Proposal for

Regulatory Upgrade and Process Improvement Project Appleton Water Treatment Facility

October 2012

Submitted to

City of Appleton
Utilities Department Water Treatment Division

CH2MHILL®

CH2M HILL
135 South 84th Street
Milwaukee, WI
53214
Tel 414.272.2426
Fax 414.272.4408

Mr. Chris Shaw—Director of Utilities
Appleton Water Treatment Facility
2281 Manitowoc Road
Menasha, WI 54952

Dear Mr. Shaw:

Appleton's Regulatory Upgrade and Process Improvement Project is an important and complex project. Prior to membrane removal, the new processes must work effectively so you can continue to deliver your customers high quality water and meet regulations. Meeting the tight schedule while focusing on optimizing treatment, design details, and construction sequencing will ensure Appleton realizes significant and timely cost savings. CH2M HILL's design, operations, and constructability staff will collaborate to help you efficiently achieve these goals. We offer the following attributes to consider when selecting your consultant:

- **Proven experience with water utilities similar to and near Appleton assures we efficiently design systems that work.** CH2M HILL has an outstanding track record in Wisconsin helping utilities such as Northshore Water Commission (Glendale), Oshkosh, Milwaukee, and Oak Creek solve similar water treatment and cost issues. We tailor our designs to meet each plant's unique needs and work closely with WDNR to ensure compliance with new and future regulations. Touring some of these sites would be an excellent way for your staff to see how various plants are operated and to hear about our hands-on training. We would be happy to set up site visits and encourage you to call our references, provided herein.
- **A Project Manager who is a global water treatment expert will ensure excellent plant performance**. Before removing the membrane assets, the other treatment processes must work effectively to continue producing excellent water. Tony Myers is a local project manager who is considered a global expert in ultraviolet (UV) disinfection, lime softening, and filtration. Putting a proven project manager, who is also a skilled water treatment expert, at the helm of this project ensures that the City has a leader with the experience necessary to quickly gather and interpret relevant data and guide the team from concept to detailed designs and through construction and operations to assure high quality reliable water is delivered.
- **Operations Specialists who will help Appleton optimize operations and lower operating costs.** Our team includes UV and filter operations experts who will engage in the design and QC process for selecting proper equipment, and operations staff who specialize in training and optimization.
- **Local, reliable engineering team will be attentive to Appleton's needs and exceed your delivery expectations.** Our Milwaukee-based team includes water treatment experts and all design disciplines who have worked together for over 20 years. This means a high quality, customized project delivered on time and with great efficiency, and a team that will be with you from design through startup, training, and beyond.

We have carefully reviewed the RFP and the project components described therein. Additional scope components that the City may wish to consider include:

1. Your O&M manual will be updated with equipment and operating procedures for the process improvements. Many utilities are going to computerized O&M manuals that can incorporate all this information, plus link to design, construction, and training information for a comprehensive source of information from your SCADA screens that is easy to update.
2. Touring other water plants so operators and managers can discuss similar issues with their peers is a valuable effort that increases knowledge and helps ensure good decisions are made. It also promotes training and knowledge development. An optional task would be to visit three water plants near Appleton during the preliminary design when the most important decisions are made. Potential plants include:
    a. Northshore Water Commission—Similar size UV facility integrated into the existing plant with a low lift pump station.
    b. Oak Creek Water Plant—Filter improvements, SCADA programming for WDNR reporting, demonstration testing for higher capacity.

c. Oshkosh Water Plant—Chlorine disinfection CT basin, chemical feed improvements, SCADA improvements, and training to integrate new disinfection system.

3. Decommissioning membranes is an integral part of our scope considerations for demonstration testing, design, and construction sequencing. The physical removal of the membranes is not in the contractor's scope at this time because of unknowns in the timing of this work and WDNR approvals, plus the benefit of having membranes as a backup treatment process during construction. As the project progresses, and if removal of the membrane equipment by the contractor appears to be beneficial, demolition of these facilities can be added to the construction contract. Alternatively, a separate demolition contract could be developed so that specialists in this work are attracted and lower bids may be received.
4. SCADA improvements will be carefully determined with Appleton staff and the scope incorporated into the construction documents. CH2M HILL has the capability to program SCADA systems directly and eliminate a SCADA integrator. This may save money and time in the overall design and construction process.

The terms and conditions included with the RFP are reasonable, and the listed insurance requirements are acceptable. We would recommend the indemnification clause provide for the contractor to be responsible to the proportionate extent of their fault. As requested in the RFP, we have attached our standard form of agreement for your consideration (Appendix). The principal for this project is Kurt Hellermann, Vice President, who is in our Milwaukee office. Kurt has authority to negotiate and execute the agreement with the City of Appleton on behalf of CH2MHILL, and he will also lead our Bidding Phase and Contract Administration Services.

Our Milwaukee-based team will deliver this project while paying close attention to Appleton's needs, with a foundation of local knowledge and best-in-industry water treatment understanding. This core team has worked together for over 20 years and has delivered UV disinfection, lime softening, filtration, and process controls work for many utilities in Wisconsin and throughout North America. Finding and implementing solutions to the technical challenges our clients face is what we are most passionate about.

We have described our experience throughout this proposal; however, the best way to choose the team that will deliver the highest quality facility with the best service and support is for you to contact utilities that have completed similar projects. We urge you to contact our references and talk with other water utility managers, engineers, and operators with whom we have worked, such as:

Oshkosh WI—Mr. Steve Brand—Superintendent of Utilities
Recent project for a chlorine contact tank, chemical feed improvements, disinfection training.
Phone: 920-232-5366
Email: sbrand@ci.oshkosh.wi.us

Oak Creek Water and Sewer Utility—Mr. Mike Sullivan—Utility Engineer, incoming General Manager
Two plant expansions (1999 and 2010), filter and SCADA improvements, demonstration testing for capacity.
Phone: 414-570-8200, ext. 19
Email: msullivan@water.oak-creek.wi.us

North Shore Water Commission—Mr. Eric Kiefer—Water Plant Manager
18 mgd UV disinfection system integrated inside existing plant and using existing low lift pumps.
Phone: (414) 963-0160
Email: EKiefer@northshorewc.com

St. Paul Regional Water Services—Jim Bode—Water Quality Manager
Upgraded filters to biological GAC filters, SCADA improvements, disinfection chemical and CT improvements.
Phone: 651-266-1651
Email: james.bode@ci.stpaul.mn.us

We look forward to talking with you about this proposal, and especially about working with you to deliver a successful project for you and your water customers. If you have any questions, please feel free to contact Tony Myers (414.469.7682) or Kurt Hellermann (414.847.0401). We are committed to providing quality services that deliver your new facilities on time, exceed your expectations, and help the Appleton water utility maintain its high standards and excellent service.

Sincerely,

Kurt Hellermann, PE
Principal-in-Charge

Tony Myers, PE
Project Manager

Executive Summary

Introduction

Appleton has a proud history of supplying high quality drinking water and excellent customer service. Appleton is going to fundamentally change treatment processes by upgrading GAC contactors to filters, adding UV disinfection, improving pretreatment and chemical systems, and decommissioning membranes.

Understanding the complex nature of the needed upgrades, Appleton wisely invested in planning this project, starting with the formation of a Technical Advisory Group. We have reviewed the recommendations and believe they are sound.

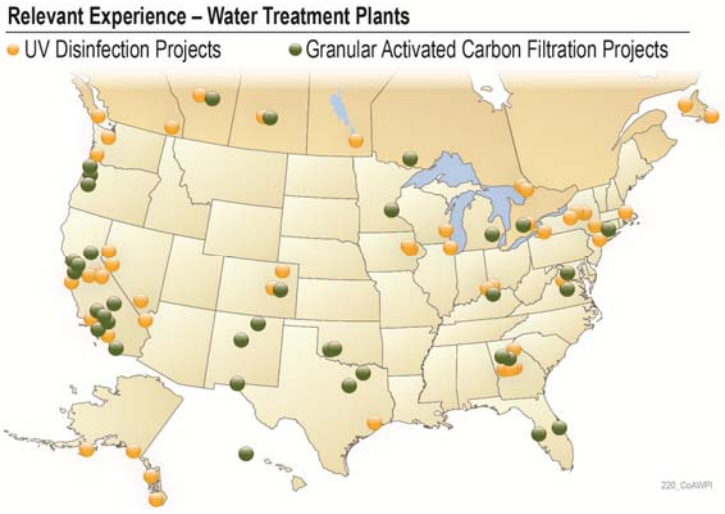
To carry this project to successful completion and realize the benefits, Appleton needs a consultant with:

- A proven project manager who understands complex water treatment technology, water plant retrofits, and meeting schedule and budget goals.
- A reliable, seasoned team that can accomplish all tasks from a local base office.
- Successful experience on similar projects.

Firm

CH2M HILL is a full-service engineering, consulting, construction, and operations firm with more than 30,000 employees worldwide. Drinking water treatment is our core service, and Milwaukee is our Midwest water treatment plant design center, from which we have delivered many similar projects.

As a leader in UV disinfection and GAC filtration, we have completed many projects in the Midwest and around the world.



Project Team

Our project team is led by **project manager Tony Myers, a global water treatment expert** with extensive experience in all the treatment technologies Appleton will use. Tony served as project manager or lead engineer on all of CH2M HILL's Midwest drinking water projects and has nearly 30 years of experience. He has upgraded over 20 lime softening plants, multiple UV systems, and GAC and filtration improvements at many surface water plants. He will ensure our team focuses on the important details that will result in a project that meets goals for water quality, schedule, and budget, as well as lowers Appleton's operating costs. Furthermore, he brings excellent relationships and a successful track record with WDNR to foster timely approvals.

Our Milwaukee-based team will be highly responsive to Appleton's needs and meet the tight schedule. Tony is supported by a strong, multi-discipline design team in Milwaukee who have worked together for over 20 years on similar projects. **Linda Mohr,** quality control manager, has over 26 years of experience on water treatment projects with lime softening, GAC filters, and UV disinfection. She served as the quality manager for CH2M HILL's Eastern Region. **Jack Knight,** SCADA/I&C design, combines water plant knowledge with SCADA expertise to provide practical systems that work for operators. He recently designed a SCADA system in Grand Chute and Oak Creek, with many useful operational features. **Kurt Hellermann** has over 30 years of construction management expertise and has successfully managed construction of many water

plants in Wisconsin and around the world. Our team includes world class experts, such as **Paul Swaim**, current president of the international UV Association, **Dr. Vern Snoeyink**, a lime softening and GAC expert, and **Dr. Russell Ford**, a filter expert. Our team also has operations specialists, such as **Dave Porter,** who will help Appleton train operators, optimize operations, and lower operating costs.

A few similar projects that this team has recently successfully completed are described below. ***We urge you to contact these water utilities and ask them what they think of the CH2M HILL team.***

- **Northshore Water Commission, Glendale, WI**—Integrated UV disinfection into a similar-sized plant.
- **Oshkosh, WI**—Chlorine and chloramine improvements to meet disinfection regulations and WDNR requirements.
- **Oak Creek, WI**—Two water plant expansions, filter optimization, and SCADA improvements.
- **St. Paul, MN**—GAC filter upgrades before lime softening, SCADA improvements, disinfection improvements.

Project Understanding

To continue producing high quality water, it is essential that the GAC contactors operate as filters and become the main particle removal barrier. The key to good filter operation is good pretreatment before the water gets to the filters. The CH2M HILL team has worked with over 20 lime softening plants to improve and optimize filter performance. We will bring that knowledge to Appleton and work with your staff and WDNR to prove performance through demonstration testing. We recently completed a successful filter demonstration test in Oak Creek that resulted in expanded capacity at no capital cost.

Chlorine disinfection will be much more important for water quality without membranes. We have ideas to improve chlorine disinfection while saving money and time.

UV disinfection will be a new process for Appleton. No one has more UV experience than CH2M HILL. We have successfully incorporated UV in many existing water plants in the Midwest and around the world. Our concepts to integrate UV while keeping the water plant operational are proven and approved by WDNR.

UV System in Glendale, WI

All these improvements will be integrated into the plant SCADA computer system for ease of operation. Features that we implemented into the Oak Creek filters for the EPA Partnership for Safe Water program are highlighted herein for Appleton to consider. Our operations experts will work with Appleton staff so they understand the new treatment and are comfortable operating it.

Schedule

Our schedule indicates completion in 2014, by working closely with Appleton and WDNR. Successful demonstration testing is critical to project schedule and we have integrated this testing with design and construction activities to accelerate the schedule, yet provide WDNR with adequate data for approval. Our plan is to complete filter and disinfection improvements first so the plant can meet regulations without membranes or UV. This will maintain high quality water and reduce operational challenges during construction and membrane decommissioning.

Summary

CH2M HILL offers the following essential features to carry this project to successful completion and realize the benefits:

- A local project manager who is a global water treatment expert and has completed many similar Wisconsin projects.
- A Wisconsin-based team with all the services needed and over 20 years of reliable performance.
- A track record of success in Wisconsin. Please call our references to discuss how we have successfully completed similar projects.

Description of Firm

CH2M HILL Water Treatment Qualifications

Established in 1946, CH2M HILL is a global leader in full-service engineering, consulting, construction, and operations for public and private clients. With more than 30,000 employees working in 200 offices worldwide—we are recognized for delivery of innovative, practical, sustainable solutions—helping clients develop and manage infrastructure and facilities that improve efficiency, safety, and quality of life. Drinking water treatment is our core service, and we were named **Water Company of the Year** by Global Water Intelligence in 2012. When our clients face uncertainties in water quality, regulatory compliance, and treatment design requirements, we collaborate with them to provide facilities with the flexibility to cost-effectively operate over a broad range of conditions.

Milwaukee is our Midwest water treatment plant design center, and home to nearly 200 professionals with extensive experience in all aspects of water treatment plant study, design, construction, and operations.

Our design team is Milwaukee-based and has been working together for over 20 years on many water plant projects similar to yours.

Our proposed project manager, **Tony Myers**, has managed most of these water plant projects. Tony is a Global Drinking Water Technologist and is dedicated to bringing the right resources to the City of Appleton's treatment and operations.

CH2M HILL also has an operations group of licensed operators specializing in drinking water treatment and operator training.

Leading the Way in Applied Treatment Technology

CH2M HILL invests in research and innovation to continuously expand knowledge in drinking water treatment technology. We take pride in working with our clients to bring into full-scale application treatment solutions that have been proven through extensive research, pilot, and demonstration projects. The following are some of our innovations:

- Invention of tri-media filtration
- First operational UV system for virus inactivation under LT2ESWTR (Cedar Rapids, Iowa)
- First permitted UV system for *Cryptosporidium* inactivation on surface water
- First lime softening plant to obtain virus inactivation credit (Cedar Rapids, Iowa)
- First use of liquid oxygen for ozone production
- Designed and patented upflow GAC contact adsorption clarifier
- Developed Integrated Disinfection Design Framework to evaluate disinfection application for emerging pathogens

UV Disinfection and GAC Filtration Qualifications

CH2M HILL brings industry-leading experience that includes more than 40 ultraviolet light (UV) disinfection drinking water projects in North America. We have been directly involved with the engineering of UV disinfection facilities for municipal drinking water supplies since 1999, shortly after UV disinfection was first found to provide effective treatment of *Cryptosporidium* and *Giardia*. We have designed systems using equipment from all major suppliers of UV equipment, including Trojan, Calgon, and Wedeco.

Beyond planning and design of these UV facilities, we bring unique experience in UV system commissioning and startup. As part of a joint venture, we led the startup and operation of the largest UV system in the world the 2-bgd Catskill Delaware (Cat-Del) UV system for the New York City Department of Environmental Protection. We designed, constructed, and now operate the award winning 180 mgd Cedar Treatment Facility in Seattle. Our senior reviewer Paul Swaim, President of the International UV Association and Todd Elliot (lead designer) worked on both of these projects.

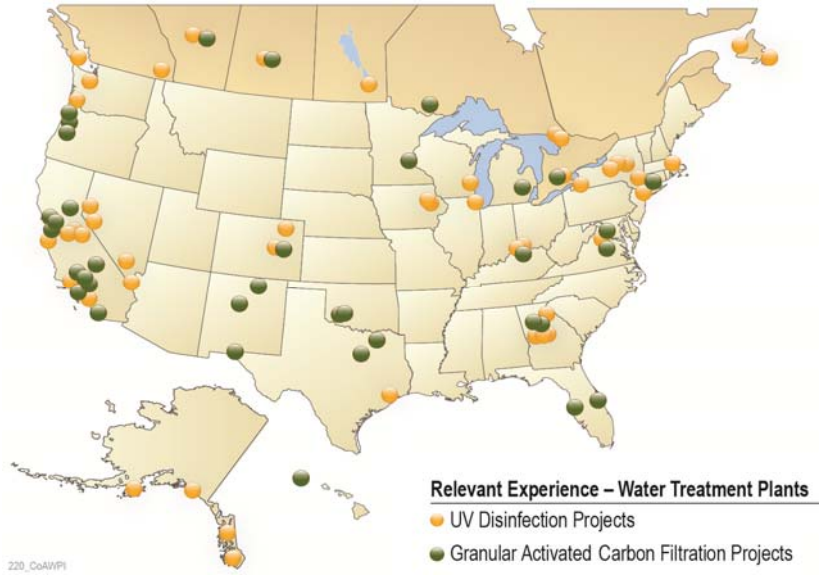
The illustration shows some of the different types of UV systems that we have recently designed.

Examples of CH2M HILL UV System Design

Trojan SWIFT 10L30 in Cedar Rapids, IA (2 WTPs totaling 82 mgd)	Wedeco K143 12/5 in Clayton County, GA (3 WTPs totaling 49 mgd)	Calgon SENTINEL 9L48 in Winnipeg, MB, Canada (2 WTPs totaling 64 mgd)
		

We are also a leader in GAC applications for drinking water, with over 20 GAC water treatment plants treating nearly 1.5 bgd. We have integrated GAC into existing plants, and combined GAC with other treatment technologies such as lime softening, ozone, and UV to best meet our clients' water quality and operational goals. Our nationwide experience in the design of UV disinfection systems and GAC treatment systems are highlighted in Map below.

Map of UV Disinfection and GAC Projects at Drinking Water Plants



Our experience includes preliminary design, design, construction management, and startup. Each plant is different and water quality varies. Our approach leverages the knowledge of our expert technologists and our operations staff to tailor designs for excellent plant performance at the lowest operating costs.

Midwest Water Treatment Plant Project Experience

Proven experience with water plants similar to the City of Appleton's assures we efficiently design systems that work.

CH2M HILL has an outstanding track record helping utilities in Wisconsin solve similar water treatment and regulatory issues. Most of our core team members worked on the projects described in the following subsections, which include rehabilitation of existing plants, incorporation of advanced treatment technologies, and capacity expansion. We tailor our designs to meet each plant's unique needs, work closely with WDNR to ensure compliance with new and future regulations, and conduct thorough training on new systems. We encourage you to call our references, provided herein, as you select your consultant for this important and complex project.

Northshore Water Commission, Glendale Wisconsin

The North Shore Water Commission (NSWC) recognized the public health risk posed by pathogens and disinfection byproducts in drinking water as a critical issue. To prepare for compliance with the LT2ESWTR Rule and Stage 2 Disinfection Byproducts Rule, the NSWC hired CH2M HILL to design, startup, and train operations staff on a new UV light disinfection system to provide an additional barrier to pathogens. CH2M HILL staff incorporated UV into the 18-mgd surface water treatment plant and used existing low-lift pumps to design an innovative recirculation system to achieve

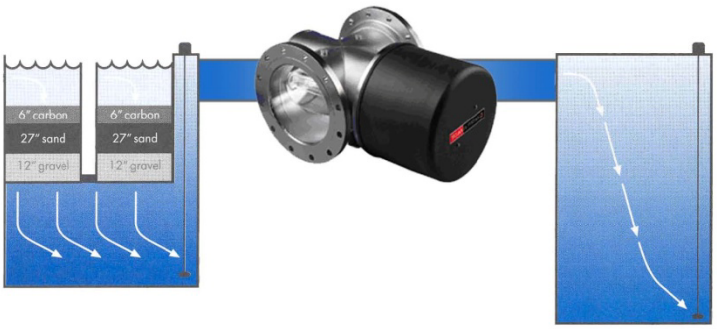
100 percent disinfection compliance. The use of conventional treatment, chlorine disinfection, and UV disinfection are all part of the Water Filtration Plant multiple barrier treatment philosophy. In this approach, different types of disinfection are used at different points in the treatment process to ensure the elimination of microorganisms found in Lake Michigan water. UV disinfection follows filtration and precedes chlorination. Following UV disinfection, chlorine is added upstream of the finished water reservoir to provide virus inactivation. Elements of UV system design include the following:

- Two process trains, each with a 24-inch-diameter UV reactor with a capacity of 18 mgd. There is space for a third UV reactor for future expansion.
- Each UV disinfection reactor was designed to remove more than 99.9 percent (3-log) of *Cryptosporidium* and *Giardia* at a maximum flow rate and with the lamps set at 80 percent of lamp power. In addition, any water not receiving the target UV dose is pumped back to the filter clearwell, eliminating the need for an uninterruptible power supply.

Project cost: $3.2 million

Reference: Eric Kiefer, Manager
North Shore Water Commission
400 W. Bender Road
Glendale, WI 53217
(414) 963-0160

Oshkosh Disinfection Improvements



For the City of Oshkosh 16-mgd Water Filtration Plant, CH2M HILL designed a new free-chlorine disinfection contact tank to serve as a backup for ozone. The 1-million-gallon tank includes supplemental filter backwash water storage. CH2M HILL developed a contact tank tracer test plan implemented by plant staff. Test results demonstrated a baffle factor of greater than 0.7. CH2M HILL prepared a primary and secondary disinfection plan for approval by WDNR. Using the disinfection plan, CH2M HILL developed software to automatically calculate CT achieved and to compare actual values with regulatory requirements. The disinfection plan and software upgrades served as the basis for refresher operator training, provided by CH2M HILL, on the subject of disinfection and regulatory compliance. CH2M HILL was also selected to assist the City with chlorine and ammonia feed equipment replacement at the filtration plant. The work is being completed in two phases to minimize utility impacts and includes new instrumentation and software programming updates.

Project Cost: $7.3 million

Reference: Steve Brand, City of Oshkosh
Public Works Utilities Bureau Manager
215 Church Avenue, P.O. Box 1130
Oshkosh, WI 54903-1130
(920) 232-5362

Oak Creek Water Plant Improvements Oak Creek, Wisconsin

Oak Creek Water Plant Improvements

CH2M HILL completed expansions to Oak Creek's surface water treatment plant in 1999 (12 mgd to 20 mgd) and 2010 (20 mgd to 28 mgd). Tony Myers served as project manager for both projects and helped the utility realize significant achievements. The first expansion won an Engineering Excellence award from the Wisconsin Association of Consulting Engineers. In the second expansion, we worked with plant staff and WDNR on full-scale plant testing **to increase the plant-rated capacity**

from 28 mgd to 35 mgd at no capital cost. Our team worked closely with water treatment plant staff and WDNR to select the process and to choose the plant layout that met their needs best.

Some of the design features included the following:

- Flocculation and plate settling are in a building instead of underground tanks, allowing easier maintenance and the ability to observe the treatment processes. The new facilities were integrated with existing basins and sludge handling without service interruption.
- Gravel-less underdrains were used for filtration, providing flexibility for more media depth and future use of GAC. Filter-to-waste was incorporated into the existing and new filters. A unique system to recycle filter-to-waste water to the filter influent was approved by WDNR for the first time.
- Eliminated chlorine gas and converted to liquid sodium hypochlorite, which improved safety and security while positioning for future regulations. The old chlorine room was converted into a state-of-the-art control room.
- Upgraded the SCADA system, incorporating operator features for automation and WDNR report generation.

Filter Pipe Gallery with Filter-to-Waste at Oak Creek Water Plant

"The CH2M HILL team met the utility requirements of the fast-track design without a time extension and well under budget ... Oak Creek Water and Sewer has developed an excellent working relationship with CH2M HILL. This relationship allowed the utility to complete design and construction in a tight timeframe with minimal disruptions to the existing water treatment plant. CH2M HILL's dedication to Oak Creek and the plant expansion project proved extraordinary, exceeding the expectation the utility had when entering this project."

Donald A. Ashbaugh
Former General Manager (retired)

Reference: Mike Sullivan, PE, Utility Engineer
Oak Creek Water and Sewer Utility
170 W. Drexel Avenue
Oak Creek, WI 53154
msullivan@water.oak-creek.wi.us
(414) 570-8200 x19

Cedar Rapids UV Study and Design, Cedar Rapids, Iowa

CH2M HILL completed the study, design, and construction of the UV disinfection project for the City of Cedar Rapids 42-mgd J Avenue lime softening plant and 20-mgd (expandable to 40 mgd) Northwest lime softening plant. The project includes preliminary design, final design, and construction services for retrofitting UV disinfection into the two existing water treatment plants. Both medium- and low-pressure high-output UV reactors were evaluated at several potential UV sites. Impacts on existing facilities, operational access, hydraulics, and future plant improvements were considered in determining the optimum UV facility location. Extensive hydraulic and site location issues were evaluated with the City in workshops.

This was one of the first water plants designed for virus inactivation with UV, and design occurred prior to the release of USEPA's final *UV Disinfection Guidance Manual*. Therefore, early stages of the project included a UV demonstration project to determine the water quality impacts of UV on chloraminated water containing nitrates. Water quality in the distribution system was monitored for 1 year, indicating no detrimental impact of UV disinfection on water quality. Key features of the project include the following:

- Through workshops with Iowa EPA and the City, additional virus disinfection credit was granted by the Iowa EPA for low filter turbidity and high softening pH. The UV disinfection system was designed to provide another 0.5-log inactivation of virus with a UV dose of about 45 milli joules per square centimeter.
- Designed flexibility into the UV system to expand it in the future (additional lamps per UV reactor and additional UV reactors in series) for advanced oxidation to control future contaminants (for example, NDMA).
- The project also included the design and construction of a chloramine contact reservoir and high-service pump station at the J Avenue treatment plant.

Cedar Rapids UV System

Reference: Bruce Jacobs
Utilities Engineering Manager, Utilities Department
Office: 319-286-5913

Water Plant Improvements Project, Ann Arbor, Michigan

The City of Ann Arbor was faced with more stringent drinking water regulations at its 50-mgd lime softening plant. The filter influent turbidity was more than 30 NTUs and stressed the shallow bed filters. Backwash recycle was upsetting the softening and filtration processes. The chloramination disinfection system could not meet disinfection requirements without increasing the chlorine contact time, but this increased disinfection byproducts beyond regulations.

The Ann Arbor plant serves about 130,000 people with a combination of river water and groundwater. The water is lime-softened, recarbonated, ozonated, and filtered through GAC/sand filters.

Treatment Process Testing

CH2M HILL performed extensive bench- and pilot-scale tests on lime softening, ozonation, and biological GAC (BAC) filtration processes. Lime softening optimization resulted in an innovative way to soften the water in two stages with lime and sodium hydroxide, which resulted in filter influent turbidity of around 2 NTUs—without any capital improvements—and also improved filter performance.

Ann Arbor Water Plant

The backwash recycle system was also evaluated. The conclusion was that the equalization tanks were too small and were requiring high-return flows that hydraulically upset the water plant. A larger backwash reclaim basin with variable speed pumps was recommended. The work was published by the American Water Works Association and referenced in the Backwash Recycle Rule by USEPA.

The pilot testing provided optimum design and operating parameters that saved Ann Arbor millions of dollars in both capital and operating costs. In addition, water quality and public health protection was greatly improved.

A few key findings include:

- Ozonation of softened water significantly reduced the cost of the ozone system versus raw water
- Ozone improved filtration, met disinfection regulations and reduced byproducts.

Water Plant Process Improvements

CH2M HILL evaluated existing treatment processes, inspected the water plant's physical condition, and recommended extensive upgrades to process systems and facilities, including improvements to the mixing, flocculation, and clarification processes; a new ozone facility; filter modifications; new chemical storage and handling facilities; and new energy-efficient pumping equipment. Extensive improvements to the electrical system were also implemented, primarily to supply the new ozone facility. We then led the design and construction management.

The construction sequencing had to be carefully planned because the ozone contactor was built on an extremely tight site between existing clarifiers. A detailed construction sequence was specified to ensure successful construction.

Reference: Larry Sanford, Water Production Manager, 919 Sunset Road, Ann Arbor, MI 48103 Telephone: 734-994-2840; E-mail: LSanford@a2gov.org

St. Paul Regional Water Services—Incorporating Biological Filters into a Lime Softening Plant

CH2M HILL completed the study, design, and construction of the biological filter upgrade for the St. Paul Regional Water Services' 120-mgd lime softening McCarrons Water Treatment Plant. The plant adds lime and alum to a rapid mix basin, followed by horizontal paddle wheel flocculation, then settling through conventional clarifiers.

The recarbonation basin also had chlorine and ammonia added. When the filters were converted from sand/anthracite to biological GAC for taste and odor control, the chlorine and ammonia were moved to post-filtration. This project included the following: upgrading 12 filters with new underdrains, air water backwash, media retaining filter troughs, and GAC media; replacing media in 12 existing filters with GAC; adding baffles to the finished water reservoir cells to provide mixing and contact time for adequate disinfection; and providing chemical feed improvements to the chlorine, ammonia and sodium hydroxide systems.

The clearwell was baffled so that there are several places to add chlorine and ammonia. The optimum location can be selected based on water quality, temperature, and flow rate. CH2M HILL developed a disinfection model to determine the optimum free chlorine contact time to maximize disinfection and minimize disinfection byproducts.

The plant had a high level (400 milligrams per liter) of Geosmin in the raw water and nothing coming out of the BAC filters. Biological activity also reduced TOC and disinfection byproducts.

Reference: Jim Bode, Water Quality Supervisor Telephone: (651) 266-1651 E-mail: James.Bode@ci.stpaul.mn.us

Water System Improvements, Milwaukee, Wisconsin

In the spring of 1993, the City discovered *Cryptosporidium* in its water supply. CH2M HILL responded with a 3-pronged approach to the issue: looking at water supply, treatment, and distribution. We prepared a report within 3 days with recommendations for bringing the Howard Avenue facility back in service. Subsequently, CH2M HILL evaluated the water system and prepared a report with short- and long-term recommendations for improving water quality. The following were the three major areas for improvement:

- Extending the Howard Avenue intake farther into Lake Michigan to obtain better source water quality.
- Making improvements to both water treatment plants.
- Adding ozone to both water plants for enhanced disinfection.

CH2M HILL completed study, design, construction services, and startup of many improvements to the water treatment processes. Pilot plant studies on coagulation, filtration, and ozone laid the ground work for the major plant improvements. The alum coagulation process was optimized and new filter media selected. Parameters for ozone disinfection were also determined.

Linnwood Water Plant: 275 mgd

Filter Improvements

To ensure the filtration system operates at peak efficiency, a new gravel-less underdrain system (Leopold type S with IMS cap) was installed and new media (24 inches of anthracite coal over 12 inches of sand) was placed in the filter bed.

At the Linnwood plant, cast-iron laterals were replaced with gravel-less air/water underdrains.

CH2M HILL prepared a conceptual filter-to-waste facility design and completed full-scale testing with filter-aid polymers. CH2M HILL developed a unique procedure for adding polymer to the filter influent to reduce turbidity spikes. Plant staff optimized the process. The polymer worked so well to reduce turbidity and particle count spikes after backwash that filter-to-waste was not necessary. The new dual-media filters greatly increase filter run times (over 100 hours) and improve water quality (consistently less than 0.1 NTU and single-digit particle counts).

Reference: Dan Welk, Linnwood Water Plant Manager
E-mail: Daniel.Welk@Milwaukee.gov

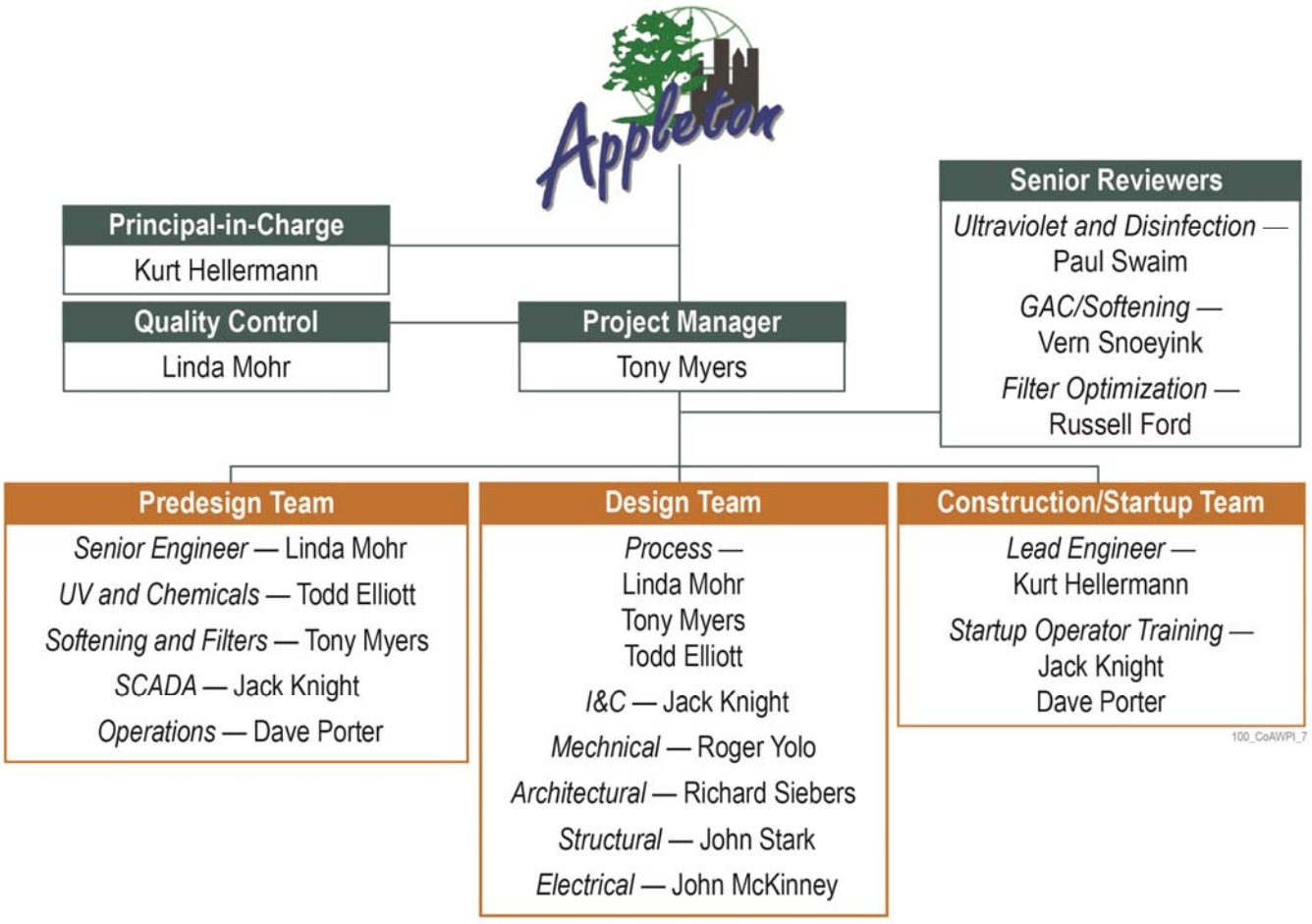
Project Team

Project Team

The City of Appleton has a long history of providing excellent quality water to its customers, and continuing that record throughout the upgrades is our number one goal. When it comes to plant performance, the devil is in the details, and having a project manager who has delivered similar projects from study through startup ensures that the team focuses on the right details. As shown in our Organization Chart, Tony Myers and QC manager Linda Mohr have lead roles in the process design because their vast experience and attention to detail is crucial on technically challenging projects such as yours. Further, Tony has an outstanding record of bringing similarly sized projects in on time and under budget, using a cohesive Milwaukee-based design team and select experts to provide meaningful input, particularly in preliminary design when the most important decisions are made. In selecting CH2M HILL, the City of Appleton is gaining a project team with the following benefits:

- A project manager and leading water firm with superior technical expertise to generate creative, cost-effective solutions for long-term facility reliability and excellent water quality at the best value.
- Milwaukee-based team of treatment process, demonstration testing, design, construction, and automation professionals to be highly responsive to the City's needs. We will be onsite when assistance is needed.
- Operations specialists who will help the City optimize operations, lower costs, and thoroughly train staff on new UV, filter, and chemical systems.
- Senior reviewers who are experts in GAC, lime softening, UV disinfection, and filtration to help tailor the treatment process for efficient operations and high-quality water.

Organization Chart



Key Personnel

The following are brief summaries of our key personnel and other design and construction management/startup staff. As shown in the project team experience table below, we have worked together on similar projects throughout Wisconsin and the Midwest.

Tony Myers, PE/Project Manager. Tony is considered a global expert in UV, lime softening, GAC, and filtration. Putting a proven project manager who is also a skilled water treatment expert at the helm of this project ensures that the City has a leader with the experience necessary to quickly assimilate relevant data and guide the team from concept through construction sequencing to assure consistent reliable water is delivered. He is active in technology development and application in the water industry and past Chair of the Wisconsin Water Association. For 28 years, he has been involved in the study, design, management, construction, and startup of dozens of water treatment plants in Wisconsin and over 50 water plants around the world. He has extensive experience upgrading existing water plants to meet new regulations and is hands-on when explaining process improvements with WDNR staff to gain timely approvals. Example projects include the following:

- Project Manager, City of Oak Creek for two water plant expansions of 8 mgd each. A demonstration test with plant staff obtained WDNR approval for another 7 mgd at no capital cost. The first $7 million expansion had a 3-month design schedule and 12-month construction schedule. It was completed on schedule and under budget. The second $10 million expansion was completed on time and under budget. The plant was designed for future incorporation of ozone and UV.
- UV Project Manager, City of Cedar Rapids. Two lime softening water plants (20 mgd and 42 mgd) were retrofitted with UV and additional chlorine contact time was added. Tony worked with regulators to prove performance (through demonstration testing) resulting in the first UV system approved for virus inactivation in Iowa

Project Team Experience

Our multidiscipline design team has worked together over 20 years to design and start up new systems in Oak Creek, Oshkosh, Glendale, Milwaukee, and other Midwest cities.

Revelant Experience	Tony Myers	Linda Mohr	Kurt Hellermann	Todd Elliott	Jack Knight	Roger Yolo	John Stark	John McKinney	Paul Swaim	Richard Siebers	Vern Snoeyink
UV Disinfection System at Two Lime Softening WTPs; City of Cedar Rapids Water Department, Cedar Rapids, IA: Design, startup, and training	●	●	●	●	●	●	●	●	●	●	
Water System Improvements, Milwaukee Water Works; Milwaukee, WI: Recommended improvements to intakes, mixing, filters, disinfection; pilot testing for filter optimization, ozone	●	●	●			●			●	●	●
Two Plant Expansions, Oak Creek Water and Sewer Utility; Oak Creek, WI: PACL coagulation, plate settling and tri-media filtration, SCADA	●	●	●	●	●	●	●	●		●	
UV Disinfection System, Northshore Water Commission; Glendale, WI: Design, startup, and training	●	●	●	●	●	●			●	●	
Water Filtration Plant Improvements; Oshkosh, WI: New free chlorine disinfection contact tank; programming	●	●	●	●	●	●	●	●		●	
Water Plant Improvements; Ann Arbor Water Plant; City of Ann Arbor, MI: Pilot- and full-scale testing, design, construction sequencing to incorporate ozone and GAC into lime softening process, backwash water recycle	●	●	●	●	●	●				●	●
Dublin Road Water Plant Expansion; Columbus, OH: Ozone and GAC with alum coagulation followed by lime softening; provisions for future UV	●			●		●				●	●
McCarrons Water Plant Improvements; St. Paul Regional Water Services; St. Paul, MN: Lime softening integration with GAC and chloramine disinfection	●	●	●	●	●	●				●	●

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and virus inactivation credits for high-pH lime softening and filtration. This complex multiyear project was completed on schedule and under budget.

- Project manager/Designer of ozone and GAC processes at the Ann Arbor, Michigan, lime softening plant, which received an ACEC National Honor Award and an award for best-tasting water in the state. Provided plant startup, operator training, and optimization. The $15 million project was completed on time (court-ordered deadline) and under budget.
- Senior Consultant, Northshore Water Commission, Glendale, Wisconsin. Incorporated UV into the 18-mgd surface water treatment plant, working closely with the plant manager to select the best location for UV and minimize interruptions during construction. The $4 million project was completed under budget so additional improvements were added (backup generator).

Tony also served as project manager or senior technical advisor for water treatment plant upgrades in Oshkosh (disinfection basin), Milwaukee (filters, chemicals, and ozone), and St. Paul (GAC filters, chemical systems, and disinfection) and more. All these project met high water quality goals and were completed on schedule and budget. Tony is highly involved in startup and operator training for these projects. He also trained wastewater operators to run a new drinking water plant in Edmond, Oklahoma, and the team won an award for best-operated plant in the state!

Linda Mohr, PE/Quality Control Manager and Senior Process Engineer. Linda is a water treatment engineer with expertise in physical-chemical processes, including filtration and disinfection. Over the past 26 years, she has worked on planning, design, and construction of over 50 water treatment plants. She has experience in treatment facility startup, working alongside factory representatives, operators, and contractors. Linda has developed and facilitated multiple water treatment training sessions for operators, both through project work and through over 25 years of volunteer service to the American Water Works Association. Because she chaired the Wisconsin Top Ops Committee for over 10 years, and helped Wisconsin teams compete at ACE, she has an understanding of how operators study, learn, and apply knowledge in their jobs.

Besides managing water treatment plant design and construction projects and leading process design, Linda has managed project quality assurance/quality control. She works closely with client/CH2M HILL project teams to ensure that calculations are checked, work is reviewed, and the right decisions are being made at the right time. She uses proven approaches to keep projects advancing efficiently with a minimal amount of rework and error. For nearly 2 years, she served as the quality manager for CH2M HILL's Eastern Regional Water Business Group.

Jack Knight, PE, SCADA Design and Operations Startup. Jack is an instrumentation and control engineer with outstanding hands-on experience not only programming SCADA systems at water and wastewater plants, but understanding the treatment process and what operators need to run an efficient plant. With a background in chemical engineering, he knows treatment processes and how they work. This combination of process knowledge and excellent computer and programming skills makes him highly effective in providing SCADA systems that relate to plant operators. Jack spends a great deal of time talking to operators to determine what they need for their specific plant. For the Oak Creek, Wisconsin, water plant, he completed extensive SCADA programming that optimized the processes. For example, the filtration process is optimized for headloss, turbidity, filter-to-waste, and backwash sequencing, which produces excellent water quality and minimizes energy and wastewater production. Plant operators can run the system in automatic or manual mode with the click of a button.

At the Milwaukee Metropolitan Sewerage District, he worked with staff to develop functional criteria and to evaluate existing SCADA system and operational problems. He then designed hardware and software to implement the new scheme. He has also worked with Tony and our core team on instrumentation and control systems, startup, and operator training for the Northshore Water Commission UV system, two new UV systems in Cedar Rapids, filter/disinfection/chemical systems in Oak Creek, Oshkosh, St. Paul, and Ann Arbor.

Paul Swaim, PE/Senior Reviewer, UV Expert. Paul has more than 20 years of experience and is a recognized international expert in UV and disinfection for drinking water applications**. President of International Ultraviolet**

Association, Paul has the most recent and extensive knowledge on the latest advances in UV disinfection. He is also Chair of the American Water Works Association's Disinfection Committee, has served as senior reviewer/technical advisor for more than 30 disinfection projects across North America, and is a member of USEPA's stakeholder group for preparation and review of the *UV Disinfection Guidance Manual* in support of the Long-Term 2 Enhanced Surface Water Treatment Rule. Paul will help the City quickly gather relevant data necessary for planning the system, and will guide the team from concept to detailed designs, ensuring the details maximize technology benefits under different operating conditions.

Vern Snoeyink, PhD, Water Quality Expert. With 40 years of experience, Vern is an expert in the fields of water chemistry, lime softening, corrosion, and GAC adsorption technology and has served as principal investigator on major treatment-based research programs for USEPA, Water Research Foundation, and National Science Foundation, among others. He has been on numerous expert panels working with CH2M HIL to solve water quality and treatment issues and to improve plant performance for clients such as Milwaukee Water Works, St. Paul Regional Water Services, Southern Nevada Water Authority, Portland Water Bureau, Cleveland Water Department, City of Tucson, and the East Bay Municipal Utilities District.

Russell Ford, PhD, Filter Optimization Expert. As CH2M HILL's Deputy Director of Drinking Water Infrastructure, Russell brings 25 years of experience helping clients identify and solve of water quality issues and improve the physical condition and operations of their plants. He recently served as project manager for a Filter Assessment and Filter Underdrain project for Passaic Valley Water Commission, Clifton, New Jersey, where he evaluated existing filtration practices and water losses, and then provided recommendations on how to improve operation. For another client in the northeast, he evaluated GAC, ozone, PAC, chloramination, enhanced coagulation, MIEX, and improving filtration capabilities. As senior reviewer, he recommended implementation of UV, filter optimization, and filter-to-waste and provided additional assistance on TOC reduction strategies.

The qualifications of the other project team members are summarized below.

Staff Classification and Projected Hours

Staff classifications and hours per task for key personnel are shown below. Senior staff involvement in all phases of this project provides continuity that will contribute to success from concept to operations. Our team is ready to begin working with you immediately, and we have allocated appropriate time over the next two years to dedicate to your project.

Name and Role	Key Qualifications
Dave Porter, Operations Expert, O&M Manuals, Training	Certified water and wastewater operator with over 25 years of experience. Develops improvement plans that focus on training and knowledge transfer so O&M staff have skills needed to achieve continuous improvement in energy and process efficiency.
Kurt Hellermann, Construction Management	Over 30 years of experience; is Construction Management Director for Water Business Group. Co-facilitates CM training courses for internal staff and clients, and brings construction sequencing expertise from multiple water and wastewater plant upgrades such as in Milwaukee and Oak Creek.
Todd Elliot, UV and Chemical Systems Design	10 years of experience with focus on process mechanical design for WTPs and UV disinfection. Creates hydraulic models, prepares drawings for UV buildings and piping, specifications for piping and valves, and develops selection criteria for UV equipment.
Roger Yolo, Mechanical Design	Over 35 years of experience as process/mechanical engineer, design manager and senior reviewer for WTP improvements, including design of chemical mixing systems, building services, and process mechanical design for UV systems and filtration improvements.
Richard Siebers, Architecture	Registered architect with over 20 years of experience. Lead architect for WTP rehabilitation projects in Oshkosh, Glendale UV, and Oak Creek.
John Stark, Structural Design	Structural engineer with 11 years of experience in design of above- and below-ground structures at WTPs and WWTPs; Provides resident engineering services as needed.
John McKinney, Electrical Design	Over 36 years of experience, including load calculation and design parameters necessary for ensuring adequate electrical service for addition of UV systems. Ensures plants have uninterrupted service during complicated upgrades.

Staff Classification and Projected Hours

Task Description	Senior Project Manager Tony Myers Hrs	QC Manager, Senior Engineer Linda Mohr Hrs	QA/QC Reviewers Paul Swaim, Dr. Vern Snoeyink, Dr. Russell Ford Hrs	Operations Specialist Dave Porter Hrs	Process Engineer Todd Elliott Hrs	SCADA Expert Jack Knight Hrs	Design Engineers Yolo, Siebers, Stark, McKinney Hrs	Construction Services Kurt Hellermann Hrs	Project Engineers Hrs	CAD Technician CAD Team Hrs	Clerical Hrs	Total Hours by Task Hrs
Preliminary Design												
Pretreatment, Lime Softening, Recarbonation, GAC Filters evaluation and workshop	40	16	16	8	0	4			16			100
Disinfection, UV, Chemicals Evaluation and Workshop	32	16	24	4	60	8			16			160
Develop Demonstration Testing Plan	16		4	2					8			30
Demonstration Testing	4	2	4	2	4				16			32
SCADA Evaluation and Workshop	8					16						24
Draft Preliminary Design Report	32	16	4	2	24	8	40		16	60	40	242
Report Review	8	8	6	2	4	4	8					40
Final Preliminary Design Report	24	8	4	2	8	4	16		8	24	24	122
Preliminary Design Total	164	66	62	22	100	44	64	0	80	84	64	750
Design Phase												
60% Design and Review with WDNR	80	40	12	8	60	60	180	4	120	300	60	924
90% Design and Review with WDNR	60	24	6	4	40	24	80	4	100	300	100	742
100% Design Documents	24	16	4	4	20	16	40	2	80	200	24	430
Design PhaseTotal	164	80	22	16	120	100	300	10	300	800	184	2,096
Bid Phase												
Bid and Award	24	16	4			2	40	8		8	32	134
Bid Phase Total	24	16	4	-	-	2	40	8	-	8	32	134
Construction Phase												
Contract Administration Assistance (Meetings, management, pay requests)	32	24						32			24	112
Submittals, Clarifications, Change Orders	24	16			32	16	160	24	24	40	140	476
Site Visits	24	16				16	180	16	40			292
Punch List	8						40	4				52
O&M Manuals	8	8	4	24	8	8		2		16		78
Startup Assistance and Training	24	8		24	24	24		4				108
On Call Assistance	16	4	4	16								40
Construction Phase Total	136	76	8	64	64	64	380	82	64	56	164	1,158
Project Total												4,138

Project Understanding

The City of Appleton has a proud history of providing safe drinking water to its citizens, from early use of artesian water to use of treated water from Lake Winnebago today. The Appleton Water Treatment Facility (AWTF) produces excellent quality water. With robust lime softening clarifiers, recarbonation, and GAC contactors, the AWTF is poised to expand capacity to serve more customers, to meet the requirements of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), and to increase operational efficiency with the improvements described in the RFP.

This section focuses on a successful approach to the following requirements:

- Production of high quality water is essential and we describe our approach to optimizing pretreatment, filtration, chemical systems and UV.
- A responsive team with the right technical, design, and operating experience provides the elements to successfully complete all phases of this project. We will leverage your knowledge of AWTF operations, but not overload your resources.
- Demonstration testing that proves performance to WDNR and allows design and construction to continue while maintaining water quality.
- Documenting improvements and operation/maintenance procedures while fully training plant staff on the new facilities.
- Proactively manage the work to meet the City's quality, budget, schedule, and water service goals.

Responsive CH2M HILL Team

A Lake Winnebago water supply presents many challenges to consistently meeting finished water quality and operational goals. We understand that the best team to partner with the City of Appleton is one with experience in demonstration testing, design, construction, startup, and troubleshooting the following processes central to this project: GAC filtration, lime softening, UV disinfection and chloramination. Our knowledge, combined with the AWTF staff expertise in actual facility performance, will result in improvements that increase plant capacity, improve operations, and meet regulatory requirements. Our Milwaukee based team enables us to respond quickly to the City's needs.

Our experience gaining approvals from WDNR for innovative designs, and implementing UV disinfection, GAC, and lime softening on challenging water supplies, will result in the City of Appleton achieving its project goals.

Our understanding of the project is further described in the discussion of technical issues integral to our detailed approach to the work. To encompass the scope of services and project requirements identified in the RFP, we propose to deliver the following professional services:

- Task 1—Preliminary Design
- Task 2—Final Design
- Task 3—Bid and Award
- Task 4—Services During Construction
- Task 5—Project Management, Quality Management

Task 1—Preliminary Design

Preliminary design is the critical project phase where the major design and operational decisions will be made. Through collaborative meetings and technical evaluations, CH2M HILL and AWTF staff will work together to establish the criteria and make balanced decisions that will be carried through design, construction, and operations.

The following preliminary design activities describe our understanding of the major issues and some ideas to achieve success with each planned improvement.

CH2M HILL involves operators in preliminary design and looks for training opportunities throughout project delivery with our operations specialists.

Subtask 1.1—Comprehensive Performance Review

A comprehensive "bumper-to-bumper" evaluation of the water treatment processes and hydraulics will be conducted. Existing water quality, treatment process, design and operational data will be evaluated. AWTF staff will be interviewed to obtain their perspective on what is working well and what is not. Overall water quality, operations, and maintenance goals will be identified and documented. The results of the performance review will be summarized in the preliminary design report and will serve as a baseline for future evaluations.

Subtask 1.1 Deliverables. The comprehensive performance review will be summarized in the preliminary design report.

Subtask 1.2—Pretreatment, Lime Softening, Recarbonation

The use of potassium permanganate and powdered activated carbon (PAC) before softening will be evaluated for performance. Chemical doses, application locations, and contact times will be evaluated. Potassium permanganate can help or hurt PAC performance depending on location and dose. Both chemicals are expensive, and optimization is critical.

Oxidation before filtration has also been a proven method to improve filter performance. We will review the best use of oxidants such as ozone before filtration for water quality and operational benefits.

The hydraulic and treatment process impacts of recycle streams on the water plant will be reviewed.

Lime softening chemistry, the use of ferric sulfate and polymer, and Accelator performance will be reviewed. Jar tests can be performed in the City's laboratory to investigate chemical doses for improved performance. If more involved testing is needed, it may be conducted at our Applied Sciences Laboratory.

Current indications are that lime softening is performing well and meeting goals for hardness, total organic carbon (TOC) removal, and turbidity. A common problem with surface water lime softening is lake turn-over in the fall when turbidity and organics increase, or low-alkalinity periods in spring when the water is cold. Specific testing during these periods will be targeted. Solutions that have worked in other plants include the following:

- Increased magnesium hydroxide precipitation for better organics and turbidity removal
- Optimizing mixing conditions, sludge concentration, and recirculation.
- Polymers to improve turbidity removal.

Recarbonation will be evaluated for efficiency, preparation of the water for filtration, and corrosion control (pH and polyphosphate addition). Additional filter influent and effluent water quality parameters may be recommended (for example, calcium carbonate precipitation potential, Langlier Index). The TomCO pressurized solution feed system is typically effective and efficient, so major changes to this process are not anticipated. The findings, discussion, and decisions made related to the pretreatment evaluation will be summarized in the

Applied Sciences Laboratory

CH2M HILL's Applied Sciences Laboratory is a valuable resource to supplement customized bench- and pilot-scale testing for various water treatment processes. We utilize this resource to obtain cost-effective analytical results that improve full-scale treatment performance. We design and conduct treatability studies for a range of water treatment technologies to optimize treatment system parameters, determine design criteria, and to troubleshoot process problems.

Jar testing

Lime softening optimization for improved turbidity and organics removal. We can conduct testing in the Appleton water plant and send water out for analysis, or send Appleton water to our ASL and do the testing and analysis there.

Rapid Small Scale Column Testing

To determing GAC performance for organics removal. Meeting new disinfection byproduct regulations is critical for the water plant improvements. Simulated distribution system testing to determine disinfection byproduct formation at various conditions of chlorine contact time, temperature, pH can easily be obtained from the ASL. This is crucial for your CT tank analysis.

Pilot-scale Testing

Proving filter performance with new media designs, filter aid polymers, and various operating conditions is important during periods of difficult to treat water. We can use your pilot filter equipment or bring in our own, depending on the results of the filter evaluation and parameters to be tested. It may turn out that full scale demonstration testing with your GAC contactors is more practical and applicable.

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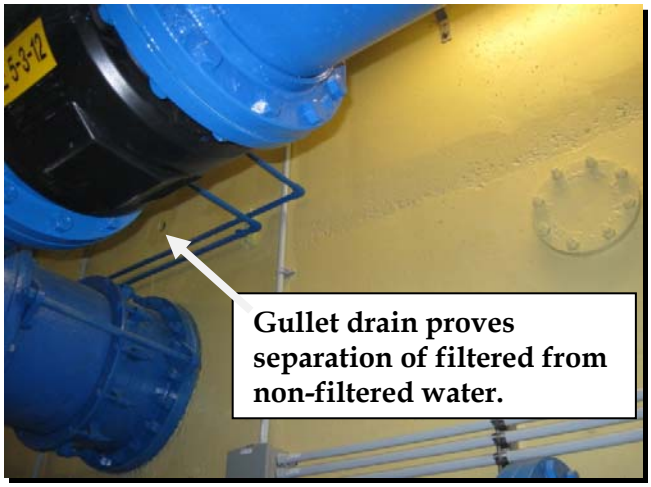
preliminary design report.

Subtask 1.2 Deliverables. Pretreatment evaluation, including analytical results, will be summarized in the preliminary design report.

Task 1.3—GAC Contactors

Ensuring that the GAC contactors operate as efficient filters is essential to the success of this project. Filter box construction, underdrains, filter valves and controls, GAC, and sand media will be evaluated. Filter construction and separation of filtered water from unfiltered water to prevent cross connections will be analyzed. Previous studies suggested removing existing gullet walls and constructing new separation walls to separate filtered water from backwash wastewater. We propose to investigate a simpler, less costly method where a separation is constructed over the existing gullet floor—a method that was accomplished at the Oak Creek Water Treatment Plant by placing concrete over a porous material with a drain. The approach was approved by WDNR and saved money and time over pouring separate concrete walls.

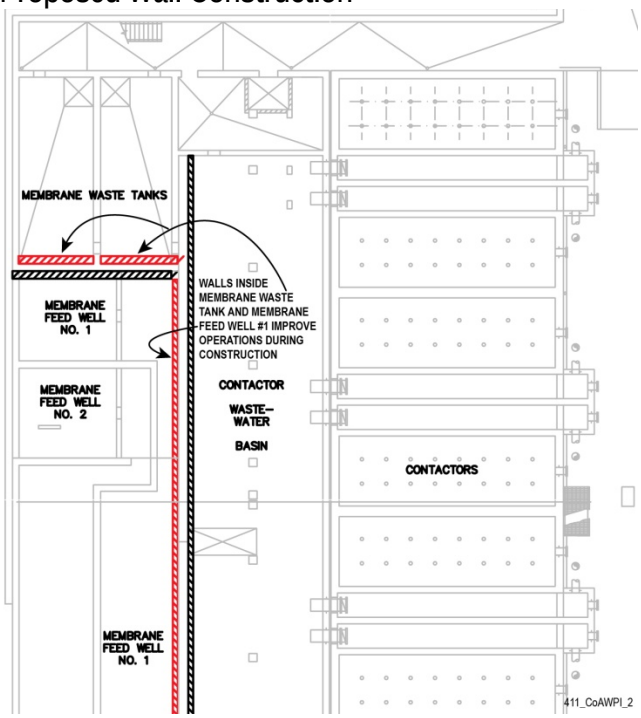


Drain between filter gullet wall at Oak Creek WI

A wall will also be placed between the GAC contactor backwash waste tank and the membrane feed well to prevent cross connections. Instead of constructing the wall in the contactor washwater basin, we propose to construct the wall in membrane feed well No. 1, which will ensure that plant operations can be maintained during construction and reduce risk. The construction will be coordinated with any baffle wall construction in the membrane feed well for disinfection improvements (see Task 1.4—Disinfection).

The membrane waste tanks also have a common wall with the membrane feed well and are another potential cross connection. However, instead of pouring another concrete wall for separation, the membrane waste tank can be abandoned in place because it is not needed after membranes are decommissioned. If use of the membrane waste tank is desired, walls could be poured inside the membrane waste tank instead of the feed wells to save money and minimize interruption to operations during construction. These wall construction concepts are shown below.

Proposed Wall Construction



Core samples of GAC and sand may be analyzed for size, uniformity coefficient and condition if current information does not exist. Current operational data throughout all seasons will be evaluated, including turbidity, particle counts (if available), headloss, filter run time, unit filter run volume, TOC, and UV transmittance (UVT) removal.

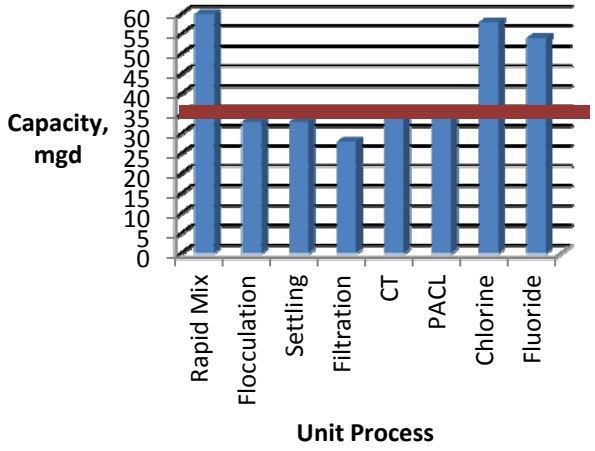
The biological removal of organic material through the filters, and subsequent UVT values, will be critically important in designing the UV disinfection system. Options for enhancing organics removal through GAC either biologically or through adsorption will be evaluated. Nutrients entering the GAC (carbon, nitrogen, phosphorus) will be

measured and evaluated for optimum biological filter performance. The use of hydrogen peroxide to improve biological filter performance will be considered. AWTF's practice of adding a polyphosphate to the GAC influent may be providing sufficient phosphorus nutrient for good biological growth, as we found in a study of the Ann Arbor lime softening/GAC plant.

Recommendations will be made for filter improvements that may include filter media modifications, additional monitoring and control, operational changes, or the use of a filter aid. The design of the GAC contactor media appears to be sufficient for obtaining filtered water that meets and exceeds regulations. CH2M HILL completed a similar project in St. Paul, Minnesota, where GAC filters were added after lime softening of Mississippi River water, and turbidity goals of less than 0.1 nephelometric turbidity unit (NTU) were achieved with only 36 inches of GAC over 4 inches of sand. In fact, the filters were approved at up to 6 gallons per minute per square foot (gpm/ft^2). AWTF GAC contactors are producing effluent with less than 0.2 NTU now without process optimization. Producing less than 0.1 NTU water during all seasons will require optimization.

Appleton Water Treatment Facility GAC Contactor Effluent Turbidity

A plan for demonstration testing will be developed, depending on the final recommendations for filtration. The plan will include testing during all four seasons. It appears feasible to do demonstration GAC filter testing with the membranes in operation as a safeguard. WDNR and AWTF operators will be heavily involved in the design of the testing plan and definition of the intended results. A full-scale testing approach worked very well in Oak Creek, where the filters were approved to operate at over 5 gpm/ft^2 and consistently produced water less than 0.1 NTU.



Oak Creek Water Treatment Plant High-Rate Testing Evaluation

Backwash procedures will be reviewed. Based on the *Regulatory Audit for Compliance with LRV Requirements and Phase 2 Planning* (AECOM, 2012) there appears to be opportunities to optimize the backwash procedure to improve filter performance and reduce backwash volume.

The backwash process will be evaluated for capacity and flexibility in operations. Backwash waste handling and recycle will be evaluated for worst-case conditions and meeting the WDNR requirement of limiting recycle flow to less than 10 percent of plant flow. The ability to incorporate filter to waste (FTW) with an air gap will be evaluated, along with impacts of the additional waste volume on the backwash waste handling system. The innovative FTW system at the Oak Creek Water Treatment

Filter to Waste Recycled to Filter Influent—Oak Creek Water Treatment Plant, WI

Plant that recycles FTW to the filter influent and eliminates impacts on the waste handling system will be evaluated. Elimination of the membrane filter waste streams will free up capacity within the existing overall recycling system.

The findings of the GAC contactors evaluation and the recommendations for capital improvements to separate filtered water from non-filtered water, operational considerations to optimize organics removal, and preliminary design criteria will be summarized in the preliminary design report. CH2M HILL will conduct a workshop with AWTF staff to discuss the results from the pretreatment/lime softening/recarbonation and GAC contactors evaluations.

Task 1.3 Deliverables. Draft and final versions of the demonstration test plan for WDNR approval; Summary of the GAC contactors evaluation, including analytical results, in the preliminary design report.

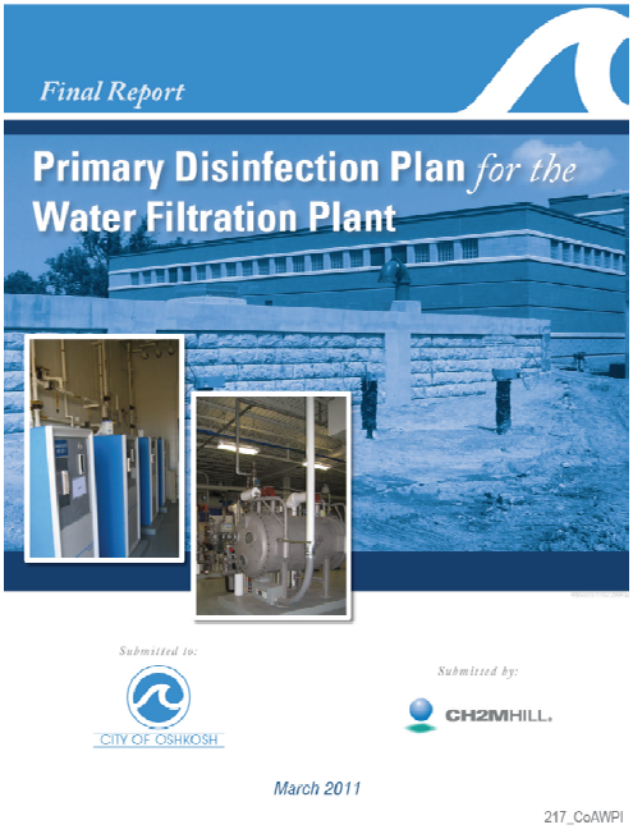
Task 1.4—Disinfection

Along with filtration, disinfection is a critical barrier for protecting public health. With the removal of membrane filters in the future, chlorine, chloramines, and UV will be the disinfectants. These systems need to be robust and efficient. Free chlorine is much more effective at disinfecting *Giardia* and viruses than chloramines. Providing enough free chlorine disinfection for at least 0.5-log *Giardia* and 2-log viruses, while minimizing disinfection byproducts, will be essential to meeting regulations without membranes. *Giardia* inactivation with free chlorine will be the critical parameter because virus inactivation is easier to achieve.

UV disinfection will be an excellent barrier for *Cryptosporidium* and *Giardia*. UV is less effective at obtaining virus inactivation credit, but can be a strong virus barrier as well, if designed properly.

Our Cedar Rapids project was the first UV system in Iowa to obtain virus removal credit.

The AWTF will be designed to meet disinfection regulations with free chlorine, even if UV is not in service. This strategy is similar to one we implemented at the Oshkosh Water Filtration Plant, where we designed a free chlorine contact tank as a backup for the primary disinfectant—ozone. As part of our work at the Oshkosh Water Filtration Plant, we completed a WDNR-approved CT Basin tracer study test plan and report. The test plan was executed by plant operators with outstanding results (0.7 to 0.9 baffle factor). CH2M HILL also conducted classroom and SCADA system operator training on obtaining disinfection credit with ozone, chlorine, and chloramines.



Oshkosh Water Filtration Plant Disinfection Plan

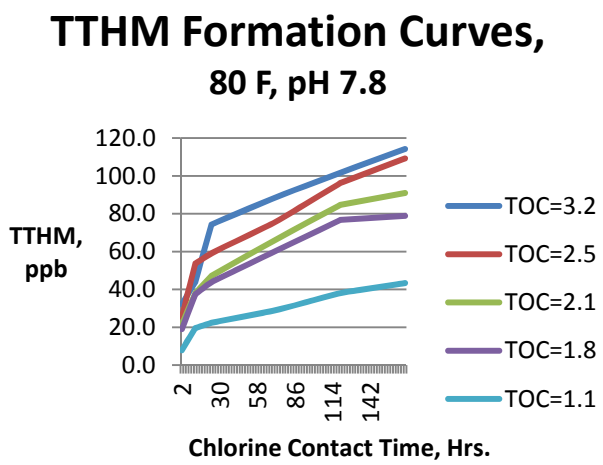
Using the AWTF chlorine contact tanks tracer study results, the ability of the basins to meet disinfection requirements and the need for additional chlorine contact will be determined. Based on preliminary calculations, additional chlorine contact time will be needed. Options include the following:

- Baffling a portion of the clearwells downstream of the contact basins
- Using the existing membrane feed wells for additional chlorine contact volume

Using the membrane feed wells for chlorine contact time could provide enough contact time for full chlorine disinfection credit (2-log virus, 0.5-log *Giardia*).

Significant savings in time and money, along with fewer operational interruptions, may be realized if the membrane feed wells are modified for disinfection.

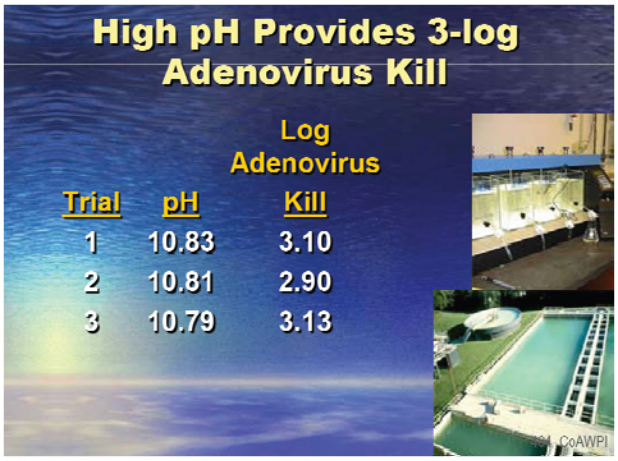
Based on the tracer test results and CT calculations, the optimum chlorine contact time will be determined for various water temperatures, pH, and chlorine concentrations. Disinfection byproduct testing will be conducted to determine total trihalomethane (TTHM) and haloacetic acid (HAA) concentrations resulting from the chlorine contact time under various conditions. Currently, AWTF TTHM and HAA levels average about half the maximum contaminant level. With new monitoring regulations in the Stage 2 Disinfection Byproduct Rule (Locational Running Annual Average), the ability to meet both disinfection and disinfection byproduct regulations and water quality goals will be determined.



Example Disinfection Byproduct Test Results

Depending on the disinfection byproduct test results, the ammonia addition location may need to be modified. We suggest at least two ammonia feed locations to provide operational flexibility to adapt treatment to seasonal conditions. This concept was applied with outstanding results in our St. Paul Minnesota project where GAC was integrated with the lime softening plant.

An innovative method of achieving additional virus inactivation is getting credit for the high pH of the lime-softened water. High pH lime-softened water is well known for its virus inactivation, but few states allow this credit. CH2M HILL successfully obtained virus CT credit for high-pH lime softening in Cedar Rapids, Iowa. The data will be reviewed with WDNR for potential virus inactivation credit.



Cedar Rapids, Iowa, Lime Softening Data used to obtain Virus Inactivation Credit

General UV System Considerations

UV disinfection has been selected by the City's Technical Advisory Group for enhanced disinfection and a *Cryptosporidium* barrier. UV equipment is validated by manufacturers through USEPA-approved procedures, so pilot or demonstration testing of UV reactors is not required. It is critical that the following decisions be made during preliminary design:

- **Equipment location and arrangement**—There is available space in the upper or lower membrane area for UV reactors and power supply units. Two reactors (1 backup) are sufficient for the 24-mgd capacity, but room for a third reactor should be allocated for potential future plant expansion.
- We have installed UV reactors in both horizontal and vertical arrangements, as shown below. The best alternative depends on plant-specific conditions and operator preference.

UV Vertical Arrangement, Seattle, Washington

UV Horizontal Arrangement, Cedar Rapids, Iowa

- **Equipment Pre-selection—**CH2M HILL has experience installing all the major UV equipment, and we understand the advantages and disadvantages of each. UV equipment selection early in the design process results in a customized installation, optimum use of existing space, and fewer construction change orders.

  Presently, UV equipment has about a 3-month delivery time, so techniques to accelerate schedule, such as pre-purchasing, are not needed. This reduces risk and cost to the City and puts procurement responsibility on the contractor.

  We recommend that the City pre-select the UV equipment using a competitive bid process that includes guaranteed capital and operating costs for the UV reactors as well as guaranteed cost and equipment life for replacement parts. The UV equipment selection process will consider different UV technologies, the number of UV reactors in operation, the number of UV lamps operating, and lamp power levels. Only UV reactors that have already been validated following USEPA's *Final UV Design Guidance Manual* (UVDGM; 2006) at an offsite testing facility by a third party will be considered for this project. Reactors meeting these requirements provide the City with economical equipment that is proven protective of public health. In addition, no demonstration testing is required, saving time and money.

  Because of the unique characteristics of each UV technology, reactor, and pricing approach by UV manufacturers, it is essential to capture all costs for operating UV systems (for example, electricity use, lamp replacement, and component replacement) and conduct a life-cycle analysis. We will establish the true costs and benefits associated with alternatives to help the City select the optimum UV reactors for the AWTF.

- **Hydraulics—**The membrane feed pumps could be modified for feeding UV reactors, or new pumps installed. Headloss through membranes is much higher than required for UV, so modifications to pump impellers and/or motors are likely required to use existing pumps. The results of the constructability review will be critical in deciding how to pump water through UV.

  Using the membrane feed wells could support a system where UV effluent is recycled in case of an emergency (UV lamp breakage). This type of system was implemented at the North Shore Water Commission, and WDNR favors zero off-specification water, or the ability to always meet disinfection requirements. The City of Appleton has a unique ability to provide this design feature with the membrane feed wells already constructed.

- **Constructability—**A constructability review will be conducted to determine how UV can be built while meeting all water quality requirements and minimizing interruption to water production. This is discussed in more detail in the Schedule section.

Task 1.4 Deliverables. Disinfection evaluation, including CT calculations, disinfection byproduct analyses, and CT contact tank modifications will be

summarized in the preliminary design report. The evaluation will also include UV design criteria, recommended layout, hydraulic modifications, and equipment selection process and results. The disinfection evaluation will also include results of high-pH virus inactivation discussions with WDNR.

Task 1.5—Chemical Systems

The chemical systems will be evaluated for capacity, condition, and ease of operations. The RFP focused on improvements to the lime softening system and ammonia system. In addition to the chemical equipment upgrades identified in the RFP, we will also review appropriate chemical systems' interface with other process changes planned for this project. For example, the locations of ammonia addition may change to minimize disinfection byproduct formation. Another example is the 2012 sanitary-survey-recommended improvements to the polyphosphate system (containment and a sanitary seal). Chemical systems' improvements, including SCADA updates, will be recommended. We will confirm with WDNR that the impacted chemical systems meet current regulations.

CH2M HILL will meet with AWTF staff to review the preliminary equipment layout and control strategies for inclusion in the chemical systems evaluation.

Task 1.5 Deliverables. Chemical systems evaluation, including hydrated lime feed equipment layout drawings and control strategies, will be summarized in the preliminary design report.

Water Treatment Facility Aqueous Ammonia System

Water Treatment Facility Hydrated Lime Softening System

Task 1.6—SCADA Improvements

Once the major treatment process decisions have been made, CH2M HILL will conduct a workshop with AWTF staff to prepare a scope of services for the SCADA system hardware and software enhancements needed to support the facility improvements. In advance of this meeting, CH2M HILL will review the AWTF SCADA system and prepare a preliminary draft scope of services. The draft scope of services will explore features critical to the City, including, for example, data collection and electronic reporting to WDNR, and controls issues essential to regulatory compliance (for example, filter control).

Data Collection and Reporting

With minor modification, the existing SCADA system can be configured to write data into a variety of file types. RSView natively supports data logging into an arbitrary ODBC data sink, so historical data can be exported into any type of file that the ODBC system supports. Included with Windows are drivers for Microsoft Access databases, Excel spreadsheets, SQL and dBase databases, and others.

A proven way to initiate reporting is to use a datalog to write important data to an Access database and create reports in Access to organize and display the data. The operator can open Access on the SCADA machine, and create and print the reports when desired. Archiving the data is as simple as backing up the Access file.

If more complex reporting is desired, the amount of data being collected is larger or there is a need to be able to easily modify and create new reports, RSView can export data to a full-featured database

(SQL, Oracle, etc.) where external, reporting-specific programs like Crystal Reports can be used for extra functionality.

CH2M HILL will work with AWTF operators to develop a customized report that meets WDNR requirements.

Filter Control

Upgrading the filters to full-functionality filters will require a comprehensive review of, and changes to, the control program. Features that we implemented into the Oak Creek filters for the USEPA Partnership for Safe Water program include the following:

- Review the backwash sequence to make sure the sequence has appropriate time lengths and the sequence detects and responds appropriately to failures and abnormal events (running long on filter-to-waste, for example).
- Add PLC logic to allow the filter to ripen automatically, with the control system monitoring effluent turbidity and automatically putting the filter in service (effluent-to-clearwell) once the initial backwash turbidity spikes have passed.
- Add PLC logic to allow the filter to switch back to filter-to-waste in the event of turbidity excursions in the effluent. This will help protect water quality even if the operator is distracted or out of the control room when a turbidity event occurs.
- Enhance the HMI displays to give the operator a better picture of what is happening with the filter, both during normal operation and during pending (and in-progress) washes.

With good design and training, an operator should never be left wondering what the control system will do next.

These types of SCADA modifications will minimize the chance for turbidity breakthrough and provide more consistent filter performance.

Task 1.6 Deliverables. SCADA improvements scope of services will be summarized in the preliminary design report.

Task 1.7—Construction Sequencing

The requirement to implement plant improvements without any disruption to water plant production or water quality will be met. In coordination with AWTF staff, CH2M HILL will develop a detailed construction sequencing plan.

The filters can be taken out of service one at a time (possibly more in winter) for construction modifications. The membrane wet wells, chlorine contact tanks, and clearwells can be taken out of service one at a time for baffling or other modifications to minimize plant operational disruptions.

When chlorine disinfection and GAC filter improvements are implemented and tested, the plant will be able to meet regulations without membranes or UV. If the City and WDNR are comfortable with the filter and chlorine disinfection improvements to meet regulations, membranes could be decommissioned before UV is finished. If not, a sequence to construct UV while keeping membranes operational will be developed. Appleton is fortunate that there is ample space for UV in the existing plant.

Task 1.7 Deliverables. The sequence of construction plan will be summarized in the preliminary design report.

Task 1.8—Preliminary Design Report

The results from the previous tasks will be summarized in a preliminary design report. The report will satisfy WDNR requirements for an Engineering Report and will include the following:

- Architectural space concepts and assignment of code classifications to process areas
- Structural design concepts for improvements
- Process mechanical equipment layouts, pipe routes, plumbing, hydraulics, and access for maintenance
- Unit process instrumentation and control strategies for integration with existing control systems
- Primary and standby electrical power requirements
- Hydraulic profile revisions

- Construction sequencing plan
- Construction cost estimate update

CH2M HILL will conduct a meeting with AWTF staff to discuss the draft preliminary design report.

Task 1.8 Deliverables. Draft and final versions of the preliminary design report.

Task 2—Final Design

Once the preliminary design is complete, final design will begin. The purpose of final design is to develop the contract documents for competitive bidding of the project. The documents will be prepared for a single construction contract. The front-end bidding, legal, and general requirements will be CH2M HILL's standard Engineers' Joint Contract Document Committee (EJCDC) documents. City of Appleton officials will review the documents for acceptability with City standards and requirements. Technical specifications will be prepared using the Engineer's standard specifications. Drawings will be prepared using the Engineer's standard format, standard size (22-inch by 34-inch full-size drawing), CAD software (MicroStation), and legends. Samples of these items can be provided to the City for review.

Prepare Contract Documents

CH2M HILL will complete final design of the project based upon the concepts documented in the preliminary design report. Design drawings will include structural, mechanical, electrical, instrumentation and control, and details for installation.

During preparation of the final design documents, CH2M HILL will meet with City of Appleton staff at the 6 percent and 90 percent complete levels to review detailed design documents. Design review comments received from AWTF staff will be logged, along with an appropriate response.

Deliverables

Contract bid documents, including drawings and specifications, will be prepared for the 100 percent complete milestone after review comments are addressed. Five copies of half-size, to-scale drawings and specifications will be submitted to the City along with one electronic PDF copy of the drawings and specifications. An update to the construction cost estimate will be prepared at the 90 percent complete submittal. Two hard copies of the estimate will be submitted along with the required schedules to WDNR and PSC for the construction permit application.

Task 3—Bid and Award Phase

CH2M HILL will provide the following services to assist the City in selection of a single construction contractor for the project. The bidding period (advertisement date to bid opening date) is estimated to be 4 weeks. The following are to be completed during Task 3:

- **Bid Advertisement:** CH2M HILL will prepare the bid advertisement for project construction.
- **Preparation and Distribution of Bid Documents:** CH2M HILL will prepare final contract documents for distribution to the owner, engineer, plan rooms, regulatory agencies, and prospective bidders. CH2M HILL will distribute the documents and maintain a list of planholders.
- **Response to Bidder Inquiries and Addenda:** CH2M HILL will receive and respond to bidders' questions and requests for additional information and will provide technical interpretation of the contract documents. CH2M HILL will prepare and distribute addenda to planholders.
- **Pre-Bid Conference:** CH2M HILL will conduct one pre-bid conference in Appleton. Specific tasks will include developing agenda, conducting the pre-bid conference, and preparing and distributing conference summary notes to planholders.
- **Bid Opening and Review:** The City will open bids and send a copy to CH2M HILL. CH2M HILL will review the bids and evaluate them for responsiveness and bid amount. CH2M HILL will also verify, through reasonable investigation, the capabilities and performance history of the low bidder and second lowest bidder. CH2M HILL will prepare a letter summarizing its review and evaluation and will include a recommendation for award of the contract for construction, or other action as may be appropriate. The City will make the final decision on the award of the contract for

construction and the acceptance or rejection of all bids.

- **Award of Contract:** CH2M HILL will assist the City in preparing the notice of award and preparation of the notice to proceed. The City will sign the notice of award and the notice to proceed.

Task 4—Services during Construction

CH2M HILL will provide the following services during the construction of the project:

- **Document Management:** CH2M HILL will manage relevant documents between the contractor, CH2M HILL, and the City. CH2M HILL will maintain hard copy records of relevant documentation and will turnover one complete set of project-approved submittals to the City.
- **Pre-construction Conference.** CH2M HILL will conduct a pre-construction conference with contractors and AWTF staff. Meeting minutes will be prepared.
- **Interpretations of Contract Documents:** CH2M HILL will provide technical interpretations of the contract documents and provide written responses to the contractor's request for information, and interpretation or clarification of the contract documents. We will evaluate requested deviations from the approved design or specifications.
- **Shop Drawings, Samples, and Submittals:** CH2M HILL will log, track, and review the contractor's shop drawings, samples, test results, and other data that the contractor is required to submit. CH2M HILL's will review shop drawings, samples, and submittals for conformance with the design concept and compliance with the requirements of the contract for construction.
- **Design Team Site Visits:** CH2M HILL will coordinate periodic visits to the site by the design team members to review progress and quality of the work, to assist and witness field performance testing, and attend site meetings, estimated at a frequency of twice per month for a 12-month construction duration. The trips will be coordinated with AWTF and the contractor and may coincide with the monthly contractor's progress meeting.
- **Field Performance Testing:** CH2M HILL will witness field performance tests for major equipment as specified in the contract for construction and CH2M HILL's contract scope. Anticipated equipment to be tested includes valves, pumps, filters, UV reactors and control panels, lime feed systems, and instrumentation and controls.
- **Change Orders:** CH2M HILL will review the contractor's cost estimates as necessary for contract change orders, and interpret consistency with the design intent.
- **Pay Requests:** CH2M HILL will review contractor's monthly pay applications and schedule progress. Recommendations for payment will be sent to the City.
- **Regulatory Coordination:** Meet with representatives of the City and appropriate regulatory agencies when necessary for consultation or conferences in regard to construction of the project. The meetings will be scheduled for the same time as the design team site visits, if possible.
- **Substantial and Final Completion:** CH2M HILL will perform inspections at substantial and final completion and will prepare up to two separate punch lists of items requiring completion or correction. CH2M HILL will submit a statement of substantial completion and a statement of final completion to the City.

Operator Training and Documentation

The City of Appleton places great value on effective operator training. CH2M HILL involves operators early, and throughout demonstration testing and design, as a means of providing information to operators about new processes or new operating strategies. Operators involved in design development will better understand the plant improvements and O&M changes.

To support learning, CH2M HILL will update the existing facility O&M manual to address changes resulting from this project. The format of the updates will be made to meet AWTF staff preferences. CH2M HILL will provide O&M

documentation for new or modified processes that includes the following:

- Unit process description
- Simple process schematic
- Standard operating procedures

Equipment description, parts lists, maintenance recommendations and troubleshooting guidance will be provided by equipment suppliers.

To provide focused, practical, and effective guidance, operator training will be conducted in both a classroom and field setting. Formal training will be provided to complement the type and content of manufacturer representative training. The goal of CH2M HILL's operator training is to make sure AWTF staff are comfortable operating the facilities associated with this project and understand the concepts.

Training will be provided by CH2M HILL's operations specialist, process engineers, and controls engineers. Depending on the preferences of AWTF operators, training materials may include PowerPoint presentations, standard operating procedures, sample spreadsheets to illustrate CT inactivation calculations, or updated SCADA system screen shots that depict process schematics and control features. Draft training materials will be reviewed with AWTF staff and revised to incorporate operator input.

GAC Contactors

Training operators to run the GAC contactors as filters and the primary particle removal barrier in the water plant is essential for proper plant operations and regulatory compliance. After evaluation of the process, operator training will be conducted for proper monitoring (headloss, turbidity, particle counts, and unit filter run volumes) and backwashing. This will be coordinated with demonstration testing to provide hands-on experience.

Training will also consist of AWTF staff operating in manual mode functions that will normally be automated, for example, filter backwashing.

Ultraviolet Light Disinfection

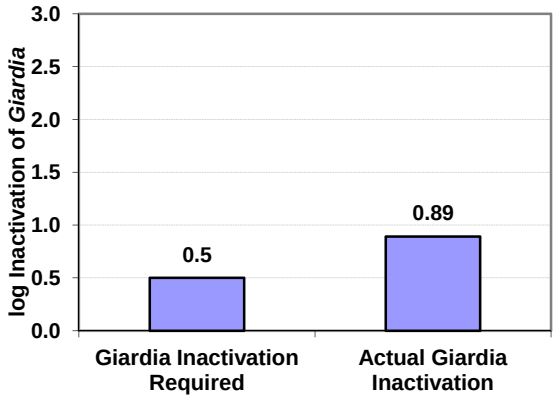
With UV disinfection startups, the biggest concerns are assuring correct lamp output intensity for sufficient disinfection, providing proper cleaning/maintenance instructions, and performing correct startup and shut down sequence. To address correct output intensity, CH2M HILL will walk AWTF staff through the calculations of what each bulb will produce, making sure they understand what the intensity levels should be, how to calibrate transmittance sensors, and the sequence in which the system should be turned on and off to extend the life of the equipment. Our SCADA design will tie to the UV manufacturer's programmable logic controller and provide alarms for intensity control, among many other things. This training will supplement the UV equipment manufacturer's training.

Todd Elliott, CH2M HILL engineer, operations assistance during Catskill Delaware Aqueduct UV system startup

Chlorine Disinfection

The City already understands chlorine CT calculations and their importance. The impact of new chlorine contact time modifications will be documented with representative CT calculations and reviewed with AWTF staff. The same process was used at the Oshkosh Water Filtration Plant to train operators on its new chlorine contact tank. SCADA modifications can be made to show real-time disinfection compliance, as illustrated in the following graphic.

Disinfection Compliance on SCADA



Project and Quality Management

To proactively manage this project to meet the City's quality, budget, schedule, and water service goals, CH2M HILL's seasoned project manager and quality manager will use proven tools and work approaches. Effective tools include detailed project instructions with guidance for the team on scope, schedule, budget, and individual responsibilities. Successful work approaches include frequent and informal communication through e-mail, telephone, and team meetings. Communication will also include submission of monthly progress reports to the City.

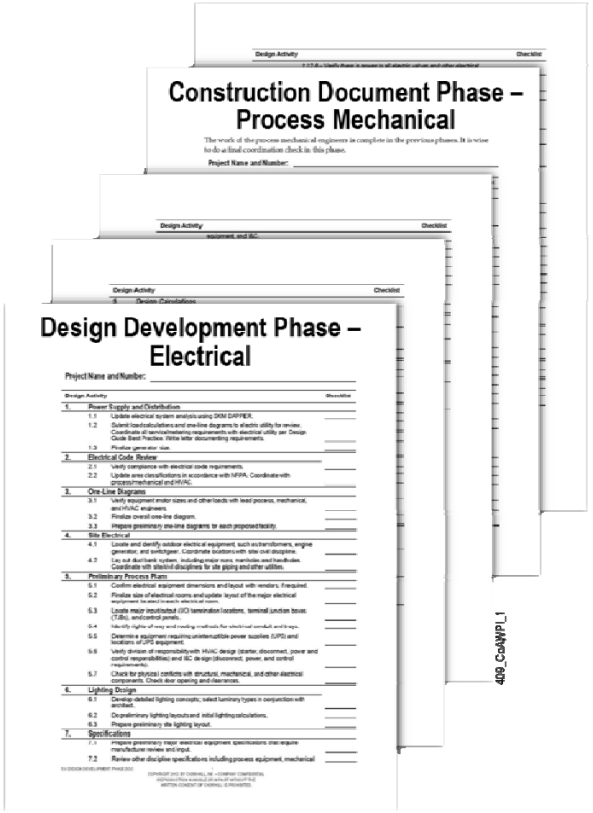
It is CH2M HILL's philosophy that quality is an element to be proactively built into a project from the start. Our quality management system incorporates quality assurance (QA) and quality control (QC) best practices. For this project, CH2M HILL will provide quality assurance by developing and following a quality management plan (QMP) tailored to this project. The QMP will define the QA/QC processes CH2M HILL will use and will include resources like checklists and worksheets to help the team do the right things, the right way.

CH2M HILL uses a system of frequent routine and formal milestone QC reviews that result in quality design products. When QA/QC processes are in place, technical work and collaboration among design disciplines can be performed correctly the first time, reducing rework. Other benefits of robust QA/QC processes and tools include the following:

- Money is saved during design and construction when mistakes are eliminated.
- Time is saved when design work advances efficiently.

The results are important because the City has a finite budget and an aggressive schedule for the project.

CH2M HILL will monitor and audit implementation of the project QMP through actions like verifying that lead designers are using design checklists and are also responding to comments from QC reviewers. CH2M HILL diligently uses a quality management system because it enables early detection of issues that need resolution or that may impact budget or schedule. It provides us with a framework to efficiently deliver the project and potentially exceed the City's expectations of quality consulting services.



Project Schedule

Project Schedule

Our proposed project schedule is shown on the following page. Highlights and assumptions for each major section are provided in the following paragraphs.

Preliminary Design—November 2012 to March 2013—5 months

This critical task will involve the systematic evaluation of the existing water plant, determining how to upgrade filters and chemical systems and incorporate UV. The demonstration test plan will also be developed and initiated. We propose to continue the demonstration test plan for a year to prove performance to WDNR over each season. However, initial results will prove the concepts and allow design and construction to continue.

Workshops at the AWTF will be conducted for the following:

- Pretreatment, lime softening, and filtration. Demonstration testing will be reviewed.
- UV, disinfection, and chemical systems. The UV selection process will also be determined. Current information on UV delivery times indicates delivery will take 3 months, so pre-purchase of equipment is not necessary. UV equipment can be pre-selected and assigned to the general contractor to avoid risk and reduce Appleton's coordination efforts.
- SCADA System. Information required by plant operations will be documented.
- Construction Sequencing. The critical sequence of construction will be developed to sustain operations during demonstration testing and construction.

WDNR will be invited to all workshops, which will accelerate review time.

Final Design—March 2013 to June 2013—4 months

Based on the preliminary design concepts, final detailed design drawings and specifications will be prepared. Review meetings at the 60 percent and 90 percent level will be conducted. WDNR will be invited to the design milestone meetings to accelerate review time. Although WDNR has 60 days to review design documents, integrating them with the review meetings shortens the time and allows bidding to proceed.

Bidding—July 2013 to August 2013—2 months

One month for bidding is standard for this type of project. The second month is for City Council approval and signing agreements.

Construction—Sept 2013 to Sept 2014—12 months

A 1-year construction period is reasonable, and CH2M HILL has completed similarly sized projects in 12 months. The first Oak Creek Water Plant expansion was $7 million and was completed in 12 months.

Beginning construction in fall often promotes an advantageous bidding environment because contractors are attracted to indoor work during the winter. Water demand is also lower, which provides more flexibility in operations.

Startup and O&M Training

As discussed previously, some operator training takes place during design, but the majority of training will take place when new systems are being commissioned. Training will likely progress from chemical systems to filters to UV, following the anticipated flow of construction. Some training will be provided by vendors in accordance with the construction contract documents. CH2M HILL classroom and field training will supplement equipment vendor training and will be conducted on a schedule that is most conducive to AWTF operations.

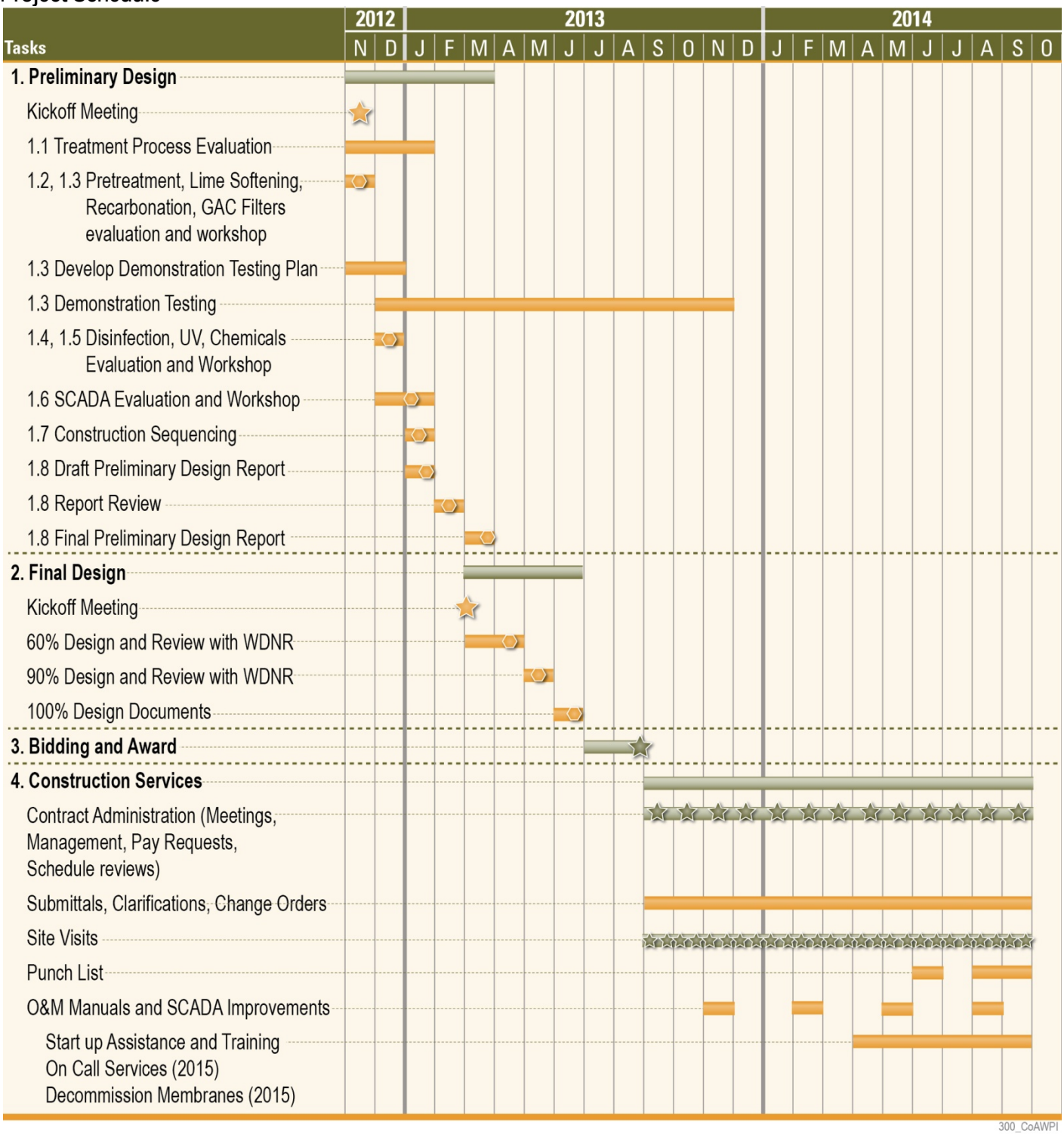
On-Call Services

The project manager and water treatment expert, Tony Myers, and our operations specialist, Dave Porter, will be available to come to your plant and work on any issues that may arise in the first year after construction. Both have extensive experience in plant operations and optimizing water treatment processes. The other project team members will also be available, depending on the skills needed.

Membrane Decommissioning

Our schedule shows membrane decommissioning in 2015. Our plan is to implement chlorine disinfection and filtration improvements such that current regulations can be met without membranes or UV. Depending on when demonstration testing convinces WDNR that regulations can be met, membranes may be able to be decommissioned in 2014. However, to be conservative, we assumed that membranes would remain in operation through construction as a backup process.

Project Schedule



Appendix

Attachment A – Resumes

Tony Myers, PE

Project Manager and Process Engineer

Education

M.S., Environmental Engineer, University of Illinois, 1984
B.S., Civil Engineering, Michigan Technological University, 1983

Professional Registrations

Professional Engineer: Wisconsin, Michigan, Ohio, Minnesota

Distinguishing Qualifications

- Managed the Water System Study for Milwaukee Wisconsin after the Cryptosporidium outbreak.
- Worked with a team of international experts responding to the Sydney Australia and Waterloo Canada Cryptosporidium crises.
- Contributing author on two water treatment textbooks and over 30 technical papers.
- Designed and upgraded over 20 lime softening plants.
- Extensive experience with UV, GAC and filtration at surface water plants.

Relevant Experience

Mr. Myers is a water treatment expert. For 28 years, he has been involved in the study, design, construction, and startup of many water treatment facilities around the world. He has upgraded or designed over 50 water treatment plants. He has extensive experience in upgrading existing water plants to meet new regulations and water quality goals.

Representative Projects

Project Manager, Lead Engineer, UV Upgrade, Cedar Rapids, Iowa. Managed the study, design, construction, start up and operator training for integrating UV into two lime softening plants, 20 mgd and 42 mgd. Extensive bench and full scale testing was done to prove virus inactivation and water quality aspects. A new chlorine/chloramine contact tank and reservoir were designed for improved disinfection.

Project Manager, Water System Study, Milwaukee, Wisconsin. In response to the *Cryptosporidium* outbreak, worked with a team of internationally recognized experts to recommend improvements to two water plants (100 mgd and 275 mgd). After extensive plant evaluations and pilot plant testing, improvements to the mixing, filtration, disinfection and chemical systems were recommended and implemented:

Project Manager/Lead Process Engineer, Water Plant Expansion, Oak Creek, Wisconsin. The Lake Michigan water plant was expanded from 12 to 20 mgd. New rapid mix, flocculation, plate settling, tri-media filters were added. Sodium hypochlorite replaced the gas chlorine facilities, which were converted into a new control room. Ten years later, Mr. Myers was hired to expand the plant again, from 20 mgd to 28 mgd. The plant was approved to treat up to 35 mgd with no additional treatment facilities, after the State approved higher hydraulic rates based on full scale testing. This plant recycles filter-to-waste effluent to the filter influent to avoid treating the water twice.

Senior Reviewer, 18 mgd UV Disinfection Plant for the North Shore Water Commission, Glendale, Wisconsin. UV was integrated into an existing water plant. Existing low service pumps were used to convey water through UV reactors and to the clearwell.

Lead Process Engineer, Chlorine Contact Tank, Oshkosh, Wisconsin. Added a new chlorine contact tank and upgraded two pump stations for improved backwash supply and disinfection at a 20 mgd surface water plant. Chlorine was implemented as a primary disinfectant to backup ozone. Tracer tests and CT calculations were done to prove performance. Plant operators were trained in chlorine, chloramine and ozone CT calculations and how to achieve disinfection during different times of the year. A disinfection plan was prepared for operators and approved by WDNR. The SCADA system was programmed for tracking disinfection parameters and reporting CT to WDNR.

Project Manager, Various Water Plant Upgrade Projects, Ann Arbor, Michigan. Managed a number of projects to upgrade the Ann Arbor Michigan water plant for improved water quality and reliability. The following improvements were made to this 50-mgd lime softening plant:

- Ozone was integrated into a tight plant site for improved disinfection and taste and odor reduction. Extensive pilot and full scale tests optimized the ozone and biological GAC process for particle removal, taste and odor, DBP's, corrosion and overall water quality.
- The GAC filters were converted to biological filter adsorbers.
- The water plant upgrade project won a national engineering excellence award, and Ann Arbor was voted as having the best tasting water in Michigan the year the project was completed.

Senior Technology Consultant, Dublin Road Water Plant Upgrade, Columbus, Ohio. Mr. Myers led the bench and pilot testing of ozone, GAC, BAC and enhanced coagulation/softening to upgrade a 65 mgd surface water treatment plant to 80 mgd. Alternatives to meet future disinfection byproduct regulations were determined and a cost/benefit analysis determined the best path for the future. Over $100 million was saved compared to other alternatives being considered.

Project Manager/Lead Engineer, McCarrons Water Plant Improvements, St. Paul Regional Water Services, St. Paul, Minnesota. As the project manager, Tony Myers oversaw integrating GAC filters into the lime softening plant. Tony was also responsible for all disinfection improvements made throughout the project, including the initial pilot testing, which resulted in the use of GAC media. The plant added lime and alum to a rapid mix basin, followed by horizontal paddle wheel flocculation, then settling through conventional clarifiers. No sludge was recycled and clarifier effluent turbidity was typically less than 5 NTU. This project included: upgrading 12 filters with new underdrains, air water backwash, media retaining filter troughs, and GAC media; replacing media in 12 existing filters with GAC; adding baffles to the finished water reservoir cells to provide mixing and contact time for adequate disinfection; and providing chemical feed improvements to the chlorine, ammonia, sodium hydroxide, and stannous chloride systems.

Lead Process Engineer, Lake Michigan Expansion, Sheboygan, Wisconsin. 12-mgd expansion to an existing 36 mgd Lake Michigan water plant. Additions include new rapid mix, flocculation, plate settling, alum system.

Ozone Operations, Edmond, Oklahoma. Optimized full scale ozone operations with lime softening and GAC facilities. Operators who never ran a water plant before received an award for the best operated water plant in the state of Oklahoma.

Lime Softening Expertise

Worked on the following lime softening water plant projects: Ann Arbor MI (50 mgd), Minneapolis MN (180 mgd), Dayton Ohio (96 mgd), Middletown OH (20 mgd), Columbus OH (50 mgd), Mexico MO (5 mgd), Fort Wayne IN (120 mgd), St. Paul MN (130 mgd), St. Charles MO (6 mgd), Jefferson County MO (5 mgd), Edmond OK (12 mgd), Cedar Rapids IA (42 mgd and 20 mgd).

Developed a Lime Softening Workshop half-day program with Dr. Vern Snoeyink, which covers the chemistry, process, and practical applications of lime softening.

Granular Activated Carbon Expertise

Mr. Myers was water treatment technical consultant for the following GAC projects:

- Ann Arbor MI—Optimization of ozone/GAC in the 50 mgd lime softening plant.
- St. Paul MN—Use of biological GAC filter adsorbers for taste and odor control in the 130 mgd lime softening plant.
- Columbus OH—bench and pilot testing of ozone, GAC, BAC for a 100 mgd water plant.
- Edmond OK—Operational optimization of GAC with ozone and lime softening.
- Macon MO—Pilot testing of GAC for organics removal and DBP reduction.
- Milwaukee WI—Pilot testing and full scale evaluation of biological GAC with ozone.
- Oak Creek WI—Evaluation of GAC retrofit for taste and odor control.
- Lake Bluff, IL—Disinfection of biological GAC effluent with UV disinfection.
- Dayton OH—PAC for organic contaminant removal at the 96 mgd water plant.
- Weymouth, MA—DAF, ozone and BAC for taste and odor and DBP control.

Publications and Presentations (Partial Listing)

Technical Reviewer. *Water Quality and Treatment*, *6th Edition*. AWWA. Chapter on "Lime Softening." New York: McGraw Hill. 2012.

Contributing author. *Water Quality and Treatment*, *4th Edition*. AWWA. Chapter 3, "Guide to the Selection of Water Treatment Processes." New York: McGraw Hill. 1990.

Contributing author. *Water Treatment Plant Design 2nd Edition*. AWWA/ASCE. New York: McGraw Hill. 1989.

"Evaluating Alternative Disinfectants for THM Control in Small Water Systems." *American Water Works Association Journal* 82 (June 1990): 77.

"Optimizing Yesterdays Lime Softening Technology for Today's Challenges." *Proceedings of the American Water Works Assoc. Annual Conference*. San Diego CA: 2009.

"GAC – New Applications for an Old Treatment Technology". AWWA OpFlow, January 2010.

"Controlling Water Plant Operations with Particle Counting." *Proceedings of the Water Quality Technology Conference*. San Francisco, California. 1994.

"High Rate Testing for a Lake Michigan Water Treatment Plant." *Proceedings of the American Water Works Association Annual Conference*. Kansas City, Missouri: American Water Works Association. 1987.

Cryptosporidium Considerations for Water Utilities. WI AWWA Conference 1994, MN AWWA Conference 1994. Distribution System Symposium. 1994.

"Powdered Activated Carbon for Organic Contaminant Control." *Proceedings of the American Water Works Association Annual Conference*. Kansas City, Missouri: American Water Works Association. 1987.

Startup and Optimization of an Advanced Water Treatment Plant. Presented at the Missouri Section AWWA Conference. April 1987.

Filter Optimization for Particle Removal and Biological Enhancement. Presented at the Michigan AWWA Conference. 1998.

How to Operate Biologically Activated Filters. Presented at the International Ozone Association Conference, Dearborn MI 1999.

New Technology Enhances Old Filtration Infrastructure. AWWA Annual Conference and Exposition. June 2003, Anaheim CA.

"The Role of UV in a Multiple Barrier Approach to Virus Reduction" *Proceedings of the American Water Works Association Annual Conference*. San Francisco, CA: American Water Works Association. 2005.

Awards

Fuller Award, Wisconsin American Water Works Association (AWWA)
Leon Smith Award, Wisconsin AWWA
Ken Miller Founders Award, Water for People
Thurston Larson Award, Illinois AWWA
Best Paper Award, Minnesota AWWA
National Engineering Honor Award, American Consulting Engineer's Council for Ann Arbor Water Plant Improvements
Wisconsin Association of Consulting Engineer's Award for Oak Creek Water Plant Expansion
Missouri Consulting Engineers Council Award for Warrensburg Ozone System

Patents

Method and Apparatus for Treatment of a Fluid Stream (2)

Memberships

American Water Works Association
Past Chair—Wisconsin Section AWWA
Past Chair—Wisconsin Water for People Committee
International Ozone Association

Kurt Hellermann, PE

Principal-in-Charge, Construction/Startup Team—Lead Engineer

Education

M.S., Civil Engineering, University of Wisconsin-Milwaukee
B.S., Civil/Environmental Engineering, University of Wisconsin-Madison

Professional Registration

Civil Engineer: Wisconsin

Distinguishing Qualifications

- 33 years of experience in project and construction management for water and wastewater treatment projects.
- Successfully tested and started up a 92-mgd water treatment plant with multiple interrelated contracts and constructors.
- Negotiated and executed more than $10 million in value engineering changes on a $100 million potable water construction program.

Representative Projects

Contracts Manager, UV Disinfection System at Two Lime Softening WTPs, City of Cedar Rapids Water Department, Cedar Rapids, Iowa. Kurt negotiated change orders and mitigated contractor claims through monitoring adherence to the contract requirements and proactively communicating with the Owner and contractor when issues arose.

Project Manager, Oak Creek Water Treatment Plant Expansion and Improvements, Oak Creek Water and Sewer Utility, Wisconsin. Managed all services during construction for a $6 million expansion and improvements project. Required managing multi-prime construction contracts for civil, mechanical, and electrical and instrumentation and control. This surface water treatment facility was expanded to increase capacity from 12 to 20 mgd. The project included a rapid mix system, flocculation and sedimentation basin, and four rapid sand filters. Other ancillary improvements included a sodium hypochlorite and coagulant (PACL) storage and feed system and a supervisory control and data acquisition (SCADA) system and control room. This multi-prime delivery required extensive review and management of contractors' schedules culminating in successful facility testing, startup, and commissioning.

Contracts Manager, Water Filtration Plant Improvements, Oshkosh, Wisconsin. Kurt was called in as a senior consultant to review and develop merit determination for differing site condition claims. He led the claims review process and negotiating team for resolution of difficult issues.

Project Manager, Water Plant Improvements, Ann Arbor Water Plant, City of Ann Arbor, Michigan. During the project, Kurt Performed cost estimating and change management**.** Project involved assessment of existing water treatment facilities, including lime softening, ozone, and biological activated carbon (BAC) filtration, and storage reservoirs. Water treatment process and facilities optimization evaluations were completed to develop capital and operational improvement recommendations.

Project Manager, San Juan-Chama Drinking Water Treatment Plant, Albuquerque Bernalillo County Water Utility Authority, Albuquerque, New Mexico. Managed design, permitting, and construction management services for implementing the City of Albuquerque's Water Resources Management Strategy. Included a series of water reclamation and reuse projects and a new 92-million-gallon-per-day (mgd) drinking water treatment plant that is expandable to 120 mgd. This $170 million, state-of-the-art treatment plant is the first facility for treating surface water to provide the city's drinking water supply, rather than the prior process of pumping and disinfecting water from depleting groundwater sources. *Southwest Contractor* magazine named the treatment plant as the "Best of 2009 New Mexico" project in the civil/public works category.

Contracts Manager and Resident Engineer, Cairo Water II Potable Water Program, U.S. Agency for International Development (USAID) and the General Organization for Greater Cairo Water Supply (GOGCWS), Egypt. Performed various roles on a $100 million, 4-year potable water program that involved the construction of four 30,000-cubic-meter prestressed concrete reservoirs, two pump stations, and 18 kilometers (km) of transmission pipeline. As contracts manager, was responsible for all contract issues including change order preparation and negotiation, claims mitigation and analysis (including establishment of an alternative disputes resolution team Claims Appeal Board), and contract close out, start up, and resolution of warranty issues. The change order work included various value engineering change proposals presented by the contractor, which were executed for a gross program savings of more than $10 million, a savings that was shared equally between the contractor and the owner (USAID/GOGCWS). As resident engineer for the $35 million reservoirs and pump stations contract, was responsible for shop drawing review, contractor, and owner correspondence, and quality control and assurance of the constructed project through management of inspection and field engineering staff.

This potable water program was completed on schedule and under budget (due in large part to the value engineering savings). The savings generated through the value engineering process made it possible to fund an additional 5 km of 1,000-millimeter (mm) ductile iron potable water transmission main (original contract included 18 km of transmission main). This $14 million variation was successfully negotiated, executed, and performed 4 months ahead of schedule.

Linda Mohr, PE

Quality Control, Predesign Team—Senior Engineer, Design Team—Process

Education

M.S., Civil Engineering, University of California at Davis
B.S., Civil Engineering, University of Wisconsin at Madison

Professional Registration

Civil Engineer: Wisconsin, California, Nevada, Missouri, Indiana

Distinguishing Qualifications

- Lead process engineer and lead hydraulics engineer for water treatment plants.
- Quality control/quality assurance reviewer for water utility projects.

Representative Projects

Project Manager/Lead Engineer, Water Filtration Plant Chemical and Electrical Systems Improvement Project, Oshkosh, Wisconsin. Managed the design of improvements to the existing anhydrous ammonia, chlorine, and alum feed equipment and instrumentation for the 16-mgd Water Filtration Plant. The project was completed in two phases to minimize utility impacts. Project included replacement of a backwash supply pump drive and the plant uninterruptible power supply.

Project Manager/Lead Engineer Water Filtration Plant Modifications and Demolition Project, Oshkosh, Wisconsin. Managed the design, bid phase and construction phase engineering services for the construction of a new chlorine contact basin, rehabilitation of low lift and high lift pump stations, and major yard piping modifications. Project included demolition of previously decommissioned water filtration plant and water tower. New 1-million gallon basin designed to fit in existing plant hydraulic profile. System upgrades include upgrades to existing disinfection chemical feed systems and process monitoring instrumentation and controls.

Project Manager/Lead Engineer, UV Disinfection Project, North Shore Water Commission, Glendale, Wisconsin. Preliminary and final design of UV disinfection facilities retrofit to an existing 18-mgd surface water treatment plant. The UV system was designed for 3 log *Cryptosporidium* credit using equipment validation information per the 2003 Draft of Ultraviolet light Disinfection Guidance Manual. Project included preparation of bid documents for competitive pre-selection by Owner of UV equipment, bid documents for installation of UV system and other plant upgrades, and development of disinfection plan and operating procedures for new UV system. The UV system was designed to fit hydraulically within the existing plant hydraulic profile.

Design Manager/Lead Engineer, Well No. 3 and No. 10 Radium Removal Facilities, Waukesha, Wisconsin. High-rate removal process based on design criteria developed through pilot study: chlorination, hydrous manganese oxide (HMO) addition for radionuclide adsorption and pressure filtration. Design manager and lead process and hydraulics engineer for the design of new1.0-mgd Well 3 and 3.5-mgd Well 10 radium removal facilities. Both projects were designed on a fast-track schedule for regulatory compliance.

Lead Chemical Systems Engineer/Hydraulics Quality Control Reviewer, GAC Filtration and Disinfection Project, Saint Paul regional Water Services, Saint Paul, Minnesota. Lead process designer for chlorine feed system improvements and chlorine and ammonia mixing systems for the 100-mgd McCarrons Water Treatment Plant. Senior reviewer for the plant hydraulics engineering (filters and finished water reservoirs only).

Chemical Systems Engineer and Operator Training, Numerous Water Treatment Plants. Final design, startup assistance, operator training and O&M documentation for chemical systems including potassium permanganate, sodium hypochlorite, chlorine gas, sodium bisulfite, carbon dioxide, ferric chloride, ferric sulfate, alum, polyaluminum chloride, sodium hydroxide, soda ash, lime, polymer, aqueous ammonia, anhydrous ammonia, and hydrofluosilicic acid.

Quality control reviewer, City of Oshkosh Water Filtration Plant Water Quality and Disinfection Process Update, Oshkosh, Wisconsin. Update operating materials (e.g., standard operating procedures, refresher training for operators) related to the operation of the primary and backup disinfection processes at the Water Filtration Plant. Developed operating materials following evaluation of raw water quality data, treatment water quality parameters and operator setpoints, and finished water quality. Developed new comprehensive disinfection plan to Wisconsin Department of Natural Resources approval. Updated SCADA system software on the basis of the approved plan. Provided educational materials and refresher training to plan operators.

Quality Control Reviewer, **Minneapolis Water Works, Ammonia System Enhancements, Minneapolis, Minnesota.** Quality control reviewer for ammonia feed (aqueous and anhydrous ammonia) alternatives evaluation. Senior reviewer for the final design of new anhydrous ammonia storage and feed facility for the 120-mgd Fridley Filtration Plant. The design consisted of three steel anhydrous ammonia storage tanks, five pressurized ammonia gas feeders, one ammonia gas wet scrubber.

Quality Control Reviewer, City of Cedar Rapids Water Department, UV Disinfection Design, Cedar Rapids, Iowa. Quality control reviewer for the process mechanical and plant hydraulics design of new UV disinfection facilities and finished water clearwells for 40-mgd and 42-mgd water treatment plants.

Quality Control Reviewer, Priority Improvements Plan, Minneapolis, Minnesota. Rigorous evaluation of water utility assets to identify and prioritized potential capital and operational improvements to be implemented with available funding sources over the next 10 years.

Quality Control Reviewer, Water Master Plan, Ann Arbor, Michigan. Project involved assessment of existing water treatment facilities, including lime softening, ozone, and biological activated carbon (BAC) filtration, and storage reservoirs. Water treatment process and facilities optimization evaluations were completed to develop capital and operational improvement recommendations.

Paul Swaim, PE

Senior Reviewer—Ultraviolet and Disinfection

Education

M.S., Civil and Environmental Engineering, University of California/Berkeley
B.S., Civil Engineering, University of California/Berkeley

Professional Registration

Professional Engineer: California, Arizona, Colorado, Utah

Distinguishing Qualifications

- President of the 500-member International UV Association and Chair of AWWA's Disinfection Systems Committee.
- More than 20 years of experience in process selection, pilot studies, facilities plans, design, construction, and startup of water treatment projects.
- CH2M HILL's Global Technology Leader for Water Treatment, responsible for leadership across the spectrum of drinking water treatment processes and services.
- Technical expert in water treatment process selection, treatability testing, UV disinfection, ozone, advanced oxidation, granular activated carbon (GAC), and treatment for emerging contaminants.
- Recognized international expert in UV disinfection for drinking water and water reuse applications. Served as senior reviewer/technical advisor for more than 30 disinfection projects across North America, including key roles on water treatment UV disinfection projects totaling more than 1 billion gallons per day of capacity.
- Member of the EPA's stakeholder group for preparation and review of the *UV Disinfection Guidance Manual* in support of the Long-Term 2 Enhanced Surface Water Treatment Rule.

Representative Projects

Senior Consultant, 18-mgd North Shore Water Commission, Wisconsin. Startup occurred in 2006.

Senior Consultant, UV disinfection system for virus inactivation credit for two WTPs totaling 62 mgd in Cedar Rapids, Iowa.

Senior Consultant, 100-mgd WTP in Southern California, CA. Planned and led treatability testing for evaluation of UV advanced oxidation for 100-mgd post-membrane application for taste and odor control. Evaluated removal of spiked taste and odor causing compounds, hydrogen peroxide quenching, impacts on by-product formation, and impacts on biological stability.

Senior Consultant, Luggage Point Advanced Water Treatment Plant for the Western Corridor Program, Brisbane, Queensland, Australia. Process lead/senior consultant for the 18.5 mgd UV advanced oxidation system for the Luggage Point Advanced Water Treatment Plant for the Western Corridor program in Brisbane, Australia. Low-pressure, high-output UV

reactors were selected. Detailed design and construction have been completed, and the UV advanced oxidation system is currently operational.

Senior Consultant; UV and Chloramination Water Treatment System, Ketchikan Public Utilities (KPU), Alaska. For KPU's 15-mgd UV and chloramination systems, Paul served as senior reviewer, met with State regulators to obtain operational approval, and conducted training sessions on both disinfection technologies for the plant operators.

Senior Consultant, Cedar Water Treatment Facility, Seattle Public Utilities, Washington. Senior consultant for design and construction of the 180-mgd ozone/UV facility for an unfiltered system. At the time of startup, the system was the largest operational drinking water UV disinfection system in North America. The Cedar UV system was also the first UV system to be granted *Cryptosporidium* inactivation credit. Technical lead for the updated validation testing effort approved in 2007 to address EPA's Final UVDGM.

Technical Advisor, City of Syracuse Water Department, Syracuse, New York. Senior technical advisor for 80-mgd of combined UV disinfection capacity of an unfiltered drinking water source to meet LT2SWTR requirements. Led workshop with NYSDOH and OCHD to obtain acceptance of the UV design criteria including UV dose and flows. Was successful in gaining acceptance of T1 phage as the validation test organism, which significantly reduced the applied UV dose for SWD, saving them operating costs. Detailed design of the two new UV disinfection facilities is ongoing.

Senior Consultant; Prairie Waters Project, UV-Advanced Oxidation for the Aurora Reservoir Water Purification Facility; Aurora Water, Aurora, Colorado. Planned and led treatability testing for evaluation of UV advanced oxidation for a 50-mgd application as part of the Prairie Waters Project. Provided oversight during pre-design and design, and developed procurement document for equipment supply.

Senior Consultant, Oxnard GREAT Program Advanced Water Treatment Facility, Oxnard, CA. Providing senior oversight of UV advanced oxidation design for the GREAT program for Oxnard, California. This 6.25 MGD UV system includes low-pressure, high-output UV reactors designed to provide 1.2-log NDMA destruction and 0.5-log destruction of 1,4-dioxane. Equipment selection has been completed and detailed design is ongoing.

UV Disinfection Regulatory Issues

Participated as member of the USEPA's stakeholder group for preparation and review of the UV Disinfection Guidance Manual in support of the Long-Term 2 Enhanced Surface Water Treatment Rule. As an outgrowth of this involvement, delivered a project for AWWA to "beta-test" the regulatory requirements for reactor validation. In 2006, Paul was asked by AWWA to serve as final outside reviewer of the UVDGM.

In 2007, Paul was selected by AWWA as part of the team to deliver UV disinfection training via a series of webcasts to state regulators from all 50 states across the country. The three webcasts were attended by more than 300 state regulators, with the final session held in July 2007. In 2011, Paul delivered a webcast for the USEPA on UV validation and implementation issues to more than 500 State regulators.

Vern Snoeyink, PhD

Senior Reviewer—GAC/Softening

Firm: CH2M HILL Consultant/Professor Emeritus at University of Illinois at Urbana-Champaign

Education

Ph.D., Water Resources Engineering, University of Michigan
M.S., Sanitary Engineering, University of Michigan
B.S., Civil Engineering, University of Michigan a

Distinguishing Qualifications

- One of the world's pre-eminent experts in the field of water chemistry, lime softening, corrosion and granular activated carbon (GAC) adsorption technology
- Has served as principal investigator on major treatment-based research programs for the USEPA, Water Research Foundation and National Science Foundation, among others
- Member of numerous expert panels for water quality and treatment issues, including Southern Nevada Water Authority; Portland Water Bureau; Cleveland Water Department; City of Tucson; East Bay Municipal Utilities District; and USEPA

Relevant Experience

Dr. Vern Snoeyink is a Professor Emeritus in civil and environmental engineering at the University of Illinois at Urbana-Champagne, and over the past 40 years has specialized in the treatment of water and wastewater using a broad range of technologies. His research focus has been on use of GAC for drinking water treatment, lime softening optimization, lead/copper corrosion, corrosion of water distribution systems, distribution system water quality and post-precipitation in water distribution systems.

Representative Projects

Consultant, Various Projects, Nationwide. Has served in a consultancy role on the following relevant projects.

- Ann Arbor Michigan lime softening optimization for improved clarifier performance, corrosion control, biological filtration and backwash water handling.
- St. Paul Minnesota to integrate biological filters into a large lime softening plant. Disinfection and disinfection byproduct issues were addressed, along with distribution system water quality
- Minneapolis Minnesota lime softening clarifier optimization for improved turbidity performance.
- Fort Wayne Indiana lime softening plant optimization to review the entire chemistry of the treatment process, recommend improvements to the softening process, and improve sludge handling.
- Prepared and presented a lime softening optimization course with Tony Myers for several water utilities and regulatory agencies.

- Washington Aqueduct: Provided advice on water treatment to control lead in Washington DC tap water
- East Bay Municipal Utilities District: Provided advice on WTP optimization, installation, and operation of GAC filter-adsorbers, and Surface Water Treatment Rule compliance
- Consumers Water Company: Provided advice on the use of GAC for the removal of petroleum components from a contaminated well
- WaterOne, Johnson County, MO: Member of the technology panel for selection of processes for a new WTP
- U.S. EPA, Drinking Water Committee of the Science Advisory Board: Provided advice on proposed drinking water standards
- CH2M HILL: Provide advice on drinking water pilot plant and corrosion control studies and water treatment plant design and optimization
- Suez Environnement, Paris, France: Member of the Foresight Advisory Council to Suez Environnement and the Science and Technology Committee
- Portland Water Bureau, OR: Provided advice on control of lead corrosion
- Cleveland Water Department, Cleveland, OH: Provided advice on controlling red water
- American Water Works Service Company, Voorhees, New Jersey: Provided advice to eliminate a problem related to mineral precipitation in tap water
- Farnsworth Group, Bloomington, IL: Provided advice on ammonia, manganese, radium, and arsenic removal
- Southern Nevada Water Authority, NV: Panel on methods to prevent the formation of red water
- The Pepsi-Cola Company: Consult on water quality and treatment issues
- City of Tucson, AZ: Member of expert panel to evaluate technology to control red water
- Northern Illinois Water Corporation: Provided advice on control of scale in their distribution system
- Economic and Environmental Engineering Services: Provided advice on control of red water problems in distribution systems
- Danville, IL: Provided advice on processes for nitrate removal from drinking water
- Ontario Ministry of Environment: Provided advice on pilot plant studies for removal of trace organics from the Niagara River, and at Ottawa, Windsor and Brantford, Ontario
- Monsanto Corporation, St. Louis, MO: Provided advice on pesticide adsorption

Russell Ford, PE, PhD, BCEE

Senior Reviewer—Filter Optimization

Education

Ph.D., Environmental Engineering, Stevens Institute of Technology
M.E., Environmental Engineering, Stevens Institute of Technology
B.S., Chemical Engineering, Syracuse University

Professional Registration

Professional Engineer: New York, New Jersey, Connecticut, Maryland, Pennsylvania

Licensed Water Treatment Plant Operator: New Jersey

American Academy Environmental Engineers Board Certified Environmental Engineer (BCEE)

Distinguishing Qualifications

- More than 25 years of experience in developing, evaluating, and designing treatment processes to remove a variety of contaminants from drinking water.
- Experienced in facilities and process evaluations, computer modeling, and water treatment plant design.
- Active nationally in the water industry organizations that provides insight into key issues facing the City of Syracuse.

Representative Projects

Water Quality Specialist, South Central Connecticut Water Authority, New Haven, Connecticut. In this role, Dr. Ford provides water quality consulting services for them on issues related to drinking water regulations, water quality issues and drinking water treatment processes.

Water Quality Specialist, Onondaga County Water Authority, New York. In this role, Dr. Ford is responsible for providing water quality consultant services to the Authority to address issues as they arise during the design of upgrades to their 24-mgd water treatment plant. Key issues include the switch to chlorine dioxide, potential application of high-rate clarification, modifications to the coagulation process and filter improvements.

Senior Technical Advisor, Poughkeepsie' Water Treatment Facility Water Quality Evaluation, Poughkeepsie, New York. Developed testing program to evaluate disinfection by-product formation, evaluation of lead and copper corrosion issues and dirty water complaints associated with chloramination. In addition evaluated new technologies to reduce DBP formation and to allow the water system to remain on free chlorine treatment.

Lead Process Engineer, Design of the 15-mgd Lake Whitney Water Treatment Plant, South Central Regional Water Authority, New Haven, Connecticut. In this role, Dr. Ford is responsible for the process/mechanical design of an advanced water treatment plant that includes processes such as: in-line mechanical mixing, flocculation, dissolved air flotation, ozonation, deep bed granular media filtration and chemical feed systems. As part of the design, pilot testing was conducted to confirm the effectiveness of the high-rate processes.

Project Manager, Safe Drinking Water Act Compliance, South Central Regional Water Authority, New Haven, Connecticut. Evaluated treatment alternatives to meet current and future regulatory requirements. These services have evolved into reviewing, updating and assisting the RWA in prioritizing the capital improvement program as well as providing guidance and technical input for ensuring that the RWA's three water treatment plants (Lake Galliard – 80 mgd; Lake Saltonstall – 12 mgd; and West River – 10.4 mgd) are meeting current and will meet future regulations. The work included preparation of statewide general permits for the discharge of recycle water into ground and/or surface waters; Preparation of detailed site plans and process schematics of each of RWA's treatment plants. Additional work assignments ranged from filter investigation and rehabilitation at existing plants to the preliminary design of a new 15 mgd treatment plant. Preparation of a Water Quality and Regulatory Compliance Master Plan. The main objectives of the plan were to evaluate the RWA's three treatment plants in regards to their ability to meet current and anticipated regulations. A cost benefit analysis was conducted to determine the most feasible alternatives for meeting anticipated regulations.

Assistant Project Manager, Pre-Design Studies for New Filtration Plant, Yorktown Water Filtration Plant, New York. Served as assistant project manager for this project, which engineering and support services were provided for pre-design studies a new 6-mgd filtration plant, which is utilizing dissolved air flotation. The plant treats water from the New York City Catskill Aqueduct. The preliminary design included flexibility to comply with future regulations and meet future demands such as: providing provisions in the hydraulic grade line of the plant for ozone, and hydraulic capacity in the piping to expand the plant to 10-mgd.

Project Engineer, New York Water Filtration Study, Westchester County, New York. This comprehensive study involved identifying and evaluating alternatives for treating the three New York City sources of supply: Croton, Catskill, and Delaware systems, for all of the water suppliers in Westchester County that utilize these sources. During this study, Dr. Ford determined conceptual design criteria and developed budgetary cost estimates.

Project Engineer, Alternatives Evaluation for Expansion of Pinesbridge Water District, Town of Yorktown, New York. Investigated alternative sources of water, evaluated treatment options, and prepared a conceptual distribution plan for a 1-mgd water supply system in southern Yorktown. The study involved investigating alternate water supply sources, evaluating the treatment that might be required, preparing a conceptual distribution system plan, reviewing New York State and New York City permitting requirements, and developing budget-level cost estimates. Worked with municipal and state agencies to meet watershed regulations, the State Environmental Quality Review Act, and local planning and zoning laws.

Project Engineer, Evaluation of Amawalk Water Filtration Plant, Yorktown, New York. The evaluation consisted of conducting bench-scale testing to identify potential causes of water quality complaints and solids depositions with the Town of Yorktown's distribution and storage system, and assessing the physical condition and operations of the treatment plant for continuing to provide water quality meeting all applicable regulations.

Currently an Adjunct Professor at Stevens Institute of Technology, Hoboken, New Jersey. Teaches Senior Environmental Engineer Design which focuses on basic design principles for cost-effective design of environmental systems such as water and wastewater treatment plants. Also teaches Numerical Methods for Engineers, a graduate level course in the application of numerical methods for real-life situations and Water Distribution System Analysis, a graduate level course on the study and design of water distribution systems.

Todd Jason Elliott, PE

Predesign Team—UV and Chemicals, Design Team—Process

Education

M.S., Civil Engineering, University of Wisconsin-Madison
B.S., Civil Engineering, University of Wisconsin-Madison

Professional Registration

Professional Engineer: Wisconsin

Distinguishing Qualifications

- More than 10 years experience on a wide variety of water and wastewater treatment plant projects ranging from 1- to 100-mgd.
- Process engineer and technologist with focus on drinking water treatment.
- Strong background in water treatment process design, including:
  - Drinking water treatment process selection and design
  - UV disinfection systems
  - Bench-scale and pilot testing
  - Project alternatives analysis using economic and non-economic criteria

Representative Projects

Process Mechanical Lead, City of Cedar Rapids Water Department, UV Disinfection Design, Cedar Rapids, Iowa. Process mechanical lead for preliminary design, final design, construction, and start-up of UV disinfection facilities for 40-mgd and 42-mgd water treatment plants, one of the first to receive virus inactivation credits using UV disinfection. Led development of the UV equipment pre-purchase bidding documents utilizing a cost-benefit analysis approach to select the optimal UV equipment option for Cedar Rapids. Both medium pressure and low-pressure-high output UV reactors were considered. Eight (8), TrojanUV Swift 30-inch medium pressure reactors with capability of future expansion to provide advanced oxidation of NDMA were chosen for the City.

Process Mechanical Lead, North Shore Water Commission, UV Disinfection Design, Glendale, Wisconsin. Process mechanical lead for preliminary design, final design, construction and start-up of UV disinfection system for existing 18-mgd water treatment plant, the first UV system installed in Wisconsin. Led development of the UV equipment pre-purchase bidding documents utilizing a cost-benefit analysis approach and comparing both medium pressure and low-pressure, high-output reactor options. Two (2), TrojanUV Swift 24-inch medium pressure reactors were selected. Retrofit design into existing pump gallery required efficient pipe and UV reactor layout while ensuring adequate space for maintenance and upstream pipe hydraulics.

Process Mechanical Lead, City of Oshkosh Water Utility, Disinfection Improvements Design, Oshkosh, Wisconsin. Lead process mechanical engineering for preliminary design, final design, construction, and start-up of 1 million gallon chlorine contact/backwash supply storage basin, low lift pump station, and high service pump station. Responsible for creating a hydraulic models and preparing drawings and specifications for process equipment.

Project Engineer, City of Ann Arbor Water Utility, Water Master Plan, Ann Arbor, Michigan. Developed water quality monitoring plan for the City of Ann Arbor Water Utility's source water system. The utility derives its water source from a combination of river and well water. The project tasks included a review of continuous, on-line water quality devices and laboratory analyses for both surrogate parameters and specific contaminants. In addition, types of technologies for creating an early warning system in the distribution system were recommended. Developed plan for Early Warning System development on the source water. Also developed jar testing procedures and conducted jar testing studies at CH2M HILL's Applied Sciences Laboratory to identify target chemical doses and effectiveness of various softening processes.

UV Specialist and Process Mechanical Lead, City of Syracuse Water Department, Syracuse, New York. Process mechanical lead for preliminary through final design of UV disinfection facilities for 80-mgd of combined UV disinfection capacity of an unfiltered drinking water source to meet LT2SWTR requirements. The design UV dose capital sizing is 40 mJ/cm^2 for 2-log *Cryptosporidium* inactivation credit using UV disinfection. Responsible for creating leading workshops with the SWD to establish the UV design criteria and system operational scenarios, preparing drawings for UV buildings and piping, preparing specifications for process piping and valves, preparing bid documents for UV disinfection equipment, develop monetary selection criteria for UV equipment, coordinating with I&C and electrical on equipment needs. Construction of the two new UV disinfection facilities is ongoing, with UV equipment delivery expected at the end of 2012. Will also lead training sessions for Syracuse operators at that time.

Project Technologist, Region of Peel, OBM2 Expansion, Mississauga, Ontario, Canada. Led UV equipment selection and preliminary design for the UV disinfection system as part of the 440 MLD OBM2 treatment plant expansion which includes BAC contactors, UV disinfection, and microfiltration membranes. Developed UV pre-purchase and preliminary design documents. Project led to the selection of using Trojan Technologies latest UV reactor technology, the UV Torrent reactor, which will help to reduce operating costs and carbon footprint during the life of the project.

Pilot Operator/Project Engineer, Milwaukee Metropolitan Sewerage District, CEPT Pilot Project, Milwaukee, Wisconsin. Operated pilot chemically enhanced primary clarification (CEPT) processes and UV disinfection system for three months on site in Milwaukee, Wisconsin. Pilot-scale DensaDeg® and ACTIFLO® solids-contact clarifier units were operated in parallel at overflow rates up to 60 gpm and were followed by a medium-pressure Trojan UV4000® system. Project evaluated the effectiveness of using chemically enhanced primary clarification (CEPT) processes for treating wastewater during actual and simulated wet weather events and applying UV disinfection to the treated wastewater. The chlorinate WWTP effluent water quality was compared to UV treated WWTP effluent and CEPT/UV treated primary influent with respect to fecal coliform, *E. coli*, enteric virus, *Giardia*, and *Cryptosporidium*. Responsibilities included collecting samples and field data, analyzing results, writing the final report, and developing full scale design criteria. **Winner of the 2007 American Academy of Environmental Engineers (AAEE) Grand Prize Award in the Small Projects Category.**

Jack Knight, PE

Predesign Team—SCADA, Design Team—I & C, Construction/Startup Team—Startup Operator Training

Education

B.S., Chemical Engineering and Biomedical Engineering, Carnegie Mellon University

Professional Registration

Chemical Engineer: South Carolina

Distinguishing Qualifications

- Extensive experience with small upgrade/improvement projects and new unit startups.
- Manages a variety of water and large wastewater control projects involving high degrees of automation.
- Writes control programs for water and wastewater facilities.
- Quality control/quality assurance reviewer for water utility projects.

Representative Projects

I&C Lead, J Avenue and Northwest Water Plants Disinfection System Improvements, Cedar Rapids, Iowa. Designed control portion and interfaces with reactor control systems. Existing network was upgraded to a fiber ring, and existing and facility improvements connected to upgraded network. Designed interface system between plant controls and two 40 MGD UV disinfection systems, one at each plant.

SCADA Evaluation, Metropolitan Milwaukee Sewer District, Milwaukee, Wisconsin. Evaluated the existing SCADA system and existing operational problems. Worked closely with District staff to develop functional criteria against which the existing system was evaluated. Developed detailed report summarizing system deficiencies and proposing corrective actions. Focus areas involved Siemens SINAUT communication protocol and radio telemetry issues.

Overall I&C Task Lead, Oak Creek Water Treatment Plant, Oak Creek, Wisconsin. Responsible for the HMI work (AB RSView32), reporting (MS Access), standards development (PLC and HMI), and SLC controller network (five PLCs) controlling. The HMI screen development for the plant included 40 unique screens with approximately 100 templated screens. Wrote and developed new PLC software (AB SLC-500) and software for 12 unique daily, monthly, and custom plant reports.

I&C Task Lead, UV Disinfection System, Northshore Water Commission, Glendale, Wisconsin. Responsible for the control system design for the UV system and integration with the plant SCADA system. Staff selected the new Bristol ControlWave architecture as an upgrade from their existing Bristol-based system. Designed UV reactor system to integrate with existing plant system.

I&C Task Lead, Water Filtration Plant, Improvements, Oshkosh, Wisconsin. Responsible for design of plant improvements, mainly on chemical feed and storage systems. Identified modifications to existing PLC and HMI systems to implement the improvements. Developed

action plan to re-integrate electrical and generator control around a failed SyMax PLC system, when the original PLC program was lost to history. Worked with Staff to develop software upgrade plan to keep the PLC software, firmware and hardware current enough to last 10+ years and forestall major upgrade work.

I&C Lead, Filter Automation Project, Ann Arbor WTP, Michigan. Project involved a retrofit an advanced filter control system into the existing plant. The selected design leverages advanced digital valve network technology to minimize equipment and wiring costs while simplifying troubleshooting and maintenance procedures. Developing and providing startup services for the PLC control software, HMI configurations, and actuator networks.

I&C Lead, Saint Paul Regional Water Services, St. Paul, Minnesota. Designed control portion, commissioned and started up a new PLC based filter control system for filters 13-24 for the McCarron's treatment plant. Developed replacement software for filters 1-12. New software was designed to be as similar as possible between all filters, even though filters used different PLC hardware (AB SLC vs. AB PLC5). Developed PLC software for all filters, supervisory/backwash PLC and touchscreens for filters 13-24.

I&C Task Lead, Design of New Lime Softening Plant, Jefferson County Water Authority WTP, Festus, Missouri. After designing the automation and control systems for the plant, responsible for developing, testing, and starting up the PLC control software and HMI operator interface configuration.

SCADA Security, Madison Water Utility; Madison, Wisconsin. Evaluated the existing SCADA system and evaluated potential vulnerabilities, including physical threats, unauthorized access or intrusion from the City of Madison WAN, and threat interference with the existing telephone system. Evaluated the strengths and weaknesses of a proposed radio telemetry system. Focus areas included cryptographic challenge-response and password protection systems to secure SCADA communication between nodes, foil eavesdroppers and man-in-the-middle type attacks; information security of the SCADA workstations and servers, including network security policies and equipment, firewalling, access control, and procedural controls; physical security specific to cyber attacks such as access control to critical computer resources, layered password management, and electronic access control devices; emergency and auxiliary power sources; backup communication systems; and embedded logic to prohibit or mitigate malicious operation of SCADA controlled equipment.

Dave Porter

Predesign Team—Operations, Construction/Startup Team—Startup Operator Training

Education

B.B.A., Management, Iowa State University

Professional Registration

Class IV Wastewater Operator

Distinguishing Qualifications

- David has more than 24 years of experience in water and wastewater treatment in the area of project management, process control, operations, and laboratory work.
- David has a BBA in management and has completed numerous industrial, water, and wastewater treatment courses.

Representative Projects

Senior Optimization Specialist, Optimization and Energy Evaluation, Columbus, Ohio. Mr. Porter evaluated three water and wastewater treatment plants and recommended cost saving measures in the energy, heating, and chemical process totaling $175,000 annually. The evaluation concentrated on day-to-day process savings in the areas of pumping, solids dewatering, and digester gas reuse. This project included current ongoing support for implementation of cost savings measures and follow up of opportunities on a quarterly basis.

Start up and Commissioning Manager, Twin Oaks Valley Water Treatment Plant Startup and Commissioning, San Diego, California. Start up and Commissioning Manager for the 100 MGD Twin Oaks Valley Ca. Water Treatment Plant, a membrane facility with ozone disinfection and BAC contactors, two gravity thickeners and two 150-gpm centrifuge dewatering units. This assignment included verifying design criteria and optimization throughout the facility.

Senior Operations Specialist, Filtration Pilot Plant, Detroit, Michigan. Dave operated, collected, and compiled data for a super pulsator, high rate filtration pilot plant for the City of Detroit. Part of his responsibilities also included presenting the results to the Michigan Department of Environmental Protection.

Project Manager, CH2M HILL, Quincy, Florida. Served as project manager of Department of Public Works water and wastewater treatment facilities, which included a 1.5-mgd contact stabilization wastewater treatment plant, six wastewater lift stations, a 2.5-mgd surface water treatment plant, and two ground water pumping stations. Duties included managing operations and maintenance of the facilities; supervising personnel; implementing safety, training, sludge management, and emergency response programs; and budgeting and cost control.

Senior Operations Specialist, Hato Ray, Puerto Rico. Mr. Porter worked with a joint venture between CH2M HILL, CSA architects and engineers, and the Authority for the Finance of the Infrastructure of Puerto Rico. The goal of the project is to identify, coordinate construction and implement improvements to the infrastructure on the Island of Puerto Rico to improve water production, distribution, collection and waste water treatment capacity through the year 2050.

Senior Operations Specialist, Operations Optimization Evaluation, Macon Water Authority, Macon, Georgia. Currently providing support for the Macon Water Authority Lower Poplar Water Reclamation Facility (LPWRF) in developing new process control strategies for improvements to the process control facility. The LPWRF is a 20 mgd bio tower nutrient removal plant with activated sludge. Recent changes to the plants flow and loading have required the need to optimize the facility and require new operation strategies to improve treated water quality and optimize the plant processes.

Senior Operations Specialist, Hamilton City Council, Hamilton, New Zealand. Operations evaluation and management support. Dedicated to the Hamilton City council's water and wastewater staff to provide operations management, developing risk management practices, operating strategies for nutrient removal with conversion to biological phosphorus removal and implementing business practices during the transition of their utilities manager.

Reviewer, Energy Optimization Study, West Palm Beach, Florida. Mr. Porter evaluated West Palm Beach's water and wastewater treatment facilities and identified cost saving measures totaling more than $1 million.

Roger Yolo, PE

Design Team—Mechanical

Education

M.B.A., University of Puget Sound
B.S., Mechanical Engineering, Washington State University

Professional Registration

Professional Engineer: Wisconsin, Washington, Minnesota, Kentucky, Iowa, Michigan, Tennessee, New Jersey, Ohio, Illinois, Missouri and South Dakota

Distinguishing Qualifications

- A seasoned mechanical engineer with more than 35 years' experience.
- Involved in the design of numerous municipal water and wastewater treatment plants.
- Provided services during construction, performed site inspections, and conducted failure investigations on mechanical equipment.

Representative Projects

Design and Services During Construction Manager, UV Disinfection System at Two Lime Softening WTPs, City of Cedar Rapids Water Department, Cedar Rapids, Iowa. As the Design Manager, Roger managed the design team and the services during construction projects. The design team included several CH2M HILL offices, as well as a remotely located major subcontractor. The team produced a 172 design drawings. Major items included a large retention wall, protected below grade finished water reservoirs, replacement of high service pumping and UV systems installations. The WTPs in Cedar Rapids needed UV disinfection facilities for 40-mgd and 42-mgd water treatment plants.

Design Engineer, Plant Expansions, Oak Creek Water and Sewer Utility, Oak Creek, Wisconsin. For the Oak Creek Water and Sewer Utility for the City of Oak Creek, Wisconsin, Roger provided preliminary and final HVAC, plumbing, and fire protection design for the new flocculation and filter building, as well as construction services for expansion of the Oak Creek water treatment plant from 12 to 20 mgd. The new plant expansion was designed for ultimate expansion to 48 mgd, and incorporation of ozone in the future.

Quality Review, UV Disinfection System, Northshore Water Commission, Glendale, Wisconsin. Roger was responsible for reviewing the process drawings and working closely with the client to ensure the overall quality of the UV project. Preliminary and final design of UV disinfection facilities retrofit to an existing 18-mgd surface water treatment plant.

Building Services Engineer, Water Filtration Plant Improvements, Oshkosh, Wisconsin. Throughout the project, Roger was responsible for the quality control review of the process, HVAC, fire protection, and plumbing for the facilities, which included valve vault, pumping station, and process areas. The expansion of the current treatment plant included construction of a new chlorine contact basin, rehabilitation of low lift and high lift pump stations, and major yard piping modifications. The previously decommissioned water filtration plant and water tower were demolished. New 1-million gallon basin designed to fit in existing plant hydraulic

profile. System upgrades include upgrades to existing disinfection chemical feed systems and process monitoring instrumentation and controls.

Design Engineer, Water Plant Improvements, Ann Arbor Water Plant, City of Ann Arbor, Michigan. Roger provided mechanical engineering and design, as well as services during construction for the 50-mgd Ann Arbor Water Treatment program in Ann Arbor, Michigan. Ozone optimization for the Ann Arbor water plant was achieved by addressing the issues of ozone feed location, contactor location and configuration, and air versus oxygen gas supply for the ozone generator. A post-sedimentation ozone feed point was selected to reduce ozone dose, byproduct formation, and construction costs. An ozone contactor design was developed that incorporated off-gas recycling to improve process efficiency and minimize ozone dose requirements. Liquid oxygen with high-concentration ozone generation was chosen because of favorable economics, simple operations/maintenance, and less space requirements. The ozone facility was integrated into an extremely tight plant site in a residential area.

Quality Control, Dublin Road Water Plan Expansion, Columbus, Ohio. As the Quality Control Engineer, Roger did a complete review of the HVAC, and plumbing design, which were done by a subcontractor on the project team. The review included several buildings, including filters, chemicals, pumping, and electrical. CH2M HILL was selected by the City to complete project design, which also included increasing plant capacity from 65 to 90 mgd. The City of Columbus planned on addressing upcoming requirements for limiting formation of disinfection by-products and intermittent periods of high nitrate concentrations in source water by implementation of reverse osmosis.

Process Engineer, McCarrons Water Plan Improvements, St. Paul Regional Water Services, St. Paul, Minnesota. Roger was responsible for the design of the chemical mixing, ammonia, and chlorination system upgrades. The design included providing new ammoniators, chlorinators piping and eductors, chemical metering pumps and mixing pumps. CH2M HILL completed the study, design, and construction of the biological GAC filter upgrade for the St. Paul Regional Water Services' 130 mgd lime softening McCarrons water treatment plant. Twenty four filters were converted from sand/anthracite to biological GAC/sand for TOC removal, disinfection byproduct precursor reduction, and taste and odor control.

Richard Siebers

Design Team—Architectural

Education

B.S., Architecture, University of Wisconsin-Milwaukee

Professional Registration

Registered Architect: Wisconsin

Distinguishing Qualifications

- Building condition and space utilization assessments done on numerous projects.
- Water and wastewater system vulnerability assessment experience.

Representative Projects

Architectural Designer/Architectural Task Leader, WTP Improvements Project, Ann Arbor, Michigan. Completed the architectural design of the new ozone building, the new administration and laboratory addition and rehabilitation, the new building and grounds, and the lubricant storage building. Richard also assisted the project manager in overseeing the project. Richard assisted with a thorough predesign that documented the present and future needs of the plant staff throughout the design and construction.

Architectural Designer/Task Leader, Oak Creek Water Treatment Plant Improvements, Oak Creek, Wisconsin. Project involved adding a new pretreatment building and a filter addition that matched the existing architecture and allowed for easy expansion in the future. Richard oversaw the rehabilitation of existing building space for a new lunch room, control room, locker rooms, bathrooms, and accessible entrances. He worked closely with plant staff to first identify the space needs and did a thorough predesign that was built on throughout the design and construction.

Lead Architect, Water Filtration Plant Modifications and Demolition Project, Oshkosh Wisconsin. Lead architectural designer on all phases of design and construction for Water Filtration Plant Modifications and Demolition Project. Two new pump stations were designed with large, removable skylights for natural light and to allow for future equipment removal. The buildings were designed with brick walls, glass block windows, and metal standing seam roofs to complement the existing architecture in this highly visible plant. The project also included demolition of previously decommissioned treatment plant facilities. A new partially above ground water basin was built using concrete form liners on the walls and stained to replicate the appearance or natural stone.

Lead Architect, Water Plant Disinfection System Improvements for the City of Cedar Rapids, Iowa. Lead Architect on all phases of design and construction for the Water Plant Disinfection System Improvements project. The project included adding a new UV disinfection building connected by a walkway to the Northwest Water Treatment Plant and new UV disinfection addition between the existing filter building and the existing reservoir/pump station at the J Ave. Water Treatment Plant. The project also included a new reservoir/pump station building, which was connected by an above ground walkway to the J Ave. UV disinfection building. The City was concerned about the appearance of both sites. The new Northwest UV disinfection building will serve as a new standard for future construction at this plant. The new J

Ave. buildings were to match the existing historic brick and stone buildings with large arched windows, brick pillars, stone copings, and accents.

Lead Architect, UV Disinfection, Northshore Water Commission, Glendale, Wisconsin. Preliminary and final design of UV disinfection facilities retrofit to an existing 18-mgd surface water treatment plant. As the lead architect, Richard did modifications to the existing building to allow for the addition of a new UV system. The City was concerned about safety and appearances, since they planned on giving tours to showcase the new disinfection upgrades. Richard oversaw architectural wall and floor finishes, including repairs to a historic terrazzo floor and a new epoxy floor coating. Existing spaces and doors were modified as require to accommodate the new work. The additional work, including adding handrails, helped to bring areas of the plant up to code.

Architectural QC Reviewer, Dublin Road Water Plant Expansion, Columbus, Ohio. Richard was responsible for architectural quality control reviews throughout the design of 4 large contracts to upgrade and expand the existing water plant. The emphasis of his reviews was to verify safety and code compliance, along with constructability and technical reviews. Richard used his 24 years of architectural experience to enhance the design of these 4 large projects.

Lead Architect, McCarrons Water Plant Improvements, St. Paul Regional Water Services, St. Paul, Minnesota. CH2M HILL completed the study, design, and construction of the biological GAC filter upgrade for the St. Paul Regional Water Services' 130 mgd lime softening McCarrons water treatment plant. Richard led the Architectural design of a new Finished Water Reservoir Building on top of the existing reservoir. The new building had to be light weight, but still match the existing historic buildings. A metal building was designed with an exterior insulation and finish system with joints matching the existing stucco building walls, and standing seam metal roof was provided to match the existing roofs. Translucent panel windows were provided to allow for natural lighting and match the existing large windows. Special door and window shapes were provided to match the existing and enhance the building's appearance.

John Stark, PE

Design Team—Structural

Education

M.S., Civil Engineering (Structural), Virginia Tech
B.S., Civil Engineering (Structural), Trine University

Professional Registration

Professional Engineer: Wisconsin, Ohio
Certified Welding Inspector: American Welding Society
Quality Auditor: Metal Building Certification Program, American Institute of Steel Construction

Distinguishing Qualifications

- Experienced in design of water and wastewater holding structures.
- Experienced field engineer and problem resolution specialist.
- Experienced in structural condition assessment and structural remediation projects.

Representative Projects

Quality Control, UV Disinfection System at Two Lime Softening WTPs, City of Cedar Rapids Water Department, Cedar Rapids, Iowa. Quality control review of structural calculations. Structural steel and concrete shop drawing review. Review and verification of Requests for Information. The WTPs in Cedar Rapids needed UV disinfection facilities for 40-mgd and 42-mgd water treatment plants. The design UV dose is 60 mJ/cm^2 for 0.5 log virus credit using UV disinfection equipment, the first plants in the United States to receive virus credit using UV disinfection. The CH2M HILL team created a hydraulic model of both plants, prepared drawings for UV buildings and piping, prepared specifications for process piping and valves, prepared bid documents for UV disinfection equipment, developed monetary and non-monetary selection criteria for UV equipment, coordinated with I&C and electrical on equipment needs, and provided services during construction.

Resident Engineer, Oak Creek Water and Sewer Utility, City of Oak Creek, Oak Creek, Wisconsin. Provide structural services during construction, including field observation of large diameter pipe and elevated water tank installation. Field resolution of differing field conditions discovered during construction. Precast and reinforced concrete, structural steel, and welding diagram shop drawing review. RFI resolution and respone. The City of Oak Creek needed to expand the Oak Creek water treatment plant from 12 to 20 mgd.

Resident Engineer, Oshkosh Water Treatment Plant Expansion, Oshkosh, Wisconsin. Rapid response construction issue resolution and structural steel and concrete shop drawing and RFI review. Pre construction inspection and review of chlorine contact basin and associated piping. The expansion of the current treatment plant included construction of a new chlorine contact basin, rehabilitation of low lift and high lift pump stations, and major yard piping modifications.

Resident Engineer, Grand Chute Menasha Wastewater Treatment Plant Expansion, Town of Grand Chute, Neenah, Wisconsin. Design of above- and below-ground structures including primary and secondary clarifiers, ultraviolet (UV) treatment facility, and aeration tank. Prepared structural project specifications. Provided resident engineering services as needed.

Lead Structural Engineer DePere/Green Bay Facility Upgrades, Green Bay Metropolitan Sewerage District, Green Bay, Wisconsin. Lead structural engineer for grit handling facility design and construction, structural modifications design, shop drawing, and RFI review.

Structural Engineer, James River Treatment Plant Improvements Project, Hampton Roads Sewerage District, Virginia. Responsible for aluminum access structure design and facility structural modifications.

Lead Structural Engineer, First and Second Creek Pump Stations and Force Mains, Kansas City Water Services Department, Kansas City, Missouri. Design of gravity interceptor structure, screening building, valve vaults and pumping stations. Prepared structural project specifications.

Lead Structural Engineer, Biofilter Improvements, City of Davenport Compost Facility, Davenport, Iowa. Design of new aeration facility including reinforced concrete slab on ground with embedded piping system and CIP push wall. Prepared structural project specifications.

Lead Structural Engineer, Fridley Filter Plant Ammonia System Replacement Project, City of Minneapolis Department of Public Works, Minneapolis, Minnesota. Design of cast-in-place concrete building. Prepared structural project specifications. Provided services during construction as needed.

Design Engineer, Climax Mine, Climax, Colorado. Design of reinforced concrete and steel structures for Property Discharge Water Treatment Plant facility.

Field Engineer, 200 West Pump and Treat Project, Department of Energy, Hanford, Washington. Responsible for fast track construction of Odor Control facility for $1.6 Billion dollar, LEED Gold Certified groundwater treatment and river protection project.

John McKinney, PE

Design Team—Electrical

Education

B.S., Systems Engineering (Electrical), Wright State University

Professional Registration

Professional Engineer: Ohio, Tennessee

Distinguishing Qualifications

- Managed and developed design-build industrial, commercial, institutional, and residential electrical projects.
- Developed electrical estimates for new and renovation work for electrical construction projects and generated cost savings on material purchases, requisitions, and value engineering.
- Project experience ranges from small conceptual studies, to determine feasibility and approximate/budget cost of proposed projects, to project management and design of large, multi-discipline construction projects which includes major electrical upgrades.

Representative Projects

Electrical Consultant, Two Plant Expansions, Oak Creek Water and Sewer Utility, Oak Creek, Wisconsin. John provided electrical consulting at the end of the construction phase. The City of Oak Creek needed to expand the Oak Creek water treatment plant from 12 to 20 mgd. New processes included rapid mixing, tapered flocculation, plate settling, tri-media filtration, sodium hypochlorite and polyaluminum chloride chemical systems, and backwash waste disposal. The facilities also include a new SCADA system and renovation of existing building space for a control room, lunch room, locker rooms. The new plant expansion was designed for ultimate expansion to 48 mgd, and incorporation of ozone in the future.

Electrical Engineer, Water Filtration Plant Improvements, Oshkosh, Wisconsin. John has been the responsible electrical engineer to interpret the electrical design developed by others and respond to question and request for information during the Construction phase. Also supported reviewed some of the electrical material submittal, O&M manuals and field test reports. Verified the short circuit and coordination electrical analysis for accurate and the presentation reflected the electrical system as installed. Conduct field inspections to verify that the electrical installation complied with contract documents and codes.

Lead Electrical Engineer, Grand Chute Menasha West Waste Water Treatment Facility Expansion and Rehabilitation, Grand Chute Menasha West Sewerage Commission, Neenah, Wisconsin. John is lead electrical engineer responsible for the electrical additions and changes to the 480 and 120 volts systems design. This project included adding a second utility service to a new ATAD facility, new motor control center with AFDs, new individually mounted AFDs, modifications to existing AFDs, lighting, lightning protection, upgrade to influent pumps station, upgrade UV systems, addition of primary clarifier, addition of secondary clarifier, infrastructure for new DDC distribution raceway, and replacing many motors with new motors to upgrade the plant capacity.

Electrical Engineer, Energy Audit and Evaluation Study for Monitoring and Renewable Energy Gap at Jones Island and South Shore Water Reclamation Facilities, MMSD, Milwaukee, Wisconsin. Provided site audit at both site to record existing conditions of equipment and processes. Electrical consultant to determine the best locations to install monitoring equipment. This study reviewed the existing conditions of the electrical systems at both plants and made recommendations for monitoring points on the electrical equipment and ancillary systems to allow the District to monitor power usage at the process level.

Electrical Engineer, Jones Island Water Reclamation Facility Gas Turbine Replacement Project—Turbine Building, MMSD, Milwaukee, Wisconsin. Provided electrical engineering and design for lighting, receptacle power, fire alarm system coordination, Turbine Building electrical power distribution for HVAC and mechanical systems, medium voltage interface between the new Turbine Building, and the existing Power House switchgear. Consulted with design engineer for the medium voltage distribution and 480 volts distribution systems in the Turbine Building.

Attachment B – Standard Engineering Agreement

STANDARD AGREEMENT FOR PROFESSIONAL SERVICES

This AGREEMENT is between CH2M HILL ENGINEERS INC., ("ENGINEER"), and

_____ ("OWNER")

for a PROJECT generally described as:

ARTICLE 1. SCOPE OF SERVICES

ENGINEER will perform the Scope of Services set forth in Attachment A.

ARTICLE 2. COMPENSATION

OWNER will compensate ENGINEER as set forth in Attachment B. Work performed under this AGREEMENT may be performed using labor from affiliated companies of ENGINEER. Such labor will be billed to OWNER under the same billing terms applicable to ENGINEER's employees.

ARTICLE 3. TERMS OF PAYMENT

OWNER will pay ENGINEER as follows:

3.1 Invoices and Time of Payment

ENGINEER will issue monthly invoices pursuant to Attachment B. Invoices are due and payable within 30 days of receipt.

3.2 Interest

3.2.1 OWNER will be charged interest at the rate of 1-1/2% per month, or that permitted by law if lesser, on all past-due amounts starting 30 days after receipt of invoice. Payments will first be credited to interest and then to principal.

3.2.2 In the event of a disputed billing, only the disputed portion will be withheld from payment, and OWNER shall pay the undisputed portion. OWNER will exercise reasonableness in disputing any bill or portion thereof. No interest will accrue on any disputed portion of the billing until mutually resolved.

3.2.3 If OWNER fails to make payment in full within 30 days of the date due for any undisputed billing, ENGINEER may, after giving 7 days' written notice to OWNER, suspend services under this AGREEMENT until paid in full, including interest. In the event of suspension of services, ENGINEER will have no liability to OWNER for delays or damages caused by OWNER because of such suspension.

ARTICLE 4. OBLIGATIONS OF ENGINEER

4.1 Standard of Care

The standard of care applicable to ENGINEER's Services will be the degree of skill and diligence normally employed by professional engineers or consultants performing the same or similar Services at the time said services are performed. ENGINEER will reperform any services not meeting this standard without additional compensation.

4.2 Subsurface Investigations

In soils, foundation, groundwater, and other subsurface investigations, the actual characteristics may vary significantly between successive test points and sample intervals and at locations other than where observations, exploration, and investigations have been made. Because of the inherent uncertainties in subsurface evaluations, changed or unanticipated underground conditions may occur that could affect total PROJECT cost and/or execution. These conditions and cost/execution effects are not the responsibility of ENGINEER.

4.3 ENGINEER's Personnel at Construction Site

4.3.1 The presence or duties of ENGINEER's personnel at a construction site, whether as onsite representatives or otherwise, do not make ENGINEER or ENGINEER's personnel in any way responsible for those duties that belong to OWNER and/or the construction contractors or other entities, and do not relieve the construction contractors or any other entity of their obligations, duties, and responsibilities, including, but not limited to, all construction methods, means, techniques, sequences, and procedures necessary for coordinating and completing all portions of the construction work in accordance with the construction Contract Documents and any health or safety precautions required by such construction work.

4.3.2 ENGINEER and ENGINEER's personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions and have no duty for inspecting, noting, observing, correcting, or reporting on health or safety deficiencies of the construction contractor(s) or other entity or any other persons at the site except ENGINEER's own personnel.

4.3.3 The presence of ENGINEER's personnel at a construction site is for the purpose of providing to OWNER a greater degree of confidence that the completed construction work will conform generally to the construction documents and that the integrity of the design concept as reflected in the construction documents has been implemented and preserved by the construction contractor(s). ENGINEER neither guarantees the performance of the construction contractor(s) nor assumes responsibility for construction contractor's failure to perform work in accordance with the construction documents.

For this AGREEMENT only, construction sites include places of manufacture for materials incorporated into the construction work, and construction contractors include manufacturers of materials incorporated into the construction work.

4.4 Opinions of Cost, Financial Considerations, and Schedules

In providing opinions of cost, financial analyses, economic feasibility projections, and schedules for the PROJECT, ENGINEER has no control over cost or price of labor and materials; unknown or latent conditions of existing equipment or structures that may affect operation or maintenance costs; competitive bidding procedures and market conditions; time or quality of performance by operating personnel or third parties; and other economic and operational factors that may materially affect the ultimate PROJECT cost or schedule. Therefore, ENGINEER makes no warranty that OWNER's actual PROJECT costs, financial aspects, economic feasibility, or schedules will not vary from ENGINEER's opinions, analyses, projections, or estimates.

If OWNER wishes greater assurance as to any element of PROJECT cost, feasibility, or schedule, OWNER will employ an independent cost estimator, contractor, or other appropriate advisor.

4.5 Construction Progress Payments

Recommendations by ENGINEER to OWNER for periodic construction progress payments to the construction contractor(s) will be based on ENGINEER's knowledge, information, and belief from selective sampling that the work has progressed to the point indicated. Such recommendations do not represent that continuous or detailed examinations have been made by ENGINEER to ascertain that the construction contractor(s) have completed the work in exact accordance with the construction documents; that the final work will be acceptable in all respects; that ENGINEER has made an examination to ascertain how or for what purpose the construction contractor(s) have used the moneys paid; that title to any of the work, materials, or equipment has passed to OWNER free and clear of liens, claims, security interests, or encumbrances; or that there are not other matters at issue between OWNER and the construction contractors that affect the amount that should be paid.

4.6 Record Drawings

Record drawings, if required, will be prepared, in part, on the basis of information compiled and furnished by others, and may not always represent the exact location, type of various components, or exact manner in which the PROJECT was finally constructed. ENGINEER is not responsible for any errors or omissions in the information from others that is incorporated into the record drawings.

4.7 Access to ENGINEER's Accounting Records

ENGINEER will maintain accounting records, in accordance with generally accepted accounting principles. These records will be available to OWNER during ENGINEER's normal business hours for a period of 1 year after ENGINEER's final invoice for examination to the extent required to verify the direct costs (excluding established or standard allowances and rates) incurred hereunder. OWNER may only audit accounting records applicable to a cost-reimbursable type compensation.

4.8 ENGINEER's Insurance

ENGINEER will maintain throughout this AGREEMENT the following insurance:

(a) Worker's compensation and employer's liability insurance as required by the state where the work is performed.

(b) Comprehensive automobile and vehicle liability insurance covering claims for injuries to members of the public and/or damages to property of others arising from use of motor vehicles, including onsite and offsite operations, and owned, nonowned, or hired vehicles, with $1,000,000 combined single limits.

(c) Commercial general liability insurance covering claims for injuries to members of the public or damage to property of others arising out of any covered negligent act or omission of ENGINEER or of any of its employees, agents, or subcontractors, with $1,000,000 per occurrence and in the aggregate.

(d) Professional liability insurance of $1,000,000 per occurrence and in the aggregate.

(e) OWNER will be named as an additional insured with respect to ENGINEER's liabilities hereunder in insurance coverages identified in items (b) and (c) and ENGINEER waives subrogation against OWNER as to said policies.

ARTICLE 5. OBLIGATIONS OF OWNER

5.1 OWNER-Furnished Data

OWNER will provide to ENGINEER all data in OWNER's possession relating to ENGINEER's services on the PROJECT. ENGINEER will reasonably rely upon the accuracy, timeliness, and completeness of the information provided by OWNER.

5.2 Access to Facilities and Property

OWNER will make its facilities accessible to ENGINEER as required for ENGINEER's performance of its services and will provide labor and safety equipment as required by ENGINEER for such access. OWNER will perform, at no cost to ENGINEER, such tests of equipment, machinery, pipelines, and other components of OWNER's facilities as may be required in connection with ENGINEER's services.

5.3 Advertisements, Permits, and Access

Unless otherwise agreed to in the Scope of Services, OWNER will obtain, arrange, and pay for all advertisements for bids; permits and licenses required by local, state, or federal authorities; and land, easements, rights-of-way, and access necessary for ENGINEER's services or PROJECT construction.

5.4 Timely Review

OWNER will examine ENGINEER's studies, reports, sketches, drawings, specifications, proposals, and other documents; obtain advice of an attorney, insurance counselor, accountant, auditor, bond and financial advisors, and other consultants as OWNER deems appropriate; and render in writing decisions required by OWNER in a timely manner.

5.5 Prompt Notice

OWNER will give prompt written notice to ENGINEER whenever OWNER observes or becomes aware of any

development that affects the scope or timing of ENGINEER's Services, or of any defect in the work of ENGINEER or construction contractors.

5.6 Asbestos or Hazardous Substances

5.6.1 If asbestos or hazardous substances in any form are encountered or suspected, ENGINEER will stop its own work in the affected portions of the PROJECT to permit testing and evaluation.

5.6.2 If asbestos is suspected, ENGINEER will, if requested, manage the asbestos remediation activities using a qualified subcontractor at an additional fee and contract terms to be negotiated.

5.6.3 If hazardous substances other than asbestos are suspected, ENGINEER will, if requested, conduct tests to determine the extent of the problem and will perform the necessary studies and recommend the necessary remedial measures at an additional fee and contract terms to be negotiated.

5.6.4 Client recognizes that CH2M HILL assumes no risk and/or liability for a waste or hazardous waste site originated by other than CH2M HILL.

5.7 Contractor Indemnification and Claims

5.7.1 OWNER agrees to include in all construction contracts the provisions of Article 4.3, ENGINEER's Personnel at Construction Site, and provisions providing contractor indemnification of OWNER and ENGINEER for contractor's negligence.

5.7.2 OWNER shall require construction contractor(s) to name OWNER and ENGINEER as additional insureds on the contractor's general liability insurance policy.

5.7.3 OWNER agrees to include the following clause in all contracts with construction contractors, and equipment or materials suppliers:

"Contractors, subcontractors, and equipment and material suppliers on the PROJECT, or their sureties, shall maintain no direct action against ENGINEER, ENGINEER's officers, employees, affiliated corporations, and subcontractors for any claim arising out of, in connection with, or resulting from the engineering services performed. OWNER will be the only beneficiary of any undertaking by ENGINEER."

5.8 OWNER's Insurance

5.8.1 OWNER will maintain property insurance on all pre-existing physical facilities associated in any way with the PROJECT.

5.8.2 OWNER will provide for a waiver of subrogation as to all OWNER-carried property damage insurance, during construction and thereafter, in favor of ENGINEER, ENGINEER's officers, employees, affiliates, and subcontractors.

5.8.3 OWNER will provide (or have the construction contractor(s) provide) a Builders Risk All Risk insurance policy for the full replacement value of all PROJECT work including the value of all onsite OWNER-furnished equipment and/or materials associated with ENGINEER's services. Such policy will include coverage for loss due to defects in materials and workmanship and errors in design, and will provide a waiver of subrogation as to ENGINEER and the construction contractor(s) (or OWNER), and their respective officers, employees, agents, affiliates, and subcontractors. OWNER will provide ENGINEER a copy of such policy.

5.9 Litigation Assistance

The Scope of Services does not include costs of ENGINEER for required or requested assistance to support, prepare, document, bring, defend, or assist in litigation undertaken or defended by OWNER. All such Services required or requested of ENGINEER by OWNER, except for suits or claims between the parties to this AGREEMENT, will be reimbursed as mutually agreed.

5.10 Changes

OWNER may make or approve changes within the general Scope of Services in this AGREEMENT. If such changes affect ENGINEER's cost of or time required for performance of the services, an equitable adjustment will be made through an amendment to this AGREEMENT.

ARTICLE 6. GENERAL LEGAL PROVISIONS

6.1 Authorization to Proceed

Execution of this AGREEMENT by OWNER will be authorization for ENGINEER to proceed with the work, unless otherwise provided for in this AGREEMENT.

6.2 Reuse of PROJECT Documents

All reports, drawings, specifications, documents, and other deliverables of ENGINEER, whether in hard copy or in electronic form, are instruments of service for this PROJECT, whether the PROJECT is completed or not. OWNER agrees to indemnify ENGINEER and ENGINEER's officers, employees, subcontractors, and affiliated corporations from all claims, damages, losses, and costs, including, but not limited to, litigation expenses and attorney's fees arising out of or related to the unauthorized reuse, change or alteration of these PROJECT documents.

6.3 Force Majeure

ENGINEER is not responsible for damages or delay in performance caused by acts of God, strikes, lockouts, accidents, or other events beyond the control of ENGINEER. In any such event, ENGINEER'S contract price and schedule shall be equitably adjusted.

6.4 Limitation of Liability

6.4.1 To the maximum extent permitted by law, ENGINEER's liability for OWNER's damages will not, in the aggregate, exceed $1,000,000.

6.4.2 This article takes precedence over any conflicting article of this AGREEMENT or any document incorporated into it or referenced by it.

6.4.3 This limitation of liability will apply whether ENGINEER's liability arises under breach of contract or warranty; tort; including negligence; strict liability; statutory liability; or any other cause of action, and shall include ENGINEER's officers, affiliated corporations, employees, and subcontractors.

6.5 Termination

6.5.1 This AGREEMENT may be terminated for convenience on 30 days' written notice, or for cause if either party fails substantially to perform through no fault of the other and does not commence correction of such nonperformance within 5 days of written notice and diligently complete the correction thereafter.

6.5.2 On termination, ENGINEER will be paid for all authorized services performed up to the termination date plus termination expenses, such as, but not limited to, reassignment of personnel, subcontract termination costs, and related closeout costs.

6.6 Suspension, Delay, or Interruption of Work
OWNER may suspend, delay, or interrupt the Services of ENGINEER for the convenience of OWNER. In such event, ENGINEER's contract price and schedule shall be equitably adjusted.

6.7 No Third-Party Beneficiaries
This AGREEMENT gives no rights or benefits to anyone other than OWNER and ENGINEER and has no third-party beneficiaries.

6.8 Indemnification
6.8.1 ENGINEER agrees to indemnify OWNER for any claims, damages, losses, and costs, including, but not limited to, attorney's fees and litigation costs, arising out of claims by third parties for property damage or bodily injury, including death, to the proportionate extent caused by the negligence or willful misconduct of ENGINEER, ENGINEER's employees, affiliated corporations, and subcontractors in connection with the PROJECT.

6.8.2 OWNER agrees to indemnify ENGINEER from any claims, damages, losses, and costs, including, but not limited to, attorney's fees and litigation costs, arising out of claims by third parties for property damage or bodily injury, including death, to the proportionate extent caused by the negligence or willful misconduct of OWNER, or its employees or contractors in connection with the PROJECT.

6.9 Assignment
This is a bilateral personal Services AGREEMENT. Neither party shall have the power to or will assign any of the duties or rights or any claim arising out of or related to this AGREEMENT, whether arising in tort, contract or otherwise, without the written consent of the other party. Any unauthorized assignment is void and unenforceable. These conditions and the entire AGREEMENT are binding on the heirs, successors, and assigns of the parties hereto.

6.10 Consequential Damages
To the maximum extent permitted by law, ENGINEER and ENGINEER's affiliated corporations, officers, employees, and subcontractors shall not be liable for OWNER's special, indirect, or consequential damages, whether such damages arise out of breach of contract or warranty, tort including negligence, strict or statutory liability, or any other cause of action. In order to protect ENGINEER against indirect liability or third-party proceedings, OWNER will indemnify ENGINEER for any such damages.

6.11 Waiver
OWNER waives all claims against ENGINEER, including those for latent defects, that are not brought within 2 years of substantial completion of the facility designed or final payment to ENGINEER, whichever is earlier.

6.12 Jurisdiction
The substantive law of the state of the PROJECT site shall govern the validity of this AGREEMENT, its interpretation and performance, and any other claims related to it.

6.13 Severability and Survival
6.13.1 If any of the Provisions contained in this AGREEMENT are held for any reason to be invalid, illegal, or unenforceable, the enforceability of the remaining provisions shall not be impaired thereby.

6.13.2 Limitations of liability, indemnities, and other express representations shall survive termination of this AGREEMENT for any cause.

6.14 Materials and Samples
Any items, substances, materials, or samples removed from the PROJECT site for testing, analysis, or other evaluation will be returned to the PROJECT site within 60 days of PROJECT close-out unless agreed to otherwise. OWNER recognizes and agrees that ENGINEER is acting as a bailee and at no time assumes title to said items, substances, materials, or samples.

6.15 Engineer's Deliverables
Engineer's deliverables, including record drawings, are limited to the sealed and signed hard copies. Computer-generated drawing files furnished by ENGINEER are for OWNER or others' convenience. Any conclusions or information derived or obtained from these files will be at user's sole risk.

6.16 Dispute Resolution
The parties will use their best efforts to resolve amicably any dispute, including use of alternative dispute resolution options.

6.17 Ownership of Work Product and Inventions
All of the work product of the ENGINEER in executing this PROJECT shall remain the property of ENGINEER. OWNER shall receive a perpetual, royalty-free, non-transferable, non-exclusive license to use the deliverables for the purpose for which they were intended. Any inventions, patents, copyrights, computer software, or other intellectual property developed during the course of, or as a result of, the PROJECT shall remain the property of the ENGINEER.

ARTICLE 7. ATTACHMENTS, SCHEDULES, AND SIGNATURES

This AGREEMENT, including its attachments and schedules, constitutes the entire AGREEMENT, supersedes all prior written or oral understandings, and may only be changed by a written amendment executed by both parties. The following attachments and schedules are hereby made a part of this AGREEMENT:
Attachment A--Scope of Services
Attachment B--Compensation

IN WITNESS WHEREOF, the parties execute below:

For OWNER, _____

dated this _____ day of _____ , 20__

Signature	_____	Signature	_____
Name (printed)	_____	Name	_____
Title	_____	Title	_____

For ENGINEER, CH2M HILL ENGINEERS INC.,

dated this _____ day of _____ , 20__

Signature	_____	Signature	_____
Name (printed)	_____	Name (printed)	_____
Title	_____	Title	_____

For additional information, please contact

Tony Myers
Project Manager

CH2MHILL®
135 S. 84th Street, Suite 400
Milwaukee, WI 53214
414-847-0238
tony.myers@ch2m.com