



This project is being funded through the Solicited Research Program's Nutrients Challenge Area (NUTR), which enables WRF to solve broadly relevant subscriber issues and challenges with targeted, sustained research efforts.

The objectives of the NUTR challenge are to develop and share credible scientific information about nitrogen and phosphorus in wastewater to help regulators and permittees make informed decisions; and to better understand existing mechanisms of nutrient removal and recovery, best available technologies, and practical limits.

Solicited Research Request for Proposals (RFP)

Guidelines for Optimizing Nutrient Removal Plant Performance (RFP #4973)

Project Objective

Building on existing work, the objective of this project is to develop updated guidelines for optimizing nutrient removal plant performance. This will be accomplished through additional research or demonstration and from documented performance for nitrogen and phosphorus removal through the use of tools such as operational best practices, online instrumentation, control capabilities, model-based controls, and smart systems (research and LIFT).

Budget

Proposals may request WRF funds up to \$130,000. WRF funds requested and total project value will be criteria considered in the proposal selection process. This project requires at least a 35% in-kind match from the Principal Investigator and partners.

Estimated Duration

This project is expected to take 12 to 18 months.

Background

One of the most pressing water quality challenges utilities face is nutrient removal. WRF's Nutrient Removal Challenge (2007-2018) conducted 44 studies on nutrient characterization and cost-effective processes to meet nutrient limits, assessing technology performance and evaluating environmental impacts (Neethling et al. forthcoming). Research shows that efficient biological treatment, chemical addition, and solids separation are necessary in order to achieve secondary and tertiary nutrient levels.

Thus, operational guidelines for performance optimization and ensuring the stability of nutrient removal processes are becoming increasingly important. This guidance is particularly needed for plants that are looking to meet very low effluent nutrient concentrations. Facilities that seek to implement advanced approaches and technologies such as short-cut nitrogen removal, sidestream treatment, carbon redirection (which can impact carbon to nitrogen and carbon to phosphorus ratios, as well as energy recovery), advanced solids fermentation, and certain treatment processes for resource recovery purposes will also benefit from this guidance.

Due to the rapid pace of instrumentation advances, there is an opportunity to monitor critical operating parameters for optimization. Several new instrumentation technologies have been researched, but that research has not been completed to a level where these new technologies can be implemented on a full scale. Therefore, there is a need to investigate how big data and information on existing experiences with the implementation and development of model predictive controls should be collected, systematized, and used to suggest what kind of adaptive control can be used at various specific facilities and infrastructure systems, and what the potential benefits could be.

The results of this research should be presented as a set of guidelines for both facility operators and design engineers. These guidelines will expedite the use of advanced technologies and can help reduce energy and chemical consumption and better manage the impact of carbon diversion on resource recovery.

Research Approach

An ideal research approach will recognize the various strategies for optimizing systems for nutrient removal (and recovery) and explore a range of these methods. This may include, but is not limited to: 1) instrument-based optimization, including the most efficient location of instrumentation; 2) advanced online sensors; 3) the impact of optimizing energy recovery (i.e., carbon redirection); and 4) the use of modeling tools.

Rather than performing a pilot study, this research should analyze extensive data collected via a literature review and conduct a suitable number of face-to-face workshops where operators share their needs, experiences, etc. with optimizing nutrient removal at their plants. Nutrient removal experts should participate in these workshops to help the utilities, particularly smaller facilities, learn about nutrient management opportunities and strategies. The workshops should gather information on what issues plants are dealing with; identify trends across facility size, regional location, and/or other specified parameters; develop recommendations to help set guidelines; and identify gaps for future research.

Proposals should clearly describe the types of facilities that will be invited to the workshops. This investigation should recognize that not all plants are alike. A broad range of regional representation, facility sizes, and facility types in the research and at the workshops is important. Considerations may include:

- *Facility size.* Plant size and resources can impact the approach to nutrient management, as well as the selection and installation of technologies to improve nutrient removal. In addition to large facilities, attention should be focused on small to medium sized plants. According to the 2012 Clean Watersheds Needs Survey, almost 80% of centralized wastewater treatment and collection facilities across the nation are small to mid-sized. Proposers should be prepared to present guidelines that are applicable to facilities of a wide variety of scales in urban, suburban, and rural settings.
- *Treatment types.* Proposers should determine where to focus, but may want to consider the broadest range of treatment facilities, which could include smaller and less complex processes such as lagoons and treatment ponds, BNR, etc. These treatment systems are currently in practice at more than 50% of wastewater treatment plants in the U.S.
- *Broad range of scenarios.* Proposals should recognize and explore the various driving forces behind the optimization of nutrient removal, as well as the ways in which this may influence approaches to, and guidelines for, optimization. Important scenarios to consider may include:
 1. Timeframe for optimization: “low-hanging fruit” strategies to meet compliance.

2. Optimization of nutrient removal that sets utilities up for future potential to incorporate nutrient recovery.
3. Balancing competing drivers and needs at a facility (e.g., nutrient removal, energy management, etc.).
4. Others as proposing teams see fit.

In order to achieve the objectives, proposers are expected, at a minimum, to:

- Review and investigate existing literature on best practices, in order to inform the content of the workshops.
- Conduct a series of regional workshops with utility operators and industry experts to identify and vet information to be incorporated into the guidelines and provide information sharing and training for workshop participants.
- Identify gaps and additional research needs to accelerate the adoption of technologies and practices for successful nutrient removal at facilities of varying sizes.
- Identify regulatory barriers and how to achieve optimized performance.
- Develop guidelines based on reviewed materials and operator experience, which could include and consider:
 - Determine operating parameters and control setpoints for optimal performance of existing facilities under existing conditions
 - Select suitable online instruments, installed locations, and control logic for optimal performance
 - Select and use suitable process models to optimize the plant
 - Identify low cost upgrades to existing facilities to improve performance

Deliverables

When considering the schedule and budget, the proposers should take into account the following required deliverables:

- *Quarterly progress reports*
- *Literature review* – See “Resources and References” for more information.
- *Workshop summary report* – Proposers should include a preliminary agenda and breakdown of the workshop costs in the proposal. The WRF project manager will work with the project team to organize the workshops, which can be held in conjunction with events hosted by entities such as the Water Environment Federation (WEF), WEF Member Associations, etc. Essentially, the report should be brief and cover findings, analyze common themes, highlight lessons learned, and identify future research needs.
- *Guidelines* – This is the bulk of the project’s outputs and the most important deliverable. It should include key findings from the workshops. Education and training for end-users is an end-goal of this project. To ensure the most efficient use of equipment and to advance nutrient removal, guidelines should be developed with a mindset of how they will ultimately be used. A good example of guidelines utilities can use can be found in WRF project ENER1C12, through which Tarallo et al. (2015) produced diagrams showing how various energy flow configurations and scenarios can impact overall plant performance. The guidelines should have built in flexibility in order to adapt and respond to changing technologies and improvements for operation efficiencies. They should also include cost estimations for proposed instrumentation and process improvements, including the appropriate level of staff training needed to effectively operate the proposed processes.

Proposers are encouraged, but not required, to consider other valuable outputs for this work. Examples of such deliverables include:

- Boilerplate training materials customizable to regions or utility size.
- Filling in gaps of WEF Manuals of Practice (MOP) in the guidelines document.
- Proposing workshops for WEFTEC, WEF Nutrients specialty conference, regional workshops, etc.

Resources and References

A strong proposal will leverage pre-existing information to build a robust set of guidelines based on existing work, while advancing the industry to the next level. Therefore, proposers should be aware of these and other resources.

- Brown, J.; Davies, G.; Jeyanayagam, S.; Smith, R.; and Tsuchihashi, R. 2009. *Operation and Control of BNR Facilities – Compendium Document*. Project No. NUTR1R06g. The Water Research Foundation: Alexandria, VA.
- Connor, T., and K. Dowell. 2015. *Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reduction at Wastewater Treatment Plants*. United States Environmental Protection Agency (USEPA): Washington, DC. <https://www.epa.gov/nutrient-policy-data/case-studies-implementing-low-cost-modifications-improve-nutrient-reduction>.
- Hill, R. 2010. *Optimizing Biotreatment: Integrated Process Models and Control Strategies*. Project No. 03-CTS-11. Water Environment Research Foundation: Alexandria, VA.
- Neethling, J.B.; Clark, D.; Stensel, H.D.; Sandino, J.; and R. Tsuchihashi. Forthcoming. *Nutrient Removal Challenge Synthesis Report*. Project No. NUTR5R14g. The Water Research Foundation: Alexandria, VA.
- Palmer, T.M.; Nutt, S.G.; and Kharkar, S. 2007. *On-Line Nitrogen Monitoring and Control Strategies*. Project No. 03-CTS-8. Water Environment Research Foundation: Alexandria, VA.
- Tarallo, S.; Shaw, An.; Kohl, P.; and Eschborn, R. 2015. *A Guide to Net-Zero Energy Solutions for Water Resource Recovery Facilities*. Project No. ENER1C12. Water Environment Research Foundation: Alexandria, VA.
- Tsuchihashi, R. 2015. *BNR Process Monitoring and Control with Online Nitrogen Analyzers for Nitrogen Credit Exchange Program in Connecticut*. Project No. NUTR1R06y. Water Environment Research Foundation: Alexandria, VA.
- Water Environment Federation. 2015. *Shortcut Nitrogen Removal – Nitrite Shunt and Deammonification*. WEF and Water Environment Research Foundation: Alexandria, VA.
- Weaver, G. 2018. *Lean, Mean Operational Excellence Machine*. WE&T, (Volume 30 Number 6), pp.40-43.

Selection Process and Criteria

Selection of proposals is a very competitive process. Proposals will be reviewed by WRF and the Project Advisory Committee. This external review team may be complemented as needed by subject matter experts. As part of the evaluation process, WRF reserves the right to request interviews, either via conference call or in person, with qualified proposers if necessary.

Proposers are encouraged to develop and submit their intended research plan that meets the research goals of this RFP, provide sufficient details of their budget, as well as schedules and milestones that can successfully deliver on the stated research goals, objectives, and tasks that are proposed.

WRF will evaluate proposals on the following components:

- **Understanding the Problem and Responsiveness to RFP (20%)**
Does the proposal adequately explain the problem? Does it reflect knowledge of the issue and how solving the problem will benefit the water industry? Have the RFP objectives been adequately addressed? If proposed objectives differ from the RFP, do stated objectives address current or future needs of the water industry? Are data quality objectives specified?
- **Technical Approach and Scientific Merit (20%)**
Is the proposal prepared with supportive information and is it self-explanatory and clearly understandable? Is the proposed effort technically defensible? Is the approach practical? Can the project objectives be achieved in the stated time period with the allotted personnel and budget?
- **Management and Communication Plans (25%)**
Communications and outreach is essential in this project, given the research approach with regional workshops. Does the proposal specify a clear path for establishing and facilitating workshops in a meaningful way? How will operators be engaged? Are the roles, responsibilities, and assignments clear? Do the supporting organizations on the team have complementary skills? Does the lead organization have adequate resources to provide the appropriate level of management, oversight, and project implementation? Is the Quality Assurance/Quality Plan acceptable? Are schedules and deliverables clearly defined?
- **Budget and Schedule (15%)**
Is the budget within the advertised budget for the project? Has the applicant provided appropriate (at least 35%) and significant in-kind contributions to the project? Is the level of effort allocated to each task logical? Is the Indirect Cost Rate reasonable (35% or less is competitive) and has it been detailed in the proposal? Is the schedule realistic? Do the proposed budget and schedule match funding needs to milestones and demonstrate the value of the research relative to the proposed cost?
- **Qualifications of Organization and Key Personnel (20%)**
Does the lead organization demonstrate experience and expertise in the issues and objectives discussed in the RFP? Do the key project personnel have experience in the proposed area of research? Have key personnel committed an appropriate amount of time to the project? Are water and wastewater agencies involved? Does the proposed team include demonstrated experience in designing and facilitating workshops?

Proposal Preparation Instructions

Proposals submitted in response to this RFP must be prepared in accordance with The Water Research Foundation's document *Guidelines for Focus Area Program Proposals*. These Guidelines are applied to the Solicited program as well. The most current version of these guidelines is available at:

<http://www.waterrf.org/funding/ProposalDocuments/GuidelinesForFocusAreaProgramProposals.pdf>.

The guidelines contain instructions for the technical aspects, financial statements, and administrative requirements that the applicant must follow when preparing a proposal.

Please note that the selection criteria listed here are different from those listed in the Guidelines for Focus Area Program Proposals document. The selection criteria in this RFP will be used to evaluate the proposal.

Eligibility to Submit Proposals

This RFP solicits proposals from all technically qualified applicants, including educational institutions, research organizations, federal or state agencies, municipalities, and consultants or other for-profit entities.

WRF's Board of Directors has established a Timeliness Policy that addresses researcher adherence to the project schedule. The policy can be reviewed at <http://www.waterrf.org/funding/Pages/policies.aspx>. Researchers who are late on any ongoing WRF-sponsored studies without an approved no-cost extension are not eligible to be a named participant in any proposal. If you have any questions about your eligibility for WRF projects, please contact the WRF research staff listed at the bottom of this RFP.

Administrative, Cost, and Audit Standards

WRF's Solicited Research Program standards for administrative, cost, and audit compliance are based upon, and comply with, Office of Management and Budget Uniform Grants Guidance, 2 CFR Part 200 Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, and 48 CFR 31.2 Contracts with Commercial Organizations. These standards are referenced in the WRF's *Guidelines for Focus Area Program Proposals*, and include specific guidelines outlining the requirements for indirect cost negotiation agreements; financial statements; and the Statement of Direct Labor, Fringe Benefits and General Overhead. Inclusion of indirect costs must be substantiated by a negotiated agreement or appropriate Statement of Direct Labor, Fringe Benefits and General Overhead. Well in advance of preparing the proposal, your financial staff should review the detailed instructions included in WRF's annually released *Guidelines for Focus Area Program Proposals*.

Budget and Funding Information

The funding available from WRF for this project is up to \$130,000. A minimum of 35 percent of the total project value must be contributed by the applicant (i.e., the applicant's minimum contribution must equal one-third of WRF funds requested). Acceptable forms of applicant contribution include cost-share, applicant in-kind, or third-party in-kind that comply with 2 CFR Part 200.306 cost sharing or matching. The applicant may elect to contribute more than 35 percent to the project, but the maximum WRF funding available remains fixed at \$130,000. **Proposals that do not meet the minimum match of 35 percent of the total project value will not be accepted.**

Period of Performance

The proposed project schedule should be realistic, allowing ample time for the preparation of final reports and for review of project results. It is WRF's policy to negotiate a reasonable schedule for each research project. Once this schedule is established, WRF and its sub-recipients have a contractual obligation to adhere to the agreed-upon schedule. Under WRF's No-Cost Extension Policy, a project schedule cannot be extended more than nine months beyond the original contracted schedule, regardless of the number of extensions granted. The policy can be reviewed at <http://www.waterrf.org/funding/Pages/policies.aspx>.

Utility and Organization Participation

WRF is especially interested in receiving proposals that include both participation and contribution of resources from water utilities and organizations in the research effort. Information on utilities and/or organizations that have indicated an interest in participating in this research project are listed on the last page of this RFP. While WRF makes utility and organization participation volunteers known to applicants, it is the applicant's responsibility to negotiate utility and organization participation in their particular proposal, and the utilities and/or organizations are under no obligation to participate.

Application Procedure and Deadline

Proposals are now being accepted exclusively online in PDF format. Proposals must be submitted before 2:00 PM Mountain Time, Wednesday, February 27, 2018. All the forms and components of the proposal are available online in the "Proposal Component Packet" zip file. A login is required to download this packet and use the proposal website. *If you have never logged in to WRF's proposal submission system, it is imperative you request a login as soon as possible. It may take up to 48-hours to provide credentials to new users.* This information is available at <https://proposals.waterrf.org/Pages/RFPs.aspx>.

The online proposal system allows submission of your documents until the date and time stated in the RFP. To avoid the risk of the system closing before you press the submit button, do not wait until the last minute to complete your submission.

Questions to clarify the intent of this Request for Proposals and WRF's administrative, cost, and financial requirements may be addressed to the Program Director, Christine Radke, at (571) 384-2106 or by email at cradke@waterrf.org.

UTILITY AND ORGANIZATION PARTICIPANTS

To date, no utilities have indicated an interest in participating in this research. As utilities express interest, their information will be added below within 24 business hours of receipt of a volunteer form, and this RFP will be re-posted with the new information. **(Depending upon your settings, you may need to click refresh on your browser to load the latest file.)**

Adam Hendricks

Research Program Supervisor
Philadelphia Water Department
1101 Market Street
Philadelphia, PA 19107
USA
(215) 685-6323
adam.hendricks@phila.gov

Robert Bocarro

Deputy Commissioner
City of Atlanta Dept of Watershed Management
72 Marietta St, NW
Atlanta, GA 30303
USA
(404) 546-3229
rbocarro@atlantaga.gov