationBS - Business Administration,
University of Colorado, 1990

OSHA 10-hour Construction CPR/First Aid Competent Person –

Trenching/Excavations

Technical Skills
Primavera
Suretrak
AutoCAD
Expedition
Constructware
Timberline

Mr. Stalnaker is a chief estimator with 25 years of experience in water and wastewater treatment plant and conveyance construction. As CDM Smith's chief estimator for the Central U.S., his responsibilities have included the preparation of conceptual, preliminary design, and final design estimates, detailed bid estimates, and change order pricing.

Estimator, WATER202S Process Selection and Pilot, City of Westminster, Colorado. Mr. Stalnaker is providing cost estimation support for this visionary program for Westminster, focusing on providing high-quality water to its customers and transitioning from the Semper Water Treatment Plant to a new water treatment plant. The new plant will ultimately be designed to improve treatment resiliency to address varying water quality conditions, adapt to changing regulatory standards, improve water supply flexibility and water quality, and embrace environmental sustainability and resource stewardship. The team will also be providing expertise and counsel regarding the design and construction of a new WTP.

Estimator, Southern Delivery System, Colorado Springs, Colorado. For Colorado Springs Utilities, Mr. Stalnaker served as estimator for the \$76M Southern Delivery project. The project involved three 50 MGD+ pump stations to convey raw water from Pueblo Reservoir to the City of Colorado Springs. The piping between the stations was not part of this contract.

Estimator, Tollgate Interceptor Parallel – Sand Creek to Alameda, Aurora, Colorado. Mr. Stalnaker served as estimator for this project, including identification of possible pipeline routes through an urbanized area, analysis of the potential routes, and route selection. The work also included design of approximately 4 miles of gravity interceptor ranging in size from 36-inches to 48-inches in diameter. The new interceptor runs approximately parallel to an existing interceptor with the new and existing have flow transfer points along the route. The project included significant permitting and habitat management tasks, as well as coordination with Parks and Open Space to provide for construction through a historic farm site.

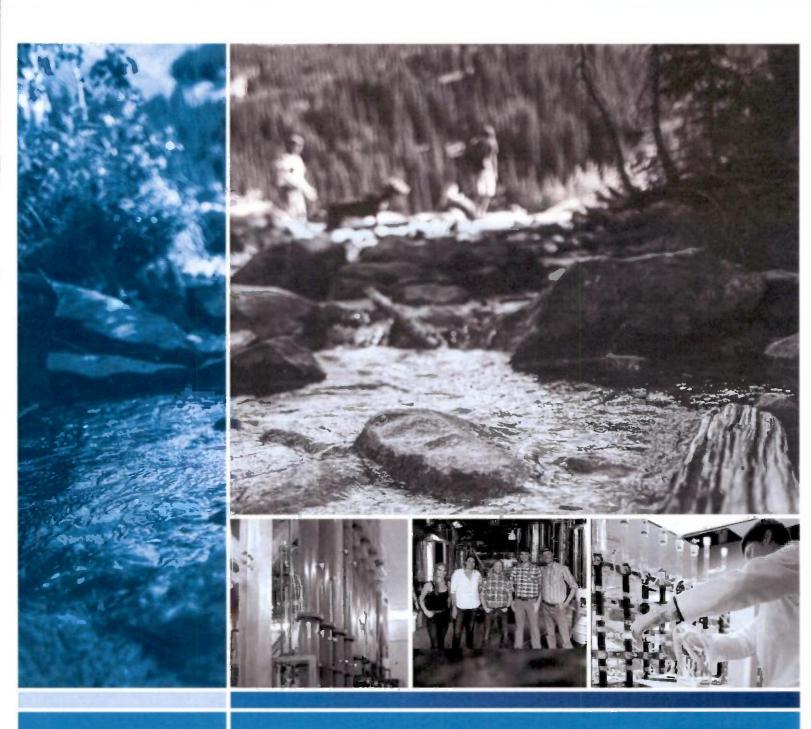
Estimator, Denver Water Marston Reservoir Submerged Down Flow Contact Oxygenation System, Denver, Colorado. Mr. Stalnaker served as estimator for a new \$1.4 million submerged downflow contact oxygenation unit that was implemented on a fast-track schedule for Denver Water.

Estimator, Metro Wastewater Reclamation District North Bar Screen and Grit Improvements Project, Denver, Colorado. Mr. Stalnaker served as estimator for the \$16M improvements project, including an overflow channel, replacing bar screens, a new grit building and two new grit chambers, as well as a new electrical building. All work was completed during continuing plant operations.

Estimator, Metro Wastewater Reclamation District Disinfection System Improvements, Denver, Colorado. Mr. Stalnaker served as estimator for the \$7.8M disinfection system improvements project involving converting the existing gas chlorine/sulfur dioxide system to a sodium hypochlorite/sodium bisulfite system.

Estimator, Weslaco North Wastewater Treatment Plant Improvements GMP, Weslaco, Texas. Mr. Stalnaker served as estimator for this \$16 million project that involved the design of a new 2.5-MGD wastewater treatment plant.





CDM Smith

WWW.CDMSMITH.COM

EXEMPLAR – NOT FOR EXECUTION

EXHIBIT 2



COLORADO		rack oraci
TAS	SK ORDER	
This Task Order, dated this day o terms and conditions of the Town of Castle Rock Consulting dated ("Agreement"), i of work to be performed under this Task Order i Task Order number assigned above on all corre	Services Agreement to noluding rates and fees attached as Exhibit 1.	Provide On-Call Water Quality established therein. The scope Consultant shall reference the
Task Title:		
Cost of Task:		
Schedule:		
Attest:	Town of Castle Rock	X
Lisa Anderson, Town Clerk	Dept. Dir/Manager/M	ayor
Approved as to form:	Approved as to conto	ent:
Robert J. Slentz, Town Artorney		
Consultant:		
CDM Smith, Inc.		
Ву:		
Its:		
Account Number: Project Manager:		

RENEWAL OF TOWN OF CASTLE ROCK SERVICES AGREEMENT TO PROVIDE ON-CALL WATER CONSULTING SERVICES

DATE:				
PARTIES:	ARTIES: TOWN OF CASTLE ROCK, a Colorado municipal corporation, 100 N. Wilcox Street, Castle Rock, Colorado 80104 (Town).			
	CDM SMITH, INC., a Massachusetts corporation, 555 17th Street, Suite 500, Denver, Colorado 80202 ("Consultant").			
RECITALS:				
A. Agreement	The Town and Consultant are parties to the Town of Castle Rock Services to Provide On-Call Water Quality Consulting Services date, 2019 (the "Agreement").			
B. the same term	Pursuant to Section 3 of the Agreement, the parties may renew the Agreement under as and conditions for an additional one-year term.			
	(If Applicable) The parties desire to amend the Agreement to update the hourly rate ule for the Services, and extend the term of the Agreement for an additional one-year on December 31, 201			
TERMS:				
Section term of the A	n 1. Renewal of Agreement. Upon execution of this Renewal Agreement, the greement be extended to December 31, 20			
Section Agreement is	n 2. <u>Amendment.</u> The rate and fee schedule attached as <i>Exhibit I</i> to the amended and replaced with the attached <i>Exhibit A-(ADD RENEWAL YEAR)</i> .			

(SIGNATURE PAGE TO FOLLOW)

Agreement shall remain in full force and effect, including the rights for early termination.

Remaining Terms. All other terms and conditions set forth in the

EXEMPLAR - NOT FOR EXECUTION

EXHIBIT 3

ATTEST:	TOWN OF CASTLE ROCK
Lisa Anderson, Town Clerk	David L. Corliss, Town Manager
Approved as to form:	Approved as to content:
Robert J. Slentz, Town Attorney	Mark Marlowe, Director of Castle Rock Water
CONSULTANT:	
CDM SMITH, INC.	
By:	
Its:	



MEMORANDUM

To: Dave Corliss, Town Manager

Thru: Mark Marlowe, P.E., Director of Castle Rock Water

From: Tim Friday, Assistant Director

Mark Billman, EHS Program Manager

Date: May 8, 2019

Title: Professional Services Agreement with CDM Smith for On-Call Water Quality

Consulting Services

Executive Summary

The purpose of this memo is to request Town Manager approval of a Services Agreement with CDM Smith to provide 2019 On-Call Water Quality Consulting Services (see *Attachment 1*). The scope of work generally will include providing expertise in water quality consulting with emphasis on reuse water and contaminants of emerging concern, and mixing of different water supplies (imported, surface water, reuse water, groundwater, etc.) and the resulting impacts on corrosion control, regulatory limits and aesthetics.

The total scope of this agreement is not to exceed \$50,000. Individual task orders will be issued on an as-needed basis for services. Work will begin May 2019 and continue through December 2019.

Discussion

Castle Rock Water, through a competitive Request for Proposals (RFP) process, solicited proposals from three nationally recognized water quality consulting firms: CDM Smith, HDR, Inc. and Jacobs Engineering. CDM Smith rose to the top as the recommended firm to engage in an on-call contract for 2019 with the option to renew for two successive years. CDM Smith is an employee-owned consulting firm providing integrated solutions in water, environment, transportation, energy, and facilities. CDM Smith specializes in water supply, water and wastewater treatment, hydraulic modeling, comprehensive facility planning, and water quality assessment. The CDM Smith Team will provide the credible, national expertise to support Castle Rock Water's drinking water program, giving guidance and peace of mind that we are doing the right thing for now and in the future.

CDM Smith has been a pioneer in the implementation of potable reuse; from design of the world-renowned Orange County Groundwater Replenishment System, to the support of potable reuse programs in Singapore, Australia, and Kuwait. They understand the unique challenges of developing a potable reuse program that is safe, reliable, and supported by both regulators and the community as a whole. CDM Smith experts supported the USEPA in developing a supplemental document to their Guidelines for Water Reuse that surveys the state of potable water reuse in the United States. The document focuses on summarizing federal laws affecting potable reuse and state regulatory frameworks for potable reuse; highlighting opportunities, challenges, and trends in potable reuse; and potable reuse applications, treatment technologies, research results, and case studies.

The recommendation to retain CDM Smith as Castle Rock Water's water quality expert is based on a qualitative review of all proposals followed by face-to-face interviews with each consultant team.

Budget Impact

The work that CDM Smith will perform over the course of the year will be paid from the 2019 Regulatory and Water Quality Compliance Division professional services account 210-4263-442.30-70 not to exceed \$50,000. This account has an available balance of approximately \$24,000; however, it is earmarked for other professional services. Therefore, a budget transfer will be needed to cover the additional \$50,000 to fund this contract. The transfer will come from account 210-4275-442.77-51 - Canyons South Red Zone Extension. Individual task orders will be developed for each item of work and will be coded to this account.

<u>Attachments</u>

Attachment 1 – Town of Castle Rock Services Agreement to Provide On-Call Water Quality Consulting Services



AGREEMENT & CONTRACT ROUTING FORM

TI	TLE On-Call Water Quality Consulting	Services DEPT Water
VE	NDOR CDM Smith	DATE 5 8 19
	Department Signatures	Contract for Capital Project?
1,	Supervisor/Requesting Employee Signature	Contract signed by Vendor Date 5/8/19
2.	Assistant Director Signature 7.7. Fuday	Date 5/8/19
3.	Department Director Signature	Date 5/13/19
4.	Other Department Director (Budget impacts another department	t OR it involves IT)
	Signature	Date
5.	Submit to Robbie Schonher/Town Clerk's Office	
 7. 	LEGAL Signature FINANCE	
	Budget & GL Account Approved A GL Account Correction	
	Analyst Signature 1	Date
	Director Signature Multiple	Date
8.	Signature May for D. COVISS	Date 5 21119
9.	TOWN CLERK Signature SusaAnderson	Date 5-21-19



Finance Director

Date: 5/17/19	
From: Trish Muller, Finance Dept.	
Re: Contract Signing Authority	
I will be out of the office $\frac{5/17 - 5/21}{4}$	
In my absence, <u>Michael Tempel</u> have authority to sign on my behalf.	will be Acting Director and will



Date: May 17, 2019

From: David L. Corliss, Town Manager

Re: Contract Signing Authority

I will be out from May 18-27, 2019.

In my absence, Kristin Zagurski will be Acting Town Manager and will have authority to sign on my behalf.

David L. Corliss, Town Manager